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Community Research

SEVENTH FRAMEWORK PROGRAMME

Impact Quantification of Global Changes
GLOBAL-IQ

Description of Work

Fp7 Collaborative project

(small or medium-scale focused research project)

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Sommario

PART B

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B 1.1 Concept and project objective(s)

World societies experience today large transformation processes both in the social, economic and environmental dimensions. These transformations are usually described under the heading of 'global change' to emphasize the increasing interactions between them. An important feature of this ongoing 'globalization' process is the prime importance taken by quantitative aspects. We see a fast increase in goods flows, financial flows and knowledge flows around the world while populations move in a much lesser degree. On the other hand, political, religious and cultural interdependences evolve at a slower pace, one important exception being the political and economic integration process taking place inside Europe since fifty years. Hence globalization appears today as a mix of integration and fragmentation processes operating at different scales and in different areas of human activity.

Such a huge transformation process has attracted a considerable attention from scholars in all disciplines of social sciences and humanities, leading to the development of numerous conceptual approaches to global changes and interpretation grids of its mains drivers and impacts over societies. Over this general landscape, the recent discovery that mankind economic activity, by releasing greenhouse gases into the atmosphere, could have an influence over the earth climate may be seen as an additional proof that the humanity has reached a new integration age, being now collectively responsible for the future of the climatic conditions over the planet. The environmental literature has also produced a bulk of concepts and definitions of global change, usually based upon the sustainable development research program or the polluting growth framework. There has always been a tension between the view that environmental and climate change issues should be analyzed as only one aspect of a broader socio-economic transformation process, the solution to environmental issues being mainly dependent upon the prospects of further political, social and economic integration at the world scale, and the view that environmental problems have their own specific aspects, justifying a dedicated analysis and policy approach. We shall adopt a balanced view in this debate by focusing our research program mainly upon socio-economics and environmental issues but with an explicit incorporation of other main global changes processes inside the analysis.

The climate sciences community has made a considerable work through the IPCC reports to describe the climate challenge faced by humanity. It appears now that the research load will involve more and more the social sciences and humanities communities. But as emphasized before, global changes studies should not confine themselves to climate change as the unique globalization challenge faced by humanity. Social scientists have more generally to assess the consequences of global changes upon our societies as a whole while contributing to policy action both to mitigate the impacts of climate change and identify the most relevant adaptation strategies in the environmental domain.

The objective of the proposal is to provide significant advances in these two directions from the viewpoint of the economist's community. Economics of globalization is a prominent research topic in contemporary economics. Economics of climate change is also an area of intense research since twenty years especially in Europe. The publication of the Stern Review has been the corner stone of these research efforts, bringing to a large audience the conclusion that present action was needed now, the cost of action being much lower than the costs of inaction in terms of adverse impacts of the future climate upon the well being of humanity. However much remains to be done in this

research area both to strengthen the reliability of the Stern Review conclusions and to help design the best policy options for present action in the broader perspective of global changes. To contribute to this overall objective we plan research actions in several directions.

The Stern review conclusions follow from an aggregate cost-benefit analysis for the very long run. A first objective of the project is to refine the cost and benefit analysis of the Stern review. This objective fits well with the first sentence of the call which refers explicitly to the Stern review. The assessment of the impacts and associated costs of global change will be made for the transportation systems, water and natural resources use (agriculture, forests), health impacts, the energy sector and population dynamics. This assessment part of the project is closely in line with the queries of the call which asks for sectoral analysis of global changes at the world scale with particular emphasis upon Europe. Concerning the socio-economic impacts, consequences of global change upon competitiveness will be examined, with an emphasis upon international trade issues. This will allow building a closer link between climate change oriented economic studies and globalization studies than already done in the literature. The potential changes of the structure of relative prices resulting from the global change are of particular interest there, since all analysis of intra and inter sectoral impacts are highly dependent upon the dynamics of the price structure at the European and world level. This is especially true for employment and labour allocation evolutions between sectors which should result from global change, an issue we plan to deal with inside the project.

The partners involved in the project have a strong record of experience in economic analysis, economic modelling and in economy-energy-climate integrated assessment in particular. The participating teams have already developed several economic models to address climate change socio-economic issues. These models differ by their degree of spatial or sectoral disaggregation and the level of integration of climate, environmental and economic dynamics. Instead of trying to develop a single modelling tool, we think of exploiting the specificities of the models in two complementary directions. First we shall produce arrays of potential economic evolutions in the near and far distant future. This research strategy is analogous to those of the climatologists' community and appears to be the most realistic approach to deal with the huge uncertainties affecting both economic and climate dynamics by the end of the century. Second we plan significant progress in the areas of models harmonization. We shall develop soft and hard links between models to get the best informed scenarios from the existing modelling tools. This modelling strategy will also allow drafting simulations of the relevance of various types of policy measures in addressing the global change challenge for Europe and the world. It will also be used to assess the adaptation potential of the private and public sector to global change. This item of the project is in line with the query of the call to contribute to the development of modelling tools in order to assess both the possible impacts of global change and the potential for policy action.

The need to adapt policy strategies to socio-economic evolutions is also an important topic raised by the call. To address this issue we plan a two part approach with close interrelationships. The first part is a thorough analysis of the simulation outputs from the models. How to interpret their differences, to identify their similarities? How to analyze their anticipations of the consequences of different policy measures and which policy advice may be derived from such an analysis? At this stage we shall need to perform a detailed analysis of the empirical results in the light of the existing theoretical literature. We shall also address more policy implementation oriented issues like the redistributive consequences of policy measures over households or the harmonization of regulations in Europe in the trade, competition, energy, food and transportation domains in particular.

The debate which followed the publication of the Stern review inside the economists' community has stressed the overall importance of a relevant approach to risk and uncertainty issues. The choice of a good time discounting strategy together with the area of application of the precautionary principle to climate change have raised a number of contributions in the recent economic literature. We plan to improve upon this line of research in several directions. Risk and uncertainty have to be assessed both at the individual household level and at the collective level. Concerning future

impacts of the ongoing global change, this collective level has to incorporate future generations, raising difficult ethical and intergenerational coordination issues. At the household level we plan to mobilize recent modelling advances in household behaviour over time. Furthermore we plan to apply these innovative approaches to uncertainty inside the modelling kit used to assess the possible impacts of global changes.

Due care will be given to the research results dissemination. The call expects the establishment of a research network joining European skills and experience in the field of socio-economic impacts assessment of global change. Some partners have been already involved in such collaborative efforts, other are newcomers. As a whole the consortium joins forces of established experts in the field at a momentum in climate economics research. The difficulties faced by the Conference of Parties in Copenhagen to design an acceptable agreement illustrate the importance of a sound scientific approach to the economic issues at stake in the international debate. They show also the importance of developing an integrated expertise approach, first in Europe and later to be shared with the world economic community involved in climate change economics studies. Particular attention will be devoted to make progress in the direction of research standards both in modelling and analyzing global change issues. The policy debate has also shown the prime importance of disseminating the best available knowledge to the stake holders and to the general public. One output of the project will be the edition of an update of the Stern review analysis incorporating the most recent scientific achievements in the field of global change economics studies.

B 1.2 Progress beyond the state of the art

Socio-economic studies of global change have been a burgeoning field of applied and theoretical research since the last twenty years. They organize along a gradient between ‘globalization oriented’ studies, where issues like climate change are only one aspect of a larger global interaction process transforming societies and domestic economic systems, and ‘climate economics’ studies, more focused upon the understanding of the interactions between economic and climate dynamics. All share the view that global change organize around so-called ‘global public goods’, climate and knowledge being two emblematic examples of such goods.

The Nordhaus work at Yale constitutes the seminal contribution of economics to the climate change issue. The Stern review build upon these premises by providing the first comprehensive account for the potential cost impacts of climate change over a one century range. The review reached the conclusion that time for action was coming now; a reasonable mitigation cost effort being able to avoid significant losses of GDP per capita at the end of the century. However economic studies of climate change do not limit to the Stern review and the economic community has provided since ten years a respectable amount of insights into the climate economics issues.

More and more precise assessments at various levels of detail have been produced, on a regional or country basis or for specific issues: impacts upon the environment, food production, agriculture, water, amenity values, health impacts, sea rise impacts, catastrophic events among the few. All these approaches suffer from a high diversity of the methodologies used, data processing and levels of details description. They are often hard to aggregate or to include into a meta-analysis perspective.

The EPA climate economics modelling strategy is a good example of this. It combines a computable general equilibrium model of the US economy with a dynamic macro model at the world level together with dedicated models towards specific US economic sectors: agriculture,

forestry or energy production[1]. The EPA claims that this array of models provides a comprehensive view of the climate change issue from an economic perspective. But one can remark that all these models do not share the same calibration and development methodology and lack integration and cross validation. However, there are first steps into this direction. A new IFPRI study by Nelson et al. (2009) combines climate models providing projections changes in precipitation and temperature and a crop model to capture biophysical effects with IFPRI's economic model of world agriculture. The latter can then estimate the socio-economic impacts, which cover changes in the production, consumption and trade of major agricultural commodities. Without adjustments, this research shows that there will be reductions in irrigated wheat yields in 2050 by around 30% in developing countries, while irrigated rice yields will fall by 15%. Climate change is not the only global change, however: even without climate change, food prices will rise. Climate change only worsens the situation. This study is one rare example in going beyond the state-of-the-art.

We plan to make progress beyond this current state-of-the-art in global change economics in three main directions.

1. Sectoral assessment of impacts

The variety of impacts of climate change over economic activities is a complex challenge. This point is acknowledged in the Stern Review as in several IPCC reports. The project wants to go beyond single-sector views by looking at more areas, where socio-economic impacts might be triggered by global changes of different types. These areas include (1) water, energy, fuels availability and energy security, (2) transport, infrastructures, tourism, (3) competitiveness, labour market, international trade, financial stability, and (4) population, health and migration. Studying such a broad range of areas consistently throughout the work packages (see pert chart) will enhance the understanding of interrelationships, possible repercussions (e.g. through linkages with general equilibrium models) and enable a better than the state-of-the-art cost estimate in different scenarios (WP4) and analysis of adaptation strategies (WP5).

An area in which WP3 will expand the state of the art is the analysis of international trade of electricity by means of super-grids. The idea of analysing the impacts of super-grids emerges from the need to evaluate the real costs and economic attractiveness of concrete research projects and investment plans that aim at the implementation of a Europe-MENA solar based Super Grid (TREC project; World Bank Clean Technology Fund -CTF). Research on this topic has already been performed, there is, in fact, good data on irradiance and concentrated solar power (CSP) potentials in the MENA region and on cost estimates (Richter 2009, Trieb 2005, Trieb 2006). Some economic studies have already been carried out and investigate the feasibility of this option. The tools that have been applied are mainly policy analysis and scenario analysis (PIK 2008, Trieb 2006, Ummel 2008). These methods identify potential risks, implementation barriers, required subsidies and policies or choose and describe feasible future situations to evaluate their effects and pathways towards them. There is the need for research efforts that compare this option with other available mitigation strategies, possibly using long term optimization models. To our knowledge, the only attempt to introduce a super-grid in a hybrid-energy economic model is that of Bauer (2008), that aims at finding the political barriers to the electricity trade between Europe and MENA analysing the effects on macroeconomic activity, sectoral outputs and trade relations.

This example illustrates the important fact that any convincing impact analysis has to take into account the adaptation capacities of the impacted activity sectors. The issue of adaptation has important policy implications we discuss below. We plan to make significant progress in the study

[1] See EPA climate model web page: http://www.epa.gov/climatechange/economics/modeling.html

of adaptation strategies to climate change at least at the European level even if we could no be exhaustive on this topic.

2. Climate change economic modelling

As noted before, developing hard and soft linkages between economic models addressing the global change issues is a key element of their reliability and usefulness for policy analysis. More specifically, we shall devote specific workpackages to expand and interlink existing models, thus enabling for a better socio-economic impact assessment in response to global changes.

Considering the case of the agricultural sector as an example, we know that it is likely to be the most directly affected by many global changes. Rules governing international trade will impact agriculture and the global allocation of land. European Union re-definition of the Common Agricultural Policy will also have local and global repercussions. Most notably, climate change will reshape agriculture and land allocation worldwide due to changing patterns of temperature, precipitations and water availability. Mitigation policies to climate change will also impact the agricultural sector due to the growing importance of bio-energy. Trade policy, domestic and global agriculture policy regimes, technological progress, evolving energy systems, will all be a challenge for agriculture and land allocation in general.

In order to capture part of these linkages, the agricultural and forestry partial equilibrium model GLOBIOM[2] (IIASA) will be linked with the WITCH model (FEEM). WITCH is a model specially suited to study long-term endogenous optimal investment decisions in a framework that integrates the economy, energy and climate (Ramsey-type optimal growth, hard-linked). Therefore, it will perfectly complement GLOBIOM, which is instead a partial equilibrium model and thus which lacks endogenous drivers of global and regional demand of major world commodities and of land.

Issues such as EU agricultural policy and international trade will be major areas of interest. FEEM will work to introduce land use and forestry dynamics in the WITCH model. The model will be linked to the GLOBIOM of IIASA. Bio-energies supply curves, which now enter the model in reduced form, will be an output of the GLOBIOM model. WITCH will provide long-term output scenarios and demand of land to GLOBIOM. WITCH will also provide technological progress dynamics to determine land productivity in GLOBIOM. The international market of carbon allowances in WITCH will be linked by means of certificates from REDD – Reduced Emissions and Deforestation and Land Degradation – to the GLOBIOM model. The highest possible degree of spatial resolution will be used in order to study impacts – e.g. climate change, water availability –

[2] GLOBIOM is a global recursively dynamic partial equilibrium model integrating the agricultural, bio-energy and forestry sectors with the aim to give policy advice on global issues concerning land use competition between the major land-based production sectors. See http://www.iiasa.ac.at/Research/FOR/globiom.html for the current version of the model, which has been developed in the context of several other EU-funded projects such as Global Earth Observation – Benefit Estimation: Now, Next and Emerging (GEO-BENE, www.geo-bene.eu, No. 505539), ENSEMBLES (ensembles-eu.metoffice.com, No.212535), Climate Change - Terrestrial Adaptation and Mitigation in Europe (CC-TAME, www.cctame.eu; No. 226487), European approach to GEOSS (EUROGEOSS, www.eurogeoss.eu, see Article II.30. of the Grant Agreements), the EU LIFE program funded EC4MACS project (www.ec4macs.eu), QUEST/Quatermass project funded by NERC, UK (quest.bris.ac.uk), Paradigm Shifts Modeling and Innovative Approaches (PASHMINA, http://www.pashmina-project.eu/, No. 244766). For an exhaustive project list see http://www.iiasa.ac.at/Research/FOR/globiom/projects.html. The model has mainly been used for policy-relevant studies, see e.g. a recent publication on biofuel targets and their impact on land use by Havlik et al (Havlik, P., et al., Global land-use implications of first and second generation biofuel targets. *Energy Policy* (2010), doi:10.1016/j.enpol.2010.03.030).

with a sufficiently high level of precision. Methodologies to use in GLOBIOM-WITCH high resolution Global Circulation Models climate scenarios will be developed. These activities will be complemented by the already existing soft coupled REMIND-R (a Ramsey-type optimal growth energy-economy-model) /LPJmL-MAgPIE (an agro-economic model driven by a dynamic vegetation model) complex from PIK.

The REMIND model was used for the contribution to the ADAM project financed from the FP7. In the ADAM project the Work Package M2 was dealing with mitigation at the global level. The REMIND model was one of five models that analyzed the feasibility and costs of low-stabilization scenarios that were consistent with a high probability of achieving the 2°C target. The Work Package performed a model comparison exercise. During this process the REMIND model was continously improved according to the discussions with the other project partners. The REMIND scenarios also cross-fertilized the work of the ADAM Work Package on mitigation at the European level. The results were published in a book (Knopf et al. 2009) and a special issue of the *Energy Journal* (Edenhofer et al. 2009, Leimbach et al. 2009).

The MAgPIE model was partly developed during the SustainabilityA-Test project (Advanced Techniques for Evaluation of Sustainability Assessment Tools, EU FP6, STREP, March 2004 – August 2006) and the MATISSE project (Methods and Tools for Integrated Sustainability Assessment, EU FP6, Integrated Project, April 2005 – March 2008). In SustainabilityA-Test the model was compared to other land use models and integrated assessment models (Lotze-Campen 2008). In MATISSE Work package 8, Interlinking and improving existing tools for ISA, the MAgPIE model was used together with the IMAGE model to generate sustainable biomass scenarios for Europe in a global context. During this project the model was significantly improved, in order to provide a consistent link between economic processes and spatially-explicit land use allocation (Lotze-Campen et al. 2008, 2009).[3]

Note that while MAgPIE is more advanced in the sense that it includes induced technological change and more detail on the agricultural side, GLOBIOM captures more of the forestry side – therefore the two approaches are expected to cross-fertilise each other and help to gain insights previously impossible with the existing modelling tools (i.e. the state-of-the-art).

The existing state-of-art emphasizes the crucial issue of uncertainty in climate change impacts assessment. The uncertainty issue may be split in two main topics of interest. First uncertainty affects the policy decision process itself rendering more or less uncertain the social value of action. This problem has been at the core of the vivid debate that followed the publication of the Stern Review. We shall devote a specific work package to this problem. But all climate analysis emphasizes the fact that perhaps more than the mean increase in temperature, one main consequence of global change will be an increase of the random variability of climate over the earth. Taking this variability into account is a difficult challenge for climate economics modelling.

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[3] Lotze-Campen, H. (2008): The role of modelling tools in Integrated Sustainability Assessment (ISA*). International Journal for Innovation and Sustainable Development* 317(1/2): 70-92.

Lotze-Campen, H., Müller, C., Bondeau, A., Rost, S., Popp, A., Lucht, W. (2008): Global food demand, productivity growth and the scarcity of land and water resources: a spatially explicit mathematical programming approach. *Agricultural Economics* 39(3): 325-338. doi: 10.1111/j.1574-0862.2008.00336.x

Lotze-Campen, H., Popp, A., Beringer, T., Müller, C., Bondeau, A., Rost, S., Lucht, W. (2009): Scenarios of global bioenergy production: The trade-offs between agricultural expansion, intensification and trade. *Ecological Modelling*, doi:10.1016/j.ecolmodel.2009.10.002

An analysis taking into account the sources of uncertainty and their effects on adaptation strategies will thus be a further contribution beyond the state-of-the-art. For this purpose use will be made of IIASA experiences gathered in uncertainty analysis and stochastic modeling in the context of other projects such as Paradigm Shifts Modeling and Innovative Approaches (PASHMINA, http://www.pashmina-project.eu/, No. 244766) and Climate Change - Terrestrial Adaptation and Mitigation in Europe (CC-TAME, www.cctame.eu; No. 226487).

3. Policy analysis

The European expertise upstream to the design of the European energy and climate policies has intensively relied upon various models (e.g. the PRIME model for energy forecasts in the EU). These models share the philosophy adopted in our models, integrating in various ways climate projections and economic linkages between energy uses and global changes scenarios. The project plans improvements in this state-of-the-art in three main directions. We shall cover a larger number of sectors and issues into an integrated framework, more specifically the proper environmental impacts will be better assessed in our analysis, most in house EU analyses focusing rather upon human impacts of global change. Second, a significant effort will be made to explicitly model the uncertainty issues especially relevant to global changes in the very long run. This was one of the main criticisms addressed to the Stern Review. Most EU expertise models treat this problem by introducing different possible scenarios intended to cover the uncertainty span over climate of economic evolutions. But the real difficulty is to model how individual agents, firms of consumers, deal with uncertainty concerning global changes, and how this affects their behaviour, resulting on the aggregate in modifications of the patterns of economic evolutions. Third we shall provide a thorough investigation of the adaptation issue. Adaptation is mostly studied in qualitative terms of through scenarios approaches. We plan to go further by introducing inside the models adaptative behaviours of economic agents, either households or firms, and so we shall be able to provide quantitative assessments of adaptation strategies in terms of adaptation costs and benefits.

Aside from shedding new light over various sectoral issues: agriculture, forestry; transportation, energy consumption health, labor market, population, competitiveness and trade, the project will provide insights upon various policy issues by incorporating explicitly these policies into the model assessment. Agricultural, energy, trade and climate policies will be then considered globally allowing for an economic analysis of different scenarios for the evolution of these policies in the future. This is of particular interest for policy makers who need to understand and manage the existing linkages between this set of policies. Second the project will provide overall assessments of the costs and benefits from global change under different policy options in a Stern Review like way. These new figures will benefit from the significant improvements that have been achieved in this field since the publication of the Stern Review.

Summing up, we plan to make progress with respect to the state-of-the-art in mainly four directions.

1. **New knowledge acquisition.** Several kinds of impacts are far less documented than others. Amenity and ancilliary values are one example together with the changes in household's behaviour with respect to global changes. The same applies to the cost of air pollution in large cities of the developing world. Mixing meta analysis of the existing knowledge, new econometric developments and complementary case studies, we plan to improve over the existing knowledge about socio-economic impacts of global changes. As examples we shall estimate the main drivers of energy elasticities in the production sector for Central Europe Countries we suspect should be rather different from the available estimates for western countries. The climate policy debate as emphasized the heterogeneity problems faces by the

firms when coming to some coordinated agreement between countries. We shall develop a specific analysis of this heterogeneity problem in the international trade context. We shall also provide case study results for the improvement of air quality in China. These various works will provide significant contributions in the ongoing process of getting better figures for impacts measures of global changes over the economic system and the societies both at the regional and world scale.

2. **New tools of analysis.** We plan to do an intensive use of modelling approaches and in particular integrated assessment models (IAM) inside the project. The project's partners have already developed several tools of this kind. We shall develop their linkages through both soft and hard methods resulting into new modelling capabilities with respect to the current state-of-the-art in IAMs.
3. **New assessment advances.** The combination of better impact measures and more sophisticated modelling tools will contribute to improve the impacts assessment precision and reliability. It will also open the room to new questions and issues, like the integration of international trade dynamics and climate change impacts for example or upon the description of the predicted impacts over the agricultural and the forestry sectors. While being not completely new with respect to the existing literature, the project will provide a larger perspective and enhanced assessments upon such issues.
4. **Innovative approaches and issues.** Despite the existing considerable knowledge on the global change topic, many issues remain to be settled at the theoretical and methodological stage. We plan to make significant advances in the inclusion of uncertainty and discounting strategies into global change analysis. We plan also improvements in the measurement of competitiveness effects, price and labor effects. With respect to climate mitigation issues, the adaptation problem to climate change is far less settled in the economic literature. Building upon the progress we shall make in modelling and assessment, we plan to provide significant contributions in assessing the adaptation potential of the socio-economic systems to global changes and its consequences for policymaking.

More precise statements about the specific advances we expect during the project are given inside the work package description.

B 1.3 S/T Methodology and associated work plan

B 1.3.1 Overall strategy and general description

B.1.3.1.1 Overall strategy

The call asks for investigations into three main directions. The first one concerns the impact assessment of global changes, at the world scale with special emphasis upon Europe. This broadly splits into two topics: impacts upon natural assets, infrastructure and amenities (water, forests, transportation, health) and impacts along the socio-economic dimension (labor and employment effects, competitiveness, international trade). The second direction calls for an improvement of the state-of-the-art in economics modelling both at a macro level and at the sectoral level, and both in the medium term and in the very long term. The third direction is more policy oriented and asks for an analysis of required policy adaptation and implementation needed to face global change. The main difficulty comes from the necessary integration of these different research directions into a comprehensive framework. This difficulty manifests itself into three main areas:

1. The level of required process integration;
2. The degree of methodological integration;
3. The interplay between policy implementation and socio-economic dynamics.

We shall meet this challenge in two ways: A careful scientific coordination organization (to be described in Section 2) and the inclusion of participants of various teams specialized in each field in common tasks inside the workpackage organization. The idea is that these integration issues cannot be treated in a top-down manner but rather require a bottom-up approach based upon available data, methodologies and understanding of the different processes at stake. That is we plan to develop an integrated view of the previous problems within each task and workpackage by mixing specific expertise of the participants members, a more realistic and efficient approach. This explains why we decided not to devote a specific ‘end of pipe’ workpackage to knowledge integration of dedicated expertise, as is frequently done in medium scale projects.

A side benefit of this work plan strategy is to allow for a more readable list of workpackages with respect to the call queries. Apart from one coordination (WP8) and one dissemination workpackage (WP7) fully described in part B, the research core will be split into six workpackages.

WP1 is intended to provide a conceptual basis for global change analysis. It will also stand as a sort of experience record of the participants over their own interaction experience in assessing global change impacts.

WP2 will be devoted to impact assessment. Split into different sector dedicated tasks, the WP will cover health, amenities, population, land use, water, energy, trade and transportation externalities issues, performing meta analysis of the existing literature and providing original empirical studies for household’s water and energy demands together with health impacts measurements.

Various outputs from WP2 will serve as inputs inside the modelling WP 3, 4, 5 to be described below. The external costs of transportation systems estimations, water, energy and health impacts together with population scenarios will then be used either directly as input figures or indirectly inside the models building process and parameterization. The WP2 contributions about competitiveness and trade will also help to interpret and analyze the results from the models assessment performed in WP5, in particular the global change adaptation part of this WP. We now turn to the presentation of the modelling block of the project.

WP 3 will be modelling oriented. The general objective of this WP is to enhance already existing models with features that will enable in WP4 the assessment of impacts of global changes outlined in WP1, and the analysis and quantification of optimal adaptation strategies and total costs in WP5. Soft and hard linkages among existing global models will be a main area of work, in order to incorporate the description of different sectors (e.g. energy models and land-use models, migration models and general equilibrium models) into a coherent framework of analysis and to exploit synergistically the strengths of different modelling approaches (e.g. partial equilibrium and general equilibrium models). WP3 will use new empirical estimates and new theoretical insights from WP2.

WP 4 will be the 'assessment-box' of the project. Impact estimates generated within this WP will be used as drivers for the suite of impact functions assembled by the consortium. Mitigation policies will not be explicitly addressed at this stage, in order to avoid "optimality" issues. By "optimality" we here mean incorporate inside the scenario design the optimal adaptation strategies to global change which may be undertaken by economic agents. A set of alternative scenarios – which will depart from the baseline approach – will be produced as a 'sensitivity' analysis on exogenous driving forces, namely global changes. For example, there will be scenarios on climate change policy, with different stabilization targets. But also scenarios on the degree of openness of international markets and on migration flows, which depart from present trends. These alternative scenarios can also be seen as mitigation scenarios and they could become object of specific policies. While in WP5, in a selected number of cases, it will be the welfare maximizing scenario that will be matched with the optimal adaptation strategy. Total costs will be assessed generating aggregate impact functions that could be used by macroeconomic growth models, also in WP5 and WP6.

WP 5 will focus upon adaptation issues; it will also provide the overall figures of the cost benefit analysis of global change. It will first produce scenarios in which the negative (positive) socio-economic impacts from global changes – examined in WP4 with models developed in WP3, are limited (enhanced) by means of appropriate adaptation measures, at the EU, national and macro-regional scales.

The debate that followed the publication of the Stern review has shown that uncertainty and discounting issues are worth a specific study when dealing with large-scale, long-term global changes. This is the objective of WP6. New theoretical insights will be developed in Task 6.1 and in Task 6.2 they will be tested, deriving further theoretical insights, using some of the models that are part of this study.

B.1.3.1.2 General description

<u>Work Package 1</u>

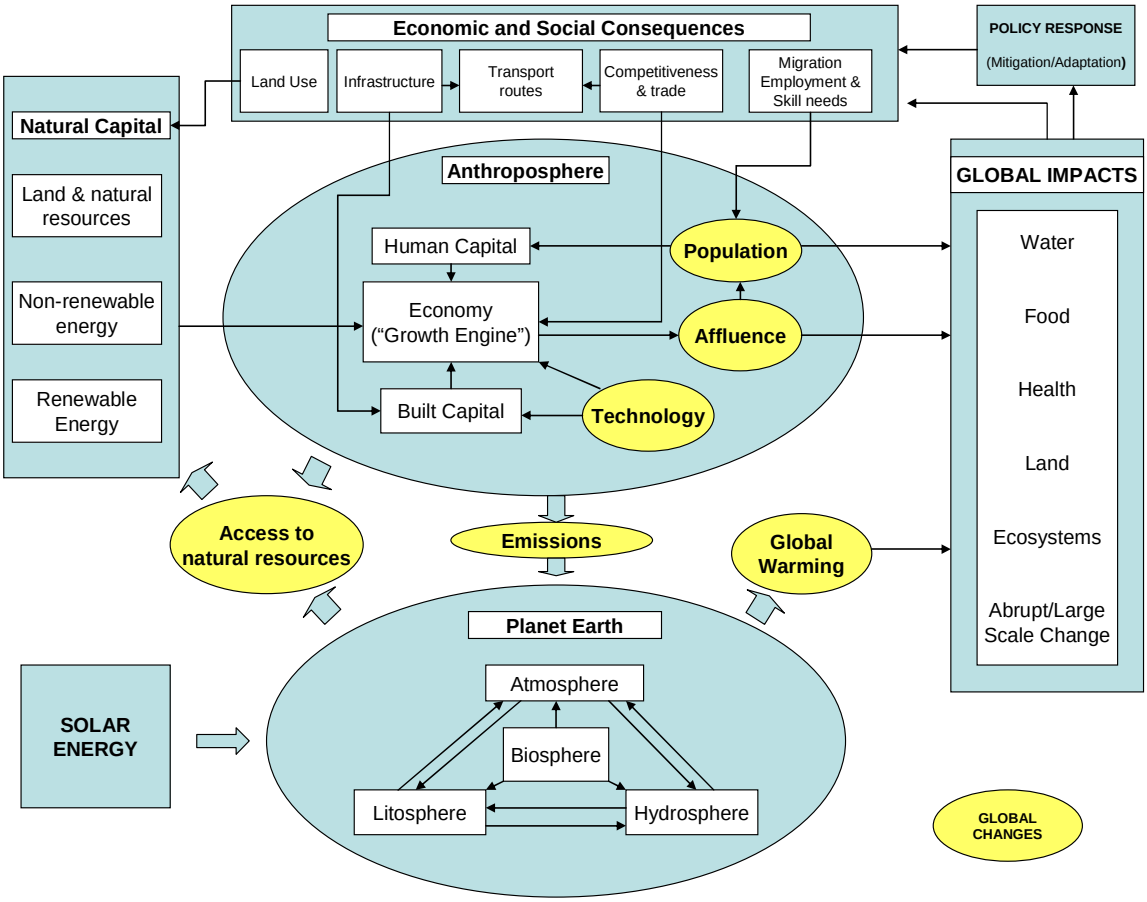
More in detail, WP1, building on a literature review of the present state of the art on global change studies, will:

- Produce and share with project partners the conceptual framework to define and analyse global changes, impacts and economic and social consequences;
- Make a review of the global impacts of global changes;
- Assess the learning achieved through the project about the economic and social consequences of likely global changes.

Analysing global changes and impacts is a complex issue. In today's world, human impacts on ecological life support systems are increasingly complex and far-reaching. In this world, the emphasis needs to shift from addressing problems in isolation to studying whole, complex, interconnected systems and the dynamic interactions between their components. Complexity implies that the whole is significantly different from the sum of the parts and that scaling (the

transfer of understanding across spatial, temporal, and complexity scales) is a core problem. Incorporating both biophysical and social dynamics makes these problems impossible to address within the confines of any single discipline.

This is the reason why it is important to start with an interdisciplinary and system overview of the complex, dynamic history and future of human-environment interactions at the global scale. A first system overview – whose single elements will be reviewed and discussed with the partners in WP1 – is provided in the figure below:



At the core of this overview there is the interaction between the natural processes on the planet Earth and the economic and social processes in the anthroposphere. The former include the physical and biogeochemical cycles between the atmosphere, lithosphere, hydrosphere, and the interactions with the biosphere, all fuelled by solar energy (bottom part of the figure). The latter include, at the core, the economy as a "growth engine", producing affluence for the population, using different forms of capital (natural, human, man-made capital) combined by means of technology embodied in the built/manufactured capital or disembodied - i.e. innovation in the production processes (top part of the figure).

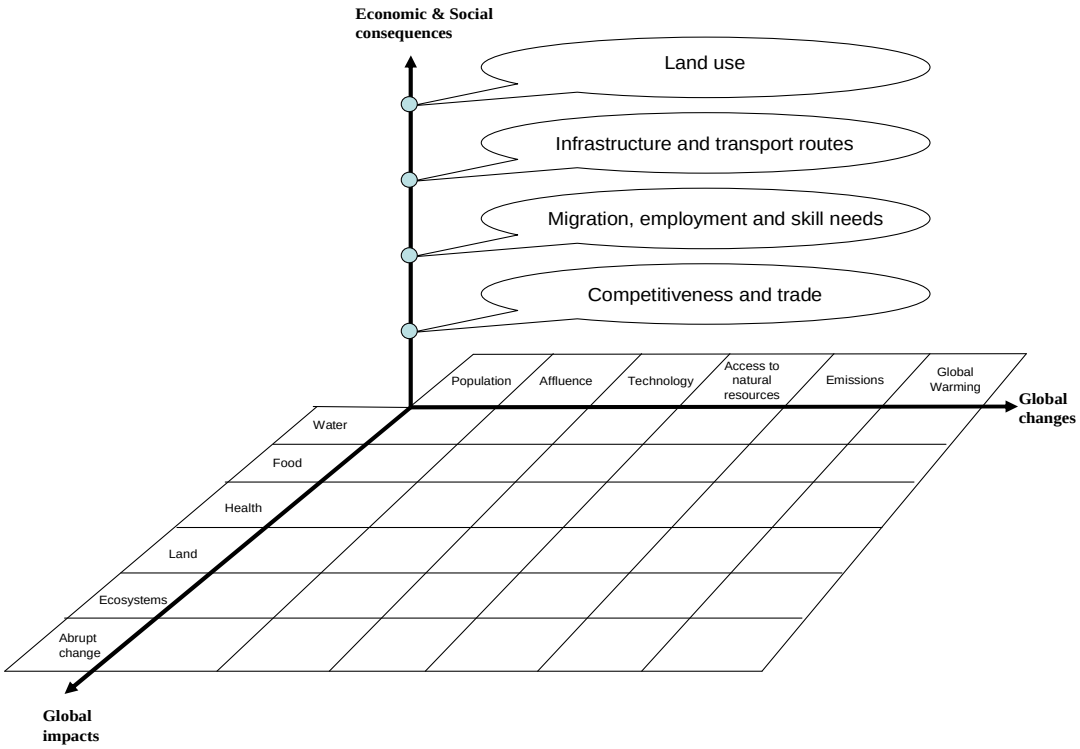
Global changes in this picture (yellow circles) include large scale changes in world population, affluence (GDP) and technology in the anthroposphere, and the related global changes in the interaction with nature – i.e. the access to natural resources, GHG emissions and global warming effects.

Global impacts are the direct influences of the global changes that will affect people around the world. They include in particular the impacts of global warming, population and affluence growth, whereas the other global changes – i.e. technology, emissions and access to natural resources – are

to be considered intermediate factors which influence the dynamic and performance of the global socio-economic system. Global impacts in this picture are identified according to the Stern Review, including impacts on water, food, health, land, ecosystems and possible abrupt and large-scale changes.

Global impacts will trigger **economic and social consequences**, spontaneously or through the mediation of mitigation and/or adaptation policies, including in particular consequences for migration, employment and skill needs, competitiveness and trade, infrastructure (energy, water, transportation) and transport routes, and land use. All these consequences will feedback upon different elements of the anthroposphere, changing built capital endowments, competitiveness, trade and GDP performances, population and human capital availability, land and natural resources (including energy) use, in the world as a whole and in different regions.

Based on a common understanding and sharing of the above conceptual framework, the partners will undertake a review aiming to assess the existing knowledge about the dynamic history and future development of global changes and impacts. The review will be organised on the basis of the following framework:



This framework includes the three key dimensions of the overall system overview presented above – i.e. the global changes, the direct global impacts and the economic and social consequences. The review will be organised making for each global impact category (water, food, health, land, ecosystems, abrupt/large scale changes):

- a qualitative assessment, producing a narrative of the historic influences and future developments associated to: i) each relevant global change among those mentioned[4] and ii) the interactions between the different global change influences;
- as far as possible, an analysis of quantitative megatrends and forecasts based on the existing data and key indicators of global changes, global impacts and their correlation.

The third dimension of the framework shows the economic and social consequences which will be assessed – with the help of modelling tools and scenario analysis – in the subsequent WPs of the project. This dimension is introduced here because, when the assessment of the economic and social consequences will be completed by the other WPs, a final task of WP1 will be to make a "meta-assessment" of the learning achieved in the project and future research needs. This will be done using the conceptual framework and the initial review of global changes and impacts as the state-of-the-art reference knowledge, against which to assess the foreground knowledge produced by the project.

Work Package 2

WP2 is the sectoral assessment block of the project whose components will further be used by other WPs. WP2 is split into four main tasks, itself divided into sub tasks. **Task 1** emphasizes the issue of non-marketed goods provision in measuring global change impacts. Many impact assessments of global change ignore the reactions of households or firms to changes. This underestimation of the potential of reaction of people to global change leads to inaccurate measurements of impacts. **Task 2** objective is to investigate this issue for households. **Task 3** is more focused upon energy consumption behaviour in reaction to global change while **Task 4** deals with trade and competitiveness issues.

Task 1 aims at providing the monetary values for non-marketed goods and services that can be either relevant to climate change, or would be affected by GHG mitigating policies, i.e. ancillary effects. Climate change has significant impacts on human health, leisure activities, agriculture, natural and semi-natural ecosystems, including forest ecosystems (IPCC 2001a; b). Where there are well established markets, measuring economic impacts of climate change can be based upon market prices or firms' profits. However, economic consequences of climate change upon non-marketed goods are somewhat hidden or cannot be priced. For instance, non-timber functions of forest, such as recreational and aesthetical services, or health benefits as reduced mortality and morbidity, are not traded on ordinary markets; therefore their monetary values are not known directly. Stated preference methods (CV, conjoint choice) and revealed preference techniques (TCM, hedonic pricing) are some of the methods that can be used when placing a monetary value over non-traded goods with their strengths and weaknesses. If such values are not available, benefit transfer exercise could be carried out; i.e. non-market values derived from existing valuation studies are transferred to a target study of interest using single (naive) point value transfer, transfers adjusting by purchasing power, benefit function transfer, or meta value analysis (Navrud and Ready 2007).

The objective of this task is to review monetary values of non-market benefits that are sensitive to climate change, especially impacts on human health, leisure activities, agriculture, water quality, natural and semi-natural ecosystems, including forest ecosystems. We focus on the transferability of monetary values for morbidity endpoints, premature mortality, or changes in quality of natural

[4] Although in complex systems everything seems to be (and probably ultimately is) connected to everything, not all global changes will produce relevant impacts in all categories – i.e. some of the "cells" in the two-dimensional grid of global changes and impacts will be empty.

ecosystems, including forest ecosystems and provide meta-analysis of values for the main impact categories.

