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

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Collaborative project

**DELIVERABLE No 1.2**  
**Interactive public web-database with automated implementation of diagnostic and  
validation routines**

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## Interactive public web-database with automated implementation of diagnostic and validation routines

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## 1. Introduction

Testing how integrated assessment model (IAM) scenarios of the future compare to historical patterns and diagnosing model behaviour under well-defined, stylised conditions is important for obtaining a proper interpretation of the differences across different models. In addition, increasing the transparency and accessibility of the models, as well as developing and applying standardised tests for validation and diagnostics, is vital for increasing confidence in IAM results.

Given the considerable differences in key results across different models, e.g. those regarding technology choice or costs and achievability of mitigation targets, there is an obvious need to improve our understanding of how these results compare to empirical evidence, and how differences across models relate to different model structures and input assumptions. This is a particularly demanding, but necessary, exercise for the current generation of IAMs, which have grown in sophistication and complexity to more accurately represent the coupled energy-economy-land-use-climate system

The development of standard model diagnostic experiments and validation experiments for IAMs, however, is still in its infancy. In the context of the completed EU-FP7 project, AMPERE, and the US-DOE-sponsored PIAMDDI project, pioneering work has been undertaken in this direction, e.g. by testing how well historically observed “stylized facts” are reproduced by models. ADVANCE builds upon these experiences, and expands the scope of validation and diagnostics to establish greater transparency of model results. In addition, based on a broader set of scenarios new experiments have been and will continue to be designed to test the response of a broader set of models under well-defined conditions. Such diagnostic scenario runs are a valuable tool for investigating the differences in model results and putting policy-relevant findings from the different models into the context of historically observed behaviour.

Based on an existing platform at IIASA (used in a number of international modelling comparison projects, e.g., the FP7 AMPERE and LIMITS projects, and the IPCC Working Group III 5th Assessment Report), a web-database for storing and disseminating model results has been developed within the ADVANCE project under Task 1.2. Specifically, the web-database has been extended with features for standardised diagnostics of scenarios. The methods for diagnostics and validation have been developed jointly with Task 1.1. So far, the new diagnostic database includes results from three pioneering modeling teams that are part of the ADVANCE consortium. However, there is ongoing coordination process with the Scientific Working Group on Evaluation and Diagnostics of the Integrated Assessment Modeling Consortium (IAMC) to develop community-wide standard diagnostic tests for which the work done within ADVANCE will serve as a starting point. Once the coordination process with the IAMC will have been finalised, it is planned to make the diagnostic database openly available to the entire IAM community.

Section 2 provides an overview of the diagnostic scenario specifications and the application of the MAGICC simple climate model to derive harmonized climate indicators for emissions scenarios from different IAMs. A more detailed description of the diagnostic scenarios and their implementation can be found in the ADVANCE diagnostics modeling protocol which is included in Appendix A. Section 3 then describes the capabilities of the ADVANCE Diagnostic Database and provides illustrations of its application to diagnostic scenarios from the three pioneering IAMs. Finally, Section 4 summarizes the achievements under Tasks 1.1 and 1.2 and highlights plans for further development of the newly established database infrastructure.

## 2. Model Validation and Diagnostics

### 2.1 *Diagnostic Indicators and Scenarios*

Model diagnostics aims to characterize, compare and classify the behavior of models for climate policy analysis. The experimental setup is dedicated to generate model output that can be used to estimate a set of diagnostic indicators of model response to carbon pricing policies. The ultimate goal is to better understand differences in model behavior, enable fingerprinting of model responses, and classify models along their fingerprints. The feasibility of this approach has been demonstrated in the AMPERE project (see Kriegler et al., (2014)). A set of four diagnostic indicators has been established that allows model fingerprinting and classification based on the type of diagnostic experiment. These indicators are

- Transformation Index (TI)
- Relative Abatement Index (RAI)
- Carbon Intensity over Energy Intensity (CIEI)
- Costs per Abatement Value (CAV)

Within the ADVANCE project, one of these indicators, the so-called Transformation Index (TI), is applied at various levels of the energy system, primary and final energy. An extension to other parts of the energy system, such as electricity generation or liquid fuel production, is straight forward and an application to land-use indicators, for example, land cover, is also possible if the required data is available. It is planned to add more diagnostic tests in the future, as a result of which many of the variables that are listed in the data template have been classified as recommended or optional.

The diagnostics indicators listed above are calculated based on a set of standardized scenarios which can be run with modest effort by national, regional and global energy-economy and integrated assessment models. The diagnostic scenario setup is comprised of a total of sixteen scenarios that are grouped into five mandatory scenarios, five recommended scenarios and six optional scenarios. In general, the diagnostic scenarios are not expected to reproduce current observations or policy settings. They are constructed with the sole purpose of allowing the academic community to conduct model diagnostics. They are explicitly not intended to provide policy analysis.

To increase visibility of the diagnostic work within ADVANCE and to ensure that it becomes useful not just for the modeling teams participating in the ADVANCE project, but for the entire modeling community, a coordination process with the Integrated Assessment Modeling Consortium (IAMC) has been started. This process is ongoing and as a basis for the discussion with the Scientific Working Group on Evaluation and Diagnostics of the IAMC, a draft modeling protocol has been produced by the ADVANCE consortium (see Appendix A).

