



**Advanced Model Development
and Validation for the Improved
Analysis of Costs and Impacts
of Mitigation Policies**

newsletter
January - 2014



The **ADVANCE** project

What is our aim?

Since January 2013, fourteen research institutions from all over Europe have started cooperating with the aim to trigger the development of a new generation of Integrated Assessment Models (IAMs).

Why is this important?

Integrated Assessment Models (IAMs) describe the environmental, social and economic factors and interactions that determine climate change. They have become central tools to inform policy makers on different climate mitigation options and their impacts. It is worthwhile to mention that the results from such assessments are heavily used in the reports of the Intergovernmental Panel on Climate Change (IPCC) to provide world governments with a clear scientific view on climate change.

However, with the increasing use and growth in complexity of the models, the demand for improved representations as well as thorough validation of model behaviour has grown significantly over the past years.

What do we do?

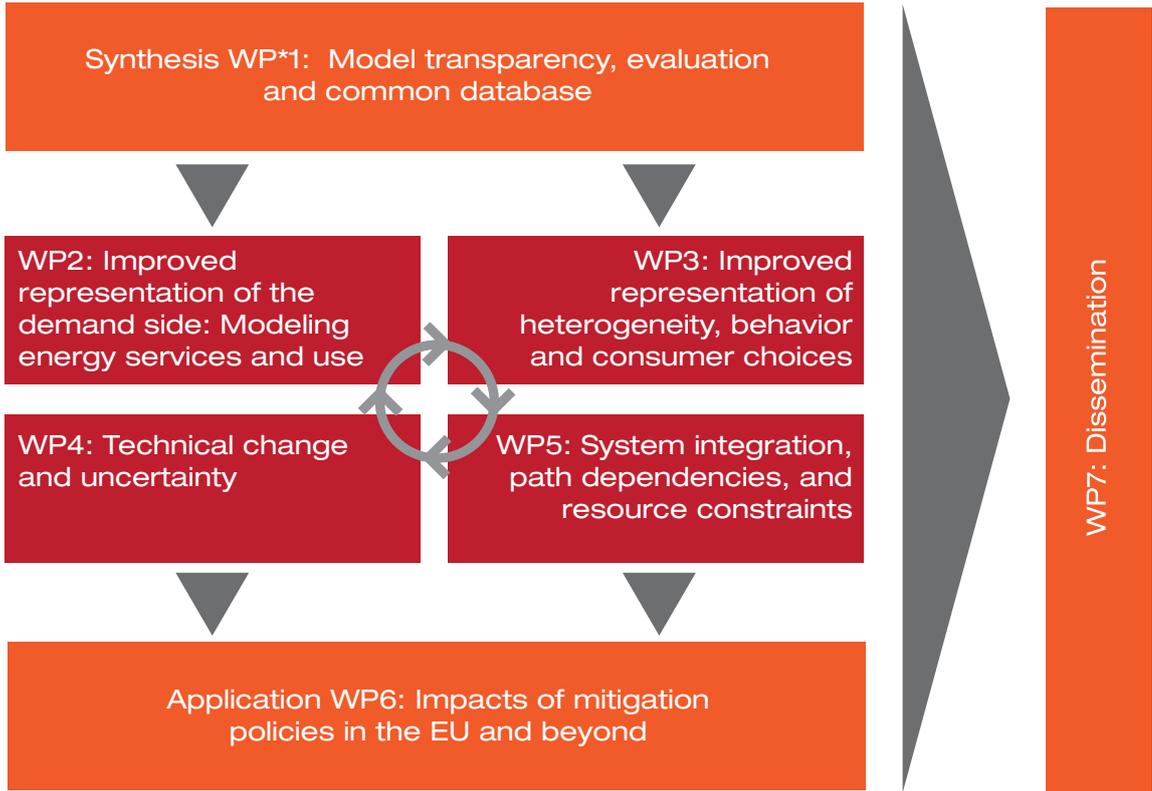
We improve modelling methodologies with a focus on the following priority areas:

- End-use technologies providing energy services, drivers of energy demand and potentials for energy efficiency improvements;
- Heterogeneity of consumer preferences and effects of behavioural changes on energy demand;
- Innovation, technological change and uncertainty;
- Systems integration of variable renewable energy sources, path dependencies and resource constraints;
- Impacts of energy and climate policies on economic sectors with a focus on the EU and beyond.