Many studies have shown that air quality ancillary benefits of GHG mitigation may be a significant benefit, offsetting a substantial proportion of mitigation costs (Pittini and Rahman, 2004; van Vuuren et al. 2006, Amann et al, 2006). Similarly, policies specific to air quality may involve large side effects in terms of abated GHG; for instance, Barker and Rosendahl (2000), Kouvaritakis et al. (2005), Pye at al. (2008), or Ščasný et al. (2009) documented that AQ policies lead to significant decreases in GHG. Studies reviewed in the IPCC Fourth Assessment report show that moderate CO_2 reductions (10 to 20%) in the next 10 to 20 years also reduce SO_2 emissions by 10 to 20%, and nitrogen oxides (NOx) and particles (PM) emissions by 5 to 10%. Most of these estimates of ancillary benefits use simple relationships of the tons of emissions abated and the economic benefits. They do not consider the air quality benefits using an approach that quantifies the health or ecosystem benefits in physical terms, nor take into account the importance of location in air quality issues. To quantify ancillary benefits of GHG abatement, we shall review the latest results from the ExternE method. Specifically, we shall provide monetary values for airborne pollution and for transportation related impacts. Moreover, we shall review the ancillary benefits measures in developing countries and provide benefit transfer techniques wile directly quantifying the ancillary benefits of air quality through performing an original case study in China Beijing.

In **Task 2** we propose to analyse the impact of climate upon household's attitudes and adaptive behaviour. Firstly, we intend to analyze joint adoption of water and energy efficient appliances which is new in the literature. We propose to measure the impact of climate change related variables upon household's environmental concern including specifically climate change, upon household's habitual behaviour related to water and energy use (including among others turning off lights when leaving a room, cutting down on heating/air conditioning etc.), and on household's adoption of water- and energy-saving appliances (eg water-efficient washing machines, water tanks to collect rainwater, energy-efficiency rated appliances, thermal insulation and so). Hence it will provide new evidence upon how household's opinions, attitudes and effective behaviour are impacted by climate change. This issue will be addressed using a unique household database covering 10 OECD countries.

In the second subtask, we analyse barriers and preferences for installations of a source of renewable energy in households (micro-generation technology). Walker (2008) identified several barriers for the renewable energy micro-generation such as costs and affordability, complexity of the system, opportunity and reliability. On the other hand, presence of external motivational factors like public support (Long 1993, Scarpa and Willis 2009) as well as internal motivational factors like attitudes, values or habits (Vringer et al. 2007) can play an important role in increasing the share of renewable energy in household energy consumption. Decision-making processes and individual attitudes forming the potential changes in the energy consumption behaviour have been so far analysed qualitatively (EC 1997, Dobbyn and Thomas 2005, Bahaj and James 2006, Schwezeir-Reis et al 2000, Jenny et al. 2006 in Keirstead 2007), while other studies analyse adoption of renewable energy without searching for motives (Kriström 2009). Except the OECD study that analysed WTP for renewable energies analysed by Kriström (2009), Farhar and Coburn (1999), Champ and Bishop (2001), Rowlands, Roe et al (2001), Wiser (2003), Zarniku (2003), Longo et al. (2006), Ek and Söderholm (2008), or Harris (2008) analysed WTP for renewable. However, most if not all studies analysed WTP for green electricity rather than for the adoption of renewable energy micro-generation technology. The objective of this task is twofold, first to identify and analyse the main barriers that hinder the adoption of renewable energy sources by households and second to elicit the willingness to pay of households to adopt/install renewable energy micro-generation technology.

In **Task 3** we aim at analysing energy consumption and behaviour of households and economic sectors due to the fact that effects of policy upon consumption and welfare depend of agents responsiveness to exogenous changes. First, we propose to estimate parameters of household

demand system in Europe, specifically on some of CEE countries, for which there is no so much empirical evidence so far. We intend to examine the key assumptions for the existence of a strong double dividend, i.e. cross price elasticites between demand for dirty goods and leisure (Fuest and Hubber 1999; Goulder, Parry, Butraw 1996). Cross-price elasticities of household energy demand have been estimated from macro data by e.g. Abbott and Ashenfelter (1976), or Barnett (1979), while Blundell and Walker (1982) use micro data while correcting for selection bias, benefiting form the work of Amemiya (1974) and Heckman (1979). Alderman and Sahn (1993) perform one of the first studies that adjust the Almost Ideal Demand System (Deaton and Mullbauer 1980) so that it incorporates male and female leisure, in addition to five commodity groups. Next, Madden (1995) is the first one to directly apply the estimated elasticities for optimal tax purposes. Probably, the most reliable estimates of cross-price elasticities between a commodity and leisure is provided by West and Williams (2007) who employ an augmented AIDS for the USA. We propose here to follow up the work by Alderman and Sahn and especially West-Williams and to estimate cross price elasticities for energy goods including leisure in one of transition countries in the CEE region.

Then, the key parameters of a production function, i.e. the elasticity of substitution, will be estimated for economic sectors in some CEE countries, for which no such estimates have been provided. The estimated elasticity of substitution between production factors (capital, labour and energy) can be further used as a model parameter by CGE in WP3 and thus will serve to address the criticism regarding the reliability of parameter values of CGE models. The need to estimate production functions with nested structure is discussed since Berndt and Wood (1979). For more recent studies we name Van der Werf (2008) who estimates a 2-level nested production function for 12 OECD countries for 1978-1996, or Okagawa and Ban (2008) who estimate a nested CES function using another OECD dataset. We suspect that the elasticity of substitution might be different in Central European countries from that of Western European countries due to the difference in their economic structure. The estimated elasticities of production are parameters for the CGE models and enable comparison of the results, when using the newly estimated parameters and when using the conventional value of parameters.

The failure, hereto, to agree upon binding, internationally-coordinated climate targets will result in nations pursuing national climate change policies that are only partially coordinated. As the ultimate object of these policies is to raise the cost of carbon emissions, national differences in the shadow price of carbon will affect the international competitiveness of energy intensive industries exposed to trade. Such “competitiveness” effects on industries create political economy forces that typically result in national tariffs and subsidies designed to offset the competitiveness effects. In the EU and Japan, for example, energy intensive industries exposed to international competition has been awarded free allowances of carbon permits to avoid raising their costs. The same outcome was observed with the US Super Fund tax on chemical-using industries and the Montreal Protocol on Ozone Depleting substances. While driven largely by special interest politics, the tariffs and subsidies will like be justified as limiting “carbon leakage”.

Task 4 will explore this socio-economic impact of global changes in three ways: first, we shall synthesize and critic the existing econometric evidence over the magnitude of the competitiveness effects. Second, we shall develop theoretical international trade models that allow for firm heterogeneity and also include carbon linkages. Third we shall expand the analysis to consider the larger issue of the implications of using second best policy tools to address the climate change problem.

The difficulties of the international coordination between parties and the need for action result in the design of policy architectures at the national, EU of international level which are more or less far from a first best ideal. Taking the EU mitigation policy and the US planned policy as prime examples, we shall examine the second best properties of such tools upon the long run achievement of climate objectives, substitution between energy sources and energy prices. Local versus global policies in a transition context implying progressive entry of South countries inside a North

common regulation scheme will also be considered. Making use of an endogenous growth general equilibrium model, we shall also assess empirically the consequences of designing second best policies both on growth and the climate dynamics in the long run.

Work Package 3

The objective of WP3 is to enhance already existing models with features that will enable (in WP4) the assessment of impacts of global changes outlined in WP1, and the analysis and quantification of optimal adaptation strategies and total costs in WP5. Soft and hard linkages among existing global models will be a main area of work, in order to incorporate the description of different sectors (e.g. energy models and land-use models and general equilibrium models) into a coherent framework of analysis and to exploit synergistically the strengths of different modelling approaches (e.g. partial equilibrium and general equilibrium models). As a result, WP4 and WP5 will be able to give a better representation of socio-economic effects of global changes compared to what has been done so far.

While other projects have been more focussed on quantification of biophysical impacts and mitigation cost assessment (cf Climate Cost), this project attempts to specifically address the lack of an adequate representation of socio-economic dynamics in models designed to address global and regional issues in the long-term. In this way, it will be possible to design scenarios of socio-economic impacts of environmental global challenges (cf related call in the Environment Theme: ENV.2010.1.1.6-3 *Quantifying the costs of mitigating climate change by means of activities involving joint climate and economic modelling*) and to explore with robust modelling work other global challenges (e.g. energy, international competitiveness, etc) not adequately studied so far.

This WP is responsible for setting up the infrastructure to do so with the input from WP2, while WP4 and WP5 will make active use of the framework of WP3 to identify and analyze different scenarios and assess alternative adaptation strategies in the light of likely global changes. This approach will serve to get a more detailed (and precise) assessment of the costs of global changes.

The first task is dedicated to enable the comparison of scenarios and mutual exchange among models in WPs 4 and 5. Models' assumptions on exogenous trends will be aligned, but models-specific structures will be preserved, without attempting to conduct a thorough and coherent modelling comparison exercise. The goal is instead to maximize the exchange of information between models – e.g. by means of soft-links – in order to design richer scenarios and produce more accurate impact estimates and adaptation options in WP4 and WP5, the ultimate goal being to identify the optimal trade-off between mitigation and adaptation to major impacts of global changes.

The following task is then organized along the major impact areas: (1) agriculture and forestry markets, (2) water, energy, fuels availability, energy security, (3) transport, infrastructures, tourism, (4) competitiveness, labour market, international trade, financial stability, and (5) population and migration. Different models will be adapted, further developed and partially integrated to enable assessment of the socio-economic impacts of global changes in these areas. Inputs for this task will come from WP2. We now describe the involved models and how they will be expanded by area, giving the necessary motivation and also methodological details:

(1) **Agriculture and forestry.** The agricultural sector is likely to be the most directly affected by many global changes. Rules governing international trade will impact agriculture and the global allocation of land. European Union re-definition of the Common Agricultural Policy will also have local and global repercussions. Most notably, climate change will reshape agriculture and land allocation worldwide due to changing patterns of temperature, precipitations and water availability. Mitigation policies to climate change will also impact the agricultural sector due to the growing importance of bio-energy. Trade policy, domestic and global agriculture policy regimes,

technological progress, evolving energy systems, will all be a challenge for agriculture and land allocation in general.

In order to capture part of these linkages, the agricultural and forestry partial equilibrium model GLOBIOM[5] (IIASA) will be linked with the WITCH model (FEEM). WITCH is a model specially suited to study long-term endogenous optimal investment decisions inside a framework that integrates the economy, energy and climate (Ramsey-type optimal growth, hard-linked). Therefore it will perfectly complement GLOBIOM which is instead a partial equilibrium model which lacks endogenous drivers of global and regional demand of major world commodities and of land. Issues such as the EU agricultural policy and international trade will be major areas of interest.

FEEM will work to introduce land use and forestry dynamics into the WITCH model. The model will be soft-linked to the GLOBIOM model of IIASA. Bio-energies supply curves, which now enter the model in reduced form, will be an output of the GLOBIOM model. WITCH will provide long-term output scenarios and demand of land to GLOBIOM. WITCH will also provide technological progress dynamics to determine land productivity in GLOBIOM. The international market of carbon allowances in WITCH will be linked by means of certificates from REDD – Reduced Emissions and Deforestation and Land Degradation – to the GLOBIOM model. The highest possible degree of spatial resolution will be used in order to study impacts – e.g. climate change, water availability – with a sufficiently high level of precision. Methodologies to use in GLOBIOM-WITCH high resolution Global Circulation Models climate scenarios will be developed.

These activities will be complemented by the already existing soft coupled REMIND-R (a Ramsey-type optimal growth energy-economy-model) /LPJmL-MAgPIE (an agro-economic model driven by a dynamic vegetation model) complex from PIK.

Note that while MAgPIE[6] is more advanced in the sense that it includes induced technological change and more detail on the agricultural side, GLOBIOM captures more of the forestry side – therefore the two approaches are expected to cross-fertilise each other. Furthermore, in the current

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[5] GLOBIOM (developers at IIASA: Petr Havlik, Aline Mosnier) is a global recursive dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to give policy advice on global issues concerning land use competition between the major land-based production sectors. Concept and structure of GLOBIOM are similar to the US Agricultural Sector and Mitigation of Greenhouse Gas (ASMGHG) model (Schneider, McCarl and Schmid 2007). The global agricultural and forest market equilibrium is computed by choosing land use and processing activities to maximize the sum of producer and consumer surplus subject to resource, technological, and political restrictions, as described by McCarl and Spreen (1980). Prices and international trade flows are endogenously computed for 11 world regions.

[6] In MAgPIE, crop yields for each grid cell are supplied by the Lund-Potsdam-Jena dynamic global vegetation model with managed Lands (LPJmL) (Sitch et al., 2003; Bondeau et al., 2007). LPJmL endogenously models potential crop yields by linking climate and soil conditions, water availability and plant growth, and takes the impacts of CO2, temperature and radiation directly into account. Actual yields are derived from potential ones through a 'management factor' based on FAO statistics. LPJmL also covers the full hydrological cycle on a global scale, which is crucial as carbon and water-related processes are closely linked in plant physiology (Gerten et al., 2004; Rost et al., 2008). The suitability of LPJmL for crop and water studies has been demonstrated by validating simulated phenology and yields (Bondeau et al., 2007, Fader et al. 2010), river discharge (Gerten et al., 2004), soil moisture (Wagner et al., 2003), evapotranspiration (Sitch et al., 2003; Gerten et al., 2004) and irrigation water requirements (Rost et al., 2008). Crop yields for MAgPIE are computed as a weighted average of irrigated and non-irrigated production, if part of the grid cell is equipped for irrigation according to the global map of irrigated areas (Döll and Siebert, 2000). Water discharge is computed including downstream movement according to a river routing scheme.

Spatially explicit data on yield levels and freshwater availability for irrigation is provided to MAgPIE on a regular geographic grid, with a resolution of three by three degrees, dividing the terrestrial land area into 2178 discrete grid cells of an approximate size of 300 km by 300 km at the equator

MAgPIE version (Lotze-Campen et al. 2008, Popp et al. 2010), each cell of the geographic grid is assigned to one of ten economic world regions: Sub-Saharan Africa (AFR), Centrally-planned Asia including China (CPA), Europe including Turkey (EUR), the Newly Independent States of the Former Soviet Union (FSU), Latin America (LAM), Middle East/North Africa (MEA), North America (NAM), Pacific OECD including Japan, Australia, New Zealand (PAO), Pacific (or Southeast) Asia (PAS), and South Asia including India (SAS).

The regions are initially characterized by data for the year 1995 on population (CIESIN et al., 2000), gross domestic product (GDP) (World Bank, 2001), food energy demand (FAOSTAT 2008), average production costs for different production activities (Narayanan and Walmsley, 2008), and current self-sufficiency ratios for food (FAOSTAT, 2008). While all supply-side activities in the model are grid-cell specific, the demand side is aggregated at the regional level. There are 12 demand categories, compared to 23 cropping and livestock activities. Certain demand types can thus be satisfied with different crop types, which allows for substitution between supply categories. Aggregate demand within each region, defined by total population, average income and net trade, is being met by the sum of production from all grid cells within the region.

Trade in food products between regions is simulated endogenously, constrained by minimum self-sufficiency ratios for each region. This is to say that some minimum level of domestic demand has to be produced within the region, while the rest can be allocated to other regions according to comparative advantages. For this project, we aim to increase the number of regions by disaggregating EUR into finer macro-regions based on the GTAP 7 Data Base (Narayanan and Walmsley, 2008). Thereby the impact cascade, triggered by weather-related effects of global warming, onto food prices and macroeconomic parameters could be studied. We shall explicitly upgrade the LPJ-mL-MAgPIE-suite for the representation of extreme weather events, which are expected to acquire an over-proportional effect under global warming.

(2) **Water and energy.** Examples of sources of global changes include, for example, access to natural resources, climate change and large risks for societies. These different factors might, in addition, reinforce each other. Under climate change, for instance, efficient use of resources in agriculture will become more important than ever to avoid disastrous impacts upon food security in developing countries. This will require, next to the investments into research and extension, also investments into local transport infrastructure and irrigation facilities. These changes will in part happen autonomously (i.e. autonomous adaptation), thanks to market forces, and in part thanks to government intervention (i.e. planned adaptation). GLOBIOM (IIASA) relies currently upon EPIC simulations for spatially and system-specific estimates of current and potential crop yields. This feature will be expanded to take into account climate change (and possibly other global changes depending on the insights delivered by WP1 and WP2) and to design sustainable management strategies contributing to closing the yield gaps (Research). Furthermore, GLOBIOM represents currently four different irrigation systems which differ in applicability and in water use efficiency (Sauer et al. forthcoming) EPIC simulations contain as information irrigation water demand by crops. Spatially explicit (0.5 degree) irrigation water availability constraints will be introduced through linking with a global hydrological model (Irrigation). The modelling suite around MAgPIE (PIK) simultaneously addresses the water cycle as a prerequisite to be able to be informative on food production, thereby providing an alternative set of estimates to the abovementioned issues on water.

With respect to socio-economic impacts related to energy issues, BEWHERE (IIASA) will be linked to GLOBIOM. The BEWHERE[7] model will be able to provide information on production plant capacities, and therefore bio-energy costs may be assessed. Those costs will be used into the GLOBIOM model from which the land use for bio-energy purposes can better be estimated. In addition, the BEWHERE model will be developed to be run at the global level. The energy demand such as transport fuel and heat consumption will be defined spatially on a half degree grid (the locations of the bio-fuel production plants are highly dependent upon the location of the heat demand). This also relates to the next sub-task. The energy use from the households estimated in WP2 will be an important input to the BEWHERE (IIASA) model, in order to better define the possible location of bio-energy production plants.

FEEM will improve the description of the fossil fuels sectors in the WITCH model. The WITCH model developed by the climate change modelling and policy group at FEEM (Bosetti, Massetti, Tavoni, 2006; Bosetti et al., 2006; Bosetti, de Cian, Sgobbi, Tavoni, 2009) is a regional model in which the non-cooperative nature of international relationships is explicitly accounted for. The regional and intertemporal dimensions of the model make it possible to differentiate climate policies across regions and over time. In this way, several policy scenarios can be considered. WITCH is a truly intertemporal optimization model, in which perfect foresight prevails over a long term horizon covering the whole century. The model includes a wide range of energy technology options, with different assumptions over their future development, which is also related to the level of innovation effort undertaken by countries. Special emphasis is put on the emergence of carbon-free backstop energy technologies in the electricity as well as the non-electricity sectors, and on endogenous improvements in energy efficiency triggered by dedicated R&D investments contributing to a stock of energy efficiency knowledge.

So far, international trade of fuels has not been explicitly modelled in WITCH. In this sub-task investments in extraction capacity will be modelled for each fossil fuel, in each region, coherently with the WITCH Ramsey-type optimal growth framework. Fossil fuels imports and exports, as well as their international price, will be endogenously determined. Technological progress, both endogenous and exogenous, in fossil fuels extraction capital will be modelled.

FEEM will introduce super-grids inside the WITCH model. Super-grids will be necessary to expand the penetration of renewable energy in Europe and in other world regions. They will allow exploiting efficient production sites, e.g. distant sites for wind generation. In particular, they are in principle capable of exploiting solar thermal power plants, which need direct sunlight. Investments to build super-grids will be endogenous and will be valued against other investment possibilities. Endogenous technical change will affect the cost of the grids as well as the cost of power plants that will be connected to the grids. The distribution of grids will have the highest possible geographical resolution.

FEEM will introduce in a single optimization framework international trade of fossil fuels and super-grids by updating the WITCH model with the two developments undertaken in this sub-task.

[7] The BEWHERE (developer at IIASA: Sylvain Leduc) model calculates the optimal spatial distribution and size of bio-energy plants, pulp and paper mills and sawmills given the spatial biomass supply distribution from biophysical models. Together with a demand estimated from a geographically explicit driver maps and aggregate demand from EU-FASOM Model or GLOBIOM Model, BEWHERE calculates the optimal positions of plants and mill, such that economies of scale and scope under poly-production of spatial explicit bio-energy systems can be assessed. Size, costs and optimal location of bio-fuel (methanol, ethanol), sawn-wood or pulp for paper plants are calculated, given the biomass and demand distribution, and international trade. Side products are also considered: the residual heat can be delivered to district heating networks. The model includes calculation of infrastructure costs of the heat distribution, and estimates the heat demand regarding the housing infrastructure. Trade with other countries can also be considered, such as imports/exports of the raw material or the final product.

This will require finding efficient solution algorithms to manage multiple international markets (of fuels and multiple markets of electricity) in a computationally tractable way. By means of the work undertaken in this task WITCH will be able to produce estimates of economic impacts – at global, European and regional level – for most of the global changes that affect energy supply, energy demand, international policy (e.g. policy scenario regarding Northern Africa and Middle East countries and Europe), global economic growth, national security. REMIND (PIK) does already resolve trading of primary energy carriers, certificates and a generic good. While being relatively advanced on the trade side, the representation of the electricity network infrastructures needs to be implemented (herein similarly to WITCH). Furthermore, extra costs induced by the fluctuating nature of renewable energy sources need to be upgraded.

(3) **Transportation, infrastructures and tourism**. Global changes will also require a closer examination of the possible impacts on infrastructure demand and transport means. In order to facilitate the adoption of new capital-intensive technologies in poor rural areas, for example, local transport networks need to be improved, to ensure market access. An adapted version of GLOBIOM (IIASA) has been used for the analysis of deforestation drivers in the Congo Basin, including current transport networks and projections of their developments. Local transport infrastructure will be expanded to the other world regions within this project, and scenarios on its development will be considered (Roads) in work packages 4 and 5. Furthermore, international trade is sometimes considered to be one of the major means of adaptation. There are currently many physical/financial and institutional barriers to trade. GLOBIOM already represents the tariff barriers, and it will be expanded to explicitly represent also the cost of international transport. This will enable to quantify the role of reducing the cost of trade in adaptation.

Finally, the GRACE tool (ISIS) will be developed in order to provide input to the models. The GRACE model is designed to provide social costs in € per vehicle of congestion and accidents in Europe, calculated on major transport routes. Depending on the input required by the assessment model, the GRACE model will be further developed to provide the evaluation of social costs for other world regions, including developing countries. The input of the GRACE model will contribute to the best assessment of the social costs of climate change impacts on the transport system.

In an in-depth regional study PIK will derive the interaction of growth, vulnerability and adaptive capacity for 1-2 key regions in the OECD and/or China on cities or pan-continental infrastructure. Hereby we will explicitly address the effect of growth inducing the build-up of new infrastructure (either within cities or on a pan-continental level), which then – in the absence of an adaptation policy – could make society more vulnerable to climatic change. On the other hand an exchange of infrastructure, triggered by an adaptation policy, could reduce vulnerability. External drivers beyond climatic change such as policies addressing urban sprawl or energy security, respectively, will simultaneously be considered. These insights will be used to cross-check certain calibrations and/or in of/from ICES.

(4) **Competitiveness, labor and trade.** WIIW will expand the ICE general equilibrium model with emphasis on three extensions to core trade-related applications: (a) employment effects (this will entail mapping the sector and country effects to detailed satellite accounts on employment), (b) migration (this will include econometric research on the major determinants and using the CGE work to inform how trends/change feed into major migration drivers), and finally (c) WIIW will use Ramsey-type medium-term mechanics to examine the impact of increased investment uncertainty on medium term real investment trends, with implications for production, growth, trade, wages, etc. This will put us into a position to investigate issues such as the lasting effects of a financial crisis.

The WIIW team will employ the expanded ICE model to estimate the impact of basic global macroeconomic trends on global production and trade patterns, the competitiveness of European industry, the cross-industry and cross-member patterns of impact on labour markets, and the impact on food and energy markets. Projection analysis will be reconciled with the outputs from other

elements supplied as outputs from other WP elements within the project. The range of issues addressed in the baseline scenario definitions, in conjunction with possible policy responses, point to uneven pressure on the market for skilled and unskilled labour, the competitiveness of EU industry, and likely changes in the rates of return in EU industry (which impacts on financial stability to the extent this drives the health of key financial sub-sectors). The WIIW team will give particular attention in to baseline EU assumptions about human capital investment (the growth of skilled and unskilled labour stocks) and variations in these target human capital investment level (target education policies) for variations in labour market impacts. In addition, the WIIW team will also examine alternative degrees of intra-EU labour mobility for the response of member level and continental labor markets (wages, employment patterns) to major global change drivers. This involves mapping model projections to medium-term EC skill forecasts (CEDEFOP 2009), as well as to alternative specifications for future intra-EU mobility of labor.

REMIMD (PIK) at present explicitly predicts the effects of climate policies upon 11 global actors that are linked by trade and competition. After the resolution of MAgPIE has been upgraded to be accessible for climate impact information, the already soft-linked REMIND/MAgPIE complex will be informative on the consequences of energy and trade policies upon European competitiveness. Linkages between IIASA and FEEM models will also enable for a more detailed analysis of competitiveness and trade issues. It was already mentioned that trade barriers are already considered in GLOBIOM (IIASA) and that the related impact over prices can be estimated and used by other models. Other sources of global change may lead to (energy) price shocks, an issue which can also be investigated by creating soft links between models.

(5) **Population, migration and social impacts.** The WIIW team will include basic projected population dynamics in medium term projection scenarios with the ICE model. The basic decomposition of projected population trends and their contribution to global trends will be assessed as a follow-up decomposition of the baseline. This includes indirect pressure on European labour markets through trade linkages. Estimated changes in labour supply and labour market conditions, as well as shifting income and price patterns, will also be used to quantify possible changes in the global drivers of migration. Regarding migration, the WIIW team will work with recent primary datasets (especially from the World Bank) to analyse econometrically current migration and remittance patterns based on key determinants like per-capita income levels, language differences, population growth, and unemployment. This will be used to structure a stylized or reduced form model that, in conjunction with the model-based scenario analysis outlined elsewhere in the project draft, will be used to quantify the range of possible directions and relative magnitudes of change in the current mechanisms driving migration.

Subsequently, we shall aim at developing methods enabling to include sectoral and partial estimates of global changes socio-economic impacts into a general equilibrium framework in order to derive total costs estimates. In particular, FEEM will enrich ICES, a recursive dynamic general equilibrium model for the world economic system, with new mathematical specifications in order to make it an appropriate tool for impact assessments. This research phase can entail two different activities. (1) Build a set of “interfaces” able to translate the relevant sources of pressures into meaningful economic input for the model. Pressures can be either linked to climate-change, but also to more “traditional” market dynamics (e.g. change in land use, in technology, in tourism flows, in migrations etc.). All these need to be transformed into changes in supply or demand of the inputs or outputs considered by the model. (2) Modify the functional specification of the model when its original structure does not allow examining some sources of changes. This is typically the case when a given shock affects variables which are endogenous to the model or variables that are not currently included in the model.

FEEM and PIK will co-derive *reduced form impact functions* as emulators from ICES, which could then be implemented in both REMIND (PIK) and WITCH (FEEM) for macro-economic analyses in WPs 4 and 5. To supplement this, WIIW will estimate general equilibrium impact elasticities to

isolate reduced form impacts of changes in key global change drivers on socio-economic variables of interest. The WIIW team will also place emphasis over the impact of the drivers of global change upon social dimensions of European labour markets – employment, earnings, and relative inequality. The range of issues addressed in the baseline scenario definitions, in conjunction with possible policy responses, point to uneven pressure on the market for skilled and unskilled labor, the competitiveness of the EU industry, and likely changes in the rates of return in the EU industry. Such changes have impacts over financial stability and affect the health of key financial sub-sectors).

Having developed the model infrastructure for the assessments to be undertaken inside the following two work packages, it is necessary to conduct a set of tests to ensure consistency of the results. Sensitivity analysis or tests using Monte Carlo techniques will be employed to examine the robustness of outcomes. In addition, because of the large-scale nature of some of the modelling tools and scenarios, sensitivity analysis will be conducted using Gaussian quadrature methods by the WIIW team.

Work Package 4

Impact estimates generated within WP 4 will be based upon the suite of impact functions assembled in WP3. A first task will be to build up a reference scenario. This scenario will be first designed at a sectoral level for agriculture, forestry, water, transportation, energy, together with inclusion of population prospects, labour markets and employment, trade and competitiveness impacts. The basic scenario blocks will then be assembled inside an integrative scenario at various regional, EU and global scales. Then a set of alternative scenarios which will depart from the baseline approach will be produced as a “sensitivity” analysis with respect to exogenous driving forces, namely global changes. For example, there will be scenarios of climate change policies with different stabilization targets, but also scenarios about the degree of openness of international markets and on migration flows, which shall depart from present trends. These alternative scenarios can also be seen as mitigation scenarios and they could become themselves the object of specific policies. In WPs4+5, in a selected number of cases, the welfare maximizing scenario will be matched without and with the optimal adaptation strategy, respectively, in the face of selected global change impacts. This scenario building sequence will take full advantage of the variety of models developed by the participating teams. It will also benefit from the model integration effort performed inside WP3. The WP4 will be organized around three main tasks.

The objective of **Task 1** will be to build a reference scenario. Split into different sub-tasks for the various relevant sectors, the work will design a reference socio economic pattern without considering at this stage adaptation possibilities.

Task 2 will extend the reference scenario to various alternative scenarios, keeping the same no adaptation assumption. The objective of this task will be to construct an array of possible evolutions to be assessed at different scales.

In **Task 3**, total costs will be developed by merging information from Task 4.1 and 4.2, generating aggregate impact functions that could be used by macroeconomic growth models, and also in WP5 and WP6. The main difference between the impact functions developed in this work package with respect to their counterparts in WP 5 is that the scenarios build up in WP4 do not take explicitly into account the adaptation of economic agents to global change. One can speak of “gross” impacts to label them by contrast to the “net” impacts (including adaptation) which will be computed in WP5. This “gross” impact assessment is what is usually produced in global change simulation exercises, thus allowing us to compare our results with the already existing figures.

In a further alternative set of scenarios we shall also impose limits to the degree of flexibility by which models react to global changes. In fact, our models typically assume smooth action, perfect

foresight and costless reallocation of investments among sectors. In the real world adjustment is slower and costly.

Work Package 5

WP 5 will focus upon adaptation issues; it will also provide the overall figures of the cost benefit analysis of global change. It will first produce scenarios in which the negative (positive) socio-economic impacts from global changes – examined in WP4 with models developed in WP3, are limited (enhanced) by means of appropriate adaptation measures, for the EU, National and macro-regional levels. This work package is split into three main tasks.

In **Task 1** we shall deal with adaptation scenarios. The analysis will discern between autonomous and planned adaptation. Autonomous adaptation will be examined by using a better description of decision makers' behaviour, with the help of models developed in WP3. For instance, by modelling farmers' choices regarding crops and investments for irrigation, it will be possible to see to what extend they can adapt to stresses – e.g. from international trade, climate change, and water shortages – as a simple reaction to changes in relative prices and other institutional and market conditions. Planned adaptation will instead be examined by isolating those potentially welfare enhancing adaptation responses that need coordination, specific financial support and government intervention.

The agricultural sector has become over the past a champion in adaptation, as necessary reaction to inter annual weather fluctuations. Now it seems to face a new challenge in adapting to the global change characterized on the one hand by likely unprecedented increases in food demand due to population expansion and even more importantly to income increases and the resulting diet changes especially in Asia, while on the other hand by likely slow down in yield increases because of the climate change, and to random shortages resulting from increased frequency of extreme weather events. The applied models enable through the bottom-up approach to represent the main impacts of climate change on agricultural and forestry productivity, as well as the adjustments in the management systems to cope with the latter. Within the project we shall focus especially on an analysis of how much of the adaptation can take place locally and which part needs to come from changes in the international trade flows with its impacts on employment, income distribution, and finally food security.

Where possible, inter-relationships among sectors will be explored and optimal response to multiple stresses will be examined; firstly, by producing scenarios of optimal adaptation with the highest possible spatial resolution, exploiting the new features of models developed in WP3; secondly by considering the international inter-linkages and chains of distribution of impacts from global changes, including the international implications of optimal adaptation responses; thirdly, by examining the inter-generational distribution of impacts, when the costs and the benefits of adaptation are taken into account.

Task 2 will complement Task 1 This will be done by providing a sensitivity analysis – including Monte Carlo approaches – to incorporate major sources of uncertaintly into the adaptation scenarios. Then in **Task 3**, estimates of the impacts net of adaptation and estimates of adaptation costs/benefits will be used to study the optimal mix between adaptation and mitigation. At this stage we shall depart from the positive approach of global changes assessment adopted in the previous WPs to introduce a normative dimension into the analysis. More specifically the issue of the optimal mix between mitigation and adaptation will be referred to long run welfare evolutions. Last, we shall determine the total costs of global changes taking into account adaptation possibilities. With respect to the Stern Review conclusions which did not incorporate adaptation issues, one can remark that by taking into account adaptation strategies, our cost estimates will identify in fact to the lower bound of global change costs, the agents being assumed to adopt strategies minimizing the negative impacts of such changes.

Work Package 6

In WP6 we shall develop theoretical innovations on discounting, risk and ambiguity. We shall apply and develop the latest research from behavioural economics and incorporate discounting schedules that explore consequences for discounting when households care not only about their absolute income levels, but also about their relative income compared to others. Previous studies have shown that relative income concerns may have important consequences for policy in several areas.

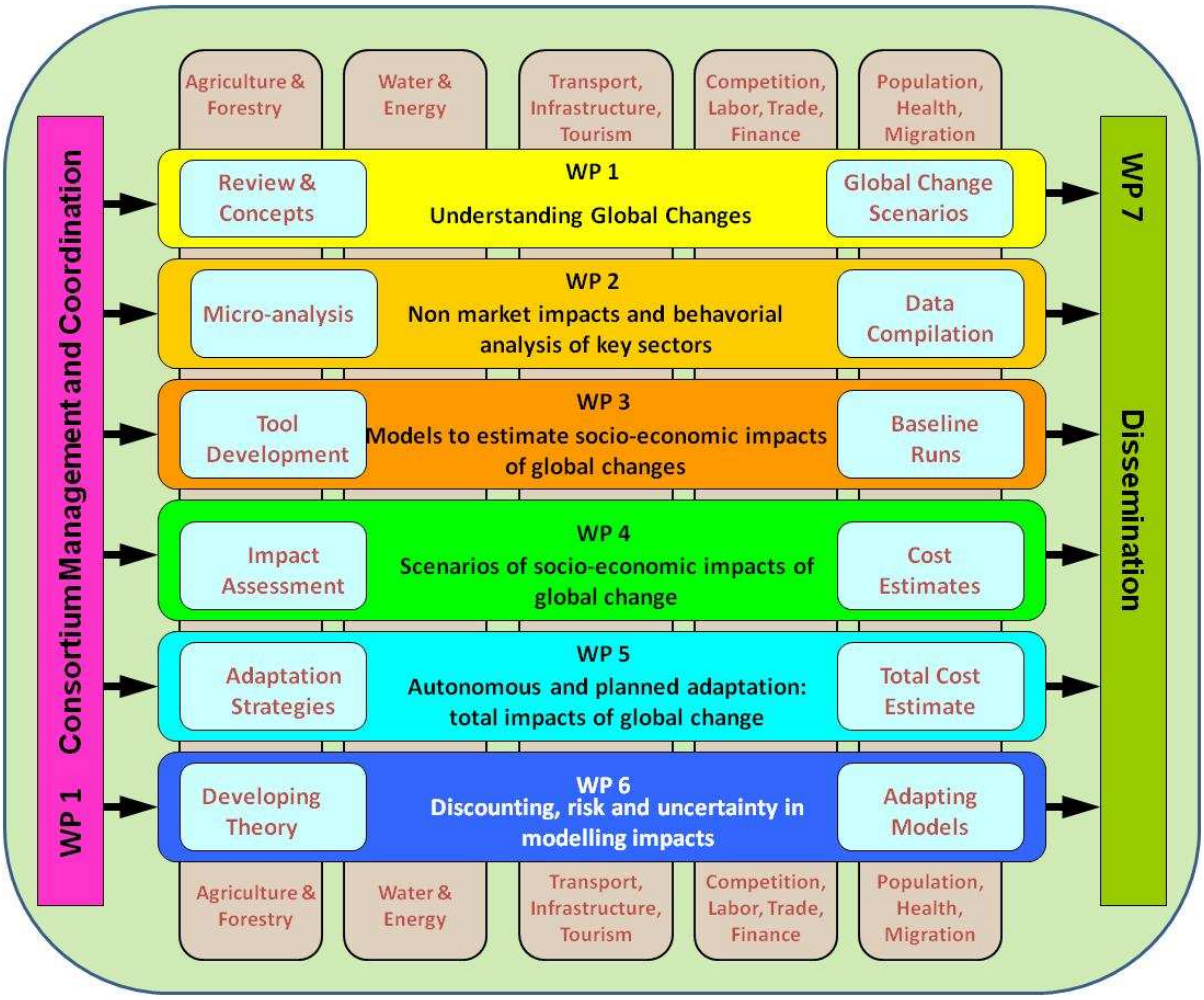
We shall also examine the case of habit formation when households extract welfare from the environment, or from their anticipatory feelings related to future risk and ambiguity. We shall explore how habit formation will modify the optimal social discount rate, and also how such effects interact with effects of uncertainty regarding the future growth rates. Finally, the consequences for discounting of differential growth rates in a model with several sectors will be explored. If sectors grow at different speeds, we either need different growth rates or relative prices of the various sectors that takes changes in relative scarcity into account.

The Stern Review did not explore ambiguity and ambiguity aversion, and thus raised several questions, on for example ambiguity, which are still unanswered (Weitzman, 2008). Several sources of impacts of global changes do involve ambiguity (deeper uncertainty), which makes incorporation of precautionary principles in policy analysis essential. We shall also study methods for incorporating ambiguity and aversion to ambiguity in models for impact studies in WP6.

Integrating research ideas into already existing IAMs poses several modelling challenges to the existing models. Nevertheless, FEEM, IIASA, PIK, LSE, UGOT and FOND JJLTS will work jointly in WP6 to incorporate new theoretical developments. The discounting schedules and uncertainty mentioned above will be incorporated for selected issues in the models. For example, we shall explore the implications of alternative discounting methods on long-term economic growth patterns, on demand of fossil fuels, on technological change and on climate. We shall conduct analyses of optimal investments under uncertainty on fossil fuels resources, on climate change impacts and on land productivity. Research will also be undertaken to implement and assess impacts of catastrophic climatic risk in slim versions of IAMs as well as simulating effects of behavioral aspects such as precaution and ambiguity aversion in policy analysis.

B.1.3.1.3 Graphical presentation of the components showing their interdependencies

A graphical presentation of this implementation plan is presented in the Pert Chart below.