### 2.2 *Harmonized Simple Climate Model*

A challenge in the analysis and comparison of climate mitigation scenarios has been that different IAMs employ different simple climate models to calculate climate indicators such as radiative forcing, greenhouse gas concentrations or temperature change. Given the large uncertainties in the climate system response, the direct use of native climate model output from IAMs introduces distortions when comparing scenarios with similar climate outcomes across different models. The recently published Fifth Assessment Report (AR5) of IPCC Working Group

III (IPCC 2014) has therefore employed a single simple climate model to harmonize climate indicators across different IAM-based scenarios and thus improve comparability across models. For this purpose the simple climate model MAGICC (Meinshausen et al. 2008) has been used (Clarke et al. 2014; Krey et al. 2014). To make the quite elaborate harmonization process accessible to the larger community, the ADVANCE consortium has integrated a version of the MAGICC model into the web-database. As a result, emissions from global models can be fed into MAGICC to allow a comparison of climate indicators from this harmonized climate model across different energy-economy and integrated assessment models and also to compare the results of MAGICC with those of the native climate model employed by the IAMs. For the application of the MAGICC model a step procedure is necessary:

- Harmonization of the IAM GHG and other emissions for the model base year to guarantee a smooth transition from historical data to future scenario data. This is particularly important for short-lived climate forcers for which a jump in emission levels produces a discontinuity in radiative forcing results of the climate model. A well-established procedure described in Schaeffer et al. (2014) has been used for the base year harmonization is used.
- Supplementing missing GHG and other emissions information that are required by the MAGICC model, but that are not supplied by each energy-economy or integrated assessment model. A simplified approach is used here which supplements data from a scenario that provides the required output. Following Rogelj et al. (2011), for this purpose the Representative Concentration Pathway (RCP) 3PD has been chosen. Consistent with IPCC (2014), it was decided to only run emissions from scenarios for which at least fossil fuel and industrial CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and SO<sub>x</sub> emissions are available through the MAGICC model.
- For reasons of transparency, the resulting emissions trajectories are imported into the diagnostic database and are then passed to MAGICC.
- Ultimately, the climate indicators as calculated by MAGICC are also imported into the ADVANCE Diagnostic Database.

### 3. Diagnostic Database

The ADVANCE project is offering a web-based platform to collect the results from individual energy-economy and integrated assessment modeling teams in a diagnostic database. This database offers easy access to the diagnostic indicators, their comparison across participating models, and thus allows teams to assess how their model is situated in the space of available models. It is meant to make the process of data collection and comparison more efficient and thus allow researchers to focus on substance rather than having to spend significant amounts of time collecting and harmonizing the required data. The database can be accessed via the following link: <https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB>. Technical instructions for diagnostic scenario submissions to the diagnostic database and a brief documentation of the web-database can be found in Appendix B.

#### 3.1 *Diagnostic Indicators*

In the following section, a few screenshots of the ADVANCE Diagnostic Database showing various diagnostic indicators that have been automatically calculated by the database are shown

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(Figure 1, Figure 2, Figure 3). As previously mentioned, three pioneering modeling teams from within the ADVANCE consortium (MESSAGE, REMIND and WITCH) have so far submitted diagnostic scenarios to test the newly developed database infrastructure and to illustrate its capabilities.

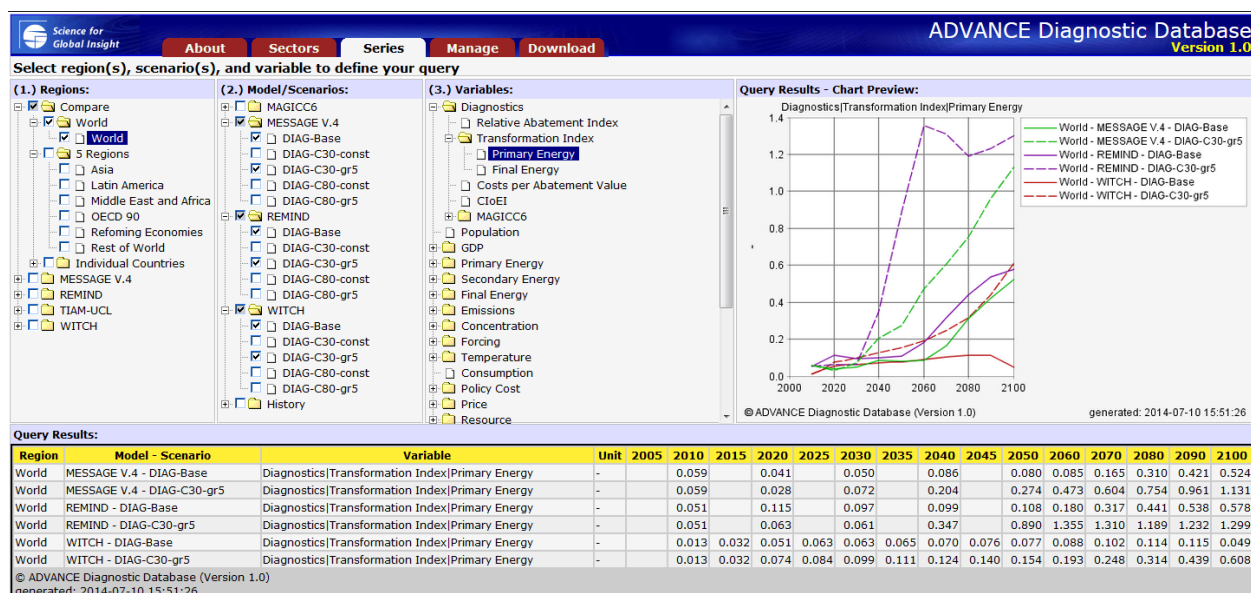


Figure 1: ADVANCE Diagnostic Database screenshot showing the *Transformation Index (TI)* – Primary Energy for two diagnostic scenarios from the models MESSAGE, REMIND and WITCH.