We promote model transparency by elaborating a comprehensive and harmonized documentation of models, which elucidates their structure, assumptions, limitations and input data. In parallel, we develop automated validation tests allowing for assessment and comparison of model performance. Datasets and methodologies generated in the course of the project are made available to the broader scientific community via an open access resource.

We apply the improved models to assess EU climate policy in the framework of policy impact assessments.

Overview of main project activities and their interrelation



*WP = Work Package

How do we work?

For all research activities related to methodological improvements, we have a first phase in which a core group of 1-3 “pioneer” modelling teams develops, implements and tests innovative modelling approaches. Based on results, suitable reduced representations for use in other models are developed. In a second phase, the other participating teams adopt and implement the modelling approaches in their models. Eventually, the resulting model algorithms and relevant raw input data sets are made available to the entire modelling community as an open access resource.



Who are we?

Our consortium is composed of leading modelling teams from all over Europe. Such strong modelling expertise is complemented by extensive knowledge on bottom-up and empirical analyses of energy issues. Also, even if anchored in Europe, the project involves leading research teams from non-European countries.

Models participating in ADVANCE

Model	Institute	Category	Scale
REMIND	PIK	Hybrid energy system – Economic growth model	Global
MAGPIE	PIK	Land use allocation model	Global
MESSAGE	IIASA	Hybrid energy system – Economic growth model (soft linked)	Global
WITCH	FEEM	Hybrid energy system – Economic growth model	Global
IMACLIM	SMASH	Recursive dynamic hybrid energy system – computable general equilibrium model	Global
GEM-E3	IPTS/ ICCS	Recursive dynamic computable general equilibrium model	Global, EU28
IMAGE/ TIMER	PBL	Integrated energy land-use partial equilibrium modelling system	Global
POLES	IPTS/ UPMF	Energy system partial equilibrium model	Global
TIAM-UCL	UCL	Energy system partial equilibrium model	Global
ReMIX	DLR	Electricity system partial equilibrium model	Regional (e.g. Europe)
GCAM	PNNL- JGCRI*	Integrated energy land-use partial equilibrium model	Global
AIM/CGE	NIES*	Recursive dynamic computable general equilibrium model	Global
DNE21+	RITE*	Energy system partial equilibrium model	Global
iPETS	NCAR*	Recursive dynamic computable general equilibrium model	Global

*Associated collaborators

Highlights from the first year of ADVANCE

Increasing transparency of IAMs

Harmonized model documentation

Models have grown in sophistication and complexity, making it difficult to keep track of underlying structures and input assumptions. Moreover, there is considerable difference in model results, which immediately raises the question about the underlying reasons for the observed diversity.

One of the central objectives of ADVANCE is to enhance the understanding of models, as well as the comparability and interpretability of their results. To this end, we have elaborated such harmonized documentation for all energy-economic and Integrated Assessment Models (IAMs) participating in the project at two different levels of detail:

- Model-specific reference cards provide a quick 3-page overview of most important model characteristics. They allow for simple comparison of main features and represent an easy accessible summary for high level decision makers.
- A more comprehensive documentation of 30 to 40 pages provides detailed insight into model characteristics with regard to underlying concepts and methods, coverage of economy, energy, land-use and climate related aspects, as well as to some degree mathematical formulations.

We plan to make the model documentation publicly available by autumn 2014. This resource will be continuously updated and modelling teams from outside the ADVANCE consortium will be invited to comment on the usefulness of the documentation structure and also contribute documentations on their models.

Standard tests of scenario results

To investigate differences of model results ADVANCE will not stop at model documentation.

Over the course of 2014, ADVANCE will develop a web-based tool for standard validation and diagnostic tests of scenario results. Diagnostic experiments can reveal model response under well-defined conditions and allow explaining differences in response patterns. The web-based tool developed by ADVANCE represents the first ever attempt to assess and compare model performance in a semi-automated way.

The integrated assessment modelling community will soon be invited to join this exercise on standard validation and diagnostic tests. A related call for participation will be launched at the beginning of 2014.