B1.3.1.4 Significant risks and associated contingency plans

<u>Scientific risks</u>

On scientific and technological grounds, no major risk affects the implementation of the project, notably owing to the proven competence and expertise of the Global-IQ partners, their wide-ranging previous involvement in research activities directly related to the subject matter, and their extensive knowledge of the state-of-the-art. Such previous involvement further ensures that the required interactions with other relevant research can be promptly and successfully enacted.

Also, the Global-IQ partners have a long standing experience in participating to European RTD projects, and some of them have worked jointly in other previous circumstances, which will facilitate the smooth implementation of the Workplan.

<u>Management risks</u>

A due attention will be devoted to the all emerging concerns. The strong scientific coordination and the vigilance of the Project Steering Committee will make sure that these concerns are handled sensitively and with precaution. Particular efforts will be devoted to the continuous monitoring of

project advancement, to the strict enforcement of deadlines and to ensuring timely intermediate project results deliveries.

All consortium partners are involved in nearly all work packages. The project management structure has been designed in such a way as to achieve an appropriate balance and to reduce management risks to the minimum. The management structure is simple and the cooperative effort of putting this proposal together has further reinforced the cohesion of the team.

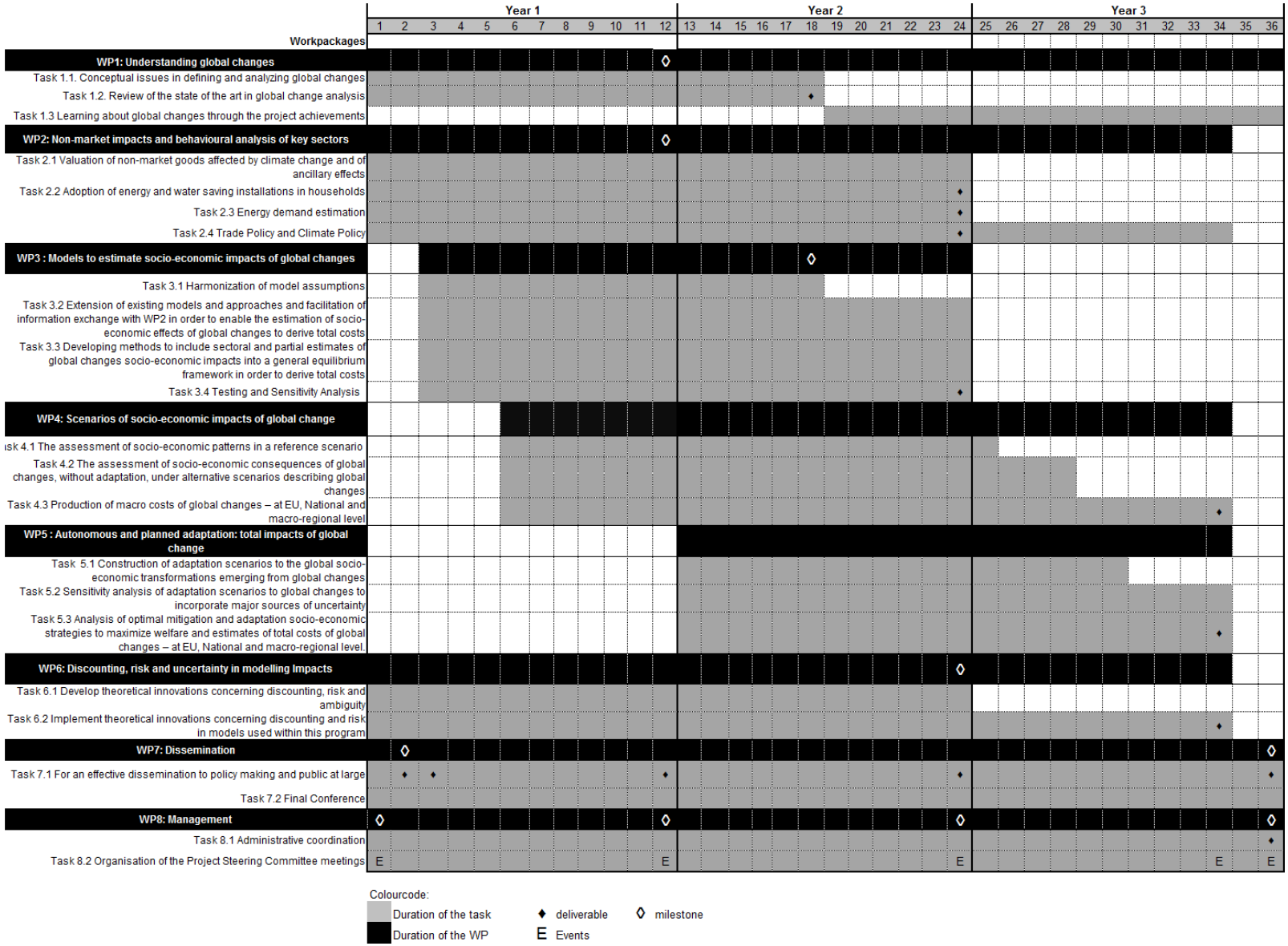
The Global-IQ management and coordination team has a proven record of successfully managing national and international projects and specifically EU RTD projects. Having participated in European research projects (as well as projects funded by other international bodies), all partners hold valuable experience in project management and co-ordination.

Workpackage Leaders and the Project Coordinator act as the first instance for conflict resolution. In case a conflict cannot be solved on a consensus basis and the issue exceeds the discretion of the Coordinator, he informs the Project Steering Committee about the issue and requests a decision. The Project Steering Committee (which decisions shall be taken by a majority of two-thirds (2/3) of the votes, unless otherwise provided in the Consortium Agreement), will then make a final decision.

The Consortium Agreement between the partners will be signed before any work on the project starts. The agreement will clarify all financial, administrative, knowledge management, and any other issues that may arise in the project.

B 1.3.2 Timing of work packages and their components

The following Gantt chart shows the timing of the different Work Packages and their components. The duration of the project is 36 months.



WT1: List of work packages

List of work packages						
WP Number	**WP Title**	**Type of activity[8]**	**Lead beneficiary number[9]**	**Person-months[10]**	**Start month[11]**	**End month[12]**
WP1	Understanding global changes	RTD	7	18	1	36
WP2	Non-market impacts and behavioural analysis of key sectors	RTD	6	44.75	1	34
WP3	Models to estimate socio-economic impacts of global changes	RTD	3	56	3	24
WP4	Scenarios of socio-economic impacts of global change	RTD	4	53	6	34
WP5	Autonomous and planned adaptation: total impacts of global change	RTD	2	51	13	34
WP6	Discounting, Risk and Uncertainty in Modelling Impacts	RTD	5	32	1	34
WP7	Dissemination	OTHER	1	15	1	36
WP8	Management	MGT	1	10	1	36
			Total:	**279.75**		

[8] **RTD** = Research and technological development including scientific coordination – applicable for collaborative projects and NoEs,
DEM = Demonstration – applicable for collaborative projects
OTHER = Other activities (including management) – applicable for collaborative projects, NoEs, and CSA
MGT = Management of the consortium – applicable for all funding schemes
COORD = Coordination activities – applicable only for CAs
SUPP = Support activities – applicable only for SAs
[9] Number of the beneficiary leading the work in this work package.
[10] The total number of person-months allocated to each work package.
[11] Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.
[12] Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

WT2: List of deliverables

List of deliverables – to be submitted for review to EC

Delive-rable Number	Deliverable Title	WP number	Lead benefi-ciary number	Estimated indicative person-months	Natur e[13]	Dissemi nation level[14]	Delivery date[15]
D1.1	Conceptual issues and review of global change assessment and analysis	1	7	3	R	PU	18
D2.1	Analysis of key determinants of costs and benefits of mitigation policy	2	6	3	R	PU	24
D2.2	Estimation of energy demand and demand for environmental quality at household level	2	6	3	R	PU	24
D2.3	Analysis of key factors that affect European competitiveness	2	9	3	R	PU	24
D3.1	Report on models development and results of sensitivity analysis	3	3	6	R	PU	24
D4.1	The socio-economic costs of global challenges, without adaptation	4	4	4	R	PU	34
D5.1	Optimal adaptation and mitigation scenarios to global challenges	5	2	4	R	PU	34
D6.1	Managing the uncertainties associated to global challenges	6	5	3	R	PU	34

13 **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

14 **PU** = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

15 Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

D7.1	Dissemination plan	7	1	1	O	PU	2
D7.2	Project presentation - brochure and .ppt	7	1	1	O	PU	3
D7.3	First periodic project newsletter	7	8	0.5	O	PU	12
D7.4	Second periodic project newsletter	7	9	0.5	O	PU	24
D7.5	Third periodic project newsletter	7	11	0.5	O	PU	36
D7.6	Working papers and policy briefs	7	1	2	O	PU	36
D8.1	Report on the good management practices of the project	8	1	1	R	PU	36
			Total	35,5			

WT3: Work package descriptions

Work package 1

Work package number	1	**Type of activity**[16]	RTD
Work package title	Understanding global changes		
Start month	1		
End month	36		
Lead beneficiary number	7		

Objectives

The WP1 will last for the whole project duration with 3 main objectives:

- O1: Produce and share with project partners the conceptual framework to define and analyse global changes, impacts and economic and social consequences
- O2: Make a review of the global impacts of global changes
- O3: Assess the learning achieved through the project about the economic and social consequences of likely global changes.

Description of work and role of partners

This workpackage is intended to provide a strong conceptual basis to the more dedicated studies of global changes that will be done in the other workpackages. It will also provide an updated review of the state-of-the-art in global change analysis. Last we plan at the end of the project a kind of internal learning assessment process, identifying the main methodological and conclusion achievements of the project, the remaining gaps and needs for further investigations together with an assessment of the methodological advances produced as a whole thanks to the project. The work plan is thus divided into three main tasks.

Task 1.1 Conceptual issues in defining and analyzing global changes

Task leader: ISIS; participating partners: FOND JJLTS, FEEM, IIASA, PIK, ISIS

In the social sciences domain, studies of global changes range from general approaches of historical transformations where environmental issues like climate change are one among other aspects of a broader socio-economic process to dedicated studies of environmental issues in the context of global change. Global change also raises the issue of dealing with complexity in the study of the different linkages between socio-economic and environmental processes occurring in different spatial and temporal dimensions. In this task we shall provide a conceptual framework to settle these complexity issues and design the general research strategy to be undertaken in the subsequent workpackages, especially the modelling oriented workpackages, WP3-4-5. Task 1.1 must hence be seen a whole collaborative effort of the teams involved in the project under supervision by the ISIS partner.

Start: month 1

[16] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

End: month 18

Lead team: ISIS with feed from the other partners.

Task 1.2 Review of the state of the art in global change analysis

Task leader: ISIS; participating partners: FOND JJLTS, FEEM, IIASA, PIK, ISIS

Task 1.2 will provide a literature review of the present state of the art in global changes studies with a focus upon environmental global change research. The definition of what is exactly meant by 'global change' in the literature raises several conceptual issues. Task 1. 2 will deal with such issues by providing a review of different definitions and a discussion of their conceptual implications based upon the current literature. It appears that global changes approaches differ by their premises about the relevant level of integration of various social, economic and environmental processes at different spatial and temporal scales. A significant effort will be devoted to clarify this problem of outmost importance for the reliability of any assessment study of the socio-economic impacts of global change, now and in the future. The output of this task will be a review of the today state of the art in global changes analysis.

Task 1.3 Learning about global changes through the project achievements

Task leader: ISIS; participating partners: FOND JJLTS, FEEM, IIASA, PIK, ISIS

The collaborative effort of the teams involved in the project will produce an array of results which will be the prime outputs of the project. But it will also provide a learning effect over the partners in terms of experience in dealing with global changes issues and methodological expertise. We feel that this 'grey' increase of knowledge is worth reporting inside WP1. This report will summarize unanticipated difficulties solved during the project life, identify remaining gaps and need for further elaboration, and provide an update in the appraisal of the relative importance of different global changes issues in the light of the project findings. It will also present an account of the state of the accomplished knowledge and tools share of expertise between the projects participants after completion of the tasks. The report issued from this task will also illustrates the main advances of the project findings with respect to the previous state of the art to be described in Task 1.2.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	3
2	FEEM	1
3	IIASA	1
4	PIK	1
5	UGOT	0
6	CUNI	0
7	ISIS	12
8	LSE	0
9	HEID	0
11	WIIW	0
10	CEPR	0
	Total	**18**

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi nation level	Delivery date
D1.1	Conceptual issues and a review of global change assessment and analysis	7	3	R	PU	18
		Total	3			

Description of WP Deliverables

D1.1: The report will cover the following themes:

1. Report on conceptual issues in global change assessment and analysis;

2. A review of the current state of the art in global changes analysis;

3. The learning process inside the project team about global change studies, methodology and analysis and a summary of the main advances in understanding global change issues based upon the findings of the project.

Schedule of relevant milestones

Milestone number	Milestone name	Lead benefi-ciary number	Delivery date from Annex I	Comments
MS1	Concepts and scenarios of global challenges.	1	12	

Work package 2			
Work package number	2	**Type of activity**[17]	RTD
Work package title	Non-market impacts and behavioural analysis of key sectors		
Start month	1		
End month	34		
Lead beneficiary number	6		

Objectives
O1: Valuation of non-market goods affected by climate change and of ancillary effects • To provide monetary values of non-market benefits that are sensitive to climate change by reviewing relevant literature. • To carry out meta-analysis and benefit transfer of non-markets values for European wide level. • To review ancillary benefits of GHG abatement in Europe and in developing countries. • To account population dynamics and large scale health effects of global change O2: Adoption of energy and water saving installations in households • To assess the impact of climate change upon household's concern about the environment, together with attitudes and behaviour related to the environment, with a special focus on adoption of water- and energy-saving appliances and habits. • To analyze barriers and preference for installations of renewable sources of energy by households. O3: Energy demand estimation • To estimate parameters of household demand including measuring the complementarity of demand for dirty goods and leisure. • To examine the distributive impacts of energy pricing and taxation upon the households • To measure the behavioural change of the firms in terms of the production process. Specifically, we estimate the elasticity of substitution of production factors: capital, labour, energy input with special focus on transition economies in CEE region. O4: Trade Policy and Climate Policy • To synthesis and critic the existing econometric evidence on the magnitude of the competitiveness effects • To develop a theory based upon an international trade model that allows for firms heterogeneity and carbon linkages • To elaborate upon policy measures in order to address the climate change issue

[17] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

Description of work and role of partners

Task 2.1 Valuation of non-market goods affected by climate change and of ancillary effects

Task leader:CUNI; participating partners: FOND JJLTS, CUNI, ISIS, HEID

Subtask 2.1.1 Review and meta-analysis of valuation of non-market goods and services affected by climate change *(CUNI)*

The literature review will serve to identify the climate change impacts on human health, leisure activities, and some type of land use and ecosystem amenities, including forest ecosystems. We shall look for the relevant papers and studies in reference valuation databases such as EVRI, DEFRA UK and EPA US further using the online research databases like ScienceDirect, JSTOR or EBSCO and peer review journals like *Ecological Economics*, *Journal of Environmental Economics and Management of Environmental* and *Resource Economics*. Moreover, we shall review especially EU funded projects that aimed at assessment of impacts upon non-market goods relevant for climate change (e.g. INTARESE, ClimateCost) and their monetary valuations (e.g. NEEDS, HEIMTSA, VERHI-Children etc.). The impact categories, which are either not properly valued yet, or which can be included into further developed models in WP3, will be particularly addressed (end in month 9). In order to provide average European estimates of non-market values, the benefit transfer will be used. We primarily focus upon the transferability of monetary values for morbidity endpoints, premature mortality, or changes in quality of natural ecosystems, including forest ecosystems.

Subtask 2.1.2: Valuation of ancillary effects of GHG mitigating policies *(CUNI, ISIS, HEID)*

The mitigation measures of greenhouse gas emissions could have important ancillary benefits in terms of air pollution reduced. This task will apply several methods and will cover several research areas.

First, we adopt a bottom-up assessment approach using the ExternE methodology in order to quantify damages due to **airborne pollution**. We review latest results on quantification of external costs due to airborne pollution, particularly those derived thanks to Externe project series (e.g. CASES, NEEDS, EXIOPOL, HEIMTSA) in order to provide the newest estimates of external costs per unit of pollutant across Europe particularly for energy generation. We shall especially focus upon SO_2, NOx, PM, NH*3*, NMVOC, and heavy metals. The output from the analysis will be used to estimate the physical benefits for crop yields, the reduction in building damages and the full health benefits (mortality and morbidity). The physical impacts will be valued in monetary terms, using the latest updated monetary values (esp. from DROPS, NEEDS, HEIMTSA, and EXIOPOL EU funded projects where the monetary values for some of the EU countries have been reviewed and/or estimated). This will allow to provide monetary benefits of ancillary air quality improvements. Additional review work will be undertaken to assess the transferability issues for application inside the different regions (see e.g. Navrud and Reedy 2007; Ščasný et al. 2009). This task will be carried out by CUNI.

Second, **transport related externalities** will include welfare effects due to health impacts, congestion, noise, or accidents and taking into account the EC Handbook for the estimation of external costs in the transport sector, and other EU funded projects (e.g. HEATCO, WEATHER, GRACE, HEIMTSA). Concerning the transportation sector, the GRACE model will provide bottom-up estimates of air pollution costs in different situations. This task will be carried out by CUNI and ISIS.

Third, as shown in our other studies (e.g. Ščasný et al. 2008 for lung cancers, Maca and Ščasný 2009 for PM and ozone related health endpoints, or Alberini and Ščasný 2009 for mortality), monetary values for cost-of-illness and VSL vary significantly across countries and/or time. There is now a literature that spans much of the developing world whereas there has been far less analysis of developing country benefits from GHG abatement. Special attention will be devoted to **ancillary benefits of GHG abatement in developing countries**. This subtask will survey the work on estimation of ancillary benefits of GHG abatement in developing countries, and the extent to which its findings are generally transferable to assess developing country benefits. Specifically, we shall focus upon the estimation of health benefits from air pollution

abatement in developing countries. The approach will make use of benefit transfer methods for different air pollutants. We shall also perform a meta-analysis based upon developing country estimates of health benefits from air pollution abatement (Dessus and O'Connor 2001), especially with regard to health benefit estimation in developing countries generally (Alberini, Cropper et. al. , 1999, 2000). These will be based on the examples of the estimates for Delhi (Cropper et al., 2001) and for Bangkok (Chestnut 2004). We shall examine the issues of baseline assessment, and income-based differences in abatement preferences. The benefit transfer assessment will look at the potential and projected benefits to urban areas with respect to the projected income and transport changes. This task will be led by HEID.

In each of these subtasks, we shall pay special attention for making a link with macro impact assessment models designed in WP3 and further applied in WP4.

Subtask 2.1.3: Ancillary Benefits Estimation in Developing Countries: A case study (HEID)

China is a country that has been shown to benefit substantially from air pollution reductions (Ho, Jorgenson, Di 2005). The second task will be to estimate the actual air pollution related benefits for an urban area - specifically looking at the health benefits received from urban air improvements in Beijing, China. The role of such a study is to assess the previous attempts to estimate these benefits, with the use of current methodologies (Wang et. al. 2005, Wang et. al. 2003, Xu 2001). Several studies have advocated the use of health based co-benefits as a mean for motivating GHG abatement (Aunan et. al. 2003). This part of the study would implement an assessment of the health based benefits from air pollution improvements in Beijing. We shall focus upon the analysis of mortality rates (and morbidity rates if possible) against air pollution levels (Alberini, Cropper et al 2001). This would involve an analysis of daily air pollution levels against: daily mortality levels (preferably categorized by cause of death and age), morbidity levels, including hospital visits, restricted activity days/days, missed work, emergency room visits, incidence of bronchitis or other respiratory ailments. Once the mortality rate and morbidity rates attributable to air pollutants have been established, the economic costs of these deaths and missed days of work attributable to the pollution will be computed. El-Fadel (2000) presents a nice methodology for this. There are two possible approaches: a) Willingness to Pay Study. The cost is estimated by surveying the VSL for a Beijing resident and also their valuations for avoiding ER trips, missed days of work, etc. b) Inferred costs based on Productivity loss and Cost of Illness. The alternative is to infer costs through lost productivity measures and through the costs of hospital visits and treatments, etc. The task would implement this work with the collaboration of Peking University, through the collection of primary and/or survey data related to health impacts and air pollution in Beijing. This task will be carried out by HEID.

Subtask 2.1.4 Population dynamics and large scale health effects of global change (FOND JJLTS)

Future changes in population size, composition, and spatial distribution (e.g. migrations) are key factors in the analysis of global change, and their future evolution is highly uncertain. Two key issues will be addressed. First, it is crucial to establish how to account for the size dynamics of the population within the social planner objective, taking into account the age structure of the population at the world and regional scales and its vulnerability to large epidemic diseases influenced by climate change. Second, we shall integrate the uncertainties upon the future population dynamics within the integrated assessment models by providing a set a possible scenarios for the evolution of population in the future.

Tasks 2.2: Adoption of energy and water saving installations in households

Task leader:CUNI; participating partners: FOND JJLTS, CUNI

The empirical analysis will be made using data from the 2008 OECD Survey on Household Environmental

Behaviour. This survey is quite unique in its scope: it was implemented in 10 OECD countries (Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, Netherlands, Norway and Sweden) and about 1,000 households have been surveyed in each of the 10 countries. The respondents were surveyed on a set of environmentally relevant activities including adoption of water and energy efficient appliances. Respondents were also asked a series of questions regarding characteristics of their household (age, income, composition, education, ownership status), housing characteristics, and behavioral attitudes or opinions regarding the environment in general. Proposed analysis follows up on the econometric analysis by Millock and Nauges (2010) and Ščasný and Urban (2009; 2010) who analysed water efficient and energy-efficient durables respectively. However, we propose here to combine these micro-level data with country-specific or regional-specific data on climate (temperature, rainfall, number of heating degree days, etc.) and the quality of the environment in general (air pollution, water pollution, etc.). The heterogeneity in climate conditions across the 10 countries (for example, our data gather both water-abundant countries such as Canada and Norway and water-scarce countries such as Australia and Mexico) will allow us to identify the impact of climate on household's attitudes and adaptive behaviour. Moreover, we intend to analyze adoption of both types of efficient appliances jointly which is new in the literature. More precisely, we propose to measure the impact of climate change related variables on:

i. household's opinion and concern about climate change among other environmental issues including air pollution, water pollution, natural resource depletion, endangered species and biodiversity;

ii. household's behaviour related to water and energy use including among others: turning off lights when leaving a room, cutting down on heating/air conditioning, turning off appliances when not in use, turning off the water while brushing teeth, taking showers instead of bath, watering your garden in the coolest part of the day;

iii. household's (effective) adoption of water- and energy-saving appliances including water-efficient washing machines, low-flow shower heads, dual flush toilets, water tanks to collect rainwater, energy-efficiency rated appliances, low-energy light bulbs, thermal insulation, efficient heating boiler;

Relevant econometric models, including household's socio-demographic characteristics, will be specified and estimated to address these questions. Household's opinion and concern as well as household's behaviour would also be included as explanatory factors in the models explaining adoption of water- and energy-saving appliances, renewable energy and habitual behaviour. Hence it will provide new evidence on how household's opinions, attitudes and their effective behaviour are impacted by climate change. This issue will be addressed using a unique household database covering 10 countries.

Except energy savings due to habitual behaviour and efficient installations, renewable energies can substantially reduce GHG emissions. At the level of households, consumers can either consume green energy from the grid, or install their own micro-generation technology. Installation of renewable sources of energy by households can however require high effort. To date, there are quite many studies analysing household demand for green electricity (see Kristrom 2008 for the review), but not so much on the adoption of a microgeneration renewable technology in household. For instance, Walker (2008) identified several barriers for the renewable energy micro-generation such as costs and affordability – significant upfront capital investment, complexity of the system, opportunity and reliability of the system. All these factors indicate that the potential users will be households with higher income and with educated members. On the other hand, presence of external motivational factors like public support in different forms of economic instruments (Long 1993, Scarpa and Willis 2009) as well as internal motivational factors like attitudes, values or habits (Vringer et al. 2007) can play important role in increasing the share of renewables in household energy consumption. The objective of next task is twofold, first to identify and analyze the main barriers that hinder the adoption of renewable energy sources by households, and, second to elicit the willingness to pay of a sample of households to adopt/install renewable energy micro-generation technology (by using stated preference method learning particularly from conjoint choice experiment by Scarpa and Willis 2009). After reviewing the relevant literature, we analyse preferences and the barriers of households through conducting interviews and a survey (likely in the Czech Republic since the market of renewable microgeneration technologies has emerged recently thanks to newly announced public programme in 2009).

The outputs from this work will also be helpful in WP5 'adaptation' task to assess the importance of incentives to be given to households to move towards renewable energy adapt through installations of

efficient devices.

Tasks 2.3: Energy demand estimation

Subtask 2.3.1: Household energy demand and tax incidence (CUNI, FOND JJLTS)

The effect of policy regulation over consumption and welfare depends upon household and firm responsiveness to price changes. In this task, we propose to estimate parameters of household demand systems in Europe, specifically for some of the CEE countries, for which there is not much empirical evidence so far. We intend to estimate demand system augmented by adding leisure (price of labour supply) in order to estimate the key parameters of the utility function, i.e. to examine whether demand for dirty goods such as energies is substitute or complement to leisure, which is one of the key assumption for an existence of strong double dividend (Fuest and Hubber 1999; Goulder, Parry, Butraw 1996).

Cross-price elasticities of household energy demand have been estimated from macro data by e.g. Abbott and Ashenfelter (1976), or Barnett (1979), while Blundell and Walker (1982) use micro data. We shall also benefit from the work of Amemiya (1974) and Heckman (1979) which allows to correct for selection bias. Alderman and Sahn (1993) belongs to one of the first study that adjust the Almost Ideal Demand System (Deaton and Mullbauer 1980) so that it incorporates male and female leisure, in addition to five commodity groups. Then, Madden (1995) is the first one to directly apply the estimated elasticities for optimal tax purposes. Probably, the most reliable estimates of cross-price elasticities between a commodity and leisure is provided by West and Williams (2007) who employ an augmented AIDS – similar to the one used by Alderman and Sahn – with three types of goods: gasoline, other goods and leisure. We plan to follow up the work by Alderman and Sahn and especially West-Williams approach to estimate cross price elasticities not only for several competing energy goods such as electricity, natural gas, solid fuels or centrally supplied heat, but also for the cross price elasticity between these dirty goods and leisure in one of the transition countries in the CEE region, namely the Czech Republic. This task will be led by CUNI and will provide results in month 24.

Then, we build an empirical model in which energy is used as a consumption good by the households and as an input by the firms. Tax instruments are used to control pollution associated with energy consumption. As there are two sources of pollution, we need to consider two instruments, namely a tax on energy consumption by households and a tax on energy used as an input. The model we are proposing is a generalization of the model we have introduced in Cremer *et al.* (2003). As its predecessor, it is an empirical model in which we are dealing with optimal second best taxation. The model allows for a, possibly non-linear, income tax. Households have heterogeneous productivities and have different tastes, in particular with respect to energy. The model will be calibrated on French and US data. This model will be also build up for the Czech Republic to utilize the estimation of household energy demand and production functions for its economic sectors (Subtask 3.2). It allows us to compare the predictions given by this model and by a static micro-simulation tax-benefit DASMOD model being developed for the Czech Republic by CUNI (Brůha and Ščasný 2006; Ščasný and Brůha 2008; Ščasný 2009). This model will be used to derive optimal energy taxes taking into account the externalities (as reviewed in Task 1) and the redistributive consequences of energy taxation. It will also be used to answer additional policy questions. For instance, we will study if (and to what extent) optimal energy taxes are affected by an exogenous shock on the energy price (such as an oil shock). Specifically, should the taxes be adjusted to mitigate the impact of the shock on households and/or on firms? This task will be done by FOND JJLTS and CUNI.

Subtask 2.3.2: Estimate the elasticity of substitution of production factors with special focus on CEE transition economies (CUNI)

In this task, we shall estimate the nested constant elasticity of substitution (CES) production function using OECD data including some Central European counties, such as the Czech Republic or Slovakia. The

estimated elasticity of substitution between production factors (capital, labour and energy) can be used as a model parameter by CGE modellers in WP3. This will serve to address the criticism regarding the reliability of parameter values of CGE models. The need to estimate production function with nested structure is discussed since Berndt and Wood (1979). Van der Werf (2008) estimates a 2-level nested production function, using the industrial level data from 12 OECD countries in for 1978-1996. He finds that the nesting structure having capital and labour in the same node fits reality more closely. Following his finding, in this task we plan to estimate a production function with a nested structure and examine, which nested structure fits data best. Similarly, Okagawa and Ban (2008) estimate a nested CES function using another OECD dataset. Their data set is more refined compared to that used in Van der Werf (2008), where the data are disaggregated into 7 sectors; the Okagawa and Ban (2008) data set disaggregated into 19 sectors. We suspect that the elasticity of substitution might be different in Central European countries from that of Western European countries due to the difference in economic structure. The estimated elasticities of production are parameters for the CGE models and enable comparison of the results, when using the newly estimated parameters and when using the conventional value of parameters. Further, we plan to see how this difference in the parameters will lead to different outcomes of CGE models with the cooperation of the CGE modellers.

In this task, we plan to compile the data set including Central and Eastern European Countries in addition to other OECD countries data set used in the studies described above. Data will be obtained from IEA/OECD statistics, Eurostat, and EU KLEMS Growth and Productivity Accounts.

Task 2.4: Trade Policy and Climate Policy

Task leader: HEID; participating partners: FOND JJLTS, HEID

The failure, hereto, to arrive at binding, internationally-coordinated climate targets will result in nations pursuing national climate change policies that are only partially coordinated. As the ultimate object of these policies is to raise the cost of carbon emissions, national differences in the shadow price of carbon will affect the international competitiveness of energy intensive industries exposed to trade. Such “competitiveness” effects on industries create political economy forces that typically result in national tariffs and subsidies designed to offset the competitiveness effects. In the EU and Japan, for example, energy intensive industries exposed to international competition has been awarded free allowances of carbon permits to avoid raising their costs. The same outcome was observed with the US Super Fund tax on chemical-using industries and the Montreal Protocol on Ozone Depleting substances. While driven largely by special interest politics, the tariffs and subsidies will like be justified as limiting “carbon leakage”.

This task will explore this socio-economic impact of global changes in three ways.

Subtask 2.4.1: Survey of the existing empirical evidence on competitiveness effects (HEID)

This sub-project will provide a synthesis and critic of the existing econometric evidence about the magnitude of the competitiveness effects. The goal is to identify the shortcomings and areas where further work is needed with respect to data collection and methodological aspects.

Subtask 2.4.2: Theory of competitiveness with heterogeneous firms (HEID)

The standard theoretical models used to characterise the competitiveness, or ‘pollution haven’ effect, are based upon the assumption of homogenous firms within industries. For example, existing theoretical approaches – which form the basis of the empirical investigations – assume that all Japanese steel firms on one hand and all Chinese steel firms on the other product steel at the national average emissions rate. However in reality, the best Chinese mills – i.e. the newest ones – are more efficient than the average Japanese mill. Thus raising the carbon price in Japan above that of China may have a negative competitiveness effect on Japanese steel firms, but a positive impact on carbon emissions as the oldest, least

efficient Japanese plants become uncompetitive and are replaced by new, more efficient Chinese firms. This example illustrates one of the many real-world competitiveness and leakage issues than can be addressed in the so-called 'new new' trade models typified by Melitz (2003). This sub-task will be to produce a theory paper that allows for firm heterogeneity in an international trade model that also includes carbon linkages.

Subtask 2.4.3. Climate policy analysis in a second best world (FOND JJLTS)

Most targeted mitigations policies are second-best answers to the climate challenge, being affected by several transaction costs and institutional inefficiencies. We plan to investigate the consequences of using second best tools to achieve climate change mitigation objectives in two ways. First we shall investigate the implications of the adopted mitigation plan of the EU (the three twenty objective) with respect to other regulations, like the US proposal inside the Waxman-Markey Act. The coexistence of local (or regional) policies together with general agreements will also be analyzed. Second we shall use a general equilibrium macro model to assess the performances of different policy tools in the long run. We develop an endogenous growth model with climate change considerations and including several R&D sectors (energy, backstop, abatement including CCS). We focus on the characterization of any decentralized equilibrium in which there are two types of market failures (the accumulation of anthropogenic carbon emissions in the atmosphere and the research spillovers in each R&D sector) which can be corrected by two types of policy instruments in accordance (carbon tax and research subsidies). We address the question of the second-best optimal level of one of these two instruments when the regulator is unable to set the other one to its first-best optimal level.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	13
2	FEEM	0
3	IIASA	0
4	PIK	0
5	UGOT	0
6	CUNI	21
7	ISIS	1.75
8	LSE	0
9	HEID	9
10	WIIW	0
11	CEPR	0
	Total	44.75

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi nation level	Delivery date
D2.1	Analysis of key determinants of costs and benefits of mitigation policy	6	3	R	PU	24
D2.2	Estimation of energy demand and demand for environmental quality at household level	6	3	R	PU	24
D2.3	Analysis of key factors that affect European competitiveness	9	3	R	PU	24
		Total	9			

Description of WP Deliverables

D2.1: The report associated to deliverable D2.1 will cover the following issues:

1. Review and meta-analysis of monetary values for non-market values;
2. Ancillary Benefit of GHG mitigating policies;
3. Ancillary Benefits Estimation in Developing Countries: Case study;
4. Estimation of nested CES production function for CEE countries;
5. Climate change mitigation with second best policy tools.

D2.2: The report associated to deliverable D2.2 will cover the following issues:

1. Analysis on the effect of environmental variables on environmental concerns, adoption of efficient devices and habitual behaviour of households;
2. Estimation of household energy demand system;
3. Barriers and WTP to install a source of renewable energy by households.

D2.3: The report associated to deliverable D2.3 will cover the following issues:

1. Survey of the existing empirical evidence on competitiveness effects;
2. Theory of competitiveness with heterogeneous firms

Schedule of relevant milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS2	First set of results from WP2 to be used in WP3, WP4 and WP5	6	12	

Work package 3

Work package number	3	**Type of activity**[18]	RTD
Work package title	Models to estimate socio-economic impacts of global changes		
Start month	3		
End month	24		
Lead beneficiary number	3		

Objectives

- O3.1: Harmonization of model assumptions to enable comparison of scenarios and mutual exchange among models in WPs 4 and 5.
- O3.2: Further development of existing global models in order to capture the so-far neglected socio-economic dimension of global change impacts (including non-environmental global changes).
- O3.3: Development of methods to assess society-wide major socio-economic impacts of global changes. This includes the development of methods to integrate sectoral and partial analysis into general equilibrium models.

Description of work and role of partners

Task 3.1 Harmonization of model assumptions

Task leader: IIASA, participating partners: WIIW, PIK, ISIS, FEEM

This task is dedicated to enable the comparison of scenarios and mutual exchange among models in WPs 4 and 5. Models' assumptions on exogenous trends will be aligned, but models-specific structures will be preserved, without attempting to conduct a thorough and coherent modelling comparison exercise. The goal is instead to maximize the exchange of information among models – e.g. by means of soft-links – in order to design richer scenarios and produce more accurate impact estimates and adaptation options in WP4 and WP5, with the ultimate goal to identify the optimal trade-off between mitigation and adaptation to major impacts of global changes.

Task 3.2 Extension of existing models and approaches and facilitation of information exchange with WP2 in order to enable the estimation of socio-economic effects of global changes

Task leader: IIASA, Participating Partners: WIIW, ISIS, FEEM, PIK

[18] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

This task is organized along the major impact areas: (1) agriculture and forestry markets, (2) water, energy, fuels availability, energy security, (3) transport, infrastructures, tourism, (4) competitiveness, labour market, international trade, financial stability, and (5) population, health and migration. Different models will be adapted, further developed and partially integrated to enable assessment of the socio-economic impacts of global changes in these areas. Inputs for this task come from WP2. In addition, **ISIS** will provide social costs from congestion and accidents on major transport routes in the global context.

Sub-task 3.2.1: *Agriculture markets, forestry markets*

In order to capture part of the linkages between global changes (rules governing international trade, European Union re-definition of the Common Agricultural Policy, climate change, changing patterns of temperature, precipitations and water availability, technological progress, evolving energy systems, etc) and agriculture, the agricultural and forestry partial equilibrium model GLOBIOM (**IIASA**) will be linked with the WITCH model (**FEEM**). WITCH is a model specially suited to study long-term endogenous optimal investment decisions in a framework that integrates the economy, energy and climate (Ramsey-type optimal growth, hard-linked). Therefore it will perfectly complement GLOBIOM which is instead a partial equilibrium model which lacks endogenous drivers of global and regional demand of major world commodities and of land. Issues such as EU agricultural policy and international trade will be major areas of interest.

FEEM will work to introduce land use and forestry dynamics in the WITCH model. The model will be soft-linked to the GLOBIOM of **IIASA**. Bio-energies supply curves, which now enter the model in reduced form, will be an output of the GLOBIOM model. WITCH will provide long-term output scenarios and demand of land to GLOBIOM. WITCH will also provide technological progress dynamics to determine land productivity in GLOBIOM. The international market of carbon allowances in WITCH will be linked by means of certificates from REDD – Reduced Emissions and Deforestation and Land Degradation – to the GLOBIOM model. The highest possible degree of spatial resolution will be used in order to study impacts – e.g. climate change, water availability – with a sufficiently high level of precision. Methodologies to use in GLOBIOM-WITCH high resolution Global Circulation Models climate scenarios will be developed.

These activities will be complemented by the already existing soft coupled REMIND-R (a Ramsey-type optimal growth energy-economy-model) /LPJmL-MAgPIE (an agro-economic model driven by a dynamic vegetation model) complex from **PIK**.

Furthermore, **PIK** aims to expand the current MAgPIE version (Lotze-Campen et al. 2008, Popp et al. 2010) by increasing the number of regions by disaggregating EUR into finer macro-regions based on the GTAP 7 Data Base (Narayanan and Walmsley, 2008). Thereby the impact cascade, triggered by wheather-related effects of global warming, onto food prices and macroeconomic parameters could be studied. We will explicitly upgrade the LPJ-mL-MAgPIE-suite for the representation of extreme wheather events, which are expected to acquire an over-proportional effect under global warming.

Sub-task 3.2.2: *Water, energy, fuels availability, energy security*

GLOBIOM (**IIASA**) relies currently upon EPIC simulations for spatially and system-specific estimates of current and potential crop yields. This feature will be expanded to take into account climate change (and possibly other global changes depending on the insights delivered by WP1 and WP2) and to design sustainable management strategies contributing to closing the yield gaps (**Research**).