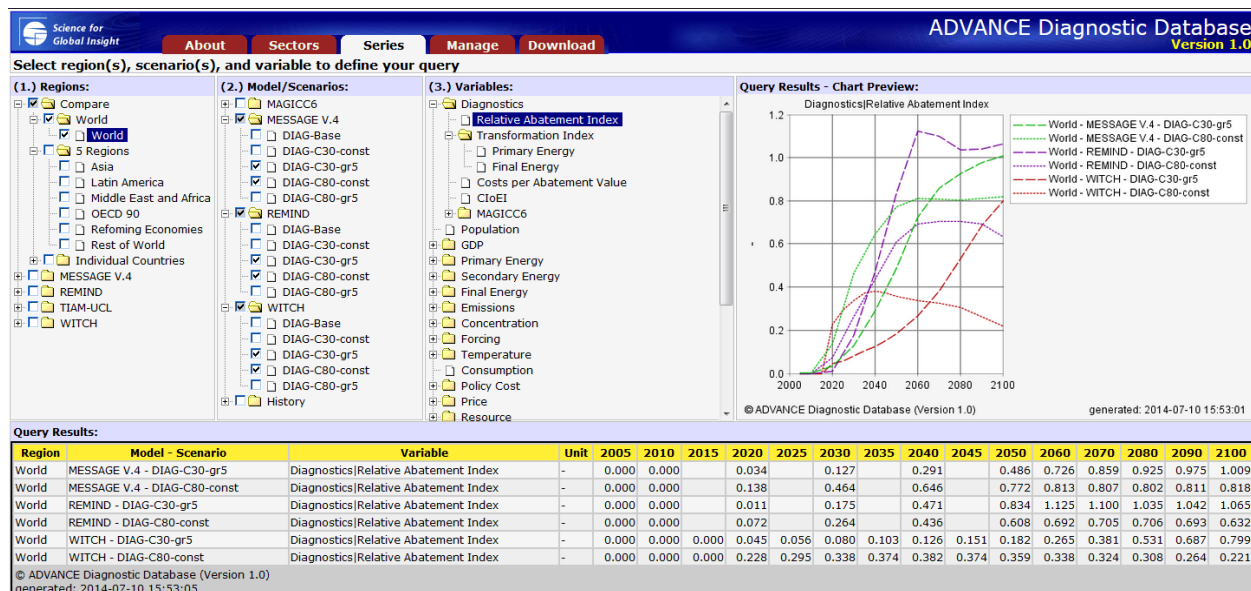


Figure 2: ADVANCE Diagnostic Database screenshot showing the *Relative Abatement Index (RAI)* for two diagnostic scenarios from the models MESSAGE, REMIND and WITCH.