Enhancing the state of transport modelling in IAMs

Results of the first ADVANCE expert workshop

In overall three stakeholder and expert workshops, ADVANCE will discuss project approaches with sectoral experts, policy makers, business and civil society with the main goal to get bottom-up feedback. The following section presents main findings of the latest of such workshops, which was held in November 2013 and focused on “Enhancing the state of transport modelling in IAMs”.

The purpose of the workshop was to bring together transport experts from various areas in order to share their extensive knowledge on the sector and ultimately to provide guidance for how to improve the models. Topics covered included data, behaviour and infrastructure.

The workshop’s opening session gave participants an overview of the present state of transport modelling within IAM frameworks, as well as the challenges that lie ahead. Speakers included Bastien Girod, Tom Longden and Oreane Edelenbosch.

Transport data experts Jari Kauppila and Lew Fulton then discussed the various sources of data that exist, where one can find this data, and the possibilities for data collection and sharing. Both speakers asserted that a large amount of transport data is available; the problem is that data sources are fragmented, and key data is often missing. Coordinated efforts are therefore needed, both at the institutional level (e.g. across governments) and within the research community. Improved datasets can be achieved through widespread cooperation and data sharing among research groups. Within the ADVANCE project, a first attempt in data sharing will be made by forming a meta-database for historical transport data and key scenario assumptions.

In the behaviour session, Jillian Anable emphasized the importance of including consumer preferences in IAMs, but noted the challenges in doing so. Non-cost factors, end-user segmentation and policy diversity are all important in this context. Mark Jaccard then described his approach for endogenously representing certain behavioural aspects within energy-economy models. Such techniques may be explored within the ADVANCE project.

Finally, David Greene, Hannah Daly and Alexander Körner touched upon several aspects of modelling transport infrastructure, both for new refuelling systems and for road/rail networks and ports. In the former case, David Greene stated that the real difficulty lies in modelling the transition towards these new systems (e.g. hydrogen or electric vehicle

infrastructure). Hannah Daly then illustrated how costs of existing road/rail infrastructure can be included in certain IAMs. Alexander Körner concluded by describing the IEA's recent scenario study on infrastructure study. He noted the large infrastructure cost savings that could potentially result in a sustainable transport future.

Short outlook for 2014

ADVANCE will continue seeking for improvements in the representation of energy demand, system integration as well as technological innovation and uncertainty. In the first half of the year 2014 related reports on energy demand and technological change will be published and a workshop on uncertainty will be held.

Work on transparency of IAMs will also continue and show first results by mid-2014.

After some time for review, reference cards and model documentation will be made publicly available. In parallel, standard validation and diagnostic tests will be developed and allow for a first exercise on model comparison.

An analysis of gaps in currently available IAMs in view of their suitability for EU policy impact assessments is under way. The analysis will be finalized early 2014 and point at model improvements to better support EU climate policy development.

Upcoming ADVANCE meetings and events

Expert and stakeholder workshop "Uncertainty"
& 3rd project meeting
13-16 May 2014 (tentative)
Milan, Italy

ADVANCE consortium

- Potsdam-Institut für Klimafolgenforschung (PIK), DE
- Internationales Institut für angewandte Systemanalyse (IIASA), AT
- Ministerie van Infrastructuur en Milieu (PBL), NL
- Fondazione Eni Enrico Mattei (FEEM), IT
- JRC - Joint Research Centre - European Commission (IPTS), ES
- University College London (UCL), UK
- Société de Mathématiques Appliquées et de Sciences Humaines (SMASH), FR
- University of East Anglia (UEA), UK
- Institute of Communication and Computer Systems (ICCS), GR
- Université Pierre Mendès France (UPMF), FR
- Norges Teknisk-Naturvitenskapelige Universitet (NTNU), NO
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), DE
- Universiteit Utrecht (UU), NL
- Enerdata SA (NRD), FR

Associated collaborators

- Pacific Northwest National Laboratory (PNNL), USA
- National Center for Atmospheric Research (NCAR), USA
- National Institute for Environmental Studies (NIES), JP
- Research Institute of Innovative Technology for the Earth (RITE), JP



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