Furthermore, GLOBIOM represents currently 4 different irrigation systems which differ in applicability and in water use efficiency (Sauer et al. forthcoming) EPIC simulations contain as information irrigation water demand by crops. Spatially explicit (0.5 degree) irrigation **water availability** constraints will be introduced through linking with a global hydrological model (**Irrigation**).

With respect to socio-economic impacts related to **energy** issues, BEWHERE (**IIASA**) will be linked to GLOBIOM. The BEWHERE model will be able to provide information on production plant capacities, and therefore bio-energy costs can be assessed. Those costs will be used into the GLOBIOM model from which the land use for bio-energy purposes can better be estimated.

In addition, the BEWHERE model will be developed to be run on the global level. The energy demand such as transport fuel and heat consumption will be defined spatially on a half degree grid (the locations of the bio-fuel production plants are highly dependent on the location of the heat demand). This also relates to the next sub-task.

The energy use from the households estimated in WP2 will be an important input to the BEWHERE (**IIASA**) model, in order to better define the possible location of bio-energy production plants.

FEEM will improve the description of the fossil fuels sectors in the WITCH model. So far international trade of fuels has not been explicitly modelled in WITCH. In this sub-task, investments in extraction capacity will be modelled for each fossil fuel, in each region, coherently with the WITCH Ramsey-type optimal growth framework. Fossil fuels imports and exports, as well as their international price, will be endogenously determined. Technological progress, both endogenous and exogenous, in fossil fuels extraction capital will be modelled. In order to have a better focus on the Mediterranean basin, the Middle East and Northern Africa region will be split in North Africa and Middle East.

FEEM will introduce super-grids inside the WITCH model. Super-grids will be necessary to expand the penetration of renewables in Europe and in other world regions. They will allow to exploit efficient production sites, e.g. distant sites for wind generation. In particular, they are in principle capable of exploiting solar thermal power plants, which need direct sunlight. Investments to build super-grids will be endogenous and will be valued against other investment possibilities. Endogenous technical change will affect the cost of the grids as well as the cost of power plants that will be connected to the grids. The distribution of grids will have the highest possible geographical resolution.

FEEM will introduce inside a single optimization framework international trade of fossil fuels and super-grids by updating the WITCH model with the two developments undertaken in this sub-task. This will require to find efficient solution algorithms to manage multiple international markets (of fuels and multiple markets of electricity) in a computationally tractable way. Thanks to the work undertaken in this task WITCH will be able to produce estimates of economic impacts – at global, European and regional level – for most of the global changes that affect energy supply, energy demand, international policy (e.g. policy scenario regarding Northern Africa and Middle East countries and Europe), global economic growth, and national energy security.

REMIND (**PIK**) does already resolve trading of primary energy carriers, certificates and a generic good. While therefore being relatively advanced on the trade side, representation of electricity net infrastructures needs to be implemented (herein similarly to WITCH). Furthermore, extra costs induced by the fluctuating nature of renewable energy sources need to be upgraded.

The modelling suite around MAgPIE (**PIK**) simultaneously addresses the water cycle as a prerequisite to be able to be informative on food production, thereby providing an alternative set of estimates to abovementioned issues on water.

Sub-task 3.2.3: *Transport, infrastructures, tourism*

Global changes will also require a closer examination of the possible impacts on infrastructure demand and transport means.

In order to facilitate the adoption of new capital-intensive technologies in poor rural areas, for example, local transport networks need to be improved, to ensure **market access**. An adapted version of GLOBIOM (**IIASA**) has been used for analysis of deforestation drivers in the Congo Basin, including current transport networks and projections of their developments. Local transport infrastructure will be expanded to the other world regions within this project, and scenarios on its development will be considered (**Roads**) in work packages 4 and 5.

Furthermore, international trade is sometimes considered to be one of the major means of adaptation. There are currently many physical/financial and institutional barriers to trade. GLOBIOM already represents the tariff barriers, and it will be expanded to explicitly represent also the **cost of international transport**. This will enable to quantify the role of reducing the cost of trade in adaptation.

Finally, the GRACE tool (**ISIS**) will be developed in order to provide input to the models. The GRACE model is designed to provide social costs in € per vehicle of congestion and accidents in Europe, calculated on major transport routes. Depending on the input required by the assessment model, the GRACE model will be further developed to provide the evaluation of social costs for other world regions, including developing countries. The input of the GRACE model will contribute to the best existing assessment of the social costs of climate change impacts on the transport system.

In an in-depths regional study **PIK** will derive the interaction of growth, vulnerability and adaptive capacity for 1-2 key regions in the OECD and/or China on cities or pan-continental infrastructure. Hereby we will explicitly address the effect of growth inducing the build-up of new infrastructure (either within cities or on a pan-continental level), which then – in the absence of an adaptation policy – could make society more vulnerable to climatic change. On the other hand an exchange of infrastructure, triggered by an adaptation policy, could reduce vulnerability. External drivers beyond climatic change such as policies addressing urban sprawl or energy security, respectively, will simultaneously be considered.

These insights will be used to cross-check certain calibrations and/or in of/from ICES.

Sub-task 3.2.4: *EU competitiveness, labour market, international trade, financial stability*

WIIW will expand the ICE general equilibrium model with emphasis on three extensions to core trade-related applications: (1) employment effects (this will entail mapping the sector and country effects to detailed satellite accounts on employment), (2) migration (this will include econometric research on the major determinants and using the CGE work to inform how trends/change feed into major migration drivers), and finally (3) WIIW will use Ramsey-type medium-term mechanics to examine the impact of increased investment uncertainty (e.g. resulting from extreme climatic events) on medium term real investment trends, with implications for production, growth, trade, wages, etc. This will put us into a position to investigate issues such as the lasting effects of a financial crisis.

The **WIIW** team will employ the expanded ICE model to estimate the impact of basic global macroeconomic trends on global production and trade patterns, the competitiveness of European industry, the cross-industry and cross-Member patterns of impact on labour markets, and the impact on food and energy markets. Projection analysis will be reconciled with the outputs from other elements supplied as outputs from other WP elements within the project. The range of issues addressed in the baseline scenario definitions, in conjunction with possible policy responses, point to uneven pressure on the market for skilled and unskilled labour, the competitiveness of EU industry, and likely changes in rates of return in EU industry (which impacts on financial stability to the extent this drives the health of key financial sub-sectors.) The WIIW team will give particular attention in to baseline EU assumptions about human capital investment (the growth of skilled and unskilled labour stocks) and variations in these target human capital investment level (target education policies) for variations in labour market impacts. In addition, the WIIW team will also examine alternative degrees of intra-EU labour mobility for the response of Member level and continental labour markets (wages, employment patterns) to major global change drivers. This involves mapping model projections to medium-term EC skill forecasts (CEDEFOP 2009), as well as to alternative specifications for future intra-EU mobility of labour.

REMIND (**PIK**) at present explicitly prognoses the effects of climate policy on 11 global actors that are linked by trade and competition. After the resolution of MAgPIE has been upgraded to be accessible for climate impact information, the already soft-linked REMIND/MAgPIE complex will be informative on the consequences of energy and trade policies on European competitiveness.

Sub-task 3.2.5: *Population, Health and Migration*

The **WIIW** team will include basic projected population dynamics in medium term projection scenarios with the ICE model. The basic decomposition of projected population trends and their contribution to global trends will be assessed as a follow-up decomposition of baseline. This includes indirect pressure on European labour markets through trade linkages. Estimated changes in labour supply and labour market conditions, as well as shifting income and price patterns, will also be used to quantify possible changes in the global drivers of migration. Regarding migration, the WIIW team will work with recent primary datasets (especially from the World Bank) to analyse econometrically current migration and remittance patterns based on key determinants like per-capita income levels, language differences, population growth, and unemployment. This will be used to structure a stylized or reduced form model that, in conjunction with the model-based scenario analysis outlined elsewhere in this report, will be used to quantify or range possible directions and relative magnitudes of change in current mechanisms driving migration.

Task 3.3 Developing methods to include sectoral and partial estimates of global changes socio-economic impacts into a general equilibrium framework in order to derive total costs

Task leader: FEEM

In this task **FEEM** will enrich ICES, a recursive dynamic general equilibrium model for the world economic system, with new mathematical specifications in order to make it an appropriate tool for impact assessments. This research phase can entail two different activities. (1) building a set of “interfaces” able to translate the relevant sources of pressures into meaningful economic input for the model. Pressures can be either linked to climate-change, but also to more “traditional” market dynamics (e.g. change in land use, in technology, in tourism flows, in migrations etc.). All these need to be transformed into changes in supply or demand of the inputs or outputs considered by the model. (2) Modifying the functional specification of the model when its original structure does not allow examining some sources of changes. This is typically the case when a given shock affects variables which are endogenous to the model or variables that are not currently included in the model.

FEEM and **PIK** will co-derive reduced form impact functions as emulators from ICES, which could then be implemented in both REMIND (PIK) and WITCH (FEEM) for macro-economic analyses in WPs 4&5. **WIIW** will also estimate a set of socio-economic impact elasticities to complement the reduced form impact functions. The impact elasticities will be estimated with respect to major policy and global change vectors within the CGE projection model used by the WIIW team.

Task 3.4 Testing and Sensitivity Analysis

Task leader: IIASA, participating partners: WIIW, FEEM, PIK

Having developed the model infrastructure for the assessments to be undertaken in the following two work packages, it is necessary to conduct a set of tests to ensure consistency of the results. Sensitivity analysis or tests using Monte Carlo techniques will be employed when probability distribution functions of relevant parameters are available from the literature to examine the robustness of outcomes.

FEEM and **IIASA** will test the linkage of WITCH and GLOBIOM by conducting sensitivity analysis with respect to crop yields to determine the robustness of outcomes to weather variability and more drastic changes such as global warming and thus deteriorating crop yields. Furthermore, there will be sensitivity testing with respect to different types of costs.

FEEM will test the new WITCH structure in two steps. First, the dynamics of the fossil fuels markets will be tested with a sensitivity analysis on fuels resources and on extractions costs. Parameters used to model extraction cost curves will also be tested. Second, a complete sensitivity analysis of cost of super-grids, of technological assumptions and of modelling choices will be made to assess the dynamics of investments in

super-grids and in related power plants.

Similarly, **IIASA** will test the adapted GLOBIOM with particular focus on aligning it with other involved models, which are updated in parallel in Task 3.1. For example, common climate change scenarios can be translated into crop yield effects through EPIC (for GLOBIOM) and LPJmL for MAGPIE. The outcomes of this analysis will therefore also be a starting point for the work undertaken in WP4 and WP5. Furthermore, robustness will be sought by developing a stochastic version of model, the details of which will be elaborated under WP6. Analogue procedures will be followed by MAgPIE/REMIND (**PIK**).

In addition to a focus in the model extension components of WP3, the **WIIW** team will also focus on extending and applying methods for the analysis of the sensitivity of baseline and adaptation scenarios to major sources of uncertainty. This will take advantage of data developed in the projects, with an emphasis on quadrature methods (Arndt 1996, Arndt and Robinson 1998). We also anticipate taking advantage of the relatively recent incorporation of non-linear econometric methods into macroeconomic CGE models (Kim and Pagan 1995). The Gaussian quadrature approach, in particular, will nicely complement the Monte Carlo approach to be followed by other teams.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	0
2	FEEM	11
3	IIASA	15
4	PIK	14
5	UGOT	0
6	CUNI	0
7	ISIS	3
8	LSE	0
9	HEID	0
10	WIIW	13
11	CEPR	0
	Total	56

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Natur e	Dissemi nation level	Delivery date
D3.1	Report on models development and results of sensitivity analysis	3	6	R	PU	24
		Total	6			

Description of WP Deliverables

D3.1: The report associated to deliverable D3.1 will be structured in four chapters/parts:

1. Strategy for model adaptations, linkages and harmonization with focus on how socio-economic impacts in the different key areas are taken into account;

2. Report on methods to assess the optimal mix between adaptation and mitigation to global changes in key sectors / areas and to on methods to estimate the total socio-economic impacts of global changes;

3. Detailed description of model developments;

4. Sensitivity analysis.

Schedule of relevant milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS3	Socio-economic impact assessment framework operational for the key sectors identified	3	18	

Work package 4

Work package number	4	**Type of activity**[19]	RTD
Work package title	Scenarios of socio-economic impacts of global changes		
Start month	6		
End month	34		
Lead beneficiary number	4		

Objectives

- O4.1 A set of reference scenarios that will assess socio-economic dynamics along the lines developed in WP1, at EU, National and macro-regional level, with models developed in WP3.
- O4.2 A set of alternative scenarios that depart from the reference path and explore alterations of major exogenous driving forces, i.e. global changes.
- O4.3 Production of total costs of global changes and aggregate impact functions, without adaptation – at EU, National and macro-regional level.

Description of work and role of partners

Task 4.1 The assessment of socio-economic patterns in a reference scenario.

Task leader: PIK, participating partners: FEEM, IIASA, PIK, ISIS, WIIW

Sub-task 4.1.1: *Agriculture markets, forestry markets*

FEEM and **IIASA** will use the WITCH and the GLOBIOM models linked in WP3 to estimate socio-economic patterns in the reference scenario, with a focus on agricultural and forestry sectors. The analysis will be carried out at the global and European level (the exact geographical detail will be determined during the linking process of WITCH, with 12 regions, and GLOBIOM, with 20 regions). Results will include long-term i) natural resource use and management – spatially detailed outcomes of land cover change (e.g. deforestation), land use change in terms of crop and livestock species choice and their management system (rainfed x irrigated, grassland based x industrialized), and irrigation water demand and management; ii) environmental effects – greenhouse gas emissions (both CO2 and non-CO2), nitrogen leaching, biodiversity; iii) agricultural markets – regional supply and demand of agricultural and forest (and bioenergy) commodities will be projected, in terms of both quantities and prices, international trade flows will be reported, and effects of local infrastructure, and international trade policies upon food availability will be analysed. The role of the agricultural sector in shaping low-income economies long-term growth will also be examined.

These results will be contrasted with those generated analogously from the already functioning REMIND-MAgPIE (**PIK**) complex that is, on the impact side, especially strong on vegetation dynamics and agro-economics. Analyses will be performed with present-day resolution for global scenarios, i.e. 10 world

[19] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

regions, as well as by an order of magnitude enhanced resolution (implemented in WP3) for Europe. We will produce scenarios with standard impact implementation vs. explicitly resolved effects of weather extreme events on food prices. As this WP is devoted to isolate the effects of impacts *before* adaptation, it will mimic myopic agricultural investors that do not anticipate future global change within each investment period.

Sub-task 4.1.2: *Water, energy, fuels availability, energy security*

FEEM will use the enhanced version of the WITCH model produced in Sub-task 3.1.2 to design a reference scenario of optimal investments in the fossil fuels sector, including optimal extraction rates and international trade of fossil fuels. The size – both in terms of quantities and values – of the international markets of fossil fuels will be estimated. The role of the mining and extraction sector in determining economic growth in fossil fuels rich countries will be examined. Scenarios of greenhouse gas emissions resulting from the extraction process will be produced. A careful analysis of the global and regional implications of extracting large amounts of non-conventional fuels (e.g. tar sands, oil shales) will be carried out. The dynamics of energy and non-energy sectors in fossil fuels rich economies will be studied. It will be examined if super-grids that allows the deployment of renewable electricity generation – for instance from Concentrated Solar Power – will be built in the reference scenario.

The REMIND-MAgPIE (**PIK**) complex that already resolves trading of primary energy carriers will explicitly address the role of trading biomass, under various 'security scenarios' for food and water. The role of cross-sectoral damage functions (derived in WP3) for macroeconomic costs of global warming and further forcing scenarios will be derived, for the case of a lack of subsequent adaptation policies (to be addressed in WP5) with and without internalised anticipated damages in the cost benefit mode. Economic losses for Europe under various scenarios will explicitly be addressed.

Sub-task 4.1.3: *Transport, infrastructures, tourism*

Ex. of sources of global changes: International trade; New means of transportation; International tourism flows.

PIK's bottom-up studies for selected regions within the OECD and/or China will have informed ICES on certain entanglements of build-up of infrastructure, growth, vulnerability and adaptive capacity. Those studies will explicitly be extended into the impact-scenario domain and contrasted with the macroeconomic results generated within this WP by REMIND and WITCH.

The baseline by the **WIIW** team can be used to quantify possible changes in trade flows under alternative baseline trade policy scenarios, and can also be linked to income driven shifts in demand and processed commodity prices. Basic changes in demand for international transport services linked to these structural changes can also be assessed at the same time.

The impacts on a selected sample of key world transport routes will be estimated by the **ISIS** team through the adaptation of the GRACE tool for the evaluation of social costs of transport to the pressures exerted by future global changes. The implications of future traffic flows, new international trade patterns, migration flows, etc, will be evaluated in terms of changes in social costs, i,e, congestion, accidents, air pollution, noise, through a bottom up approach at corridor level. The assessment will be carried out taking in account all the transport modes.

Sub-task 4.1.4: *EU competitiveness, labour market, international trade, financial stability*

Ex. of sources of global changes: Energy price shocks; Migration; International trade regimes; Emerging economies; International macroeconomic coordination.

The **WIIW** team will employ the modelling resources outlined in WP2 and as extended in WP3 to examine socioeconomic impacts of major trends and policy issues as outlined in this proposal. This includes baseline macroeconomic projections like those employed to examine the energy, commodity, and industrial and

employment impacts of medium-term growth (Christie el 2009a) as well as examination of European competitiveness impacts of policy along these baselines (Francois and Wignaraja 2009, Christie et al 2009b).

The **WIIW** will also use the ICE model to estimate general equilibrium impact elasticities of incremental policy changes in major European industry and employment patterns. This involves analysis of incremental changes and policy and tracing their impact through the full general equilibrium structure of the global economy to identify marginal impacts and develop policy "multipliers" as indicative rules of thumb.

REMIND (**PIK**) explicitly resolves international trade and will be informed by off-line modelling at PIK on various scenarios on 2nd-best situations, induced by various possibilities of international *coalition formation*. The extra costs from non-cooperation will be analysed.

Sub-task 4.1.5: *Population, health, migration*

Ex. of sources of global changes: Regional economic development; East-West migration; Migration from outside the EU; Ageing; Epidemics.

The basic decomposition of projected population trends and their contribution to global trends will be assessed as a follow-up decomposition of baseline projections by the **WIIW** team with the ICE model. This includes indirect pressure on European labor markets through trade linkages. Estimated changes in labor supply and labor market conditions, as well as shifting income and price patterns, will also be used to quantify possible changes in the global drivers of migration.

Task 4.2 The assessment of socio-economic consequences of global changes, without adaptation, under alternative scenarios describing global changes.

Task leader: PIK, participating partners: FEEM, IIASA, PIK, WIIW

Sub-task 4.2.1: *Agriculture markets, forestry markets*

FEEM and **IIASA** will use the linked WITCH and GLOBIOM models to study alternative scenarios driven by global changes defined in WP1. In this WP, adaptation possibilities will be limited, as opposed to WP5. As a benchmark, we shall produce estimates of impact when land allocation is fixed. Also macroeconomic adjustment will be limited, including technological progress that affects agriculture and land allocation. The implications of limited foresight will be explored. On the economic side, we shall assess how impacts that affect agricultural sector productivity will change macroeconomic investments and long-term growth, especially in developing countries, where agriculture accounts for a large part of GDP. WITCH will translate global changes that affect energy – including climate change mitigation policies – into impacts for the agricultural sector and for land allocation.

These results will again be contrasted with those generated analogously from the REMIND-MAgPIE (**PIK**) complex. We shall produce scenarios with standard impact implementation vs. explicitly resolved effects of weather extreme events on food prices for various scenarios of flexibility in land allocation.

Sub-task 4.2.2: *Water, energy, fuels availability, energy security*

FEEM will produce scenarios of economic and geo-political impacts of global changes that affect the energy sector, using the enhanced version of the WITCH model developed in Sub-task 3.1.2. Impacts scenarios will be obtained assuming limited adaptation, including limited scope for renewables and limited R&D investments. Limited re-allocation between energy and non-energy sectors will be assumed in fossil fuels rich economies. Results will include investment patterns in major energy technologies, at the EU level and at the global level. International imbalances that might arise as a consequence of a severe contraction of fossil fuels extraction will be studied. In particular, a careful analysis of Northern Africa and the Middle East regions will be carried out, evaluating all the long-term socio-economic implications for Europe and the whole Mediterranean Basin. REMIND (**PIK**) will address potential effects of sudden interrupts of

primary energy or electricity (African/European-contribution of a supergrid) trade on European and global welfare.

Task 4.3 Production of macro costs of global changes – at EU, National and macro-regional level.
Task leader: FEEM, participating partners: FEEM, IIASA, PIK

FEEM will enrich the WITCH-GLOBIOM linked model with the improved description of fossil fuels extraction and trade. This will allow estimate with a greater richness the interaction between the energy and agricultural sectors, under different global changes, including multiple global changes. The analysis will give a comprehensive picture of how one – or multiple global changes – will affect socio-economic development, in particular in Europe and in the Mediterranean Basin. Possible challenges arising from negative impacts in Sub-Saharan Africa, in Northern Africa and in the Middle-East (e.g. slow economic growth, stresses that can induce migrations) will be examined.

FEEM will use the Computable General Equilibrium ICES model to estimate total socio-economic impacts (i.e. impacts at macro level) of different combinations of global changes, using direct global changes scenarios and information delivered by other models. The methods developed in WP3 will be applied in this Task. Inputs from Task 4.2 as well as direct application of global changes will be used.

PIK will use an emulator of the ICES model, in WP3 coupled to the energy-economically more flexible (than WITCH) model REMIND (coupled also to MAgPIE), to also calculate the macro costs of global changes. Comparison between these two alternative cost estimates will deliver orientation on the relative importance of the flexibility within the energy sector for the reduction of costs induced by global change.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	0
2	FEEM	10
3	IIASA	9
4	PIK	20
5	UGOT	0
6	CUNI	0
7	ISIS	3
8	LSE	0
9	HEID	0
10	WIIW	11
11	CEPR	0
	Total	53

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature	Dissemination level	Delivery date
D4.1	The socio-economic costs of global challenges, without adaptation.	4	4	R	PU	34
		Total	4			

Description of WP Deliverables

D4.1: The report associated to D4.1 will be structured in three chapters/parts:

1. Analysis of scenarios and socio-economic impact assessment of global challenges – Reference scenario;

2. Analysis of scenarios and socio-economic impact assessment of global challenges – Alternative scenarios;

3. Analysis of total socio-economic costs of global changes, without adaptation.

Schedule of relevant milestones

Milestone number	Milestone name	Lead benefi-ciary number	Delivery date from Annex I	Comments

Work package 5

Work package number	5	**Type of activity**[20]	RTD
Work package title	Autonomous and planned adaptation: total impacts of global change		
Start month	13		
End month	34		
Lead beneficiary number	2		

Objectives

- O5.1 A set of scenarios to estimate economic and social impacts to global changes – at EU, National and macro-regional level.
- O5.2 A sensitivity analysis of optimal adaptation strategies to global changes.
- O5.3 Analysis of the optimal mix of mitigation and adaptation socio-economic strategies to maximise welfare – at EU, National and macro-regional level – for some selected global changes.
- O5.4 Production of total costs of global changes – at EU, National and macro-regional level – with emphasis given to the inter-linkages between economic growth, vulnerability and adaptation.

Description of work and role of partners

Task 5.1 will produce scenarios in which the negative (positive) socio-economic impacts from global changes – examined in WP4 with models developed in WP3, following scenarios proposed in WP1 – are limited (enhanced) by means of appropriate adaptation measures, for the EU, National and macro-regional levels. Task 5.1 is complemented by Task 5.2, which performs sensitivity analysis to incorporate major sources of uncertainty into the adaptation scenarios. Estimates of impacts net of adaptation and estimates of adaptation costs/benefits will be used as an input to Sub-task 5.3.1, where the total costs of global changes will be examined. The optimal mix of adaptation and mitigation will be defined in sub-task 5.3.2 for a selected set of global changes.

Task 5.1 Construction of adaptation scenarios to the socio-economic transformations emerging from global changes.

Task leader: FEEM, participating partners: FEEM, IIASA, PIK, ISIS, WIIW

Sub-task 5.1.1: *Agriculture markets, forestry markets*

FEEM and **IIASA** will use the WICTH-GLOBIOM model to assess optimal adaptation to the global changes explored in Task 4.5. Contrarily to what has been assumed in Task 4.5, here we shall allow full re-

[20] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

adjustment of key economic, social and agronomic variables to external circumstances (autonomous adaptation). Scenarios in which we test the welfare implications of a set of adaptation policies – including international trade rules, technological development and structural reforms – will be produced (planned adaptation). **PIK** will estimate the effects of long-term planning within the agricultural sector, expanding the investment time-horizon of MAgPIE to that of REMIND. We expect this to result in particularly different investment streams with respect to the forestry sector.

Sub-task 5.1.2: *Water, energy, fuels availability, energy security*

FEEM will produce scenarios with the WITCH model developed in Sub-task 3.2.2. Full autonomous adaptation will be allowed to react optimally to the global challenges explored in Sub-task 4.2.2. Full flexibility to the energy sector will be given, both in fossil fuels importing and exporting regions (autonomous adaptation). Different degrees of international cooperation in managing super grids will be explored. Investments to enhance energy efficiency and to de-carbonize the economy will be other forms of market-based, autonomous adaptation measures. Carbon taxes and other market policy tools will be studied as a form of planned adaptation. **PIK** will obtain a selected set of emulations of ICES, incorporating planned adaptation. By those the analogous tasks will be studied with REMIND, providing the more flexible energy capital stock.

Sub-task 5.1.3: *Transport, infrastructures, tourism*

PIK will explicitly address the linkage between growth and adaptive capacity for the selected bottom up studies introduced in WP3. These will be cross-checked with ICES for the effects of long-term adaptation planning. This will be a pre-requisite for the tasks on total costs and optimal mitigation/adaptation strategies described below.

Sub-task 5.1.4: *EU competitiveness, labour market, international trade, financial stability*

WIIW will examine alternative responses with the ICE model to labor market pressures following from the global changes explored in WP4. This includes differential targets for development of the skill level of the European labor force, and well as increased flexibility of cross-Member and cross-sector European labor markets. Alternative scenarios for reduction of investor uncertainty (a critical dimension of financial sector stability) will also be traced through production and trade channels. The impact of alternative adaptation scenarios for the global trends linked to the energy sector over trade, EU competitiveness, and labour market performance will also be explored through a set of CGE-based simulations.

Sub-task 5.1.5: *Population, health, migration*

WIIW will examine alternative responses to population and migration pressures following from the global changes explored in WP4. This includes developing scenarios to explore the scope for technology transfer (as measured by closure in productivity gaps) as a mitigation mechanism for migration drivers, and the scope for trade and investment liberalization as mitigation mechanisms. Alternative assumptions for population trends (variations on the global changes from WP4) will also be examined with the help of the ICE model.

Task 5.2 Sensitivity analysis of adaptation scenarios to global changes to incorporate major sources of uncertainty.

Task leader: FEEM, participating partners: FEEM, IIASA, PIK, WIIW

Agricultural activity has always been subject to variability in weather patterns. Sensitivity analysis with respect to yields is therefore necessary in the GLOBIOM-WITCH linked model (**IIASA-FEEM**). At the same time, global changes, such as global warming, can have lasting effects on yields and different crops will be affected asymmetrically. The results of this sensitivity analysis will shed light on the question whether adaptation strategies in the agricultural sector need to include hedging, not only across different crop types, but also across management options. Therefore, this is the starting point for the stochastic modelling of WP6.

FEEM will carry out a careful sensitivity analysis of the optimal adaptation scenarios to global changes that will affect the energy sector with the enhanced version of WITCH. Sensitivity analysis will focus on: key parameters governing the cost of extracting fossil fuels, the amount of fossil fuels resources, the cost of Concentrated Solar Power and of wind turbines, the cost of super-grids, the availability of key power sector technologies (Coal with CCS, Nuclear). Different degrees of international cooperation will also be explored. These analyses will be complemented by Monte Carlo studies within REMIND, MAgPIE (**PIK**) and damage functions. The **WIIW** team will also work with Gaussian quadrature methods to quantify dimensions of uncertainty linked to model parameters and uncertainty about global change drivers.

Task 5.3 Analysis of optimal mitigation and adaptation socio-economic strategies to maximize welfare and estimates of total costs of global changes – at EU, National and macro-regional level.

Task leader: FEEM; participating partners: FEEM, IIASA, PIK, ISIS, WIIW

This task will produce estimates of the total socio-economic costs (i.e. costs at the macroeconomic level, including different global changes) of different combinations of global changes, including the optimal mix between mitigation and adaptation policies. The improved general equilibrium models developed in WP3 will be implemented using information from WP4 and inputs from Tasks 5.1 and 5.2. The scope of the analysis will be the global, EU and regional levels.

Sub-task 5.3.1 *Analysis of total costs of global changes*

FEEM will use the WITCH-GLOBIOM linked model with the enhanced description of energy investments (Sub-task 3.2.2) to study optimal autonomous adaptation and planned adaptation to global changes, also considering multiple global changes. A particular attention will be give to adaptation policies along the Mediterranean basin, in Sub-Saharan Africa and in Middle-East countries. The capacity of these regions to adapt to global changes, and the possibility of the EU to foster adaptation, are crucial for understanding the possible repercussions of global changes for the European economy and society.

Within this sub-task **FEEM** will apply ICES, a general equilibrium model for the world economy, but presenting a high level of sectoral and regional detail, to assess the economic consequences of the different, physical and socio economic impacts that global changes would impose to present and future societies. The structure of the model will be improved according to the work done inside WP3 and tailored to analyze appropriately the widest set of impacts. The final aim of the exercise is twofold: on the one hand it is devoted to describe final effects upon the economic system once market forces have exerted their smoothing or amplifying role (i.e. it describes autonomous adaptation); on the other hand it tries to highlight the interaction among different pressures as these will be analyzed first in isolation and then jointly. The scope of the investigation will be agreed among partners, however a country detail is devised for the EU while the rest of the world could be aggregated into larger regions. The model is recursive-dynamic, the time horizon chosen could be the medium term (say 2020), but could also be pushed further in the future (2050).

The work will be substantiated in three phases (1) building a socio economic benchmark “without pressures from global changes” for the chosen period. (2) Identifying and quantifying in meaningful economic inputs for the model the relevant sources of pressures. These can be either linked to climate-change, but also to other market dynamics (e.g. change in land availability, in crops’ productivity, in tourism flows, in migrations etc.). This phase which entails a close cooperation with WP 1 and 4 is performed mainly within WP3 subtask 3.2.2. (3) Performing the proper impact assessment exercise. Input to the estimation of social costs of global changes in the transportation sector will be also provided by **ISIS**, using the GRACE tool.

Several trials will be carried out in order to find out the best approach to include the estimations in the models. Once again, this will be complemented by the REMIND-MAgPIE complex, now allowing for the full flexibility under long-term planning in the agricultural sector as well as infrastructure investments within the energy sector.

Working closely with the CGE model analysis conducted by **FEEM** and reflecting the core baseline and variations as developed in WP3, **WIIW** will work with the ICE global multi-region general equilibrium model to examine the impact of variations in global economic policy scenarios for baseline regional incomes and hence for the base resources available to cover the policy responses to global change identified in the overall project (WP3, WP4, WP5). In particular, responses to migration and population pressure (WP5.1.5) and to globalization, labor market, and financial stability scenarios (WP5.1.4) will be examined in the context of full policy response scenarios (including stylized versions of those developed by other teams for core natural resource and energy sector responses.) Emphasis will be placed on estimation of full impact elasticities for key measures of cost and benefit linked to global change and responses.

Sub-task 5.3.2 *Analysis of optimal mix between mitigation and adaptation*

FEEM will update the reduced form impact function of the standard WITCH model with results obtained from all the previous Tasks and Sub-tasks. A cost-benefit analysis of the optimal mitigation level of climate change will be carried out with this new impact function. **FEEM** and **IIASA** will use the WITCH-GLOBIOM models to compare at the global and regional levels the welfare effects of different degrees of mitigation of climate change, including all adaptation possibilities. This will not be a full-fledged cost-benefit analysis – given the complexity of running the linked models in cost-benefit mode – but rather an analysis of mitigation costs and benefits in a richer modelling framework, under different climate policy scenarios.

Sub-task 5.3.3 *Economic-growth, impacts and adaptation*

Hereby the influence of economic growth on vulnerability and adaptive capacity shall explicitly be addressed and informed by as analogue as possible case studies. The results of these in-depths studies shall be compared to projections derived by General Equilibrium models, for the sake of mutual recalibration. From this exercise an ‘aggregate CGE-’ module will be derived that would then also allow REMIND-ICES to observe damage- and adaptation effects. Then above tasks shall be re-iterated where necessary.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	0
2	FEEM	15
3	IIASA	9
4	PIK	13
5	UGOT	0
6	CUNI	0
7	ISIS	2
8	LSE	0
9	HEID	0
10	WIIW	12
11	CEPR	0
	Total	51

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi-nation level	Delivery date
D5.1	Optimal adaptation and mitigation scenarios to global challenges.	2	4	R	PU	34
		Total	4			

Description of WP Deliverables

D5.1: The report associated to D5.1 will be structured in three chapters/parts:

1. Optimal adaptation scenarios using the models developed in WP 3, taking into account impacts scenarios produced in WP4, including sensitivity analysis;

2. Analysis of the optimal mix of socio-economic adaptation and mitigation options, including a throughout assessment of uncertainties and risk at EU, National and macro-regional level;

3. Evaluation of total economic and social cost of different global changes, considering optimal and sub-optimal mixes of mitigation and adaptation strategies and the inter-linkages between economic growth, impacts and adaptation.

Schedule of relevant milestones				
Milestone number	**Milestone name**	**Lead beneficiary number**	**Delivery date from Annex I**	**Comments**

Work package 6

Work package number	6	**Type of activity**[21]	RTD
Work package title	Discounting, Risk and Uncertainty in Modelling Impacts		
Start month	1		
End month	34		
Lead beneficiary number	5		

Objectives

- O6.1: Develop theoretical innovations concerning discounting, risk and ambiguity
- O6.2: Implement theoretical innovations concerning discounting and risk in models used within this project

Description of work and role of partners

Task 6.1. Develop theoretical innovations concerning discounting, risk and ambiguity (UGOT, FOND JJLTS, LSE)

Task leader: UGOT, participating partners: FOND JJLTS, UGOT; LSE

***Sub-task 6.1.1**: Discounting if consumers value not only income but income relative to that of their peers*

Sub-task leader: Olof Johansson-Stenman (UGOT)

We shall explore the consequences for discounting of new developments in behavioural economics. Substantial empirical evidence of different kinds suggests that people care not only about their absolute income levels, but also about their relative income compared to others. Previous studies have shown that relative income concerns may have important consequences for policy in different areas. For instance, Aronson and Johansson-Stenman (2008, 2009) show that optimal income taxes are likely to be substantially larger under relative consumption concerns than in the conventional case. Yet, as far as we know, there is no literature on how relative income concerns affect the optimal social discount rate, which is the objective of this task.

***Sub-task 6.1.2**: Discounting with non-consumption sources of welfare and extreme climatic events*

Sub-task leader: Christian Gollier (FOND JJLTS)

We explore the consequences for discounting if consumers value other sources of welfare than their own immediate consumption of goods and services. For example, we will examine the case of habit formation when the consumption level is judged not only in isolation but with respect to past consumption levels.

[21] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

People may also extract welfare from the environment, or from their anticipatory feelings related to future risks. We will explore the interaction of these aspects of the collective management of risk with the likelihood of extreme collective events, either environmental or socio-economic. Indeed, consumption habits, disappointments, or anxious feelings are most important in the anticipations of such events. In this task we will analyze how preferences based on habit formation will modify the optimal social discount rate, and also how such effects interact with effects of uncertainty regarding the future growth rates. As far as we know, these issues have not been analyzed before.

Sub-task 6.1.3: *Ambiguity, Precautionary Principles and Game-theoretic Approaches in Dynamic Programming Models*

Sub-task leader: Magnus Hennlock (UGOT)

Several sources of impacts of global changes involve ambiguity (deeper uncertainty), which makes incorporation of precautionary principles in policy analysis essential. This task will study methods for incorporating ambiguity and aversion to ambiguity that may capture precautionary principles for policy decision making in dynamic models with deeper uncertainty. Methods for introducing ambiguity and aversion to ambiguity on long-term cooperative solutions in dynamic models are also studied. So far only a few tractable solutions on robust approaches fulfilling time consistency in stochastic models have been identified in the literature. A main purpose within this task is to seek for new simplified decision rules that can be applied to models in this program used in task 6.2.

Sub-task 6.1.4*: Relative prices and sector specific discounting*

Sub-task leader: Thomas Sterner (UGOT)

We explore the consequences for discounting of differential growth rates in a model with several sectors. If sectors grow at different speeds, we either need different growth rates or either different relative prices for the future output of the various sectors that take changes in relative scarcity into account. This may be of particular importance in climate models for scarce future ecosystem resources such as water. The theory for discounting hinges on changes in the marginal utility of money. As we get richer in the future we value money less. Scarcer goods will have a higher value. Similarly, people with low income should have a higher marginal utility for money (see task 6.1.5) and damages to goods or services they consume will be particularly affected. This would apply for instance to agricultural land flooded by sea level rise in Bangladesh.

Sub-task 6.1.5: *Welfare Weights and spatial discounting.*

Sub-task leader: Simon Dietz (LSE)

The conventional Ramsey discounting rule consists of two arguments; the pure rate of time preference and a term related to the fact that people in the future are likely to have a smaller marginal utility than at present, since they are likely to get richer. The second argument is equivalent to giving a higher weight on the income of poor people compared to rich people today, while the first argument is equivalent to giving a higher weight on the well-being of people living in countries close to your own, ceteris paribus. While this is presumably difficult to reconcile with a defendable ethical theory, it may have descriptive value. Overall, the aim in this task is to develop expressions for the optimal social discount rate based on both intertemporal and spatial effects, where we will also consider different stochastic processes for future growth rates and patterns for how such processes co-vary with the spatial distribution of the income levels.

Task 6.2. Implement theoretical innovations concerning discounting and risk in models used

within this program

Task leader: UGOT, participating partners:FOND JJLTS, FEEM, IIASA, PIK, UGOT, LSE

Sub-task 6.2.1 *Implications of Alternative Discounting Methods in Models*

Task leaders: Thomas Sterner(UGOT) / PIK

Integrating research ideas into already existing IAMs can pose a number of specific modelling challenges. Nevertheless we will work in this subtask to incorporate the findings of sub-tasks 6.1.1 and 6.1.2 for selected issues in models which imply changes in discount schedules. We shall calibrate these models in two directions. First, we shall consider more realistic growth models than the benchmark used in the literature (random walk for the growth rate of consumption), in order to take into account fat tails in distributions, parametric uncertainties, or regime switches. Second, we shall numerically estimate the level of the efficient discount rate under alternative social welfare functions (with ambiguity aversion, wealth inequality, habit formation).