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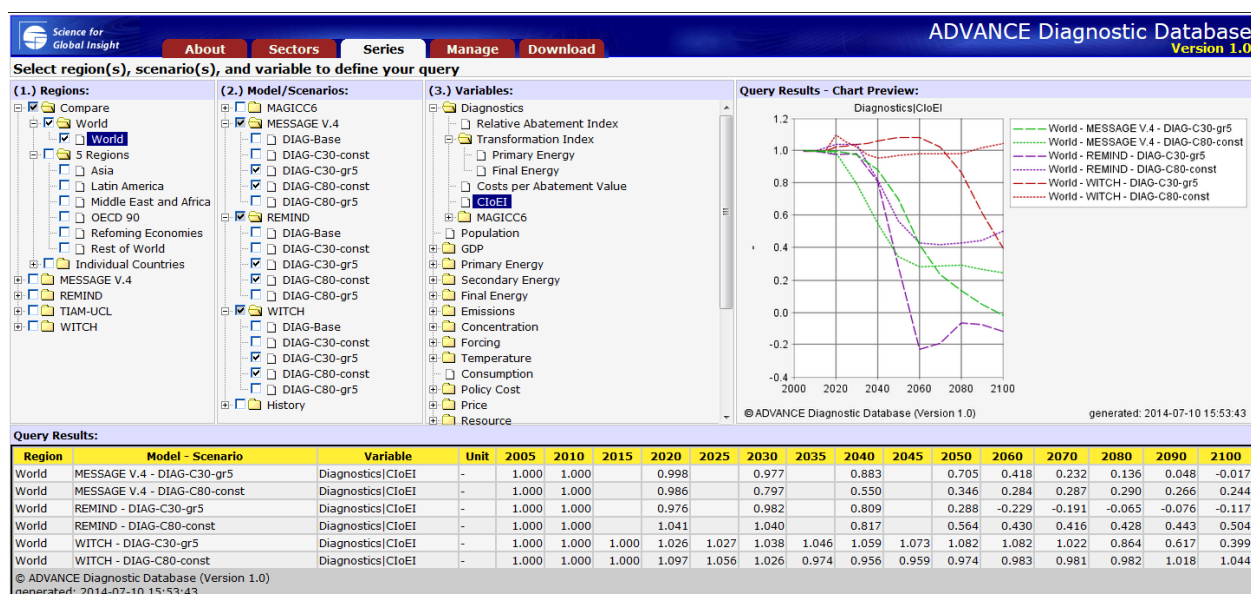
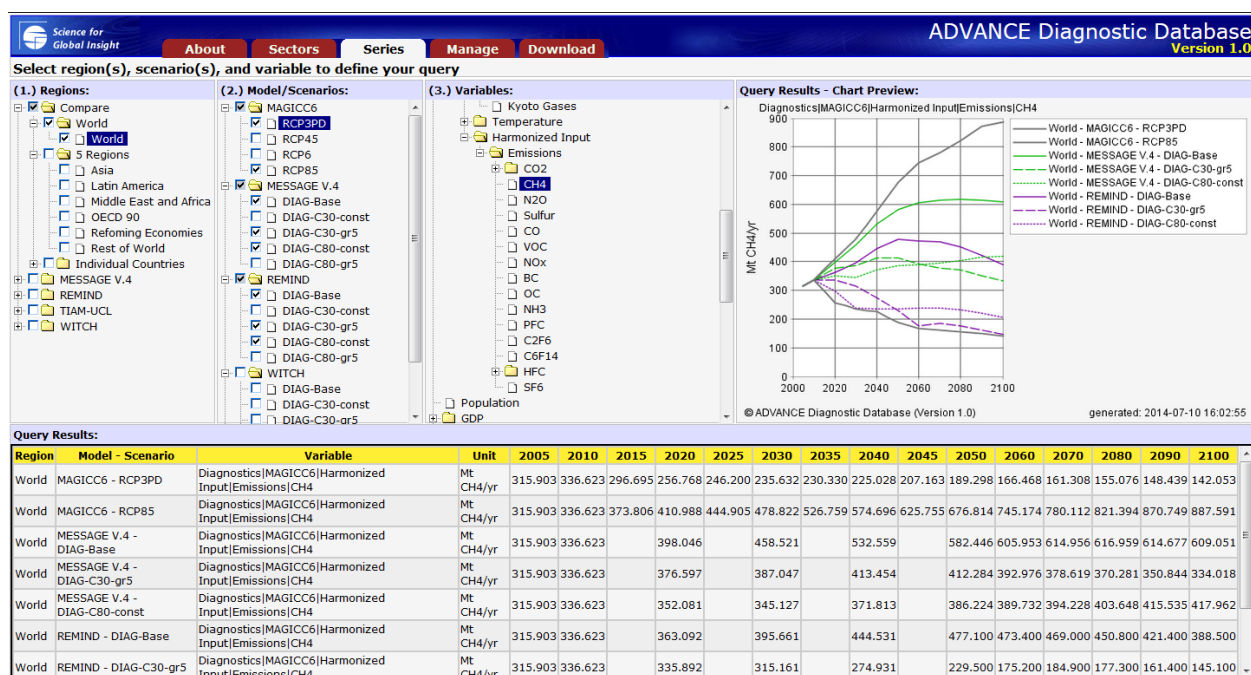


Figure 3: ADVANCE Diagnostic Database screenshot showing the *Carbon Intensity over Energy Intensity (CioEI)* for two diagnostic scenarios from the models MESSAGE, REMIND and WITCH.

### 3.2 Climate Model Indicators

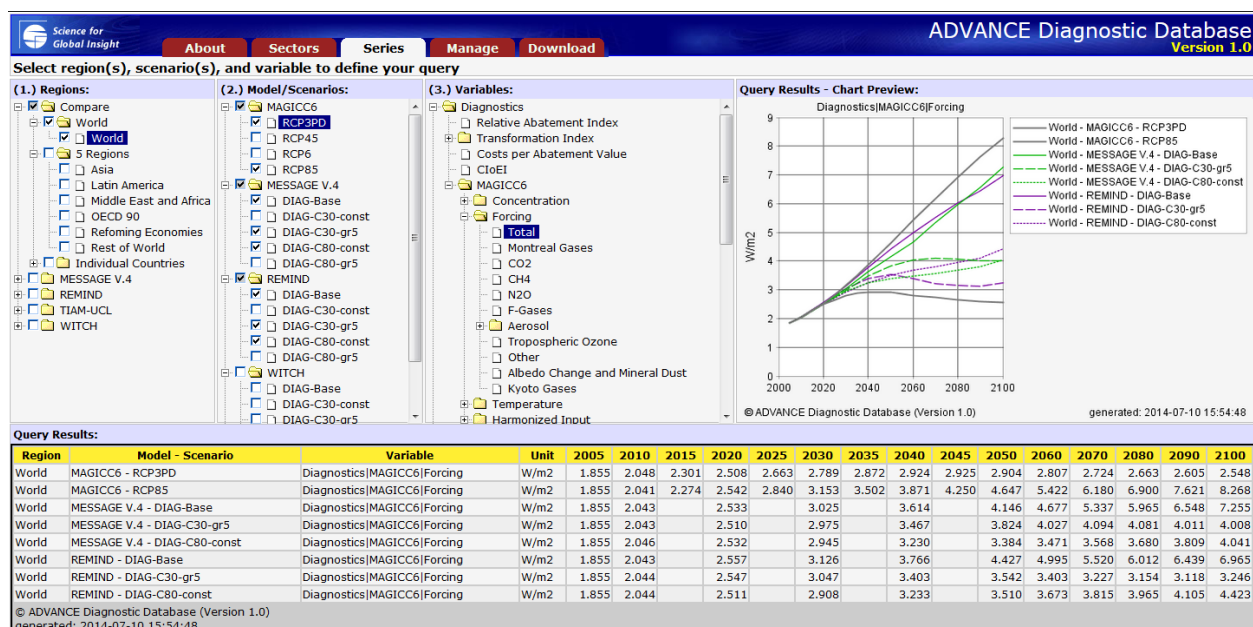
Two of the three pioneering models in ADVANCE (MESSAGE and REMIND) provide the required to emissions data to be run through MAGICC and the results will be shown for illustrational purposes in the following section. Below harmonized emissions (Figure 4), radiative forcing (Figure 5) and temperature change (Figure 6) as calculated by the MAGICC model based on two diagnostic scenarios provided by IAMs are shown.



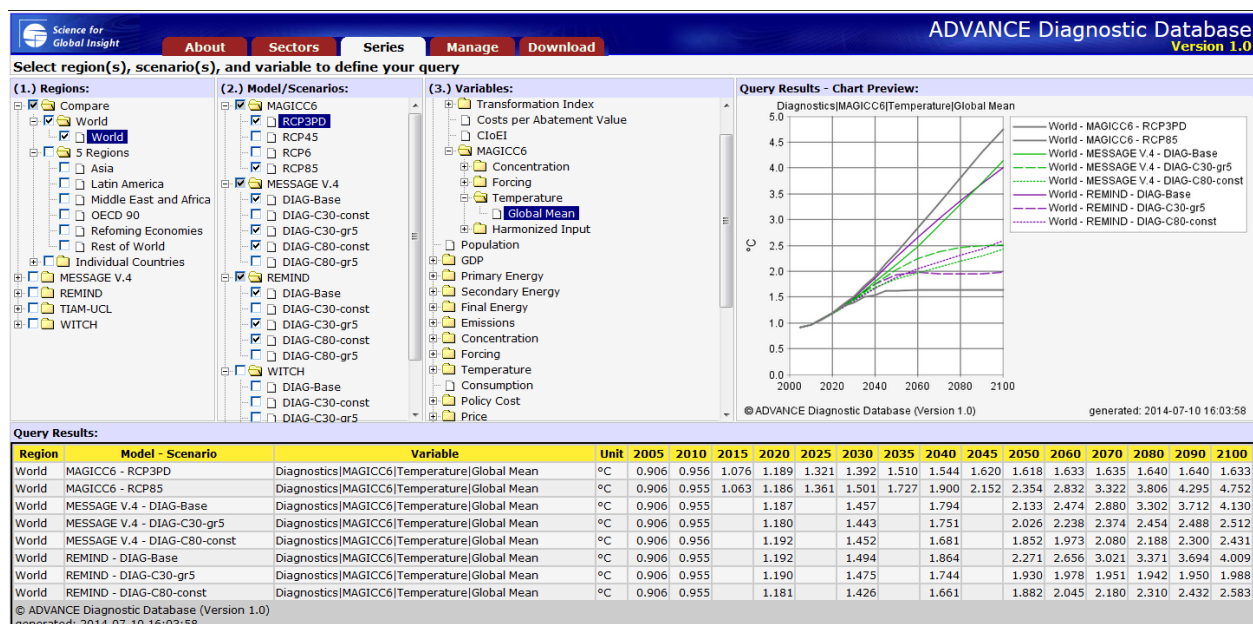


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**Figure 4:** ADVANCE Diagnostic Database screenshot showing the *harmonized emission levels of CH<sub>4</sub>* for two diagnostic scenarios from the models MESSAGE and REMIND in comparison to the emissions levels in the Representative Concentration Pathways (RCPs) 3PD and 8.5.



**Figure 5:** ADVANCE Diagnostic Database screenshot showing *total radiative forcing* calculated with the MAGICC6 models for two diagnostic scenarios from the models MESSAGE and REMIND in comparison to the radiative forcing levels in the Representative Concentration Pathways (RCPs) 3PD and 8.5.



**Figure 6:** ADVANCE Diagnostic Database screenshot showing *global mean temperature increase since preindustrial times* calculated with the MAGICC6 models for two diagnostic scenarios from the models MESSAGE and REMIND in comparison to the temperature increase in the Representative Concentration Pathways (RCPs) 3PD and 8.5.



## 4. Summary and Outlook

Under Tasks 1.1 and 1.2 the ADVANCE consortium has developed new diagnostic scenario specifications and developed an automated diagnostic database system. The purpose of this system to ease calculation of diagnostic indicators and harmonized climate indicators for a large set of energy-economy and integrated assessment models, thereby contributing to the transparency of models and building trust in model results. At present, several established diagnostic indicators are automatically calculated from the submitted scenario information. Through a call to the wider integrated assessment modeling community that is jointly prepared with the Integrated Assessment Modeling Consortium (IAMC), it is hoped to obtain diagnostic scenarios from a wide range of models by the end of 2014 that can then be used to develop further diagnostic tests and indicators. In anticipation of these future development activities, a much larger set of variables and scenarios than strictly required to calculate the currently implemented set of diagnostic indicators is being asked for in the draft call for scenario submissions to the community. The ADVANCE activity can thus be seen as a seed activity that has the potential to foster further development into this direction in other project and as voluntary work by the IAM community.