The ideas developed in 6.1.4 will also be implemented, even though this might require some simplifications of the models. A first attempt has been undertaken already with DICE, which indicates that there is a potential to expand along these lines.

FEEM will implement the alternative discounting methods in the WITCH model. WITCH is an Integrated Assessment Model in which the economy is described along the lines of a Ramsey-Cass-Koopmans optimal growth model. The model displays endogenous technical change, both as Learning-by-Doing and as Learning-by-Researching. With WITCH it will thus be possible to explore the implications of alternative discounting methods on long-term economic growth patterns, on demand of fossil fuels, on technological change, on climate. The robustness of estimated costs of climate mitigation policies will be tested against different discounting schemes.

With the MIND-L model developed at **PIK** (an 'uncertainty optimised' slim version of REMIND (Held et al. 2009, Lorenz et al. forthcoming)), we will shed light on the implications of uncertainty and anticipated learning for optimal climate policy in the cost-benefit mode. Hereby, we will absorb information from WP4 and previous tasks of WP6. With only minor adjustments, it lends itself to studying habit formation and direct extraction of welfare from the environment as proposed in sub-tasks 6.1.2. and 6.1.4. Due to its globally aggregate nature with a single representative agent, studying valuation of consumption relative to peers and spatial discounting as proposed in sub-tasks 6.1.1 and 6.1.5 would require more substantive changes to the model. The results within the MIND model will be used to inform PIK's more advanced REMIND model (see Sub-task 6.2.2).[22].

Sub-task 6.2.2 *Extension of Individual Models to Study Decision / Optimisation under Uncertainty*

Sub-task leaders: Sabine Fuss (IIASA) / PIK

An extension of existing models will enable uncertainty analysis of socio-economic impacts of global changes. GLOBIOM is currently a deterministic model, where scenario analysis can be used to examine the range of possible outcomes. However, decisions taken in the face of uncertainty can differ substantially from those taken in a scenario contingent on one fixed set of beliefs. One of this task's aims is to develop a stylized and simplified GLOBIOM model, in which uncertainty can be readily examined. The advantage of this extension will then also be that robust (adaptation) strategies (WP4, WP5) can be analyzed, where we will experiment with different risk measures (Conditional Value-at-Risk in case of loss aversion or variance if e.g. stochastic yields are normally distributed). MIND-L is ready-to-use for stochastic cost benefit analysis, allowing for optimal investments under global warming, damage and economic uncertainty, in that sense robust investment strategies. We will develop an approach to transfer its insights to the full-fledged

REMIND model. The aim is to derive the effects of the new macroeconomic damage functions generated within WP3 of investment decisions under anticipated learning.

Sub-task 6.2.3 *Implications of Ambiguity and Aversion to Ambiguity in Models*

Sub-task leaders: Magnus Hennlock (UGOT) / Simon Dietz (LSE)

The implications of ambiguity from concepts developed in 6.1.3 will be studied in simulations. Research will be undertaken to implement and assess impacts of catastrophic climatic risk in a slim version of IAMs as well as simulating effects of behavioral aspects such as precaution and aversion to ambiguity on optimal policy in slim versions of IAMs by using analytical robust approaches that make computer simulations possible.

Sub-task 6.2.4 *Optimal Investments under Uncertainty*

Sub-task leader: Emanuele Massetti (FEEM)

FEEM will enhance the stochastic version of WITCH in order to include the new model features introduced in WP3. With the enhanced stochastic WITCH model FEEM will perform an analysis of optimal investments under uncertainty. The exact scope of the analysis will be determined in function of the analysis on global changes carried out in WP1. Uncertainty on fossil fuels resources, on climate change impacts and on land productivity can be potential research areas. Where possible, theoretical insights from Task 6.1 will be implemented.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	2
2	FEEM	5
3	IIASA	5
4	PIK	5
5	UGOT	10
6	CUNI	0
7	ISIS	0
8	LSE	5
9	HEID	0
10	WIIW	0
11	CEPR	0
	Total	32

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi-nation level	Delivery date
D6.1	Managing the uncertainties associated to global challenges.	5	3	R	PU	34
		Total	3			

Description of WP Deliverables

D6.1: The report associated to deliverable D6.1 will be structure as follows:

1. Three chapters corresponding to Subtasks 6.1.1, 6.1.2, 6.1.3;

2. Three chapters corresponding to Subtask 6.1.4, 6.1.5;

3. Three chapters from each of the three areas of Subtask 6.2.2;

3. One chapter on integrating theoretical analysis concerning discounting, risk and ambiguity into Integrated Assessment Models;

4. One chapter on methodologies to incorporate uncertainty analysis in macro-economic and Integrated Assessment Models to check the robustness of adaptation strategies examined in WP5.

Schedule of relevant milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS4	Theoretical innovations concerning discounting, risk and ambiguity for application to economic models	5	24	

Work package 7

Work package number	7	**Type of activity**[23]	OTHER
Work package title	Dissemination		
Start month	1		
End month	36		
Lead beneficiary number	1		

Objectives

- Design and implement the dissemination strategy of the project in a targeted and effective manner
- Produce high-quality dissemination products and ensure their effective dissemination to targeted audiences/publics.

Description of work and role of partners

Task 7.1 For an effective dissemination to policy making and public at large

Task leader: FOND JJLTS, participating partners: FOND JJLTS, FEEM, LSE, HEID, CEPR

This task will oversee the implementation of the dissemination strategy (specified inside the Dissemination Plan included in full detail in the inception report, Del 1.1), and manage the design and content of the *dissemination* products, so as to fit the purposes of the intended audience.

The Dissemination Plan will includes the following targeted mechanisms:

Interactive Web Site: A web site dedicated to the project will be set up at the beginning of the project, in order to disseminate information on Global-IQ' activities to the outer world and to establish links with the web sites of the partner institutions. All the results produced by Global-IQ will be posted and publicly available on this site. A dedicated section for the medias will be visible and easily accessible: brief articles will be made available to stress the potential value of the project in popular and specialised media. The web site will comply with EU FP7 recommendations for e-editing and web site appearance and contents.

Project Presentation: in word (brochure) and power point a project presentation will be prepared at the beginning of the project to enhance its visibility.

E-Newsletter: an annual E-Newsletter will be drafted and sent to scientific organisations and interested parties/stakeholders/policy makers with an interest in being updated on Global-IQ's activities. In this occasion, the partners will use their own relationships networks and mailing lists to ensure proper dissemination in their own countries.

Working papers: preliminary versions of the research papers will be disseminated through the working paper series of FEEM, FOND JJLTS, LSE and the other partners.

Policy Briefs and Recommendations: will be addressed to the policy makers.

[23] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

Publications: in addition, all partners will present project results in international conferences and publish project results in scientific and policy journals (special issues of a referenced journal) and in local, national and international press.

Task 7.2 Final Conference

Task leader: LSE

A Final Conference will be organised by LSE at the end of the project (month 36) in Brussels and represents a clear means of dissemination of Global-IQ' results to the outer public and especially towards EU officials and decision makers. Its main aim will be to raise public awareness on the research field covered by Global-IQ, to bring interested parties at different levels closer to EU research and to give account of how public money is spent and to foster research in the European Research Area. The final conference will also provide the opportunity to share preliminary ideas on research gaps that remain to be filled as a follow-up to the Global-IQ research activities. It will take place in Brussels in 2014.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	4
2	FEEM	2
3	IIASA	0
4	PIK	0
5	UGOT	0
6	CUNI	0
7	ISIS	0
8	LSE	3.5
9	HEID	2
10	WIIW	0
11	CEPR	3.5
	Total	15

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi nation level	Deliver y date
D 7.1	Dissemination plan	1	1	O	PU	2
D.7.2	Project presentation - brochure and .ppt	1	1	O	PU	3

D 7.3	First periodic project newsletter	8	0.5	O	PU	12
D 7.4	Second periodic project newsletter	9	0.5	O	PU	24
D 7.5	Third periodic project newsletter	11	0.5	O	PU	36
D. 7.6	Working papers and policy briefs	1	2	O	PU	36
		Total	5,5			

Description of WP Deliverables

D 7.1: Dissemination plan

D 7.2: Project presentation - brochure and .ppt

D 7.3: First periodic project newsletter

D 7.4: Second periodic project newsletter

D 7.5: Third periodic project newsletter

D 7.6: Working papers and policy briefs

Schedule of relevant milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS 5	Website	1	2	
MS 6	Final conference	8	36	

Work package 8

Work package number	8	**Type of activity**[24]	MGT
Work package title	Management		
Start month	1		
End month	36		
Lead beneficiary number	1		

Objectives

- Ensure the efficient co-ordination and the overall management of Global-IQ Project, including the preparation and the maintenance of the Consortium Agreement
- Ensure that all partners contributions are well integrated and coordinated and that EC deliverables are produced in a timely manner
- Supervise the organisation and implementation of the planned project events
- Ensure of compliance with all relevant regulations of the European Commission, including the knowledge management issues

Description of work and role of partners

WP8 is concerned with the overall project management, the internal communication among the Consortium, the supervision of the implementation of the work plan and the involvement of the External Advisory Board.

Task 1.1. Administrative coordination (FOND JJLTS with support of FEEM and the other WP leaders)

The activities under this task will ensure sound legal, contractual and administrative management of the project, in compliance with the contractual obligations, good management practices and the provisions of the Consortium Agreement. These activities include 1) representation of the consortium in contact with the EC project officer(s) and various other scientific and policy bodies, 2) co-ordination of the knowledge management issues; 3) oversight of ethical and gender aspects within the project, 4) co-ordination of the research activities and monitoring the fulfilment of the project's objectives, 5) coordination of the Project Steering Committee meeting and 6) supervise the involvement of the External Advisory Board, 7) establishment of an Intranet platform for an effective communication and information exchange among the project partners. A particular attention will be given to ensure good linkages and exchange of information between WPs.

Task 1.2 Organisation of the Project Steering Committee meetings (FOND JJLTS, CUNI, ISIS, UGOT)

FOND JJLTS will coordinate and chair the Project Steering Committee (PSC). The PSC will meet at least four times over the life span of the project: at the beginning (Kick-off Meeting) and at the end of each project year. The kick-off meeting will be organised by FOND JJLTS and will take place in Toulouse in month 1. The other three annual meetings will be organised by CUNI, ISIS and UGOT and will take place in Rome, Prague and Goteborg, in months 12, 24 and 36 respectively. These meetings will be organised the day before the Workshops, in order to save travel costs. Moreover, virtual meetings, through electronic fora

[24] Possible values :**RTD, DEM, OTHER, MGT**, **COORD, SUPP**

and tele/video conferences will be organised every six months and more if necessary. The members of the External Advisory Board will be invited to take part to a dedicated session of the PSC with the aim to conduct a periodic evaluation.

Person months per participant

Participant number	Participant short name	Person-months per participant
1	FOND JJLTS	6
2	FEEM	4
3	IIASA	0
4	PIK	0
5	UGOT	0
6	CUNI	0
7	ISIS	0
8	LSE	0
9	HEID	0
10	WIIW	0
11	CEPR	0
	Total	10

List of WP Deliverables

Delive-rable Number	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature	Dissemi-nation level	Delivery date
D8.1	Report on the good management practices of the project	1	1	R	PU	36
		Total	1			

Description of WP Deliverables

D8.1: The report will give full details on the management of the project.

Schedule of relevant milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS7	Kick off meeting	1	1	
MS8	First Annual Meeting	1	12	
MS9	Second Annual Meeting	1	24	

MS10	Third Annual Meeting	1	34	

WT 4: List of milestones

List of milestones

Milestone number	Milestone name	Lead beneficiary number	Delivery date from Annex I	Comments
MS1	Concepts and scenarios of global challenges	1	12	
MS2	First set of results from WP2 to be used in WP3, WP4 and WP5	6	12	
MS3	Socio-economic impact assessment framework operational for the key sectors identified	3	18	
MS4	Theoretical innovations concerning discounting, risk and ambiguity for application to economic models	5	24	
MS5	Website	1	2	
MS6	Final conference	8	36	
MS7	Kick off meeting	1	1	
MS8	First Annual Meeting	1	12	
MS9	Second Annual Meeting	1	24	
MS10	Third Annual Meeting	1	34	

WT 5: Tentative schedule of project reviews

Tentative schedule of project reviews

Review number	Tentative timing[25]	Planned venue of review	Comments, if any
1	18	Bruxelles	
2	36	Bruxelles	

[25] Month after which the review will take place. Month 1 marking the start date of the project, and all dates being relative to this start date.

WT 6: Project effort by beneficiaries per work package

Project effort by beneficiary per work package

Beneficiary short-name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total per beneficiary
FOND JJLTS	3	13				2	**4**	**6**	**28**
FEEM	1		11	10	**15**	5	2	4	**48**
IIASA	1		**15**	9	9	5			**39**
PIK	1		14	**20**	13	5			**53**
UGOT						**10**			**10**
CUNI		**21**							**21**
ISIS	**12**	1.75	3	3	2				**21.75**
LSE						5	3,5		**8,5**
HEID		9					2		**11**
WIIW			13	11	12				**36**
CEPR							3,5		**3,5**
Total	**18**	**44.75**	**56**	**53**	**51**	**32**	**15**	**10**	**279.75**

WT 7: Project effort by activity type per beneficiary

Project effort by activity type per beneficiary

Activity type	FOND JJLTS	FEEM	IIASA	PIK	UGOT	CUNI	ISIS	LSE	HEID	WIIW	CEPR	Total
	RTD/Innovation activities											
WP1	**3**	**1**	**1**	**1**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**18**
WP2	**13**	**0**	**0**	**0**	**0**	**21**	**1.75**	**0**	**9**	**0**	**0**	**44.75**
WP3	**0**	**11**	**15**	**14**	**0**	**0**	**3**	**0**	**0**	**13**	**0**	**56**
WP4	**0**	**10**	**9**	**20**	**0**	**0**	**3**	**0**	**0**	**11**	**0**	**53**
WP5	**0**	**15**	**9**	**13**	**0**	**0**	**2**	**0**	**0**	**12**	**0**	**51**
WP6	**2**	**5**	**5**	**5**	**10**	**0**	**0**	**5**	**0**	**0**	**0**	**32**
	18	**42**	**39**	**53**	**10**	**21**	**21.75**	**5**	**9**	**36**	**0**	**254.75**
Demonstration activities												
-	-	-	-	-	-	-	-	-	-	-	-	-
Total Demo	-	-	-	-	-	-	-	-	-	-	-	-
Consortium Management activities												
WP8	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**
Total Management	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**

Other activities												
WP7	**4**	**2**	**0**	**0**	**0**	**0**	**0**	**3.5**	**2**	**0**	**3.5**	**15**
Total other	**4**	**2**	**0**	**0**	**0**	**0**	**0**	**3.5**	**2**	**0**	**3.5**	**15**

Total	**28**	**48**	**39**	**53**	**10**	**21**	**19**	**8.5**	**11**	**36**	**3.5**	**279.75**

WT 8: Project efforts and costs

Beneficiary number	**Beneficiary short name**	**Estimated eligible costs (whole duration of the project)**						**Total receipts (€)**	**Requested EU contribution (€)**
		Effort (PM)	**Personnel costs (€)**	**Subcontracting (€)**	**Other Direct Costs (€)**	**Indirect costs OR lump sum, flat-rate or scale-of-unit (€)**	**TOTAL costs**		
1	FOND JJLTS	28	196.000	12.000	74.500	134.300	416.800	0	352.000
2	FEEM	48	336.000	5.000	31.000	220.200	592.200	0	462.600
3	IIASA	39	312.000	5.000	31.000	188.650	536.650	0	404.125
4	PIK	53	265.000	5.000	31.000	226.840	527.840	0	397.380
5	UGOT	10	90.000	0	23.000	67.800	180.800	0	137.200
6	CUNI	21	94.500	18.000	22.500	70.200	205.200	0	155.500
7	ISIS	21.75	153.285	0	22.500	43.155	218.940	0	165.450
8	LSE	8.5	59.500	0	40.000	59.700	159.200	0	139.600
9	HEID	11	66.000	10.000	19.000	51.000	146.000	0	114.700
10	WIIW	36	252.000	0	21.000	163.800	436.800	0	328.000
11	CEPR	3.5	24.500	0	2.000	15.900	42.400	0	41.600
Total		279.75	1.848.785	43.000	307.000	1.263.245	3.462.030	0	**2.698.155**

B2. Implementation

B 2.1 Management structure and procedures

The Global-IQ Consortium comprises 11 partners that have agreed upon the management structure outlined below. This structure as well as the decision-making procedures will be established according to the following objectives:

(i) consideration of the **equality and collective responsibility of all participants**,

(ii) **efficiency and transparency** of the overall management with **little financial efforts**,

(iii) ensuring of **compliance** with all relevant regulations of the European Commission (EC),

(iv) realisation of **sound monitoring and professional administration** to avoid time and cost escalation,

(v) realisation of effective **quality management** and respect **specific schedule**, including milestones and deliverables,

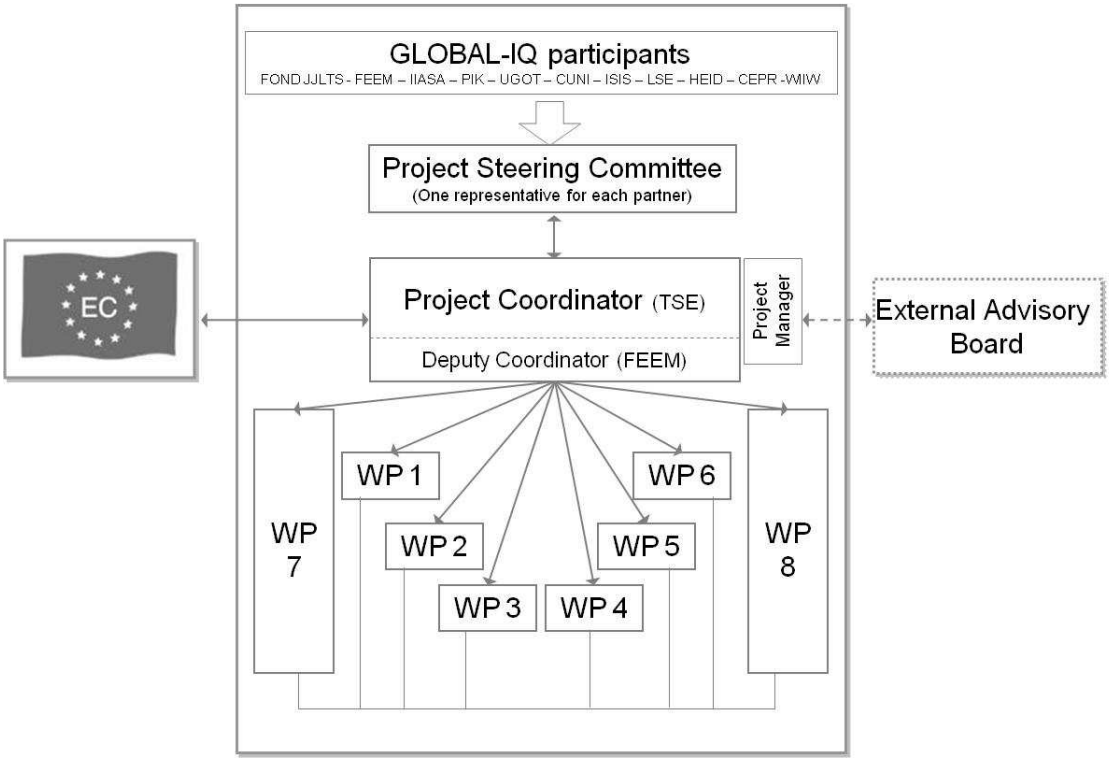
(vi) and research according **best scientific practice**.

2.1.1 Management bodies

The management bodies, their scope of power, responsibilities and working procedures will be described in detail in the Consortium Agreement that will be signed by all participants, in case of funding (see Section 2.1.3). It will be each partner's general responsibility to undertake all reasonable endeavours to perform and fulfil promptly, actively, and on time, all of its obligations under the Grant Agreement and the Consortium Agreement as well as their tasks within the work packages according to their role in the Consortium including the submission of the deliverables as described in the proposal.

The management of the project will be achieved through a simple and clearly configuration, as illustrated in the figure below.

Figure 2.1.a: Global-IQ Management Structure



The management structure is based on the following components:

1. Project Coordinator (PC);
2. Project Steering Committee (PSC);
3. Workpackage Leaders (WPL);
4. Partners (P);
5. External Advisory Board (EAB).

Project Coordinator (PC): FOND JJLTS will assume the role of PC and will retain overall responsibility of the planned activities of the project. PC will act as an interface between single participants or the Consortium as a whole and the European Commission (EC), will ensure compliance by the parties to the contractual obligations in all activities of the project, and will carry out day-by day the management and the scientific coordination.

The role of the PC for what concerns the **management coordination** is:

- to manage the overall legal, contractual and administrative issues of the project, including the preparation and the maintenance of the Consortium Agreement,
- to administer the EC Grant and the financial flow between the European Commission and the whole Consortium,
- to ensure that timely and effective communication is maintained within the Consortium and between the Consortium and the European Commission,
- to establish, finalise and manage all contractual arrangements arising from the progressive implementation of the Work-plan, monitoring the status of the budget and preparing controlling reports for the Scientific Steering Committee;
- to ensure prompt delivery of all reports and deliverables required by the EC;
- to supervise the organisation and implementation of the planned project meetings (kick-off meeting, PSC meetings and EAB meeting,) and convene extraordinary meetings, if necessary;
- to co-ordinate the knowledge management issues,
- to ensure ethic and gender control and to oversee science and society issues related to the activities conducted within the project.

The role of the PC for what concerns the **scientific coordination** is:

- to coordinate the scientific activities of the project for the implementation of the work plan, including the dissemination activities and the interactions of the activities among the Workpackages,
- to review, enforce and monitor continuously the implementation of the activity scheduling, included the production of the deliverable and achievement of milestones,
- to supervise the organisation and implementation of the scientific and dissemination events planned throughout the project lifetime,
- to establish and maintain a complete record of the material produced by the project (working documents and internal reports, workshop presentations and proceedings, deliverables, progress and management reports, etc.), to be posted on the project website and regularly updated.

FOND JJLTS will nominate a **Project Manager**, hired for the project that will give the support, the Scientific Coordinator of Global-IQ for the overall management of the project. The Project Manager will be supported by the **FOND JJLTS Project Office**, especially for issues such as budget-management, accountancy, financial controlling and reporting, legal advice and support on contract management and protection of intellectual property rights.

The PC will be supported by FEEM as **Deputy Coordinator,** who will offer its sound and proven experience in coordinating European projects and scientific networks and in organising successful events.

Project Steering Committee (PSC): The PSC is the collegial body of the project and is primarily responsible for supporting the Coordinator in fulfilling the obligations towards the European Commission, monitoring and controlling the efficient implementation of the project's objective. The PSC is composed by one representative of each participant.

The role of the PSC is:

- to decide on all budget-related matters, the acceptance of new participants, the exclusion of participants, and the modification of the Consortium Agreement;
- to ensure and promote the coordination of the project activities and in particular the interaction among the Workpackage Leaders;
- to monitor the development of the work plan and to assess its compliance with the proposed objectives, applying the appropriate rules on "intervention measures" in the case of significant delays or breach of obligations;
- to make proposals and/or recommendations on the dissemination activities and to review their implementation;
- to discuss and approve the project deliverables, the periodic activities reports and cost statements;
- to ensure overall quality control on the project implementation, including issues such as ethic and gender.

The PSC will be chaired by the Project Coordinator. Decisions shall be taken by a majority of two-thirds (2/3) of the votes, unless otherwise provided in the Consortium Agreement.

The PSC will meet at least four times over the life span of the project: at the beginning (Kick-off Meeting) and at the end of each project year. Additional meetings may be organised, subject to the availability of resources and necessity. Virtual meetings, through electronic fora and tele/video conferences will also be organised every six months.

Workpackage Leaders (WPLs): The WPLs (ISIS, CUNI, IIASA, PIK, FEEM, UGOT, FOND JJLTS) share responsibility with the PC for the timely and effective implementation of the activities planned in each WP of the project. Main activities cover:

- ensuring performance and progress of the activities with regard to the deliverables and project milestones;
- coordination and monitoring on a day-to-day basis of the progress of the Workpackages, with a particular attention to the activities carried out within the other WPs;
- ensuring communication between members of the WP and to the PSC of any plans, deliverables and information concerning the work packages;
- delivering regular activity reports, i.e. referring to work progress and budget-development to the PC, alerting in case of delay or default and if necessary with suggestions for the solution of problems.

Partners (P): Notwithstanding the above, from the administrative and financial perspective, all Partners bear the same obligations towards the Commission. Moreover this co-responsibility vision to the implementation of the project activities is an indication of all participants' strong engagement in the project and their high commitment. In details, main activities cover:

- substantive contribution to the scientific coordination of the project through the active participation of one representative of the partner to the PSC;
- efficient implementation of the tasks within their own Workpackages;

- specific support to the WPLs for what concerns the preparation of the EC periodic reports;
- basic support to the PC for what concerns the administrative and financial matters, in particular concerning the period cost statements.

External Advisory Board (EAB): The EAB is a scientific evaluation consultative body. It will advise the SSC and the PC on project orientations or special issues. In details, main activities cover:

- Provide advice to the scientific programme of activities for the project as well as the results obtained;
- Perform monitoring activity on the correct implementation of the project, by ensuring that the Project objectives will be successfully addressed;
- Propose solutions for the management of all the possible risks related to the failure of the outreach strategy.

The EAB will consist of external experts recognised for their expertise in the field of the project. They will be selected and contacted in case the proposal will be funded by the EC.

The EAB will be managed and facilitated by FOND JJLTS, guaranteeing an effective communication flow between the Global-IQ partners and the members of the EAB. The EAB will meet once a year over the life span of the project these being organised back-to back with other events to limit travel costs and provide opportunities for exchanges and discussions between Global-IQ researchers and EAB members.

2.1.2 Internal communication and project meetings

An active internal communication strategy will be developed to ensure coherence and effectiveness in the daily exchange of information and cooperation for all Consortium participants.

It will be based on the following communication facilities:

- email correspondence as the primary means of day-to-day communication,
- an internet server hosting the website of the project with download areas (reports, protocols, templates and internal circulars with restricted access), calendars and forums,
- the use of mail-lists and electronic discussions on the web server for the project,
- telephone and internet-based IRC-conferences, as well as tools such as Skype and video conferences.

Communication will be achieved through regular project meetings:

Bodies included	**Meeting frequency**	**Objective of the meetings**
Project Steering Committee	At least annually (see above)	Decisions concerned consortium agreement, budget-related issues, reports, etc. Project execution, monitoring and controlling of project implementation
WP Leaders	On a regular basis	To discuss the cooperation, to exchange information, to coordinate actions within WPs
Project's staff	On a regular basis	Day-to-day operation of the project
External Advisory Board	Three times during project lifetime	Overall policy and scientific guidance to Global-IQ.

A Kick-off meeting will be organised at the beginning of the project in order to ensure a common understanding of the scientific issues, role and responsibilities of each partner, overall approach and

timeline of the project. In order to improve the administrative management of the project, an administrative staff representative for each partner will join the Kick-off Meeting and will take part to a parallel session built up expressly to inform on FP7 financial report rules.

2.1.3 Consortium Agreement

In case the Global-IQ project should be selected for funding by the European Commission, the partners will sign a Consortium Agreement (CA) regulating specific rights, obligations and operational aspects that will not be explicitly addressed in the EC contract. The CA will be prepared during the negotiation phase, under the responsibility of the Project Co-ordinator, and in accordance with the guidelines provided by the EC. The CA will include detailed provisions to deal with critical issues such as rules and procedures for the management of the financial resources and the distribution of the funds received by the EC, decisions rules within the Consortium, management of knowledge and Intellectual Property Rights (IPR). The procedure for the management of IPR will be in accordance with that detailed through the FP7 Programme, and the relevant national rules. The main rules are set out in the EC Regulation N° 1906/2006 of the European Parliament and of the Council laying down the rules for the participation of undertakings, research centres and universities in actions under the FP7 for the dissemination of research results (2007-2013).

B 2.2 Beneficiaries

Relevant publications of the researchers involved in Global-IQ project are listed in Section 6.

Partner 1 (Coordinator): Fondation Jean-Jacques Laffont,Toulouse Sciences Economiques (FOND JJLTS)

BRIEF DESCRIPTION OF THE ORGANISATION
The origins of the **Toulouse School of Economics** can be traced back to the early 1980s, when Jean-Jacques Laffont set up the GREMAQ (research department affiliated with the CNRS and the University of Toulouse), and to the early 1990s with the creation of IDEI (Institut d'Economie Industrielle). In 2007, a new step was taken when the French government and the Academy of Sciences chose FOND JJLTS as one of 13 " Réseaux Thématiques de Recherche Avancée" (across all fields), enabling the creation of a foundation, the Foundation Jean-Jacques Laffont - Toulouse School of Economics (FOND JJLTS). This foundation is building an endowment in order to secure long term financing for a research centre that can attract students and researchers from all over the world. The FOND JJLTS relies on a prestigious scientific committee composed of 16 members (including 4 Nobel Prize winners) and now gathers about 130 senior and junior researchers affiliated with different research institutions (University of Toulouse, EHESS, CNRS, INRA, CEA, MEDDAT) and about 100 doctoral students (70% foreign), more than 230 researchers in total. This team, located in the Manufacture des Tabacs in Toulouse, is regularly ranked among the top three groups in economics in Europe. Field-wise, the EconPhD website (http://www.econphd.net), which allows economics students to compare doctoral programs worldwide, ranks FOND JJLTS 1st in the world in the economics of information and 2nd (1st in Europe) in industrial organization. FOND JJLTS also ranks 1st in Europe in business economics, in public economics, and in environmental economics. FOND JJLTS scholars have received many national and international prizes and honors, including the CNRS gold Medal - the highest scientific honour in France - and three Yjrö Jahnsson awards (awarded every other year since 1993 to the best European economist under 45).
ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE
Role in the project: FOND JJLTS will be the coordinator of the project. As such FOND JJLTS will have in charge the overall coordination of the participants' works, reporting and dissemination. These tasks are split into two workpackages: WP8 (general coordination tasks) and WP7 (dissemination), this WP joint with LSE, FEEM and HEID . Moreover, FOND JJLTS will participate to WPs 1, 2, 6. *Previous relevant experience* with European projects: Management of ERC Starting and Advanced Grant Agreements (ACAP – Long-term Risks – RMAC – Cognition), Partner in the "SCI-FI Glow" FP7 collaborative project.
SHORT PROFILE OF KEY STAFF
Jean-Pierre Amigues is research director at INRA, FOND JJLTS member. He holds a PhD from the University of Toulouse. He is a specialist in natural resources and environment economics, withba focus upon water issues and climate change. **Hippolythe D'Albis** is FOND JJLTS researcher and full profesor of economics at Montpellier University. He is specialized in population economics and demography. **Christian Gollier** is full professor at the University of Toulouse and senior member of IUF (Institut Universitaire de France). He holds a PhD from the Catholic University of Louvain. He is the director of FOND JJLTS. Fellow of the Europlace Institute of Finance, lead author of the 4th IPCC report, Chairman of the Scientific Council of Observatoire de l'Epargne Europeene, Director of the CES-IFO network in Applied Microeconomics, Associate editor of Mathematics and Financial Economics, Finance Research Letters, Management Science and the Journal of Risk and Uncertainty. He is a specialist of finance, risk and uncertainty analysis of environmental issues. **Norbert Ladoux** is FOND JJLTS reseracher and full professor of economics at Toulouse University. He is specialized in enrgy economics and redistribution aspects of energy policies in the EU. **Gilles Lafforgue** is FOND JJLTS reseracher and junior researcher at INRA. He is specialized in climate

change economics mdelling and assessment.

Michel Moreaux is FOND JJLTS researcher and full professor of economics at Toulouse University. He is specialized in natural resources economics, energy and water economics.

Céline Nauges is research director at INRA and FOND JJLTS member. She holds a PhD form the University of Toulouse. She is specialized in water economics and econometrics with mupltiple involvments in water assessment issues in Europe and the world.

Nicolas Treich is research director at INRA and FOND JJLTS member. He is specialized in risk and uncertainty economics together with cost benefit analysis in risky environments.

Partner 2: Fondazione Eni Enrico Mattei (FEEM)

BRIEF DESCRIPTION OF THE ORGANISATION

Fondazione Eni Enrico Mattei (www.feem.it) is a non-profit, non-partisan research institution established to carry out research in the field of economics and sustainable development. It is a leading international research centre and one of its principal aims is to promote interaction between academic, industrial and public policy spheres in order to comprehensively address concerns about economic development and environmental degradation. The research activities are organised into three Research Programmes: Sustainable Development, Global Challenges and Institutions & Markets. The Research Programme "Sustainable Development" covers a considerable number of key topics for research, often strictly interrelated among themselves, and in particular on climate change, natural resource management, sustainable energy and environmental valuation. FEEM has signed an impressive number of research contracts with external researchers and institutions, an internationalisation rate which is unparalleled in Europe. FEEM has become the privileged interlocutor of a number of policy institutions, among which the IPCC, the World Bank, the European Commission, the Italian Ministries, Regions and local municipalities. Finally FEEM has a large experience in the dissemination of theoretical and applied research. In the last 20-year period FEEM has organised over 350 seminars and workshops, and 17 large-scale conferences. Working papers, policy briefs, journals and books are also evidence of FEEM's research effort.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: FEEM, as Deputy co-ordinator, will support FOND JJLTS in the overall management and coordination (WP8). In particular, FEEM will co-ordinate WP5 and will participate to WPs 3, 4, 6, 7.

Previous relevant experience: **FEEM** has a sound and proven experience in coordinating European projects and scientific networks and in organising successful events. Moreover, it has participated in several international projects and networks on topics related to the Global-IQ Proposal. The relevant EU research projects include, among others PASHMINA – PAradigm SHifts Modelling and INnovative Approaches, EC FP7, 2009-12; ClimateCost – Full Costs of Climate Change, EC FP7, 2008-11; TOCSIN – Technology Oriented Cooperation and Strategies in India and China: Reinforcing the EC dialogue with Developing Countries on Climate Change Mitigation, EC FP6, 2007-09; EC FP6, 2006-10; TRANSUST.SCAN – Scanning Policy Scenarios for the Transition to Sustainable Economic Structures, EC FP6, 2006-09.

SHORT PROFILE OF KEY STAFF

Emanuele Massetti is researcher at the Sustainable Development Programme of Fondazione Eni Enrico Mattei that he joined in 2004. He holds a Ph.D. in Economics from the Catholic University of Milan, an MSc in Economics from University College London and a MA in Economics from Brown University, USA. His main research interests are in Environmental Economics. In 2007-2008 he was Research Affiliate at the Yale School of Forestry and Environmental Studies. He is one of the authors of WITCH, a climate-energy-economy model used for climate policy analysis. Present research topics include further developments of the WITCH models and econometric estimates of climate change impacts in the agricultural sector.

Valentina Bosetti holds a PhD in Computational Mathematics and Operation Research from the Università Statale of Milan and a Master Degree in Environmental and Resources Economics from University College of London. At FEEM since 2003, she works as a modeler for the Sustainable Development Programme, leading the Climate Change topic coordinating a research group on numerical analysis of carbon mitigation options and policies. She has published several papers in the field of economics of climate change policy, including some linking forest management to the climate change policies. Valentina has been fellow at the

Princeton Environmental Institute, USA (2008-2009). She is currently working on different projects, among others: Transust_Scan, Climate Cost, TOCSIN and she has recently awarded one of the prestigious 2009 European Research Council Starting Grant to perform frontier research on climate change.

Carlo Carraro holds a Ph.D. from Princeton University and is currently President of the University of Venice. He is member of the Bureau of the Intergovernmental Panel on Climate Change (IPCC) and Vice-Chair of IPCC Working Group III. He is Director of the Sustainable Development Programme of the Fondazione Eni Enrico Mattei (FEEM) and of the Climate Impacts and Policy Division of the Euro-Mediterranean Center on Climate Change (CMCC). He is Research Fellow of the Center for European Policy Studies (CEPS), Brussels, and the Center for Economic Policy Research (CEPR), London. He is also fellow of the Center of Economic Studies (CESifo), and member of the Scientific Advisory Board of the Ifo Institute for Economic Reserach, Munich, the Harvard Environmental Economics Program (HEEP) of the Kennedy School at Harvard, the Centre for Applied Macroeconomic Analysis (CAMA), Australian National University, the Research Network on Sustainable Development (R2D2), Paris, and the Istituto di Economia e Politica dell'Energia e dell'Ambiente (IEFE), Milan. He collaborates with the OECD and the European Investment Bank. He is co-editor of the Review of Environmental Economics and Policy and belongs to the editorial board of numerous academic journals. He has been publishing 30 books and about 200 articles on several economic issues.

Francesco Bosello graduated at the Ca' Foscari University of Venice, he received a Master degree in economics from the University College of London (UK) and a Doctoral degree in economics from the University of Venice. He is presently senior researcher at the Fondazione Eni Enrico Mattei (FEEM) of Milan, assistant professor of economics at the University Statale of Milan and affiliate scientist of the Italian "Euromediterranean Center for Climate Change" (CMCC). His main interests are focused on climate-change policy and modelling with particular emphasis on negotiation aspects of international environmental agreements and on optimal policy design considering adaptation and mitigation options. He is being currently involved in several research projects (ENSEMBLE, CIRCE, SESAME, VECTOR, CLIBIO, IN-STREAM) and he is undertaking research activities concentrated in the area of climate change impact assessment and in the design of optimal mitigation and adaptation strategies developing integrated assessment modelling tools. Climate change impact studies tackled within these programmes concern for instance: health, extreme events, sea-level rise, agriculture, tourism.

Partner 3: Internationales Institut für Angewandte Systemanalyse (IIASA)

BRIEF DESCRIPTION OF THE ORGANISATION

The International Institute for Applied Systems Analysis (IIASA) is a non-governmental research organisation based in Austria. IIASA has experts in the areas of mathematical modelling, land-use, forestry, energy, climate change, adaptation and mitigation, population, health, risk & vulnerability. The participating Forestry Program (FOR) has a proven record in frontier science in the fields of forest sector modelling and integrated modelling of global land-use change. The program's scientific expertise comprises integrated policy assessment of sustainability strategies (e.g. trade-offs between deforestation, food security and rural development). FOR also has a strong background in developing and adapting tools for uncertainty analysis and risk assessment.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: IIASA will lead WP3 on the further development of models, so as to enable a more integrated assessment and quantification of socio-economic impacts of global change, and participate in WPs 4, 5 and 6. With FOR's expertise on integrated policy assessment of sustainability strategies, mitigation and adaptation, and risk assessment, IIASA is well-equipped to fulfil this objective. The integrated model cluster comprising GLOBIOM, G4M and EPIC (currently being linked with BEWHERE) has successfully been used also in previous/current projects and is ideal to be further extended to analyze socioeconomics impacts of global changes.

Previous relevant experience: IIASA has carried on several FP7 projects, both as partner and as coordinator. Among the project related to Global-IQ's themes:

Climate Change – Terrestrial Adaptation and Mitigation in Europe CC-TAME. (FP7, No.212535, www.cctame.eu), *Coordinator*.

ClimateCost - Full Costs of Climate Change: ClimateCost. (FP7, No.212774, http://www.climatecost.cc/ClimateCost/Welcome.html), *Partner*.

PASHMINA - Paradigm shifts modeling and innovative approaches (FP7, No.244766, http://www.pashmina-project.eu/), *Partner*.

SHORT PROFILE OF KEY STAFF

Michael Obersteiner, Economist, senior expert in global forest modelling, spatial global modelling of socioeconomic systems, energy risk management and climate policy analysis. He has been principle investigator of a number of large-scale projects including EU funded projects both in FP6 and FP7.

Petr Havlík, Economist, expert in mathematical modelling of agricultural and forestry sectors. His experience reaches from farm-level to global economic models.

Sylvain Leduc, Expert in energy modelling, scenario analysis and programming. He has developed the BEWHERE model that will be used and further developed in this project.

Sabine Fuss, Economist, expert on uncertainty analysis, risk assessment and energy planning. She will contribute to extending the deterministic analysis to take into account uncertainty.

Partner 4: Potsdam-Institut für Klimafolgenforschung (PIK)

BRIEF DESCRIPTION OF THE ORGANISATION

The **Potsdam-Institut für Klimafolgenforschung** (PIK), founded in 1992, is a government-funded research institute addressing crucial scientific questions in the fields of global change, climate impacts and sustainable development. It is a member of the Leibniz Association, whose institutions perform research on subjects of high relevance to society. PIK currently has around 250 employees and in 2008 its core funding from the federal and state governments amounted to approx. 8 Mio€. Additional project funds come from external agencies.

At PIK researchers in the natural and social sciences work together to study global change and its impacts on ecological, economic and social systems and to devise general strategies for a sustainable development of humankind and nature. Through data analysis, computer simulations and models, PIK provides decision makers with sound information about climate change and novel concepts for sustainable development. In addition to publishing results in scientific journals, the Institute advises regional, national and global organisations and authorities. PIK plays an active and often leading role in activities such as the International Geosphere-Biosphere Programme (IGBP), the Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment (MA).

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: PIK leads the model impact scenario development in WP4, participates in the model calibration in WP3, participates in WP5 and in the optimisation under uncertainty in WP6.

Previous relevant experience: several projects at PIK deal with climate modelling and integrated assessment of mitigation policies. A selection of recent EU research projects with PIK participation is: ClimateCost – Full Costs of Climate Change; ENSURE – *Enhancing resilience of communities and territories facing natural & na-tech hazards* (FP7); ADAM – *Adaptation And Mitigation Strategies: supporting European climate policy* (FP6); ALARM – *Assessing Large-scale environmental Risks with tested Methods* (FP6); CIRCE – *Climate Change and Impact Research: the Mediterranean Environment* (FP6); ENSEMBLE – http://ensembles-eu.metoffice.com/*Ensemble-based Predictions of Climate Changes and their Impacts* (FP6); GEOBENE – *Global Earth Observation - Benefit Estimation: Now, Next and Emerging* (FP6); ATEAM – *Advanced Terrestrial Ecosystem Analysis and Modelling* (FP5).

SHORT PROFILE OF KEY STAFF

Dr. Alexander Popp, ecologist, is leading a research group on land use management. He is working on potential and limitation of bioenergy, avoided deforestation in tropical countries for mitigation, vulnerability of the agricultural sector to climate and land use change, mitigation in the agricultural sector and climate policy as a component of sustainable poverty reduction.

Dr. Franziska Piontek, PhD in Physics, is a researcher in the group on macro-economic modeling at PIK. She is focusing on modeling of climate change economics and societal impacts of climate change. Her

research interests also cover aspects of climate change impacts on security.

Dr. Elmar Kriegler, PhD in Physics, is vice chair of the Research Domain Sustainable Solutions at the Potsdam Institute for Climate Impact Research. His research focuses on the assessment of climate change mitigation policies under uncertainty about technological and climate systems properties. He is a member of the Scientific Steering Committees of the Integrated Assessment Modeling Consortium and the EMF24 Project on mitigation technologies. He is a lead author of the IPCC.

Partner 5: University of Gothenburg (UGOT)

BRIEF DESCRIPTION OF THE ORGANISATION

The major fields of research at the department of economics of the **University of Gothenburg** (UGOT) are currently Behavioral Economics, Econometrics, Environmental Economics, Development Economics and Industrial Economics. The department includes at present 12 professors and some 30 assistant and associate professors. It hosts the Enviromental Economics Unit at the Department of Economics, lead by Prof. Thomas Sterner, which is one of the leading research groups in environmental economics in Europe, particularly with regards to development and behavioural aspects of environmental economics. In a 2008 Mistra report, EEU was ranked among the strongest strategic environmental research groups in Sweden. EEU has recently increased its strength by intensifying its collaboration with 2009 Nobel laureate Elinor Ostrom and her group at Indiana University and the research fellows at Resources for the Future, Washington DC. The EEU is also part of the Centre for Globalization and Development, one of eight strategic research centres at UGOT. With support from Sida, EEU coordinates several organisations for research outreach: a) the Environment for Development network of centres in developing countries (EfD, and Sida Helpdesk. Much of the EEU research concerns climate, transport, industry and natural resource management. The EEU unit at the department has for a long period collaborated interdisciplinary with Physical Resource Theory at Chalmers University of Technology and Prof Christian Azar, Dr Martin Persson and Dr Daniel Johansson at, a leading research group on climate change.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: The Department of Economics will lead WP6 (WP leader Magnus Hennlock), which involves Prof Thomas Sterner (GOT), Prof. Olof Johansson-Stenman (UGOT), Prof Christian Gollier (FOND JJLTS) who is a leading profile in research on risk and uncertainty as well discounting and Simon Dietz (LSE), co-writer of the Stern Review, as well as other modellers in the other WPs who operate the models to be used in the project. Together with them we will integrate new ideas on discounting and ambiguity. Gollier has published several papers on the time profile of long run discounting under uncertainty and is will in this project work together with Johansson-Stenman and Sterner on the importance of habit formation for discounting.

Previous relevant experience: Earlier research by Hoel and Sterner (2007) and Sterner and Persson (2008) has shown that taking changing relative prices of ecosystem services into account in the DICE model can have similar effects as lowering the discount rate: climate damages become larger. Preliminary work suggests that this research may also imply a higher valuation of climate damages and risks. We now want to test this and several new ideas on the IAMs used in other Working packages of this research program.

Hennlock (2008, 2009) has worked on introducing deeper uncertainty in climate modelling in integrated assessment dynamic programming models. He has also been working with analytical solutions for integrated assessment models (IAMs) for implementing game-theoretic approaches in IAMs in non-cooperative as well as cooperative studies.

SHORT PROFILE OF KEY STAFF

Thomas Sterner: Professor in Environmental Economics with particular interest in issues of the design of environmental policy instruments. Has earlier worked on climate change and discounting. Also president of the European Association of Environmental and resource economics during 2008-9 and Past-President 2010-11.

Olof Johansson-Stenman: Professor of Economics with particular interest in behavioural economics, public economics and environmental economics. Recent work includes both empirical and theoretical issues related to relative income concerns as well as risk attitudes.

Magnus Hennlock: Clipore scholar 2007-2011 who defended a thesis 2006 on game theoretic approaches

in dynamic programming in natural resource models. He has been working in aversion to risk and ambiguity in dynamic programming models with closed-loop solutions and game-theoretic approaches to analytical integrated assessment models.

Partner 6: Charles University in Prague, Environment Center (CUNI)

BRIEF DESCRIPTION OF THE ORGANISATION

Charles University in Prague, the oldest university in central Europe, was founded on 7 April 1348 by Charles IV, then Holy Roman Emperor and King of Bohemia. The Charles University Environment Center, as a part of the Charles University, was founded in 1992. The Center conducts environmental research; provides environmental expertise and information for students, the staff of the University and for general public, keeps close contact with work of international bodies, OECD and EEA in particular, and actively collaborates with the Czech parliamentarian bodies and state administration taking part in various working groups, governmental councils and via expert consultations. Except Information Centre that is one part of the Center, it consists of three units where about 20 researchers are employed. The Unit on *Sustainable Development Indicators* focuses on development of appropriate measurement of socioeconomic metabolism and SD indicators via material and energy flow analysis, land use and ecosystem accounting. *Environmental Education* Unit targets links between information, education and concept of sustainable development. The research activities of Unit of *Environmental Economics and Sociology* aim at benefit valuation, particularly of health effects and ecosystems, consumer behaviour and demand analysis of environmentally-related goods, quantification of external costs and analysis of economic, environmental and distributive impacts of (environmental) regulation. Staff from the last unit will be involved in this project.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: CUNI will lead WP2 where values of non-market goods and services affected by climate change and related mitigating policies will be affected. Behaviour of households and economic sectors will be analysed in order to provide some of parameters for IA models especially for CEE region. Distributive impacts will be discussed.

Previous relevant experience: During the years 1997-2001, the Center coordinated the large-scale project of UNDP Project 'Towards Sustainable Development of the Czech Republic: Building National Capacities'. Since 2002, the Center has been involved in conducting research within almost 20 research projects funded by Framework Programmes of the European Commission. Its researchers have been collaborated with the international bodies such as OECD, EEA and EUROSTAT and have been members of expert groups and advisory boards in country's ministries. Valuation of non-market goods and quantification of externalities were targeted in many EU funded projects such as cCASHh, ExternE-Pol, SusTool, CASES, DROPS, EXIOPOL, HEIMTSA, METHODEX, NEEDS, VERHI-Children; household behaviour was analysed in IN-STREAM and many projects funded by the Czech agencies, and climate change related impacts are targeted in ClimateCosts or PASHMINA.

SHORT PROFILE OF KEY STAFF

Milan Scasny, the head of the environmental economics and sociology unit, acquired his PhD in economic theory at Charles University Prague. Before conducting research in the Center, he worked for the Czech Ministry of the Environment, Dept. of Environmental Economics (1997-2000). His research activities cover several areas in the field of environmental economics, *inter alia*, distributional effects of environmental regulation, valuation of non-market goods, and consumer behaviour. He was involved in more than ten research projects funded within the FP's, coordinated implementation of the ExternE method in several CEE and MPC countries, or has been collaborating with OECD on household consumption project (2008-). He leads regular courses on environmental economics at the university.

Vojtěch Maca (PhD in environmental law at Charles University Prague). His research is focused on economic instruments, external costs of transport and alternative fuels, and particularly human health benefit valuation by cost-based methods (cost-of-illness). He has bee dealing with health benefit valuation in the projects ExternE-Pol, NEEDS, DROPS and HEIMTSA. Cost-of-illness for respiratory illness symptoms in adults and children was analyzed in another two projects funded by the Czech authorities.

Jan Melichar (PhD in environmental economics (2007) at the University of Economics in Prague) is particularly concerned in valuation of environmental goods and damages, particularly non-market goods

provided by forest and nature, or human health benefit valuation. He has been also involved in many EC funded projects mostly focused on the external costs assessment by applying the ExternE method in various areas and countries.

Hana Skopkova, (PhD candidate in environmental studies at the Charles University Prague) is a project manager and research assistant at the Center. Her research interest is in household energy savings and renewable energy.

Fusako Tsuchimoto, (PhD candidate in economics at CERGE-EI, expected in 2010) is a researcher fellow at the Center. Her field of interest is Environmental Economics, Law and Economics and Political Economics. Recently, she has been analysing the relationship between environmental and economic performance of sectors and household demand. She has an experience of teaching undergraduate and M.A. level course in the field of Dvlp. Economics.

Jan Urban (PhD candidate in sociology at Charles University Prague). He has been analysing non-market values for health risk including risk perception, biodiversity, recreation and noise through conducting several original surveys since 2004. More recently he has been examining sociological and social-psychological theories on household behaviour and analysing residential energy consumption within the OECD project. He leads regular courses on sociology.

Partner 7: Istituto di Studi per l'Integrazione dei Sistemi (ISIS)

BRIEF DESCRIPTION OF THE ORGANISATION

Istituto di Studi per l'Integrazione dei Sistemi (ISIS) is an Italian private research and consulting firm, active since 1971 at the national and international levels in the areas of information and decision support systems, mathematical modelling and operational research. It has a proven record of successful coordination of EU research projects and studies in both the Transport and Energy sectors. In particular, ISIS co-ordinates the PASHMINA project for the DG RESEARCH, dealing with the identification of long term paradigm shift of changes. Besides, ISIS carried out for the EC, DG TREN the TRANSVisions study, providing European transport scenarios at 2050 and policy measures to address climate change. ISIS has accrued extensive practical experience in the design and development of Decision Support Systems and tools, including e.g. the RECORDIT DSS for the calculation of the full costs of modal and intermodal transport services, the GRACE tool, for the assessment of external costs of transport, and the MURE software for the simulation of energy efficiency policies and investment programmes, including the transport sector.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: ISIS will lead WP1 and will give a contribution to WPs 2, 3, 4 and 5. ISIS' role is to provide an overall framework for the identification and the analysis of the global changes; to coordinate and analyse the definition of global changes scenarios; to use the GRACE tool for the impact assessment of climate change in the transport system.

Previous relevant experience. ISIS is currently involved in the following studies and EC funded research projects relevant for this project: (1) "Technical support for assessing Options for European action to reduce Greenhouse Gas emissions from transport in the period to 2050", study funded by the European Communities – EC, DG ENV, 2009; (2) "Comparative International Review of third country measures to reduce the climate impact of transport", study funded by the European Communities – EC, DG ENV, 2010; (3) WEATHER (2009) "Weather Extremes: Assessment of Impacts on Transport Systems and Hazards for European Regions" EC, DG RESEARCH; (4) PASHMINA (2009) "Paradigm Shifts Modelling and Innovative Approaches", EC, DG RESEARCH; (5) GRACE: "Generalisation of Research on Accounts and Cost Estimation", research project funded by the European Communities – EC, DG TREN, 2008.

SHORT PROFILE OF KEY STAFF

Carlo Sessa is President of ISIS – Institute for System Integration Studies of Rome, and has specialised in the design and development of statistical indicators systems, methodologies and software. Before joining ISIS in 1983, he has conducted research at NYU, where he worked with Nobel Prize winner Wassily Leontieff. He is a consultant to many Italian Public Administration

bodies, both central and local, in the field of Public Services performances and quality. He was Project Coordinator of several national and EU research projects, including TRANSPLUS , ACT-VILL and ESTEEM for DGXII. He was the Italian representative to the COST 332 Action on Land Use and Transport Policies.

Andrea Ricci is Managing Director of ISIS - Institute for System Integration Studies. He coordinates the PASHMINA project on paradigm shift and territorial dynamics in a long term perspective. He co-ordinated by the others the European Research Project **RECORDIT** (2003) – Real Cost Reduction of Door-to-door Intermodal Transport, **BEACON** (2003 – 2005) a Thematic Network: Building Environmental Assessment Consensus on the TEN-T and **NEEDS** (2006-2009) New Energy Externalities Development for Sustainability. His key qualifications are Transport studies and information systems (sustainable mobility, transport pricing, social and environmental costs, quality of transport systems and services, transport modelling) and Government and Corporate Planning (Transportation, Energy, Environment).

Riccardo Enei, graduated in Political Science, has been an ISIS research consultant since 1990. He has specialised in the field of economic research and information systems for data analysis. His professional history includes consulting activity to CNEL (National Council for Economy And Labour) and to the University of Rome in the fields of economic and social research, implementation of studies on urban and regional systems analysis and drawing up of relevant documentation, co-operation with Research Groups of the Italian Ministry of Interiors in the area of local finance with focus on the analysis of treasury transfers to the local entities.

Partner 8: Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science, United Kingdom (LSE)

BRIEF DESCRIPTION OF THE ORGANISATION

The London School of Economics and Political Science (LSE) is the leading social-science institution in the world, with many of the world's foremost experts in their fields, and cutting-edge research.

The Grantham Research Institute on Climate Change and the Environment is the home to climate-change and environment research at LSE. The Institute is chaired by Lord Stern of Brentford, author of the 2006 Stern Review, and brings together international expertise on economics, finance, geography, the environment, international development and political economy to establish a world-leading centre for policy-relevant research and training in climate change and the environment. The Institute has been funded by philanthropists Jeremy and Hannelore Grantham, through their Grantham Foundation for the Protection of the Environment. It works closely with the Grantham Institute at Imperial College London. Within the Institutes sits the Centre for Climate Change Economics and Policy, which is funded by the UK's Economic and Social Research Council (ESRC) and by Munich Re.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

The Grantham Research Institute will participate to WP7, disseminating the outcomes of the project and will contribute to WP6 on uncertainty and risk.

Our contribution to WP6 builds directly on ongoing research at the institute, including the programme 'Developing climate science and economics', which is creating state-of-the-art applications of the economics of uncertainty to climate change, through an interdisciplinary collaboration between climate scientists, decision theorists and economists. WP6 also builds directly on the research of the Stern Review on the Economics of Climate Change, published by the UK Government in 2006. Several former members of the Stern Review now work at the Grantham Research Institute, including Lord Stern himself, as well as Dr Simon Dietz.

In WP7, the institute offers a professional policy and communications operation, lead by Bob Ward, Director of Policy and Communications. The institute hosts public lectures, open to the public and attended by media, business and policy-makers, as well as more specialised research seminars. We publish policy briefs and working papers, and have unprecedented access to contacts in government and the private sector, both in the UK and beyond.

SHORT PROFILE OF KEY STAFF

Dr Simon Dietz is Deputy Director of the Grantham Research Institute. He joined LSE in 2006, having previously worked at the UK Treasury, as a policy analyst on the 'Stern Review on the Economics of Climate Change', where he contributed analysis to key parts of the review, including quantifying the economic cost of climate change. Simon holds a starred first class honours degree in Environmental Science from the University of East Anglia, and Masters and PhD degrees from LSE, specialising in environmental policy and economics. His main research interests are in climate-change economics and policy, equity/social justice issues in environmental policy, and sustainable development.

Partner 9: Graduate Institute of International Studies in Geneva (HEID)

BRIEF DESCRIPTION OF THE ORGANISATION

The Graduate Institute of International and Development Studies (HEID) is an institution of higher education and research dedicated to the cross-cutting disciplines of international relations and development studies. Created in 2007 by a merger between the Graduate Institute of International Studies (HEI) and the Graduate Institute of Development Studies (IUED), it benefits from an expertise and a reputation that go back as far as the 1920s, and the League of Nations, in the case of international relations; and the 1960s, and the post-colonial era and the emergence of the Third World, in the case of development studies. This small and selective Institution owes its reputation to: the quality of its cosmopolitan faculty, the strength of its core disciplines (Economics, History, Law, Political Science and Development Studies), its policy-relevant approach to international affairs, and its bilingual English-French education programmes. It is a private foundation, receiving financial support from the Swiss Confederation and the Canton of Geneva.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: HEID will contribute to WP2 and WP7.

*Previous relevant experience***:** Richard Baldwin has substantial experience of directing and participating in research projects, including the EC-funded PEGGED (Politics and Economics of Global Governance: the European Dimension); and a variety of Swiss-funded projects, including NCCR Trade Regulation (an interdisciplinary project); ProDoc Trade; he is also the Policy Director of CEPR since 2006; founder and Editor-in-Chief of VoxEU.

Tim Swanson has considerable experience of working on EC projects, including: POPP (Analysis of economic instruments in environmental regulation, focusing on the role of eco-labelling in informing consumers, 2008-2010; ExioPol (Analysis of the interaction between biodiversity reserves and agricultural production systems in the EU, 2007-2009); RefGov (Legal and economic analysis of the provision of global public goods, focusing on the problem of indigenous knowledge and its use in R&D in western industries, 2005-2008); and Aquastress (Interdisciplinary analysis of water management problems, focusing on collective action problems in Tunisia and water demand management in Portugal. 2003-2008).

SHORT PROFILE OF KEY STAFF

Richard Edward Baldwin is Professor of International Economics at the Graduate Institute, Geneva since 1991; Policy Director of CEPR since 2006; Editor-in-Chief of Vox since he founded it in June 2007; and an elected Member of the Council of the European Economic Association. He was a Senior Staff Economist for the President's Council of Economic Advisors in the Bush Administration (1990-1991) following Uruguay Round, NAFTA and EAI negotiations as well as numerous US-Japan trade issues including the SII talks and the Semiconductor Agreement renewal. He was Co-managing Editor of the journal Economic Policy from 2000 to 2005, and Programme Director of CEPR's International Trade programme from 1991 to 2001. The author of numerous books and articles, his research interests include international trade, globalisation, regionalism, and European integration; he has worked as consultant for the numerous governments, the European Commission, OECD, World Bank, EFTA, and USAID. He wrote his PhD at MIT under the guidance of Paul Krugman, with whom he has co-author a half dozen articles the most recent of which was published in 2004.

Tim Swanson will be the Andre Hoffman Chair of Environmental Economics at Graduate Institute from Autumn 2010. Until Summer 2010, he was the Chair of Law & Economics in Faculty of Laws with teaching responsibilities in the Department of Economics and the School of Public Policy. He participates in both the Centre for Law and the Environment (Laws) and the Centre for Social and Economic Research on the Global Environment (Economics). He holds a Ph.D. in Economics from the London School of

Economics and the J.D. from Michigan Law School. He was a Lecturer in Law & Economics, University College London, 1987-1991; a Lecturer in Economics, Cambridge University, 1991-1997 and became Professor of Law & Economics at UCL Laws in 1998. He has advised many national and international agencies (UNEP, World Bank, China Council) on issues relating to environmental and technological management and regulation. His current areas of research include intellectual property rights, technological diffusion, and biotechnology management.

Partner 10: Wiener Institut für Internationale Wirtschaftsvergleiche (WIIW)

BRIEF DESCRIPTION OF THE ORGANISATION

The Wiener Institut für Internationale Wirtschaftsvergleiche (WIIW, www.wiiw.ac.at) The Vienna Institute for International Economic Studies (wiiw) is an independent economic research institute. The Institute is financially supported by the Austrian government, the Austrian National Bank, the City of Vienna as well as Austrian and international corporate institutions. Approximately half of its budget comes from research projects, commissioned studies, consultancies and membership fees. With a total number of 38 employees, the institute is one organizational entity. The institute has been engaged in a number of EU framework projects (e.g. EU KLEMS, COMETR, GARNET), projects for the World Bank (GDN) and is currently coordinator of a framework 6 project (MICRO-DYN). Further a number of commissioned studies for the European Commission (DG Regio, DG Employment, DG Enterprise) have been undertaken. The institute is also a member of the FP7 funded GIST project, coordinated through the Johannes Kepler University Linz by Joseph Francois.

The Institute has a strong general expertise in international economics, industrial economics, labor market and regional analysis as well as in macroeconomics. Specific research areas are in the functioning and evaluation of the enlarged European Union, the transformation of Southeast Europe and further enlargements and a strong focus on international economics and global development processes. The institute's research method is based on statistical and empirical evidence, combine with policy modelling. The institute has set up and maintains major statistical databases on various topics on Central, South and Eastern European countries (CEECs) fully in line with Eurostat classifications which allow for comparative analysis across countries, industrial sectors and regions. These databases have been established through the close co-operation with the national statistical offices in the region.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: WIIW will participate to WP3, WP4, WP5.
*Previous relevant experience***.** Over the past two decades researchers in the ITRE Programme have carried out a wide range of studies for the EC. For DG Trade and DG Enterprise, Joseph Francois has recently examined prospective regional trade agreements with Japan, Canada, Korea, ASEA, and India, as well as a prospective WTO agreement. In addition, WIIW plays a leading role in SSH research funded under FP6 and FP7.

SHORT PROFILE OF KEY STAFF

Douglas Nelson is professor of political economy at Tulane University and professor of economics at the University of Nottighamn. He has published extensively in top economics and political science journals on a range of global policy issues ranging from migration and its determinants go the public policy determinants of trade policy. He is a fellow of the GEP at the University of Nottingham, and of the IIDE in Rotterdam.

Miriam Manchin She is assistant professor at University College London and a fellow of the Institute for International and Development Economics. Her research activities cover issues related to international trade, foreign direct investment, mergers and acquisition, and CGE and gravity models.

Partner 11: Centre for Economic Policy Research (CEPR)

BRIEF DESCRIPTION OF THE ORGANISATION

The Centre for Economic Policy Research (CEPR, www.cepr.org) is a registered charity founded in 1983. CEPR is a network of 750 Research Fellows and Affiliates, based in 280 institutions in 30 countries, who collaborate through the Centre in research and its dissemination. CEPR helps them to develop projects,

obtain funding, administer the projects and disseminate their results. The Centre's expertise and services provide an essential infrastructure for research in areas that includes open economy macroeconomics and international trade, with particular emphasis on all aspects of European integration. The Centre's research is organized in seven programme areas - one of which is International Trade and Regional Economics (ITRE). The ITRE Programme has played a leading role for over twenty five years in the analysis of European economic integration and EU trade policy. One of the Centre's first studies of economic integration in Europe was the EC-funded project on 'The External Trade Consequences of 1992'. CEPR offers unique outlets for the dissemination of research and broadened policy impact. For example, CEPR has recently launched Vox, a new on-line, interactive policy journal which provides a platform for the analysis and discussion of key policy issues by leading European economists. The CEPR team includes members from both CEPR and IIDE. They bring with them a valuable range of experience related to the tasks at hand and complement the expertise available in the CEPR network, which offer valuable experience in both quantitative economics and analysis of institutional aspects of issues at the core of this project.

ROLE IN THE PROJECT AND PREVIOUS RELEVANT EXPERIENCE

Role in the project: CEPR will participate in dissemination WP7.
*Previous relevant experience***.** Over the past two decades researchers in the ITRE Programme have carried out a wide range of studies for the EC. For DG Trade and DG Enterprise, Joseph Francois has recently examined prospective regional trade agreements with Japan, Canada, Korea, ASEA, and India, as well as a prospective WTO agreement. Tony Venables, along with a team including Diego Puga (now Co-Director of the ITRE Programme) studied 'Factors Affecting the Location of Activities Within the EU'. For DG Trade, ITRE researchers carried out the 2002 study 'Multinational Corporations and Global Production Networks: The Implications for Trade Policy'. In addition, CEPR plays a leading role in SSH research funded under FP7, through major projects such as 'Globalization, Investment, and Services Trade' (GIST); 'Politics, Economics and Global Governance: The European Dimensions' (PEGGED), 'Transnationality of Migrants: Enduring ties with the home country and integration in the host country' (TOM) and 'Actors, Markets, and Institutions in Developing Countries: A Micro-Empirical Approach' (AMID).

SHORT PROFILE OF KEY STAFF

Joseph Francois (Scientific Coordinator and leader for the CEPR dissemination role) has been a Research Fellow in the ITRE Programme since 1995. He is also professor of economics with the Johannes Kepler Universität Linz, director of the European Trade Study Group, and a board member of the Global Trade Analysis Project (GTAP). He serves on the editorial board of several journals.(www.i4ide.org/francois/). He has written standard reference texts on trade policy modeling, and has led government and international organization modeling teams for NAFTA negotiations, GATT/WTO negotiations, and regional/bilateral negotiations.

Ian Wooton is Professor of Economics, University of Strathclyde. He has received a Phd in Economics from Columbia University. His research focuses on international trade, international factor mobility, foreign direct investment, tax competition and economic geography.

Key persons on the CEPR team offer access to a network of research assistants, graduate students, and post-doc researchers in addition to model and data resources.

B 2.3 Consortium as a whole

The Global-IQ Project will be implemented by a Consortium of **11 Partners** which have been described in the previous section. The Consortium composition ensures the **multi- and inter-disciplinarity of skills** in order to allow the achievement of the project objectives.

The members of the consortium have been selected on the basis of their recognised excellence within the **research fields** touched by the Global-IQ project as well as for their proven capability and commitment to research within a policy goal-oriented framework.

The choice of FEEM as **Deputy Coordinator** which will support the coordination and management activities of FOND JJLTS was due by its **large, proven and successful experience in coordinating and managing European projects** and in leading dissemination and networking activities. In fact, in the last 20 years FEEM has signed an impressive number of research contracts with external researchers and institutions, an internationalisation rate which is unparalleled in Europe: **70% of the contracts involve foreign researchers and research centres**, thus creating an extensive network of scientific co-operation. Conference activities, working papers, policy briefs and books are also evidence of FEEM's research effort.

The Workpackage Leaders (ISIS, CUNI, IIASA, PIK, FEEM, FOND JJLTS, UGOT) have sound scientific background suitable to lead the WP topic and ensure performance and progress of the work package with regard to the deliverables and project milestones. Moreover the WP Leaders have a recognised experience able to involve national and international policy-makers and business leaders, technical experts and representatives of civil society organizations.

The whole Global-IQ Consortium is well balanced in relation to the objectives of the project. In order to ensure (i) the quality of the research, (ii) the dissemination of the project results and (iii) the involvement of the policy-makers, three partner types are represented:

- **Academic Institutions (FOND JJLTS, UGOT, CUNI, LSE, HEID):** the Academic Institutions will guarantee the appropriate implementation of the scientific content of the project, ensuring innovative scientific concepts, frameworks, methods and tools are considered and further developed in Global-IQ. These partners are also well integrated in the local context of operation. This will ensure that the additional knowledge generated through Global-IQ will be widely disseminated in the academic and policy spheres of the interested countries and, at the same time, guarantee that local activities are integrated in Global-IQ work plan.
- **International Recognised Research Centres on Social and Environmental Sciences (FEEM, IIASA, PIK, CEPR, WIIW):** as the Academic Institutions, these partners will guarantee the appropriate design and implementation of the scientific content of the project programme. In particular, they will ensure the integration of the social science and the environmental science components in each workpackage. Research Centres will ensure a wide exploitation and dissemination of the Global-IQ results in the international context.
- **SMEs (ISIS):** the opportunity to involve SMEs has been addressed through the involvement of ISIS, a private research and consulting firm which carries on studies, research projects and consultancy to support the strategic thinking, planning and assessment of integrated policies at international, national and local scales.

Complementarities between participants are summarized in Table 2.3.a.

Table 2.3.a Partners' complementarities

N.	Participant	Key staff	Area of excellence	Geographic Coverage
1	**FOND JJLTS** France	J.P. Amigues (M) H. D'Albis (M) C. Gollier (M) N. Ladoux (M) G.Lafforgue (M) M. Moreaux (M) C.Nauges (F) N. Treich (M)	▪ Eco climatic macro models ▪ Risk and uncertainty analysis ▪ Cost-benefit analysis ▪ Climate change regulation ▪ Electricity regulation ▪ Renewable energy and bio fuels ▪ Demography and population ▪ Water demands ▪ Redistributive issues	▪ World large scale analysis for climate change and bio fuels ▪ France and UE for sectoral approaches ▪ US and EU comparisons
2	**FEEM** Italy	E.Massetti (M) V. Bosetti (F) C. Carraro (M) F. Bosello (M)	▪ IAM modelling; ▪ WITCH: optimal growth-ramsey type, intertemporal, game-theoretic, energy sector investments, endogenous technical change, mitigation-adaptation; ▪ ICES, dynamic CGE, multisectoral, large national detail.	▪ Italy ▪ Mediterranean region
3	**IIASA** Austria	M.Obersteiner (M) P. Havlik (M) S.Leduc (M) S.Fuss (F)	▪ FOR: forest sector modelling, regional greenhouse gas budgeting, integrated modelling of global land use change ▪ GLOBIOM: global recursive dynamic partial equilibrium model integrating agricultural, bioenergy & forestry sectors, land use competition ▪ G4M: spatially explicit, annual above ground wood increment & harvesting costs, above ground forest biomass, decision of afforestation or deforestation ▪ BEWHERE: optimal spatial distribution & size of bio-energy plants, pulp & paper mills and sawmills given biomass & demand distribution and international trade, economies of scale & scope under poly-production, residual heat, infrastructure costs, heat demand regarding housing infrastructure, trade with other countries; expertise on stochastic optimization, real options analysis, portfolio optimization, risk assessment, etc.	▪ EU ▪ Global

4	**PIK** Germany	Alexander Popp (M) Franziska Piontek (F) Elmar Kriegler (M)	▪ IAM modelling; ▪ REMIND: optimal growth-ramsey type, intertemporal, energy sector investments, endogenous technical change, trade, ▪ *LPJ-MAgPIE: dynamic vegetation model; agro economics	▪ Europe ▪ Global
5	**UGOT** Sweden	M. Hennlock (M) T. Sterner (M) O. Johansson-Stenman (M)	▪ Policy analysis ▪ Discounting ▪ Relative pricing in multisectors ▪ Behavioural economics ▪ Differential game theory ▪ Closed loop solutions in IAM ▪ Valuation of impacts ▪ Microeconomic foundation in modelling	▪ Sweden, ▪ Scandinavia
6	**CUNI** Czech Republic	M. Ščasný (M) V. Maca (M) J. Melichar (M) Skopkpova (F) F. Tsuchimoto (F) J. Urban (M)	▪ Non-market valuation (health impacts, land use) ▪ Risk perception and valuation ▪ Household behaviour and demand ▪ ETR policy	▪ Czech Republic ▪ CEE
7	**ISIS** Italy	C. Sessa (M) A. Ricci (M) R. Enei (M)	▪ Assessment of transport and energy external costs ▪ Long term socio-economic scenarios	▪ Europe
8	**LSE** UK	S. Dietz (M)	▪ Economics of climate change, including public economics and welfare economics ▪ Decision analysis and decision theory	▪ UK
9	**HEID** Switzerland	R. Baldwin (M) T. Swanson (M)	▪ Globalization ▪ Environmental law ▪ Environmental economics ▪ Multilateral diplomacy and international negotiation ▪ Regional integration ▪ Trade policies and law - WTO ▪ Europe Western and Central ▪ International Trade ▪ Regional Integration ▪ European Integration	▪ International ▪ Switzerland

10	**WIIW** Austria	M. Manchin (F) D. Nelson (M)	▪ Multi-region CGE modelling (ICE model) with GTAP type data ▪ Global economic policy scenario analysis (trade, migration, investment) ▪ Economics of service sector integration ▪ Economics of migration ▪ Globalization and labour market conditions ▪ Globalization and inequality ▪ Econometric estimation of CGE structural parameters ▪ Regional economic trends (Asia, Europe, Americas) ▪ Projection based CGE modelling (growth and trade interactions)	▪ Europe ▪ USA ▪ Asia
11	**CEPR** UK	J. Francois (M) I. Wooton (M)	▪ Research dissemination ▪ Globalization ▪ Trade policies and law ▪ International trade ▪ Regional Multi-region CGE modelling (ICE model) with GTAP type data ▪ Global economic policy scenario analysis (trade, migration, investment) ▪ Economics of service sector integration ▪ Economics of migration ▪ Globalization and labour market conditions ▪ Globalization and inequality ▪ Econometric estimation of CGE structural parameters ▪ Regional economic trends (Asia, Europe, Americas) ▪ Projection based CGE modelling (growth and trade interactions)	▪ Europe ▪ USA ▪ Asia

Eleven participants (FOND JJLTS, FEEM, IIASA, PIK, UGOT, CUNI, ISIS, LSE, HEID, WIIW, CEPR,) are established **in seven European Members States** (France, Italy, Austria, Germany, Sweden, Czech Republic, UK) and **one Associated Country** (Switzerland). The geographical spread and the different background of the **11 Participants** of Global-IQ Project contribute to the scientific exellence of the project activities and are relevant for increasing the impacts of the project results.

B 2.3.1 Subcontracting

In GLOBAL-IQ project some tasks will be performed by subcontractors. These tasks are not "core" parts of the project work, just minor ones and carried out in line with the FP7 Financial Guide. The partners possess the expertise and skills to guide the proposed research, and remain responsible for all their rights and obligations, including the tasks carried out by the subcontractors.

The partners will ensure that the intellectual property, generated by subcontractors, will be reverted to the Consortium in order to achieve the project results.

The partners will ensure transparent bidding procedures in the selection and recruitment of the subcontracts. The procedures will ensure conditions of best price-quality ratio, transparency and equal treatment, as requested in the EC FP7 Financial Guide, both in case the identity of the subcontractor is already indicated or not yet. The procedure will depend on the legal status of each partner and will be proportionate to the size of the subcontract.

In particular, two kinds of subcontract are foreseen within GLOBAL-IQ project:

- Partner HEID will recruit a subcontractor for data collection via survey to elicit values for ancillary effects of GHG abatement in China. Estimated cost is 10.000 Euro.
- Partner CUNI will recruit a subcontractor for a survey to elicit barriers to adopt renewable energy by households in EU countries. Estimated cost is 18,000 Euro.
- The website realisation will be subcontract by the Fondation Jean-Jacques Laffont / TSE – Estimated cost: 12.000 euros.

B 2.3.2 Third parties

The following third party are linked to Fondation Jean-Jacques Laffont / TSE

- GIE Economie Industrielle – PIC Number: 954044471

The GIE Economie Industrielle will help the Fondation Jean-Jacques Laffont for the management and coordination of Global IQ project.

B 2.3.3 Funding for beneficiaries from "third" countries

In Global-IQ Project all the participants requesting EU funding are based in European Members States or Associated Countries (France, Italy, Austria, Germany, Sweden, Czech Republic, UK, and Switzerland).

B 2.3.4 Additional beneficiaries/Competitive calls

There are not any as-yet unidentified participants.

B 2.4 Resources to be committed

The Glob-IQ project involves 11 institutions and covers a time frame of 36 months. The **overall cost** of this project is estimated at **3.462.030 Euro**. The total **EC grant** requested amounts to **2.698.155 Euro**.

The Global-IQ financial plan is split into RTD Activities (88%), Management Activities (5%) and Other Activities (7%) and a more detailed breakdown of costs is summarised in the following tables.