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## 6. Appendix A: ADVANCE Diagnostic scenarios

The following section is a draft of the modeling protocol that has been produced by the ADVANCE consortium and is currently being discussed with the IAMC.

Draft version 4, 19 June 2014

### 1. Motivation

The proposed model diagnostics aims to characterize, compare and classify the behavior of models for climate policy analysis. The experimental setup is dedicated to generate model output that can be used to estimate a set of diagnostic indicators of model response to carbon pricing policies. The ultimate goal is to better understand differences in model behavior, enable fingerprinting of model responses, and classify models along their fingerprints. The feasibility of this approach has been demonstrated in the AMPERE project (see Kriegler et al. (2014)). A set of four diagnostic indicators has been established that allows model fingerprinting and classification based on the type of diagnostic experiment proposed here. The ADVANCE project is continuing this work by offering a platform to collect the results from individual energy-economy and integrated assessment modeling teams in a database. The database offers easy access to the diagnostic indicators, their comparison across participating models, and thus allows teams to assess how their model is situated in the space of available models.

### 2. Participation

#### 2.1. Who can participate?

Every team with a national, regional, or global energy-economy or integrated assessment model is invited to participate in the diagnostic analysis proposed here. The diagnostic experiments can be run by every climate policy model with a time horizon until 2050 or longer, and which is able to

analyze carbon pricing policies. Minimum requirement is the submission of five core diagnostic runs (one baseline and four carbon pricing policies) in a standardized output reporting template (see below).

### 2.3. How to participate?

The first step is to register your model. Model registration requires to provide some information about model version, structure, and regional resolution<sup>1</sup>. Once your model is registered, the second step is to run the diagnostic experiment set out in this protocol. As a minimum requirement, five core diagnostic scenarios need to be reported in full. It is recommended to also report five additional scenarios of high relevance for the diagnostic analysis, but this is not a prerequisite for participation. The protocol includes five additional optional scenarios which teams may choose to report if they consider them relevant for an extended diagnostic analysis of their model.

Please make sure to implement all specifications in the protocol as requested to ensure comparability of results across models. Baseline and carbon policy scenarios must be derived from the model version that was registered. If your model was updated, and you want to resubmit updated diagnostics, you can do so by registering the new model version separately. The submission of diagnostic scenarios from different versions of the same model will allow to investigate the changes in model response due to model updates, and thus help to relate published findings from different stages of model development to each other. Model output needs to be reported in a standardized format, based on the IAMC output reporting template. The template can be downloaded<sup>2</sup>. The completed output report needs to be submitted to the ADVANCE Model Diagnostics Database hosted by IIASA<sup>3</sup>. Several checks on the fulfillment of minimum requirements, the use of standardized naming and reporting conventions, and consistency with the experimental setup of the diagnostic analysis will be performed at the time of submission. A successful submission establishes the participation of the model in the diagnostic analysis.

The ADVANCE diagnostic database will be open for submission of diagnostic scenarios for a longer period of time. However, a large-scale comparative analysis of diagnostic model output is scheduled to commence in January 2015. All teams interested in participating in this analysis need to submit their diagnostic scenarios by **15 December 2014**.

### 2.4 What are the benefits of participation?

Participants will gain access to the diagnostic database at the time of submission of diagnostic model runs. Data access will allow participating teams to compare their model results and model diagnostics with other models using a Graphical User Interface.

### 2.5 What are the terms of participation?

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<sup>1</sup> <https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB/dsd?Action=htmlpage&page=about>

<sup>2</sup> [https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB/static/download/Diagnostics\\_template\\_2014-06-29.xlsx](https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB/static/download/Diagnostics_template_2014-06-29.xlsx)

<sup>3</sup> <https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB>

The submission of diagnostic scenarios grants the planned large-scale comparative analysis on model diagnostics the permission to use and publish the scenarios in the context of the analysis. Modeling teams retain the right to update or withdraw their scenarios at any point prior to submission of a paper summarizing the diagnostic analysis (but not after submission). The diagnostics analysis will be shared with modeling teams at all stages of the analysis. Analysts are required to accommodate comments of modeling teams concerning the presentation and interpretation of their models. Modeling teams are invited to contribute to the analysis beyond the submission of results, which would entitle them to an authorship on the publication of results. Modeling teams retain the right to use and publish their own submitted scenario data individually. The diagnostic database as used for the analysis will be made publicly available at the time of publication of the diagnostic study.

### 3. The Scenario Setup

#### 3.1. Overview

The diagnostic scenario setup is comprised of a total of sixteen scenarios that are grouped into five mandatory scenarios, five recommended scenarios and six optional scenarios. In general, the diagnostic scenarios are not expected to reproduce current observations or policy settings. They are constructed with the sole purpose of allowing the academic community to conduct model diagnostics. They are explicitly not intended to provide policy analysis.

**Core scenarios:** They include a “no policy” baseline run, and four carbon price scenarios. The carbon price scenarios have two different shapes (constant and exponentially growing) and two different levels (USD 30 and 80 in the year 2040). This core set is based on the scenarios used in the diagnostic analysis conducted by the AMPERE project. It is sufficient to establish the four diagnostic indicators developed in the AMPERE study and to assess the robustness of resulting model fingerprints across different shapes and levels of assumed carbon price trajectories.

**Recommended scenarios:** They include three scenarios of price shocks in the year 2040, jumping from zero carbon pricing (in the baseline) to price levels obtained by the core scenarios in 2040. This set of scenarios adds important information for new diagnostic indicators characterizing response times to price shocks, path dependency (different past, same future setting) and system inertia (same past, different future setting). The fourth scenario describes a linear increase of carbon prices enabling an analysis to what extent the widely used Hotelling assumptions of exponentially increasing carbon prices affects the shape of the emissions response and the technology deployment schedules. Finally, the set includes a scenario with a quantity constraint on cumulative carbon emissions. This allows to compare the impact of carbon prices on emissions (and other variables) with the reverse impact of an emissions constraint on carbon prices (and other variables).

**Optional scenarios:** This set of scenarios is relevant for particular model types (e.g. models with a time horizon until 2100, models with foresight etc.) and can provide an extended set of model diagnostics. They include a reference (policy) baseline for those models that include climate policies and/or different assumptions about emissions drivers (GDP and population) in their default baseline, and would like to report this baseline in addition to the mandatory no policy baseline. The set also includes two additional carbon price shock scenarios and an additional

emissions constraint scenario with larger CO<sub>2</sub> emissions budget to augment the sensitivity analysis of price shock and carbon budget scenarios. A further scenario describes an anticipated jump in carbon prices (rather than an unanticipated shock) which can allow to identify the effect of anticipation in models with foresight. Finally, the set includes a carbon price scenario that switches from constant to exponentially increasing carbon prices, thus allowing the study of inertia in a continuous setting without price shocks.

### 3.2. General specifications

The following general specifications hold for the diagnostic scenario setup:

- **No-climate-policy baseline (DIAG-Base):** We use a no-climate-policy baseline for the diagnostic exercise with a zero (shadow) price of greenhouse gas emissions. This implies that all existing climate policies implemented in the baseline should be removed if feasible. The 'no-climate-policy baseline' is not expected to match the observed greenhouse gas emissions until 2013, since the observed quantities are already affected by current climate policies or the expectations thereof in some regions. It may be difficult for some models, particularly for national and regional models, to remove all existing climate policies in their baseline. At a minimum, any explicit carbon pricing in the baseline should be removed, and an effort should be made to remove other policies that are explicitly dedicated climate policies penalizing carbon emissions (such as standards on the carbon intensity of fuels) to the extent possible.
- **Model default baseline (DIAG-Base-Def; optional):** In addition, modeling teams may submit their default model baseline if it deviates significantly from the no-policy baseline during some time period. With climate policies being enacted in a number of world regions to date, models have increasingly included these climate policies in their reference baseline as a means to better capture the existing policy environment and to match the observed greenhouse gas emissions. Due to the recommended harmonization of population and economic growth assumptions in the no policy baseline of global models (see below), the default baseline may also be different from the no-policy baseline in terms of emissions drivers. If the no-climate-policy and default baselines are identical for a given model, only the former should be submitted with a comment that it is also used as a default baseline by the modeling team.
- **Baseline Harmonization:** It is recommended that global modeling teams (but not necessarily national modeling teams) harmonize their GDP and population assumptions in the no-policy baseline to the SSP2 marker scenario. Baseline harmonization is, however, not required in order to keep the barrier for participation as low as possible. Baseline harmonization will enhance the comparability between response patterns of models that treat population and GDP exogenously or semi-exogenously (i.e. GDP is derived from a limited set of model parameters such as labour productivity). GDP and population harmonization can be of more limited value for models that would need to make a host of choices on economic sectors and energy intensity improvements to match a prescribed GDP trajectory. Modeling teams should evaluate individually whether there is sufficient benefit from harmonizing their population and GDP assumptions, and on this basis make a decision whether to introduce it. This decision should be documented in the submission of scenarios to the IIASA database. Obviously, the no-

policy baseline (whether harmonized or not) should serve as the reference point for all primary diagnostic carbon price and carbon budget runs. There is the possibility to submit multiple sets of diagnostic scenarios, e.g. one based on a harmonized no-policy baseline and another one based on alternative baseline assumptions (e.g. the model default baseline with non-harmonized assumptions). See the naming convention for more information on this possibility.

If modeling teams choose to harmonize population and GDP trajectories in the no-policy baseline they may use their preferred approach for matching the SSP2 population and GDP scenarios on the level of their native model regions. The SSP2 population and GDP data can be downloaded at <https://secure.iiasa.ac.at/web-apps/ene/SspDb/dsd>. The SSP database (File SspDb\_country\_data\_2013-06-12 in the Download tab) provides country level population projections (IIASA-WIC POP, Scenario SSP2-v9-130115: the dataset includes total population, age cohorts, sex and education levels; share of urban population can be taken from NCAR Scenario SSP2-v9-130115) and GDP projections in Power Purchase Parity (PPP) (OECD Env-Growth, Scenario SSP2\_v9\_130325). Modeling teams should aggregate the country level GDP information to their native model regions in PPP terms before introducing a conversion to Market Exchange Rates (MER) if needed. The database provides historic country level PPP to MER conversion ratios for the year 2005 (File OECD-WB PPP-MER2005\_conversion\_rates) from which 2005 conversion ratios for the native model regions can be deduced (PPP GDP country sum vs. sum of country GDP converted to MER). Modeling teams should use their default method of adapting external PPP GDP projections in their modeling framework.