Table 2.4.a: Overall financial plan (A.3.2 Form)

Participant number	Organisation Short Name	Organisation country	Estimated budget (whole duration of the project)					Requested EC Contribution
			RTD	Demonstration	Management	Other	Total	
1	FOND JJLTS	FR	259 200	-	63 200	94 400	416 800	352 000
2	FEEM	IT	518 400	-	51 400	22 400	592 200	462 600
3	IIASA	AT	530 100	-	6 550	-	536 650	404 125
4	PIK	DE	521 840	-	6 000	-	527 840	397 380
5	UGOT	SE	174 400	-	6 400	-	180 800	137 200
6	CUNI	CZ	198 800	-	6 400	-	205 200	155 500
7	ISIS	IT	213 958	-	4 982	-	218 940	165 450
8	LSE	UK	78 400	-	1 600	79 200	159 200	139 600
9	HEID	CH	125 200	-	1 600	19 200	146 000	114 700
10	WIIW	AT	435 200	-	1 600	-	436 800	328 000
11	CEPR	UK	3 200	-	-	39 200	42 400	41 600
		Total	**3 058 698**	**-**	**149 732**	**254 400**	**3 462 830**	**2 698 155**
		% Total	**88%**	**0%**	**4%**	**7%**	**100%**	**78%**

Tables 2.4.b: Breakdown of eligible costs within RTD, MGT and OTHER Activities

Participants		RTD										
		Personnel	Sub-contracts	Other direct costs				Indirect costs		Total	%	Max EC Contribution
				Travels	*Events*	*Other*	TOTAL					
1	FOND JJLTS	126 000	0	*15 000*	*15 000*	*6 000*	36 000	60%	97 200	259 200	75%	194 400
	GIE (3rd party)	0	0	*0*	*0*	*0*	0	20%	0	0	75%	0
	TOTAL	126 000	0	15 000	15 000	6 000	36 000	60%	97 200	259 200	75%	194 400
2	FEEM	294 000	0	*22 000*	*4 000*	*4 000*	30 000	60%	194 400	518 400	75%	388 800
3	IIASA	312 000	0	*22 000*	*4 000*	*4 000*	30 000	55%	188 100	530 100	75%	397 575
4	PIK	265 000	0	*22 000*	*4 000*	*4 000*	30 000	86%	226 840	521 840	75%	391 380
5	UGOT	90 000	0	*11 000*	*4 000*	*4 000*	19 000	60%	65 400	174 400	75%	130 800
6	CUNI	94 500	18 000	*10 500*	*4 000*	*4 000*	18 500	60%	67 800	198 800	75%	149 100
7	ISIS	153 285	0	*10 500*	*4 000*	*4 000*	18 500	25%	42 173	213 958	75%	160 468
8	LSE	35 000	0	*8 000*	*2 000*	*4 000*	14 000	60%	29 400	78 400	75%	58 800
9	HEID	54 000	10 000	*14 000*	*0*	*4 000*	18 000	60%	43 200	125 200	75%	93 900
10	WIIW	252 000	0	*16 000*	*0*	*4 000*	20 000	60%	163 200	435 200	75%	326 400
11	CEPR	0	0	*2 000*	*0*	*0*	2 000	60%	1 200	3 200	75%	2 400
Total		**1 801 785**	**28 000**	***168 000***	***56 000***	***48 000***	**272 000**		**1 216 113**	**3 317 898**		**2 488 423**

Participants		MANAGEMENT									
		Personnel	Sub-contracts	Other direct costs				Indirect costs	Total	%	Max EC Contribution
				Travels	*Events*	*Other*	TOTAL				
1	FOND JJLTS	0	0	*4 000*	*4 000*	*0*	8 000	4 800	12 800	100%	12 800
	GIE (3rd party)	42 000	0	*0*	*0*	*0*	0	8 400	50 400	100%	50 400
	TOTAL	42 000	0	4 000	4 000	0	8 000	13 200	63 200	100%	63 200
2	FEEM	28 000	5 000	*1 000*	*0*	*0*	1 000	17 400	51 400	100%	51 400
3	IIASA	0	5 000	*1 000*	*0*	*0*	1 000	550	6 550	100%	6 550
4	PIK	0	5 000	*1 000*	*0*	*0*	1 000	0	6 000	100%	6 000
5	UGOT	0	0	*1 000*	*3 000*	*0*	4 000	2 400	6 400	100%	6 400
6	CUNI	0	0	*1 000*	*3 000*	*0*	4 000	2 400	6 400	100%	6 400
7	ISIS	0	0	*1 000*	*3 000*	*0*	4 000	982	4 982	100%	4 982
8	LSE	0	0	*1 000*	*0*	*0*	1 000	600	1 600	100%	1 600
9	HEID	0	0	*1 000*	*0*	*0*	1 000	600	1 600	100%	1 600
10	WIIW	0	0	*1 000*	*0*	*0*	1 000	600	1 600	100%	1 600
11	CEPR	0	0	*0*	*0*	*0*	0	0	0	100%	0
Total		**112 000**	**15 000**	***17 000***	***17 000***	***0***	**34 000**	**51 932**	**212 932**		**212 932**

Participants		OTHER									
		Personnel	Sub-contracts	Other direct costs				Indirect costs	Total	%	Max EC Contribution
				Travels	*Events*	*Other*	TOTAL				
1	FOND JJLTS	0	12 000	*0*	*18 000*	*12 500*	30 500	18 300	60 800	100%	60 800
	GIE (3rd party)	28 000	0	*0*	*0*	*0*	0	5 600	33 600	100%	33 600
	TOTAL	28 000	12 000	0	18 000	12 500	30 500	23 900	94 400	100%	94 400
2	FEEM	14 000	0	*0*	*0*	*0*	0	8 400	22 400	100%	22 400
3	IIASA	0	0	*0*	*0*	*0*	0	0	0	100%	0
4	PIK	0	0	*0*	*0*	*0*	0	0	0	100%	0
5	UGOT	0	0	*0*	*0*	*0*	0	0	0	100%	0
6	CUNI	0	0	*0*	*0*	*0*	0	0	0	100%	0
7	ISIS	0	0	*0*	*0*	*0*	0	0	0	100%	0
8	LSE	24 500	0	*0*	*25 000*	*0*	25 000	29 700	79 200	100%	79 200
9	HEID	12 000	0	*0*	*0*	*0*	0	7 200	19 200	100%	19 200
10	WIIW	0	0	*0*	*0*	*0*	0	0	0	100%	0
11	CEPR	24 500	0	*0*	*0*	*0*	0	14 700	39 200	100%	39 200
Total		**131 000**	**24 000**	***0***	***61 000***	***25 000***	**86 000**	**107 800**	**348 800**		**348 800**

The EC Contribution is devoted to cover 75% of the RTD costs and 100% of the MGT and OTHER costs. In the following a short desctiption of the project costs is provided.

Personnel

The personnel costs represent an effort of **279.75 person/months** distributed per the 11 Participants. In details:

RTD: **254.75** person/months are allocated to carry out the research activities planned in WPs 1-6;

MGT: **10** person/months for the management of the project as described in WP8;

OTH: **15** person/months for carrying out the dissemination and training activities foreseen in WP7.

Subcontracts

RTD: CUNI and HEID will recruit two subcontractors for carrying out surveys within WP2. Estimated costs for both surveys are 28.000 Euro.

MGT: audit costs for obtaining the certificates on the financial statements for the partners, whose EC contribution is higher than 375.000 Euro (FEEM, IIASA, PIK).

OTHER: realisation of the website, estimated cost 12.000 euros (FOND JJLTS)

Other Direct Costs

Travel costs

RTD: Travel costs are requested for attending the 4 internal project meetings, the WPs internal meetings and the final conference. The allocation of the travel budget has been made considering the role of each partner and in order to ensure the resource for the participation of at least one representative per partner. For HEID has been allocated an extra budget (6.000 Euro) to cover travels to China as foreseen in WP2.

MGT: A budget of 1.000 Euro per partner (except for CESR, who has not RTD persons/monts) is foreseen to cover the travel expenses of the administrative staff to the Kick-off Meeting. Moreover, to the coordinator FOND JJLTS is allocated 3.000 Euro for its participation to EC Project Review and 1.000 Euro to cover bilateral meeting with the FEEM.

Events costs

RTD: FOND JJLTS will menage the budget for the involvement of the external advisory board during the whole duration of the project (15.000 Euro). To the WP leaders is allocated a small budget (4.000 Euro) for the organisation of the WP internal meetings. Moreover LSE will be in charge to organise the final project meeting the day after the final conference, in order to discuss the follow-up of the project (2.000 Euro).

MGT: the Kick-off Meeting will be organised by FOND JJLTS in Toulouse (4.000 Euro) and the 3 Project Steering Committee will be organised by ISIS in Rome, CUNI in Prague and UGOT in Gothenburg (3.000 Euro).

OTH: LSE will organise the final conference of the project in Brussels in 2014. The conference expenses, foreseen as being rent of premises, meals and refreshments and travel expenses for invited participants.

Final Conferance (1 day) - 80 participants:	
- Conference room	4.000,00
- 2 Coffee Breaks	2.400,00
- 1 Lunch	3.200,00
- 5 Invited Speakers (travel & accomodation)	7.500,00
- 4 EAB (travel & accomodation)	6.000,00
- Consumables/Other costs	1.900,00
	25.000,00

FOND JJLTS will organize 2 workshops (18.000 Euro).

Other costs

RTD: a budget of 4.000 Euro is allocated to each partner (excluded CEPR, who has not RTD persons/months and FOND JJLTS who will have 6.000 Euro) in order to cover some research costs, among others, software, equipment, consumables, bibliography.

OTH: a budget of 12.500 Euro is allocated to FOND JJLTS forcommunication activity, , the preparation of the project brochure, and to cover other costs linking to the publication of the project results.

Indirect costs

The indirect costs are calculated on the basis of the own method of calculating indirect costs of each Participant.

B3. Impact

B 3.1 Strategic impact

Two types of impacts are expected from the project. On the one hand, there will be 'external impacts' associated with the advances in scientific knowledge and contributions to the state-of-the-art in the analysis of global changes and socio-economic impact assessment. In addition, the project will have major impacts through the dissemination of its main policy conclusions and recommendations towards policymakers and the general public. On the other hand, there will be 'internal' impacts inside the consortium. Improved common experience and share of skills of the consortium members will help to build and maintain an established research network at the European level, which is one of the expected impacts listed in the call.

External impacts will build upon the previous activities of the consortium members in the field of global change studies. They will be realized on two grounds:

1. Academic arena through scientific publication processes, participation in international conferences, events organization in direction of the academic community;
2. The arena of public debate, the shaping of the research results in a policy report format allowing for a better appropriation of the social sciences community contributions to the global change analysis by the policymakers and the general public.

These impacts will manifest themselves all along the life of the project in terms of scientific progress beyond the current state-of–the-art and the diffusion of this new knowledge in the public debate. While the IPCC reports have made achievements in popularizing the climate science conclusions about the responsibility of man for the current change of the Earth's climate, for example, the social sciences' contributions to the global change debate remain much less well known than the work of climate sciences. One important exception is the Stern Review. This is also true for other areas of global change such as the exploitation of natural resources, pressures on energy sources and changes in land use in the face of growing populations and changes in food diets, etc. One expected external impact of the project is hence to fill this knowledge gap between academic research and the public. In other words, the science-policy interface needs to be enhanced and the communication of results and insights need to be facilitated. The practical way to reach this objective is detailed in the dissemination section below.

The variety and complexity of global change issues in the socio-economic domain exclude the possibility that a single team may be able to cover all the relevant aspects of the problem. A realistic approach thus makes it necessary to join specialized forces from different research groups in order to exploit synergies from interdisciplinary work. In this respect, European scholars in social sciences have succeeded in gaining some audience in the global change field, as illustrated by the international impact of the Stern Review, but much remains to be done in this direction. Several members of the consortium have worked in the area for years and the different consortium members enjoy an international reputation in dealing with global change issues. This explains why using their own dissemination systems (web sites, conferences), they can expect to attain a large visibility relatively quickly with respect to both the projected research and its main conclusions.

Even if some members of the consortium have well-established skills in regional global change studies (FEEM for the Mediterranean area, for example), the scope and topic of the project are definitively international, requiring not only a national, but also a European, macro-regional and even global scale of operation. This is especially important in the socio-

economic impact areas of trade issues, migration, but also agricultural markets. For example, global changes might affect different countries asymmetrically and the costs of the ensuing socio-economic impacts will then also be distributed unevenly across countries or regions. Policies need to be assessed in the context of all these interactions and also at different scales. Through their own scientific networks, the consortium members have access to all the relevant research conducted in their field of interest at the national and international levels. It should be noticed that several members of the consortium are also involved in research projects with non-European research centres. After years of setback, the new US administration provides considerable support for research about global and especially climate change issues. The result is a fast surge of new projects and also new results emerging from across the Atlantic. The participants of the project follow this evolution closely and are partially involved. They will take into account interesting advances of the international research agenda in their own investigations.

Internal impacts should not be mistaken to be completely inward-focussed, but will also enhance the consortium's ties to the wider research community: by connecting institutions with different research networks (which only partly overlap), new synergies can be exploited and the maintenance of excellence can be ensured beyond the duration of the project horizon. The table below summarizes the impacts by impact category and lists the strategies envisaged for their achievement.

Table 3.1.a. Summary of impacts and relevant strategies

Impact category	Impact	Strategy to realize the envisaged impacts
External (on the research community & contribution to policy)	Improved understanding of global changes	Combining qualitative and quantitative approaches
	Improved estimates of costs (of global changes) in different socio-economic areas	New and improved model developments
	Better understanding of sustainability and the involved trade-offs: policy implications	Consistent and comprehensive socio-economic impact cost estimates; optimization of trade off mitigation-adaptation; assessment of existing policies and recommendation of new policies
	Greater visibility of results	Dissemination strategy involving not only peer-reviewed publications (academic community), but also websites, newsletters, policy briefs, ..
	Higher degree of consensus on the methods for analytical impact assessment	Dissemination and open debate (iterative process) Bringing together tools from different disciplines to bridge gaps in current assessments

	Improved scenarios	Scenarios will be more comprehensive, not only looking at biophysical impacts.
Internal (on the consortium)	Better modelling tools through integration suited for impact and policy assessment	Model integration through soft and hard links and data-exchange and analysis at different scales
	Better confidence in the robustness of models	Advances in the theory of discounting and ambiguity; application of new insights of uncertainty analysis and risk assessment in existing models; sensitivity tests; Monte Carlo Analysis
	Widening of networks in the science and policy domain	Linking up the networks of individual institutes through close collaboration and elaborate dissemination strategy

B 3.2 Plan for the use and dissemination of foreground

3.2.1 Dissemination and/or exploitation of project results

The dissemination and exploitation of project results are a fundamental component of the whole strategy devised by Global-IQ and will take place during the entire project's life. The dissemination activities will be promoted by the Project Coordinator (PC) and all partners will actively collaborate, especially Workpackage Leaders. Specific tasks of WP7 are dedicated to information, communication and dissemination activities targeting i) the science and policy communities ii) within Europe but also outside Europe.

Global-IQ partners' dissemination tools (Table 3.2 a) will be the starting point of the dissemination plan, which will take advantage of them, in order to achieve the maximum dissemination of the project's results. In particular the partners will use their own national network of contact to inform and disseminate the results from the project. These networks involve academic and policy institutions and medias. Information about the project and links to its web site will be included into the internet sites of the participants. Regular updates from the project advances will also appear on the sites, excerpt from the project site last news.

Table 3.2 a Partners' dissemination tools

FOND JJLTS	**FEEM**
▪ FOND JJLTS web site with a media and press release section (http://www.tse-fr.eu/index.php?lang=en) ▪ FOND JJLTS working papers series ▪ FOND JJLTS policy reports	▪ FEEM Web site, with a media and press release section (http://www.feem.it) ▪ FEEM Working Paper series ▪ Mailing lists with over 10.000 contacts ▪ FEEM Policy Briefs ▪ Two Book Series
IIASA	**PIK**

▪ IIASA Web site (www.iiasa.ac.at) ▪ IIASA Newsletter ▪ IIASA Policy Briefs ▪ IIASA Interim Reports ▪ IIASA Options Magazine	▪ ISI-Publications ▪ PIK policy briefs ▪ Books&special issues from larger projects such as EU project ADAM
UGOT	**CUNI**
▪ EEU/EfD/RFF websites ▪ UGOT Working Paper series ▪ Swedish Research Council´s Mediaservice to channel daily questions from journalists / Clipore Newsletter Website and Policy Briefs ▪ EfD/RFF Discussion Paper series ▪ Efd Monthly newsletter on research	▪ CUEC website (incl. Enwiwiki) ▪ CUEC Working Paper ▪ Supra Solidam Petram seminar series ▪ PhD program on environmental studies ▪ Library TGM
ISIS	**LSE**
▪ ISIS web site (http://isis-it.com) ▪ GRACE tool	▪ Grantham Research Institute website ▪ Mailing list Grantham Research Institute ▪ Policy Briefs ▪ Grantham Research Institute Working Papers ▪ LSE Public Lectures ▪ Climate Change and Environment Seminar Series ▪ Grantham Research Institute Visiting Fellow from government and business
HEID	**WIIW**
▪ Graduate Institute Web site, with a section for the CTEI ▪ CTEI Working Paper series ▪ Graduate Institute Book Series ▪ Mailing lists with over 2.000 contacts	▪ The WIIW Web site (www.wiiw.ac.at) ▪ The WIIW working paper series ▪ The WIIW publications series ▪ WIIW public lectures and workshops
CEPR	
▪ CEPR web site (www.cepr.org) ▪ CEPR Discussion Paper Series ▪ VoxEU website (on-line, interactive policy journal with 50,000 visitors daily)	

Dissemination activities and exploitation of the results of the project will be implemented through well targeted mechanisms.

An **interactive web site** is established as a major and official information channel. It provides clear and concise information on Global-IQ activities, including: partnership, work plan and outline of work packages, schedule of meetings, their participants and proceedings, main publications, links to other interesting web sites, contact details, and so forth. The web site aims to provide partners with a dynamic working tool that overcomes geographical distances. It also represents the main "business card" of the project to the outer world (stakeholders, research community, civil society, etc.).

A different set of e-facilities are foreseen. The web site is envisaged to host an **intranet**, i.e. an internal working e-space dedicated to intra-partnership communication. The timely and efficient flow of information between partners is essential to ensure an efficient implementation of the project activities. Intranet enables partners located in different countries to interact through a different set of web facilities. To this end, **e-fora** will be launched periodically to spur partners on communicating regularly in a spirit of free, creative and constructive dialogue. The provision of an interactive web page and e-correspondence allows saving on travel costs, because it makes meetings among the partners less necessary. The intranet service is mainly directed at the following activities:

- Circulation of preliminary, preparatory and internal work (both at scientific and administrative levels)
- On-line exchanges of information and documents
- Fora for internal debate (refinement of the work plan, revision of tasks, etc.)

The web site is also aimed to **disseminate information on Global-IQ activities to the outer world**, with a view to favour collaboration (so as to possibly develop follow-up initiatives and to explore ways to self-sustain the project beyond its duration) and an increasingly concerted approach between the Consortium, the EU and other interest parties both within and outside Europe. In this respect the web site acts as an informative tool covering:

- Brief and clear information on the project (funding scheme, objectives and work plan, partnership, objectives, time schedules of meetings and workshops)
- Outline of project activities and results, main publications (in user-friendly formats)
- Useful documentation, links and references in .pdf files

The design of the web site builds upon the following criteria: i) *visual communication* (possible use of colours and/or photos, web pages are easy to browse, information is kept short and links are included to web sites, publications, and so forth); ii) *Verbal communication* (the web site uses simple phrasing, no jargon is used to attract the widest audience possible, e-devices are user friendly). The new EU guidelines for FP7 projects web sites will be thoroughly used in the web site design. In particular a specific link will be added for access to data bases used during the project.

A dedicated section for the media will be visible and easily accessible; this will be regularly up-dated with simplified contents, in order to facilitate the journalists to reach swiftly the information and to stimulate the debate around the project. Brief articles will be made available from the project web site, drawing attention to the potential value of the project in popular and specialised media.

To complement the web site, **electronic mailing lists will be** established to ensure prompt communication between the Global-IQ partners on all scientific and administrative issues and beween the partners and the outside scientific and policy communities.

- A first e-mailing list will be organised for all intra-consortium information sharing and communication. Confidential communication remains restricted to the consortium. Telephone, fax devices and/or video conferences are other valid instruments of communication among participants.
- It is proposed to develop an external **e-Newsletter** that will target other scientific organisations and interested parties/stakeholders/policy makers including EU officials with an interest in being updated on Global-IQ's activities. This external e-Newsletter will be produced annually.

Also, a basic **project presentation** both in word (brochure) and power point will be prepared at the beginning of the project to enhance the visibility of the project. This will be regularly updated during the project implementation and will be the basis of the presentation made by the Consortium partners at the various external events.

Overall, **publication activities** will be actively pursued in specialised journals and newspapers. First preliminary versions of the research papers will be disseminated through the working paper series of FEEM posted on the FEEM web site (where they are downloadable free of charge). The series is currently included in the Economics Research Institutes Paper Series of SSRN, RePEc and in Econlit. Links to the working papers will be posted on the public section of the project web site. **Working papers** will be meant as intermediate outputs and their aim is precisely to stimulate the debate and to encourage broader understanding and discussion/debate on the themes. **Policy briefs** and **recommendations** will be addressed to the policy makers. We plan about four policy briefs to be written during the project. **Publications in local, national and international press and in peer-reviewed journals (Special Issue)** will also be actively sought to inform both the public at large and the scientific audience of the results of the Global-IQ studies.

In addition, all partners will be actively involved in **networking activities** so research activities and results are widely shared.

In addition, all partners will actively inform their own national and international policy networks about the outcomes of Global-IQ by specific briefings of policy officers, bringing in Global-IQ ideas in discussions and specific presentations in relevant meetings.

Finally, the **Final Conference** represents a clear means of dissemination of Global-IQ results to the outer public. Its main aim will be to raise public awareness on the research field covered by Global-IQ, to bring interested parties at different levels closer to EU research and to give account of how public money is spent and to foster research in the European Research Area. The final conference will also provide the opportunity to share preliminary ideas on research gaps that remain to be filled as a follow-up to the Global-IQ research activities. These conclusions will be used inside a final policy report which, together with the editing of the final report, composes the main piece of the post project dissemination plan. The policy report will put in perspective the results from the project with the current trends of the EU policies for energy, transportation, agriculture and climate change management in particular.

The following table summarises the different dissemination mechanisms that will be developed under the Global-IQ research projects, along with their main targeted audience.

Table 3.2 b Tools and measurement of success of the dissemination activities

Targeted public	Mechanisms/tools	Measurements of success
Academic and Scientific community	- Web site - Working Papers - Publications in peer-reviewed journals - Final Conference	- Counting visitors - N. of publications - N. of participants from the academic and scientific community at project events
Policy makers	- Web site - Project presentation - E-Newsletters - Review Workshops - Final Conference - Policy Brief and Recommendations	- Counting visitors - N. of download of the project presentation - E-Newsletter Mailing lists - N. of policy maker involved and interested in the project events - N. of Policy Brief
General public	- Web site - Project presentation - Articles in local, national and international press - Final Conference	- Counting visitors and downloads - N. of download of the project presentation - N. of articles in the press - N. of participants from Media at project events
Global-IQ partners	- Intranet - E-fora - Internal Newsletters - Project Steering Committee meetings - Video/tele conferences	- N. of download of the project documents - N. of internal and virtual meetings - N. of participants at internal project meetings

Together with this general dissemination strategy we plan more targeted actions for policy makers at the EU or the national level: meetings, seminars for results presentations. On of the project objective is to favour the emergence of a European research network about global change economics. Dissemination through seminars in direction of the European academic communities will concur to this objective.

3.2.2 Management of intellectual property

A considerable amount of “background knowledge” will be brought into the project by the consortium members, thanks to their extensive and active involvement in the relevant areas of investigation over the past decades. More importantly, the project collects abundant and varied information, in terms of methods, tools, models and datasets. The general attitude of the Consortium is to widely share such knowledge, with as few limitations as possible in terms of access to the results. In fact, the dissemination activities carried out in Global-IQ aim precisely at ensuring the maximum level of diffusion (publication, workshops, web sites, mailing lists).

The aim of the Intellectual Property Rights (IPR) management is to decrease the shortage up to the exploitation phase, in order to be able to transfer all the required right to the project partner who asked for it.

In Global-IQ Project the IPR rules will be defined in the Consortium Agreement and in particular there will be regulated i) the granting of access rights and ii) the dissemination and use of knowledge.

The following basic principles are taken into consideration:

- The background (i.e. the information and rights held prior to accession to the grant agreement) brought into the project remains the property of the partner that has generated it;
- The foreground (i.e. the results of the project activities) generated under the project is owned by the partner who has carried out the work leading to that foreground. When several partners have jointly carried out the work and their respective share of work can not be ascertained, they shall have joint ownership of such foreground, and a "joint ownership agreement" may be drawn up for this purpose (the default regime is applied if no "joint ownership agreement" is signed).

Knowledge management and intellectual property rights are addressed in full compliance with the rules identified by the 7th Framework Programme of the European Commission for Research, Technological Development and Demonstration Activities (2007-2013), including Regulation (EC) No.1906/2006 of the European Parliament and of the Council of 18th December 2006, laying down the "rules for the participation of undertakings, research centres and universities in actions under the Seventh Framework Programme and for the dissemination of research results (2007-2013)".

B4. Ethical issues

Table 4.1 : Ethical Issues Table

	Research on Human Embryo/ Foetus	YES	Page
*	Does the proposed research involve human Embryos?		
*	Does the proposed research involve human Foetal Tissues/ Cells?		
*	Does the proposed research involve human Embryonic Stem Cells (hESCs)?		
*	Does the proposed research on human Embryonic Stem Cells involve cells in culture?		
*	Does the proposed research on Human Embryonic Stem Cells involve the derivation of cells from Embryos?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Humans	YES	Page
*	Does the proposed research involve children?		
*	Does the proposed research involve patients?		
*	Does the proposed research involve persons not able to give consent?		
*	Does the proposed research involve adult healthy volunteers?		
	Does the proposed research involve Human genetic material?		
	Does the proposed research involve Human biological samples?		
	Does the proposed research involve Human data collection?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Privacy	YES	Page
	Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?		
	Does the proposed research involve tracking the location or observation of people?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Animals	YES	Page
	Does the proposed research involve research on animals?		
	Are those animals transgenic small laboratory animals?		
	Are those animals transgenic farm animals?		
*	Are those animals non-human primates?		
	Are those animals cloned farm animals?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research Involving Developing Countries	YES	Page
	Does the proposed research involve the use of local resources (genetic, animal, plant, etc)?		
	Is the proposed research of benefit to local communities (e.g. capacity building, access to healthcare, education, etc)?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Dual Use	YES	Page
	Research having direct military use		
	Research having the potential for terrorist abuse		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

B5. Gender aspects

The Global-IQ Partners fully comply with the National and European law on gender equity, moreover they acknowledge and share the European Commission effort to enforce the role of women in research. To this aim a particular attention is devoted to the consortium construction and to the development the project activities, with a special focus to the dissemination ones.

B5.1 Project Consortium

In the design of Global-IQ Proposal the involvement of the women researchers in each organisation has been encouraged. The women researchers have been included because of excellence in academic performance and, hence, they enhance both the gender mix and scientific output of the project.

Should the proposal be successful, the consortium will continue to encourage all participants to favour the hiring and nomination of female workers in the project to improve the gender balance in the project consortium. A special attention will be done to the involvement in the project of female young researchers (including PhD and Post-graduate students).

The gender balance will be regularly assessed and reported to the EC through the intermediate and final reports of the Global-IQ Project.

B5.2 Development of the project

Even if there is not any significant issue related with gender dimension in the scientific objectives of the Global-IQ project, the consortium will promote proactive ideas and actions to make sure that the gender issue will be considered explicitly wherever feasible.

A preliminary check-list of possible ideas is outlined below:

- ensuring that the language used and the actions carried out in the project are not gender biased or exclusive;
- ensuring the design and implementation of an equal opportunity policy, for example promoting in the project website the equal gender aspect, or affirmative action opportunities where appropriate;
- ensuring the participation and involvement in the project events (dissemination and training) of female researchers and stakeholders, also as speakers.

In terms of research focus, gender issues will be considered relevant in the impact assessment framework developed under WPs.

The gender actions will be regularly assessed and reported to the EC through the intermediate and final reports of the Global-IQ Project.

B5.3 Specific partners' actions

- FEEM, in 2009, adopted an Code of Conduct that includes specific provision on gender policy;
- IIASA has no explicit gender policy, but actively pursues gender equality. There are 30% female employees at IIASA, also in leading positions;

- UGOT: the Department of Economics has adopted an Equal Treatment Plan http://www.hgu.gu.se/Files/nationalekonomi/intra/misc/Likabehandlingsplan%20090610.pdf
- ISIS adopted a non discriminatory ethical code on gender policy.
- The Grantham Research Institute is governed by the LSE's policy on equality and diversity (http://www2.lse.ac.uk/intranet/LSEServices/divisionsAndDepartments/humanResources/employmentRelations/policiesAndProcedures/equalityAndDiversity.aspx)
- HEID: the Charter of the Institute defines the principles and values which unite all the individuals working at the Institute, and includes "diversity" as one of its core values. We interpret this to include diversity of gender
- The WIIW has no explicit gender policy, but actively pursues gender equality. It has a strong record with hiring and promotion of diversity among researchers, with a balanced mix of research staff and senior management.
- The RTN and ITN networks in which CEPR has participated to date have usually attracted equal numbers of applications from female and male researchers, and have a good record in hiring female researchers.

B6. References

ARNELL, W.N. (2004): 'Climate change and global water resources: SRES scenarios and socio-economic scenarios'. Global Environmental Change **14**: 31-52

Battaglini A., J. Lilliestam, C. Bals and A. Haas (2008), “The SuperSmart Grid”, European Climate Forum.

Bauer, N., Edenhofer, O., Jakob, M., Ludig, S. and Lüken, M. (2009): “Electricity Trade among World Regions. Trade Theoretic Foundation of Energy-Economy Models”. Paper presented at the NCCR Conference on the International Dimensions of climate Policy, Bern, Switzerland, January 21-23, 2009.

Bauer, N., Edenhofer, O., Kypreos, S. (2008): Linking energy system and macroeconomic growth models. *Journal of Computational Management Science* (Special Issue), 5, 95 -117.

BENITEZ, P.C., I. McCALLUM, M. OBERSTEINER and Y. YAMAGATA (2005): 'Global potential for carbon sequestration: Geographical distribution, country risk and policy implications'. *Ecological Economics*.

CLINE, W.R. (1992): *The Economics of Global Warming*. Washington, DC: Institute for International Economics

DESERTEC (2007): “Clean power from deserts“, Whitepaper, The Club of Rome, Hamburg.

EPSTEIN, P.R. and E. MILLS (2005): 'Climate change futures: health, ecological and economic dimensions', Center for Health and the Global Environment, Harvard Medical School, Cambridge, MA: Harvard University

Füssel H.-M. (2009): New results on the influence of climate on the distribution of population and economic activity. MPRA Paper 13788, 27 pp. *URL: http://mpra.ub.uni-muenchen.de/13788/*

Füssel, H.-M., Mastrandrea, M. D. (2010): Integrated Assessment Modeling of Climate Change.
pp. 150–161 in S. H. Schneider, A. Rosencranz, M. D. Mastrandrea, and K. Kuntz-Duriseti (editors): *Climate Change Science and Policy*. Island Press, Washington, DC

HATTON, T.J.and J.G. WILLIAMSON (2002): 'What fundamentals drive world migration?', Working Paper 9159, Cambridge, MA: National Bureau of Economic Research

HOPE, C. (2005): ‘Integrated assessment models’ in Helm, D. (ed.), *Climate-change policy*, Oxford: Oxford University Press, pp 77-98.

JORGENSON, D.W., R.J. GOETTLE, B.H. HURD et al. (2004): 'US market consequences of global climate change', Washington, DC: Pew Center on Global Climate Change

MENDELSOHN, R., W.D. NORDHAUS and D. SHAW (1994): 'The impact of global warming on agriculture: a Ricardian analysis', American Economic Review **84**: 753 – 771

NELSON, G.C., M.W. ROSEGRANT, J. KOO, R. ROBERTSON, T. SULSER, T. ZHU, C. RINGLER, S. MSANGI, A. PALAZZO, M. BATKA, M. MAGALHAES, R. VALMONTE-SANTOS, M. EWING, and D. LEE (2009). Climate Change: Impact on Agriculture and Costs of Adaptation, Food Policy Report 21, International Food Policy

Research Institute (IFPRI), available at http://www.ifpri.org/publication/climate-change-impact-agriculture-and-costs-adaptation.

NORDHAUS W., (1994), *Managing the Global Commons: The Economics of Climate Change*, MIT Press, Cambridge, MA.

NORDHAUS W., (2000). *Warming the World: Economic Modeling of Global Warming*, with Joseph Boyer, MIT Press, Cambridge, MA.

NORDHAUS W., (2008), *A Question of Balance: Weighing the Options on Global Warming Policies*, Yale University Press, New Haven, CT.

PEARCE, D.W. et al. (1996): 'The social costs of climate change: greenhouse damage and the benefits of control' Climate Change 1995: Economic and Social Dimensions of Climate Change, Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press pp 183-224

PIK, ECF, IIASA (2008), "Linking North Africa's Renewable Energy Resources to Europe,

Policy Challenges", Background paper for a scientific workshop International Institute for Applied Systems Analysis, Laxenburg, Austria.

Richter C., S. Teske; J. A. Nebrera (2009), "Concentrating Solar Power Global Outlook 09", Greenpeace International / European Solar Thermal Electricity Association (ESTELA) / IEA SolarPACES, Report 2009.

STERN N., (2007), *The Economics of Climate Change, the Stern Review*, Cambridge University Press, Cambridge, MA.

Trieb F. (2006), "Trans-Mediterranean Interconnection for Concentrationg Solar Power", German Aerospace Center (DLR)

Trieb F.(2005), "Concentrating solar power for the Mediterranean Region", German Aerospace Center (DLR) Institute of Technical Thermodynamics, Section Systems Analysis and Technology Assessment, Stuttgart.

Ummel K. and D. Wheeler (2008), "Desert Power: The Economics of Solar Thermal Electricity for Europe, North Africa, and the Middle East", Working Paper Number 156 - Center for Global Development.

WARREN, R. et al. (2006): 'Spotlighting Impacts Functions in Integrated Assessment Models', Norwich, Tyndall Centre for Climate Change Research Working Paper 91.

Other WP references

Antweiller, W. and D. Trefler (2002), "Increasing Returns and All That: A View from Trade," *American Economic Review*, 96: March.

Brocker, J., Schneider, M. (2002), ‚How Does Economic Development in Eastern Europe Affect Austria's Regions? A Multiregional General Equilibrium Framework', *Journal of Regional Science*, Vol. 42, No. 2, pp. 257-285.

CEDEFOP (2009), 'Future skill supply in Europe: Medium-term forecast up to 2020', European Centre for the Development of Vocational Training, synthesis report.

Christie, E., J.F. Francois, M. Holzner, S. Leitner, O. Pindyuk (2009a), "AUSTRIA 2020: The impact of medium-term global trends on the Austrian economy," report prepared for the Austrian FIW – Research Centre International Economics.

Christie, E., J.F. Francois, W. Urban and F. Wirl (2009b), “China’s Foreign Oil Policy

Genesis, Deployment and Selected Effects,” A study commissioned by the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ) within the scope of the Research Centre International Economics (FIW) and funded out of the Internationalisation Program “go international,” wiiw: Vienna.

Coelli, T.J. and D.S. Prasada Rao (2003), “Total Factor Productivity Growth in Agriculture: A Malmquist Index Analysis of 93 Countries, 1980-2000,”Centre for Efficiency and Productivity Analysis Working Paper Series No. 02/2003, School of Economics, University of Queensland, Australia.

ECORYS (2009), The impact of medium term global trends on Dutch and European Industry an Employment, report for the Netherlands Ministry of Economics, ECORYS: Rotterdam.

Francois. J.F., H. van Meijl and F. van Tongeren (2005), “Trade Liberalization in the Doha Development Round,” *Economic Policy* April: 349-391.

Francois, J.F. (2001), THE NEXT WTO ROUND: North-South stakes in new market access negotiations , CIES Adelaide and the Tinbergen Institute, CIES: Adelaide, 2001. ISBN: 086396 474 5.

Francois, J.F. (1998), "Scale economies and imperfect competition in the GTAP model," GTAP consortium technical paper. http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=317

Francois, J.F., B. McDonald and H. Nordstrom (1996b), "Trade liberalization and the capital stock in the GTAP model," GTAP consortium technical paper. http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=310)

Francois, J.F. and D.W. Roland-Holst (1997), "Scale economies and imperfect competition, in Francois,J.F. and K.A. Reinert, eds. (1997), *Applied methods for trade policy analysis: a handbook*, Cambridge University Press: New York.

Francois,J.F. and K.A. Reinert, eds. (1997), *Applied methods for trade policy analysis: a handbook*, Cambridge University Press: New York.

Francois, J.F and H. Keith Hall (2003), “Global Simulation Analysis of Industry-Level Trade Policy” IIDE Technical Report 20090803, Institue for International and Development Economics.

Francois, J.F., H. Norberg, & M. Thelle (2007), "Economic Impact of a Potential Free Trade Agreement (FTA) Between the European Union and South Korea," IIDE Discussion Papers 20070301, Institue for International and Development Economics, Prepared as part of a scoping for EU DG Trade.

Francois, J.F. and G. Wignaraja (2008), "Economic Implications of Asian Integration," Joseph Francois & Ganeshan Wignaraja, *Global Economy Journal (BE Press)*, vol. 8(3), pages 1-48.

Francois, J., H. Norberg, & M. Manchin (2008), "Trade Impact Assessment of an EU-India Free Trade Agreement," IIDE Discussion Papers 20080601, Institue for International and Development Economics. Prepared as part of an EU FTA sustainability impact assessment study for EU DG Trade.

Francois,F., H.Norberg, M.Manchin & A. Pelkmans Balaoing, (2009), "Trade Impact Assessment (Trade SIA) of an EU-ASEAN Free Trade Agreement," IIDE Discussion Papers 20090801, Institue for International and Development Economics. Prepared as part of an EU FTA sustainability impact assessment study for EU DG Trade.

Francois, J.F. and G. Wignaraja (2009a), PAN-ASIAN INTEGRATION: *Linking East and South Asia*, Palgrave Macmillan, 2009, ISBN: 0-230-22178-5.

Francois, J.F. and G. Wignaraja (2009b), NATIONAL STRATEGIES FOR REGIONAL INTEGRATION: South and East Asian Case Studies, Anthem Press 2009, ISBN-13: 978-184331789.

Francois, J.F. and J. Woerz (2009), "Non-Linear Panel Estimation of Import Quotas: the evolution of quota premiums under the ATC," *Journal of International Economics.*

Francois, J.F. and B. Hoekman (forthcoming), "Trade and Policy in Services," *Journal of Economic Literature*.

International Monetary Fund (2009), World Economic Outlook Database, IMF: Washington.

McDougall, R., ed. (2008). The GTAP database -- version 7, Global Trade Analysis Center: Purdue University.

Leimbach M, Bauer N, Baumstark L, Edenhofer O (2009): "Mitigation Costs in a Globalized World: Climate Policy Analysis with ReMIND-R." *Environmental Modeling and Assessment*, in press.

Nico Bauer, Ottmar Edenhofer, Markus Haller, David Klein, Alexander Lorenz, Gunnar Luderer, Sylvie Ludig, Michael Lüken, Robert Pietzcker (2009): "Technologies, Policies and Economics of Global Reductions of Energy Related CO2 Emissions An Analysis with ReMIND", submitted to *Energy Journal*

For WP3: (Leimbach et al. 2009, Bauer et al. 2009); an integrated assessment model, evolved from MIND, that contains a far more detailed representation of the energy sector and a spacial resolution into 11 world regions

Held, H, Kriegler, E., Leimbach, M., Edenhofer, O. (2009): Efficient climate policies under technology and climate uncertainty. *Energy Economics*, **31**, S50–S61.

Relevant publications of involved key staff

Alberini, A., Ščasný, M., Braun Kohlova, M., Melichar, J. (2006), The Value of Statistical Life in the Czech Republic: Evidence from Contingent Valuation Study. In: Menne, B., Ebi, K.L. (eds.), *Climate Change and Adaptation Strategies for Human Health*. Springer, Steinhopff Verlag, Darmstadt. ISBN: 3-7985-1591-3. pp. 373-393.

Amigues J.P., M. Moreaux and F. Ricci, (2008), Resource augmenting R&D with heterogenous labor supply, *Environment and Developement Economics, Vol 13, n°13, p. 719-745.*

Amigues Jean-Pierre and Karen Pittel, (2009) Recycling under a material balance constraint, *Resources and Energy Economics*, in press.

Antweiller, W. and D. Trefler (2002), "Increasing Returns and All That: A View from Trade," *American Economic Review*, 96: March.

Aronsson, T. and O. Johansson-Stenman (2008), When the Joneses' consumption hurts: Optimal public good provision and nonlinear income taxation. *Journal of Public Economics*, 92(5-6), 986-97.

Aronsson, T. and O. Johansson-Stenman (in press), Positional Concerns in an OLG Model: Optimal Labor and Capital Income Taxation. *International Economic Review*.

Azar, C. and T. Sterner (1996), Discounting and distributional considerations in the context of Global Warming, *Ecological Economics*, Vol.19, pp 169-184 (November).

Baldwin R. (1987), Politically Realistic Objective Functions and Trade Policy: PROFs and Tariffs, *Economic Letters*, 24, pp 287-290.

Baldwin R. (1987), The Persistence of the US Trade Deficit, with Paul Krugman, *Brookings Papers on Economic Activity*, 1:1987, p.1-43.

Baldwin R. (1988), Hysteresis in Import Prices: The Beachhead Effect, *American Economic Review*, 78, 4, pp 773-785.

Baldwin R. (1989), Growth Effects of 1992, *Economic Policy*, 9, pp 247-282.

Baldwin R. (1989), Persistent Trade Effects of Large Exchange Rate Shocks, with Paul Krugman, *Quarterly Journal of Economics*, pp 635-654, No. 419.

Baldwin R. (1992), Measurable Dynamic Gains from Trade, *Journal of Political Economy*, vol. 100, 1, pp 162-174.

Baldwin R. (1994), Exchange Rate Hysteresis: Large versus Small Policy Alignments, with Richard Lyons, *European Economic Review*, Vol. 38, No. 1, pp 1- 22.

Baldwin R. (1994), International Migration, Capital Mobility and Transitional Dynamics, with Tony Venables, *Economica*, Vol.61, No.243, pp 285-300.

Baldwin R. (1996), Alternate Approaches to the political economy of endogenous trade liberalization, with Robert E. Baldwin, *European Economic Review*, 40, pp 775-782.

Baldwin R. (1997), The causes of regionalism, *The World Economy*, Vol. 20, No, 7, pp 865-888.

Baldwin R. (1999), Agglomeration and Endogenous Capital, *European Economic Review*, vol. 43, 2, pp253-280.

Baldwin R. (2000), Trade Liberalisation and Endogenous Growth: A q-Theory Approach, with Rikard Forslid, *Journal of International Economics*, vol. 50, No. 2, pp 497-517.

Baldwin R. (2001), Multiproduct Multinationals and Reciprocal FDI Dumping, with G. Ottaviano, *Journal of International Economics*, vol. 54, issue 2, pp. 429-448.

Baldwin R. (2001), The Core-Periphery Model with Forward-Looking Expectations, *Regional Science and Urban Economics*, Vol. 31, pp 21-49.

Baldwin R. (2004), Agglomeration, Integration and Tax Harmonization, with Paul Krugman, *European Economic Review*, Vol. 48, 1, pp 1-23.

Baldwin R. (2006), Heterogeneous firms, agglomeration and economic geography: Spatial selection and sorting, with Toshihiro Okubo, *Journal of Economic Geography*. Vol. 6: pp. 323-346.

Baldwin R. (2007), Entry and Asymmetric Lobbying: Why Governments Pick Losers, with Frederic Robert-Nicoud, *Journal of the European Economics Association*, vol. 5(5), pp1064-1093.

Baldwin R. (2008), Reforming Economic Institutions of the European Union - EU Institutional Reform: Evidence on Globalization and International Cooperation, *American Economic Review*, pp 127 – 132.

Baldwin R. (2008), Trade and growth with heterogeneous firms, with Frederic Robert-Nicoud, *Journal of International Economics*, Volume 74, Issue 1, Pages 21-34.

Baldwin R. (2009), Tax Reform, Delocation, and Heterogeneous Firms, with Toshihiro Okubo, *Scandinavian Journal of Economics*, 111(4), pp 741–764.

Bertoldi P., Ricci A. and de Almeida A. (Eds) (2001), Energy Efficiency of Household Appliances and Lighting (Springer Verlag).

Bigano, A., Bosello, F., Roson, R. and R.S.J. Tol (2008) “Economy-wide impacts of climate change: a joint analysis for sea level rise and tourism", Mitigation and Adaptation Strategies for Global Change, Vol. 13, n. 8.

Biomass Technology Group (2005). Handbook Biomass Gasification. H.A.M. Knoef. ISBN: 90-810068-1-9.

Bosello, F., and Z. Jian, (2006)“ Determinare gli impatti del cambiamento climatico. Il caso dell’agricoltura ”, Questione Agraria, 1-2006, 97-124

Bosello, F., Buchner, B., Catenacci, M., Goria, A., Kuik, O., Karakaya, E. and P. Watkiss (2007), “Climate change: the cost of inaction and the cost of adaptation”, EEA Technical Report, 13.2007

Bosello, F., Roson, R. and R.S.J. Tol (2006), “ Economy wide estimates of the implications of climate change: human health” Ecological Economics, 58, 579-591

Bosello, F., Roson, R. and R.S.J. Tol (2007), “Economy-Wide Estimates of the Implications of Climate Change: Sea-Level Rise", Environmental and Resource Economics (3) 37 549-571.

Bosetti V., E. Massetti, M. Tavoni (2007), "The WITCH Model, Structure, Baseline, Solutions", FEEM Working Paper 10.2007.

Bosetti, V. and M. Tavoni (2008), "Uncertain R&D, backstop technology and GHGs stabilization", Energy Economics, in press. Supersedes FEEM Note di Lavoro N.06.2007.

Bosetti, V., C. Carraro, A. Sgobbi, and M.Tavoni (2009), "Delayed Action and Uncertain Stabilisation Targets. How Much Will the Delay Cost?", Forthcoming, Special Issue "The Economics of Climate Change: Targets and Technologies", Climatic Change.

Bosetti, V., C. Carraro, E. Massetti, A. Sgobbi and M.Tavoni (2009), "Optimal Energy Investment and R&D Strategies to Stabilise Greenhouse Gas Atmospheric Concentrations", Resource and Energy Economics 31-2, 123-137. Supersedes FEEM Note di Lavoro N.85.2008.

Bosetti, V., C. Carraro, M. Galeotti, E. Massetti and M. Tavoni (2006) "WITCH: A World Induced Technical Change Hybrid Model", with The Energy Journal, Special Issue. Hybrid Modeling of Energy-Environment Policies: Reconciling Bottom-up and Top-down, 13-38.

Bosetti, V., E. De Cian, A. Sgobbi and M.Tavoni (2009) "The WITCH model: new model features and baseline", FEEM Working Paper 10.2009.

Bosetti,V., R. Lubowski, A. Golub and A. Markandya (2009), "Linking Reduced Deforestation and a Global Carbon Market: Impacts on Costs, Financial Flows, and Technological Innovation", FEEM Note di Lavoro N.56.2009.

Brocker, J., Schneider, M. (2002), ‚How Does Economic Development in Eastern Europe Affect Austria's Regions? A Multiregional General Equilibrium Framework’, *Journal of Regional Science*, Vol. 42, No. 2, pp. 257-285.

Brůha, J. et Ščasný, M. (2005), Environmental Tax Reform Options and Designs for the Czech Republic: Policy and Economic Analysis. In: Deketelaere, K., L. Kreiser, J. Milne, H. Ashiabor, A. Cavaliere eds. Critical Issues in Environmental Taxation: International and Comparative Perspectives. Volume III. Richmond Law & Tax Publisher Ltd, Richmond, UK, March 2005. 750 pp. Chapter 17.

Carraro, C., E. Massetti and L. Nicita. 2009. “How Does Climate Policy Affect Technical Change? An Analysis of the Direction and Pace of Technical Progress in a Climate-Economy Model” The Energy Journal, Special Issue. Climate Change Policies After 2012, October 2009, 30 (Special Issue 2): 7-38.

CEDEFOP (2009), 'Future skill supply in Europe: Medium-term forecast up to 2020', European Centre for the Development of Vocational Training, synthesis report.

Christie, E., J.F. Francois, M. Holzner, S. Leitner, O. Pindyuk (2009a), "AUSTRIA 2020: The impact of medium-term global trends on the Austrian economy," report prepared for the Austrian FIW – Research Centre International Economics.

Christie, E., J.F. Francois, W. Urban and F. Wirl (2009b), "China's Foreign Oil Policy

Coelli, T.J. and D.S. Prasada Rao (2003), "Total Factor Productivity Growth in Agriculture: A Malmquist Index Analysis of 93 Countries, 1980-2000,"Centre for Efficiency and Productivity Analysis Working Paper Series No. 02/2003, School of Economics, University of Queensland, Australia.

Crampes Claude and Michel Moreaux, (2010) , Pumping Storage and Cost Saving, *Energy Economics*, vol. 32, n°2, mars 2010, p. 325-333.

D'Albis Hippolyte and B. Decreuse, (2009) Parental altruism, lifetime expectancy, and dynamically inefficient equilibria, *Journal of Economic Dynamics and Control* 33, 1897-1911, 2009.

D'Albis Hippolyte and E. Augeraud-Véron, (2009), Competitive growth in a life-cycle model: Existence and dynamics, *International Economic Review* 50, 459-484, 2009.

Dietz S. (2007), Reflections on the Stern Review (1): a robust case for strong action to reduce the risks of climate change (with Chris Hope, Nicholas Stern and Dimitri Zenghelis), *World Economics* 8(1): 121-168.

Dietz S. (2007), Right for the right reasons: a final rejoinder on the Stern Review (with Dennis Anderson, Nicholas Stern, Chris Taylor and Dimitri Zenghelis), *World Economics* 8(2): 229-258.

Dietz S. (2007), Some economics of 'dangerous' climate change: reflections on the Stern Review (with Chris Hope and Nicola Patmore), *Global Environmental Change* 17(3-4): 311-325.

Dietz S. (2007), The impacts of climate change: perspectives from the Stern Review, *The Brown Journal of World Affairs* 13(2): 173-184.

Dietz S. (2008), Why economic analysis supports strong action on climate change: a response to the Stern Review's critics (with Nicholas Stern), *Review of Environmental Economics and Policy* 2(1): 94-113.

Dietz S. (2009), Siblings, not triplets: social preferences for risk, inequality and time in discounting climate change (with Giles Atkinson, Jennifer Helgeson, Cameron Hepburn and Hakon Saelen), *Economics E-Journal*, 3, paper no. 2009-26.

Dietz S. (2009), Strategic appraisal of environmental risks: a comparison between the methods of the UK's Stern Review on the Economics of Climate Change and its Committee on Radioactive Waste Management (with Alec Morton), *Grantham Research Institute on Climate Change and the Environment Working Paper* 5.

Dietz S., (2009) On the timing of greenhouse gas emissions reductions: a final rejoinder to the symposium on "The Economics of Climate Change: The *Stern Review* and its Critics" (with Nicholas Stern), *Review of Environmental Economics and Policy*, 3(1), 138-140.

Dietz S., (2009), High impact, low probability? An empirical analysis of risk in the economics of climate change, *Grantham Research Institute on Climate Change and the Environment Working Paper* 9.

Dietz S., (2009), New frontiers in the economics of climate change (with David J. Maddison), *Environmental and Resource Economics*, 43(3), 295-306.

Dietz S., Environmental prices, uncertainty and learning (with Sam Fankhauser), *Oxford Review of Economic Policy*, accepted.

Dietz S., The equity-efficiency trade-off in environmental policy: evidence from stated preferences (with Giles Atkinson), *Land Economics*, accepted.

ECORYS (2009), The impact of medium term global trends on Dutch and European Industry an Employment, report for the Netherlands Ministry of Economics, ECORYS: Rotterdam.

Edenhofer, O., Bauer, N., Kriegler, E. (2005): The impact of technological change on climate protection and welfare: Insights from the model MIND. *Ecological Economics*, 54 , 2-3, 277-292.

Edenhofer, O., Carraro, C., Köhler, J., Grubb, M. (eds.) (2006): Endogenous technological change and the economics of atmospheric stabilisation: A special issue of The Energy Journal. Cleveland: *International Association for Energy Economics*, 284.

Enei R. (1988), Annuario ufficiale economico-statistico, CISPEL, Roma.

Enei R. (1988), Dossier sui piccoli comuni, Roma.

Enei R. (1988), Rapporto sullo stato della montagna, CNEL.

Enei R. (1991), Un algoritmo per l'identificazione delle aree metropolitane, AISRE.

Enei R. (1993), Rapporto annuale sull'analisi dei trasferimenti erariali agli enti locali per l'anno 1992, Roma.

Enei R. (1993), Ricerca sulla determinazione dei parametri obiettivi per la ripartizione dei trasferimenti erariali agli Enti Locali per l'anno 1993, Roma.

Enei R. (1994), Rapporto annuale sull'analisi dei trasferimenti erariali agli enti locali per l'anno 1993, Roma.

Enei R. (1998), XII° Rapporto sullo Stato dei Poteri e dei Servizi Locali 1999/2000.

Enei R. (1999), XIII° Rapporto sullo Stato dei Poteri e dei Servizi Locali 1999/2000.

Enei R. (2000), XIV° Rapporto sullo Stato dei Poteri e dei Servizi Locali 1999/2000.

Enei R. (2005), Drivers of ICT growth and set up of first generation scenarios. *International Journal of Technology, Policy and Management*, Vol. 5 No. 1.

Enei R. (2005), Rapporto sullo stato dell'ambiente urbano, APAT.

FAO. 2005. "Global Forest Resources Assessment 2005, Progress towards sustainable forest management." Vol. 147 of FAO Forestry Paper. FAO, Rome.

FAO. 2005. "Global Forest Resources Assessment 2005, Progress towards sustainable forest management." Vol. 147 of FAO Forestry Paper. FAO, Rome.

FAO. 2007. FAOSTAT. Available online at faostat.fao.org.

FAO. 2007. FAOSTAT. Available online at faostat.fao.org.

Flachsland, C., Edenhofer, O., Jakob, M., Steckel, J. (2008): Developing the international carbon market. Linking options for the EU ETS. Report to the Policy Planning Staff in the Federal Foreign Office. Potsdam: *Potsdam Institute for Climate Impact Research*, 103.

Fortin, I., S. Fuss, J. Hlouskova, N. Khabarov, M. Obersteiner and J. Szolgayova (2008): An Integrated CVaR and Real Options Approach to Investments in the Energy Sector, *Journal of Energy Markets* 1(2).

Francois, J., H. Norberg, & M. Manchin (2008), "Trade Impact Assessment of an EU-India Free Trade Agreement," IIDE Discussion Papers 20080601, Institue for International and Development Economics. Prepared as part of an EU FTA sustainability impact assessment study for EU DG Trade.

Francois, J.F and H. Keith Hall (2003), “Global Simulation Analysis of Industry-Level Trade Policy” IIDE Technical Report 20090803, Institue for International and Development Economics.

Francois, J.F. (1998), "Scale economies and imperfect competition in the GTAP model," GTAP consortium technical paper. http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=317

Francois, J.F. (2001), THE NEXT WTO ROUND: North-South stakes in new market access negotiations , CIES Adelaide and the Tinbergen Institute, CIES: Adelaide, 2001. ISBN: 086396 474 5.

Francois, J.F. and B. Hoekman (forthcoming), “Trade and Policy in Services,” *Journal of Economic Literature*.

Francois, J.F. and D.W. Roland-Holst (1997), "Scale economies and imperfect competition, in Francois,J.F. and K.A. Reinert, eds. (1997), *Applied methods for trade policy analysis: a handbook*, Cambridge University Press: New York.

Francois, J.F. and G. Wignaraja (2008), "Economic Implications of Asian Integration," Joseph Francois & Ganeshan Wignaraja, *Global Economy Journal (BE Press)*, vol. 8(3), pages 1-48.

Francois, J.F. and G. Wignaraja (2009a), PAN-ASIAN INTEGRATION: *Linking East and South Asia*, Palgrave Macmillan, 2009, ISBN: 0-230-22178-5.

Francois, J.F. and G. Wignaraja (2009b), NATIONAL STRATEGIES FOR REGIONAL INTEGRATION: South and East Asian Case Studies, Anthem Press 2009, ISBN-13: 978-184331789.

Francois, J.F. and J. Woerz (2009), “Non-Linear Panel Estimation of Import Quotas: the evolution of quota premiums under the ATC,” *Journal of International Economics.*

Francois, J.F., B. McDonald and H. Nordstrom (1996b), "Trade liberalization and the capital stock in the GTAP model," GTAP consortium technical paper. http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=310)

Francois, J.F., H. Norberg, & M. Thelle (2007), "Economic Impact of a Potential Free Trade Agreement (FTA) Between the European Union and South Korea," IIDE Discussion Papers 20070301, Institue for International and Development Economics, Prepared as part of a scoping for EU DG Trade.

Francois,F., H.Norberg, M.Manchin & A. Pelkmans Balaoing, (2009), "Trade Impact Assessment (Trade SIA) of an EU-ASEAN Free Trade Agreement," IIDE Discussion Papers 20090801, Institue for International and Development Economics. Prepared as part of an EU FTA sustainability impact assessment study for EU DG Trade.

Francois,J.F. and K.A. Reinert, eds. (1997), *Applied methods for trade policy analysis: a handbook*, Cambridge University Press: New York.

Francois. J.F., H. van Meijl and F. van Tongeren (2005), “Trade Liberalization in the Doha Development Round,” *Economic Policy* April: 349-391.

Fuss, S. and J. Szolgayova (2009): Fuel Price & Technological Uncertainty in a Real Options Model for Electricity Planning, *Applied Energy* 86, in press [doi:10.1016/j.apenergy.2009.05.020].

Fuss, S., D. Johansson, J. Szolgayová, and M. Obersteiner (2009): Impact of Climate Policy Uncertainty on the Adoption of Electricity Generating Technologies, *Energy Policy* 37(2):733-743.

Genesis, Deployment and Selected Effects,” A study commissioned by the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ) within the scope of the Research

Centre International Economics (FIW) and funded out of the Internationalisation Program "go international," wiiw: Vienna.

Gollier C., (2009), « Expected Net Present Value, Expected Net Future Value, and the Ramsey Rule », *Journal of Environmental Economics and Management*, in press.

Gollier C., (2009), Ecological Discounting , *Journal of Economic Theory*, in press.

Gollier C., (2009), Should We Discount the Far-Distant Future at Its Lowest Possible Rate?, *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 3, 2009-25.

Grimaud A. and L. Rougé, (2008), Environment, Directed Technical Change and Economic Policy, *Environmental and Resource Economics*, vol. 41, n°4, décembre 2008, p. 439-463.

Grimaud A., (2009), Environmental Policy and Growth when Utility is Affected by the Stock of Resource Pollution, *International Journal of Business and Economics*, vol. 1, n°1, juin 2009, p. 133-149.

Haas, M.J., McAloon, A.J., Yee, W.C. and T.A. Foglia. 2006. "A process model to estimate biodiesel production costs." Bioresource Technology 97: 671-678.

Hamelinck, C.N. and A.P.C. Faaij (2001). "Future Prospects for Production of Methanol and Hydrogen from Biomass." Utrecht University, Copernicus Institute, Science Technology and Society, Utrecht, Netherlands 2001.

Havlík, P., Enjolras, G., Boisson, J.M., Jacquet, F., Lherm, M. and Veysset, P. (2008). Environmental good production in the optimum activities portfolio of a risk averse farmer. *Review of agricultural and Environmental Studies* 86: 9-33.

Havlík, P., Jacquet, F., Boisson, J.M., Hejduk, S. and Veselý, P. (2006). Mathematical programming models for agri-environmental policy analysis: A case study from the White Carpatians. *Agricultural Economics – Czech* 52: 51-66.

Havlík, P., Schneider, A.U., Schmid, E., Böttcher, H., Fritz, S., Skalský, R., Aoki, K., de Cara, S., Kindermann, G., Kraxner, F., Leduc, S., McCallum, I., Mosnier, A, Sauer, T., Obersteiner, M. (2009). Global land-use implications of first and second generation biofuel targets. *Energy Policy* (forthc).

Havlík, P., Veysset, P., Boisson, J.M., Lherm, M. and Jacquet, F. (2005). Joint production under uncertainty and multifunctionality of agriculture: policy considerations and applied analysis. *European Review of Agricultural Economics* 32: 489-515.

Held, H, Kriegler, E., Leimbach, M., Edenhofer, O. (2009): Efficient climate policies under technology and climate uncertainty. *Energy Economics*, 31, S50–S61.

Hennlock (2008b), An International Marine Pollutant Sink in an Asymmetric Environmental Technology Game, *Natural Resource Modeling* 21(1).

Hennlock (2009), Robust control in global warming management: An analytical dynamic integrated assessment. RFF Discussion Paper 09-19, Resources for the Future, Washington, DC 20036, USA, May 2009.

Hennlock, (2009), Precautionary Policy Rules in an Integrated Climate-Economy Differential Game with Climate Model Uncertainty, *Contributions to Game Theory and Management* 2009.

Hennlock, M., (2008a), A Robust Feedback Nash Equilibrium in a Climate Change Policy Game in *Mathematical Programming and Game Theory for Decision Making* eds. S. Neogy et. al., Statistical Science and Interdisciplinary Research, (1) 2008, World Scientific Book Series.

Hermann, B.G. and M. Patel. 2007. “Today's and tomorrow's bio-based bulk chemicals from white biotechnology - A techno-economic analysis.” Applied Biochemistry and Biotechnology 136: 361-388.

Hoel, M. and T. Sterner (2007), Discounting and relative prices, *Climatic Change*, vol.84, PP 265-280.

International Monetary Fund (2009), World Economic Outlook Database, IMF: Washington.

International Monetary Fund (2009), World Economic Outlook Database, IMF: Washington.

Izaurralde, R.C., J.R. Williams, W.B. McGill, N.J. Rosenberg, and M.C. Quiroga Jakas. 2006. Simulating soil C dynamics with EPIC: model description and testing against long-term data. Ecological Modelling, 192:362-384.

Johansson-Stenman, O (2010), Risk Aversion and Expected Utility of Consumption over Time, *Games and Economic Behavior*, 68, 208-219.

Kindermann G, Obersteiner M, Sohngen B, Sathaye J, Andrasko K, Rametsteiner E, Schlamadinger B, Wunder S, Beach R (2008 forthcoming). Economic Estimates of the Costs of Reducing Carbon Emissions from Avoided Deforestation. Proceedings of the National Academy of Sciences (*PNAS*).

Kindermann, and P. Scholtz. 2008. GEO-BENE global database for bio-physical modeling v. 1.0 – concepts, methodologies and data. The GEO-BENE database report. International Institute for Applied Systems Analysis (IIASA), Austria, pp. 58.

Kindermann, G.E. 2008. “Getting forest growth functions out of yield tables.”

Kindermann, G.E., McCallum, I. and S. Fritz. 2008. “A global forest growing stock, biomass and carbon map based on FAO statistics.” Forthcoming.

Kindermann, G.E., Obersteiner, M., Rametsteiner, E. and I. McCallum. 2006. “Predicting the deforestation-trend under different carbon-prices.” Carbon Balance and Management 1: 15.

Knopf, B., Edenhofer, O., Turton, H., Barker, T., Scrieciu, S., Leimbach, M., Baumstark, L., Kitous, A., Magné, B., Kypreos, S., Bellevrat, E. (2008): Report on first assessment of low stabilisation scenarios. Potsdam: Potsdam-Institut für Klimafolgenforschung, 44. Adaptation and Mitigation Strategies: Supporting European Climate Policy (ADAM), D-M2.6.

Kriegler, E., Hall, J., Dawson, R., Held, H., Schellnhuber, H. J. (2009), Imprecise Probability of Crossing Tipping Points in the Earth System Elicited from Experts, *PNAS*, 109 (13), 5041-5046.

Kriegler, E., Held, H., Bruckner, T. (2007): Climate protection strategies under ambiguity about catastrophic consequences. In: Kropp, J., Scheffran, J. (eds.), Advanced methods for decision making and risk management in sustainability science. New York: *Nova Science Publishers*, 3-42.

Ladoux N., H. Cremer and F. Gahvari, (2009), Environmental Tax Design with Endogenous Earning Abilities (with Applications to France) , *Journal of Environmental Economics and Management*, in press.

Lafforgue G. and A. Grimaud, Climate change mitigation policies: Are R&D subsidies preferable to a carbon tax? (2008), *Revue d’Economie Politique*, 119(6), 915-940.

Lafforgue G., (2008), Stochastic technical change, exhaustible resource and optimal sustainable growth, *Resource and Energy Economics* 30(4), 540-554.

Lafforgue G., B. Magné and M. Moreaux, (2008), Energy Substitutions, Climate Change and Carbon Sinks, *Ecological Economics*, vol. 67, n°4, p. 589-597.

Leduc, S., D. Schwab, E. Dotzauer, E. Schmid, M. Obersteiner (2008). "Optimal Location of Wood Gasification Plants for Methanol Production with Heat Recovery." International Journal of Energy Research, IGEC-III special issue.

Leduc, S., Lundgren, J., Franklin, O., Dotzauer, E. (2010). Location of a biomass based methanol production plant: A dynamic problem in northern Sweden. Applied Energy, 87 (1): 68–75.

Leduc, S., Natarajan, K., Dotzauer, E., McCallum, I., Obersteiner, M. (2009). Optimizing Biodiesel Production in India. Applied Energy, 86 (1): 125-131.

Leduc, S., Schmid, E., Obersteiner, M., Riahi, K. (2009). Methanol Production by Gasification Using a Geographically Explicit Model. Biomass and Bioenergy, 33 (5): 745-751.

Leduc, S., Schwab, D., Dotzauer, E., Schmid, E., Obersteiner, M. Optimal Location of Wood Gasification Plants for Methanol Production with Heat Recovery. *International Journal of Energy Research* 2008, 32(12): 1080-1091.

Leimbach, M., Bauer, N., Baumstark, L., Edenhofer, O. (2009*):* Mitigation costs in a globalized world: climate policy analysis with REMIND-R. *Environmental Modeling and Assessment*. DOI: 10.1007/s10666-009-9204-8.

Leimbach, M., Bauer, N., Baumstark, L., Lüken, M, Edenhofer, O. (2010) *International trade and technological change – Insights from REMIND. Special Issue of the Energy Journal on the economics of low stabilization,* in press.

Luderer, G. ,V. Bosetti, J. Steckel, H. Waisman, N. Bauer, E. Decian, M. Leimbach, O. Sassi, M. Tavoni (2009): The Economics of Decarbonization: Results from the RECIPE model intercomparison. *RECIPE Background Paper*. Available online at: http://www.pik-potsdam.de/recipe.

Máca, V. Ščasný, M. (2008), Health Benefit Valuation – health impacts due to heavy metals, PCBs and dioxins. Final Report of WP2 DROPS Project.

Massetti, E. and E.C. Ricci. 2009. "Investment Scenarios in New Generation Power Grids: Integrating Super-Grids in the WITCH Model" Fondazione Eni Enrico Mattei, mimeo, November 2009.

Massetti, E. and F. Sferra. 2009. "A Numerical Analysis of Optimal Extraction and Trade of Oil Under Climate and R&D Policy" Fondazione Eni Enrico Mattei, mimeo, December 2009.

Massetti, E. and R. Parrado. 2009. "Regional Energy Sector Dynamics: a Model Comparison Exercise." Fondazione Eni Enrico Mattei, mimeo, October 2009.

McCarl, B.A. and T.H. Spreen. 1980. "Price Endogenous Mathematical Programming as a Tool for Sector Analysis." American Journal of Agricultural Economics 62: 87-102.

McDougall, R., ed. (2008). The GTAP database -- version 7, Global Trade Analysis Center: Purdue University.

Moreaux M., U. Chakravorty and M. Tidball, (2008) , Ordering the Extraction of Polluting Nonrenewable Resources, *American Economic Review*, vol. 98, n°3, p. 1128-1144.

Nagues C. and C. Van den Berg, (2009), Demand for Piped and Non-piped Water Supply Services: Evidence from Southwest Sri Lanka , *Environmental and Resource Economics*, 42(4), p. 535-549.

Nagues C., P. Koudouri, M. Laukkanen and S. Myyrä, (2009), EU Agricultural Policy Change: Effects on Farmers' Risk Attitudes, *European Review of Agricultural Economics*, 36, p. 53-77.

Nagues C., A. Lofgren and K. Millock, (2008), The Effect of Uncertainty on Pollution Abatement Investments: Measuring Hurdle Rates for Swedish Industry, *Resource and Energy Economics*, 30(4), p. 475-491.

Nagues C., Strand J. and I. Walker, The Value of Water Connections in Central American Cities: A Revealed Preference Study , *Environment and Development Economics*, 14(3), p. 349-370.

Obersteiner M (2009): Storing carbon in forests. *Nature*; 458:151 [2009].

Obersteiner M, Huettner M, Kraxner F, McCallum I, Aoki K, Böttcher H, Fritz S, Gusti M, Havlik P, Kindermann G, Rametsteiner E, Reyers B (2009): On fair, effective and efficient REDD mechanism design. Carbon Balance and Management, 4:11 [2009].

P Bertoldi, A Ricci and B. Huenges (Eds) (1998), Energy Efficiency of Household Appliances (Springer Verlag).

Ricci A (co-author, 1994), La qualità globale (Sperling & Kupfer).

Ricci A. (1999), Energy Efficient technologies : impact evaluation with MURE in MEDETEC Energy Technology for Mediterranean Countries.

Ricci A. (2003), Pricing of Intermodal Transport, Lessons Learned from RECORDIT in Europe. *European Journal of Transport and Infrastructure Research*, Volume 3, Number 4.

Ricci A. (2003), The overall socio-economic dimension of community research in the fifth European framework programme (Unione Europea).

Ricci A. (2005), Assessing the Social and Environmental Impacts of European Research (Unione Europea)

Ricci A. (2006), Equité des systèmes de péage urbain. *La tarification des transports, enjeux et défis*, Economica – A de Palma and E Quinet Eds.

Ricci A. (2006), Les externalités du transport. *La tarification des transports, enjeux et défis*, Economica - A de Palma and E Quinet Eds).

Ricci A., I Black (2005), The social costs of intermodal transport. *Measuring the Marginal Social Cost of Transport* (Elsevier – Research in Transportation Economics - C Nash, B Matthews Eds).

Ricci A., R Friedrich (1999), Environmental Costs of Transport - Report to the High Level Group on Infrastructure Charging (Unione EUropea).

Ronneberger, K., Berrittella, M., Bosello, F. and R.S.J. Tol (2008), KLUM@GTAP: introducing biophysical aspects of land use decisions into a general equilibrium model. A coupling experiment", DOI: 10.1007/s10666-008-9177-z In press Environmental Modelling and Assessment.

Sauer, T., Havlík, P., Kindermann, G., and Schneider, U.A. 2008. Agriculture, Population, Land and Water Scarcity in a changing World - the Role of Irrigation. Paper prepared for the 2008 Congress of the European Association of Agricultural Economists in Gent, Belgium.

Ščasný, M. et Brůha, J, (2003). Public Finance Aspects of a Green Tax Reform in the Czech Republic. Paper presented at the 7th Joint Meeting of Tax and Environment Experts. OECD, Paris November 2003. COM/ENV/EPOC/DAFFE/CFA(2003)126.

Ščasný, M., Braun Kohlová, M. (eds.), (2008), Modelling of Consumer Behaviour and Wealth Distribution. Matfyzpress, Praha. ISBN: 978-80-7378-039-5, pp. 224.

Ščasný, M., Kovanda, J, Hák, T. (2003), Material flow accounts, balances and derived indicators for the Czech Republic during the 1990s: results and recommendations for methodological improvements. *Ecologic Economics* 45(2003), pp. 41-57.

Ščasný, M., Máca, V., Fantke, P, Nitter, S. (2008), Health Benefit Valuation in DROPS: Integration of modelling and valuation into E3ME and CBA framework. Final Report of WP5 DROPS Project.

Ščasný, M., Melichar., J., ed. (2004), Development of the Czech Society in the European Union. Part V: Non-market valuation methods in environmental area. Charles university in Prague, Faculty of Social Sciences and Charles University Environment Center, 21-23 October 2004. Matfyzpress, Prague. ISBN 80-86732-35-5.

Ščasný, M., Pollitt, H., Chewpreecha, U., Píša, V., Vítek, L. (2009), Analysing Macroeconomic Effects of Energy Taxation by Econometric E3ME Model. *Czech Journal of Economics and Finance* **5**/2009, 59, 460-491.

Ščasný, M., Urban, J. (2009). Residential Energy Efficiency: A Cross-Country Empirical Analysis. Paper prepared for the OECD Conference „Household Behaviour And Environmental Policy“. 3-4 June 2009, OECD Environment Directorate, Paris.

Scheffer, M., Bascompte, J., Brock, W., Brovkin, V., Carpenter, S., Dakos, V., Held, H., van Nes, E., Rietkerk, M., Sugihara, G. (2009), Early warning signals for critical transitions, *Nature*, 461, 53-59, doi:10.1038/nature/08227.

Schmidt, J., Leduc, S., Dotzauer, E., Kindermann, G., Schmid, E. (2009). Biofuel Production in Austria Considering the Use of Waste Heat: a Study on Costs and Potentials of Greenhouse Gas Reduction. Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie, 18 (3): 107-116.

Schneider,U.A., B.A.McCarl, and E.Schmid. 2007. "Agricultural sector analysis on greenhouse gas mitigation in US agriculture and forestry." Agricultural Systems. 94:128-140.

Searchinger TD, Hamburg SP, Malillo J, Chameides W, Havlík P, Kammen DM, Likens GE, Lubowski RN, Obersteiner M, Oppenheimer M, Robertson PG, Schlesinger WH, Tilman DG (2009). Fixing a critical climate accounting error. *Science* 326(5952): 527-528.

Sessa C. (1985 – 1986), Articles on Local Finance Equalisation in several numbers of *La finanza Locale* review, edited by Maggioli.

Sessa C. (1989), National and local accounts: an integrated accounting framework, Economia Pubblica, Ciriec.

Sessa C. (1998), I beni relazionali e le politiche industriali territoriali, Economia & lavoro, Marsilio Editori, Venezia.

Sessa C. (co-author, 1993), Lavoro pubblico e spesa pubblica, Fondazione Brodolini, Marsilio.

Sessa C. (co-author, 1994), Global Quality Management (Handbook), Sperling & Kupfer.

Sørensen, Å.L (2005) “Economies of Scale in Biomass Gasification Systems.” IIASA, Interim Report 2005, IR-05-030.

Sterner and Persson, (2008), An Even Sterner Report: Introducing Relative Prices into the Discounting Debate, *Review of Environmental Economics and Policy*, vol 2, issue 1.

Swanson T. (2004), Diffusion and Distribution: the impacts of technological enforcement on poor countries, in Maskus,K. and Reichman,J. (eds.) International Public Goods & Transfer of Technology Under a Globalised Intellectual Property Regime, *Cambridge University Press*:Cambridge.

Swanson T. (2005), Conflicts in Conservation: the many values of the black rhinoceros, (with Andreas Kontoleon) in Koundouri,P. (ed.) *Economics Informing Natural Resource Management*, Edward Elgar: Cheltenham.

Swanson T. (2006), Designing the Legacy Library for Genetic Resources in Kontoleon, Pascual and Swanson (eds.), Biodiversity Economics, *Cambridge University Press*.

Swanson T. (2007), Economic Evaluation of Projects Involving Forced Population Displacements, (with David Pearce) in Cernea (ed.) The Problem of Forced Population Displacement, *Oxford University Press*.

Swanson T. (2007), Re-Telling the Tale of the Commons: Governance Problems as Commons Problems, *International Review of Environmental Economics*, 1(1).

Swanson T. (2007), Valuing Complex Goods: Can you get anything out of an expert other than an opinion? (with Groom and Kontoleon), Research in *Law & Economics*, 31:350-385.

Swanson T. (2008), The Value of Genetic Resources for R&D: A Survey, (with Sarr and Goeschl), *Ecological Economics*.

Szolgayova, J., S. Fuss and M. Obersteiner (2008): Assessing the Effects of CO2 Price Caps on Electricity Investments - A Real Options Analysis, *Energy Policy*, 36(10):3974-3981.

Szolgayova, J., S. Fuss, N. Khabarov and M. Obersteiner (2010): A Dynamic CVaR - Portfolio Approach Using Real Options - An application to Energy Investments, accepted at *European Transactions on Electrical Power*.

Tavoni, M., B. Sohngen and V. Bosetti (2008). "Forestry and the Carbon Market Response to Stabilize Climate", Energy Policy, 35:5346-5353.

Treich N and A. Lange, (2008), Uncertainty, learning and ambiguity in climate policy: Classical results and new directions, *Climatic Change*, 89, 7-21.

Treich N. and F. Salanié, (2009), Regulation in Happyville, *Economic Journal* , 119, 665-679.

Treich N. and Y. Bramoullé, (2009), Can uncertainty alleviate the commons problem? *Journal of the European Economic Association* , 5, 1042–1067.

Treich N., The value of a statistical life under ambiguity aversion, (2009), *Journal of Environmental Economics and Management*, 58.

Williams, J.R. 1995. The EPIC Model. In Computer Models of Watershed Hydrology (Ed.: V.P. Singh). Water Resources Publications, Highlands Ranch, Colorado, 1995, pp 909-1000.