- **Time horizon:** Carbon price scenarios are specified for the period 2020-2100, but they remain useful for models with shorter time horizon, e.g. to the year 2050. Models with a time horizon shorter than 2100 should adopt the carbon price scenarios until their particular end year. Models with a time horizon extending beyond 2100 should fix the carbon price at the value reached in the year 2100 for later periods. Carbon budgets are specified for the period 2020-2100, and therefore not applicable to models with a shorter time horizon. Model behavior should be fixed to baseline until the last model year before 2020, i.e. the imposition of a carbon price or carbon budget in 2020 is not anticipated.
- **Regional scale:** The carbon price scenarios can be applied to models on different regional scales, ranging from global to national. The carbon budget scenarios refer to global carbon budgets, and therefore can only be adopted by global models.
- **Where and what flexibility:** The carbon price should be imposed on all regions, and all Kyoto gases represented in the model. 100 yr Global Warming Potentials (GWPs) should be used to convert the carbon price to greenhouse gases prices for non-CO2 greenhouse gases. Likewise, the global carbon budget should be imposed in a way to allow full where and what flexibility, leading to a globally uniform carbon price across regions and sectors. Again, 100 yr GWPs should be used to price non-CO2 GHGs and land use CO2 emissions that are not capped by the budget at the level of the emerging global carbon price. Models should use their default assumption of 100 yr GWPs (SAR, AR4, AR5, ...) for the price conversion, and document this assumption in their submission of scenario data.

- **Implementation of carbon price scenarios:** Carbon price scenarios are specified for the period 2020-2100. Since the choice of base year and time steps varies across models, the carbon tax should only be applied from 2020 onwards, and model behavior in earlier years should be fixed to baseline, amounting to the assumption of a zero carbon price (in the case of the no-policy baseline) without anticipation of future climate policy. The carbon price for a given model year  $t$  is usually assumed to be constant over the length of the time step  $\Delta t$  (either from time  $t-1$  to  $t$  or from  $t-\Delta t/2$  to  $t+\Delta t/2$ , depending on the model). Modelling teams are requested to adjust the carbon price that they apply in the year  $t$  to the average carbon price over the constant price period that emerges in the prescribed scenario. For example, if the carbon price scenario describes a price of \$30 in 2040, increasing at 5% per year since 2020 (i.e. \$11.3 in 2020), the average carbon price over the period 2031-2040 is \$24.3 (calculated as  $0.1 * \sum_{i=-9,-8,\dots,0} \$30 * 1.05^i$ ) and \$30.3 over the period 2035-2045 (calculated as  $0.1 * \sum_{i=-4.5,-3.5,\dots,4.5} \$30 * 1.05^i$ ). For the start year 2020, the results of the calculation are as follows: \$1.1 for 2011-2020 (calculated as  $0.1 * \$30 * 1.05^{(-20)}$ ) and \$6.4 for 2015-2025 (calculated as  $0.1 * \sum_{i=0.5,1.5,\dots,4.5} \$30 * 1.05^i$ ).
- **Implementation of carbon budget scenarios:** The carbon budgets in the diagnostic experiment refer to cumulative CO<sub>2</sub> emissions from fossil fuel combustion and industry over the period 2020-2100. The calculation of cumulative emissions over a given period should take into account the model discretization, i.e. whether the emissions for a given model year  $t$  are assumed to be constant over the length of the time step  $\Delta t$  from time  $t-1$  to  $t$  or from  $t-\Delta t/2$  to  $t+\Delta t/2$ . For example, cumulative emissions over the period 2020-2100 in a model with ten year time steps and 35 GtCO<sub>2</sub> in 2020 rising by 10 GtCO<sub>2</sub> in each decade are 6435 GtCO<sub>2</sub> for constant emissions from  $t-1$  to  $t$  (calculated as  $35 \text{ GtCO}_2 + 10 * (\sum_{i=1,2,\dots,8} (35 \text{ GtCO}_2 + i * 10 \text{ GtCO}_2))$ ) or 6075 GtCO<sub>2</sub> for constant emissions from  $t-\Delta t/2$  to  $t+\Delta t/2$  (calculated as  $5.5 * (35 \text{ GtCO}_2 + 115 \text{ GtCO}_2) + 10 * (\sum_{i=1,2,\dots,7} (35 \text{ GtCO}_2 + i * 10 \text{ GtCO}_2))$ ).

As for the carbon price scenarios, model behavior should be fixed to the baseline for model years before 2020. As of 2020, there should be full where and what flexibility of emissions reductions leading to a globally harmonized carbon price across all regions and sectors. This represents an idealized policy implementation that is used as a benchmark in most studies. Emerging carbon prices should also be imposed on GHG emissions outside the cap as described above. Models should use their default methodology to implement a carbon budget in their model, including their standard treatment of when flexibility. This can range from fully endogenous carbon pricing in intertemporal optimization models (usually leading to a Hotelling carbon price path) to the iterative adjustment of a pre-scribed carbon tax trajectory or the adoption of a heuristic to convert the budget into a global emissions trajectory (both methods often used by myopic models). Modelling teams should document their method of implementing the carbon budget in their submission of scenario data. Infeasibilities to reach the imposed carbon budget should be reported.
- **Currency:** All carbon tax scenarios are specified in US 2010 dollar. Model using a different base year for US dollars should apply an appropriate deflator to convert the carbon prices to the given base year. In particular, models using US 2005 dollars as



currency unit should divide the carbon tax values by a uniform deflator of 1.10774 (taken from WG3 AR5). Models using a different currency should convert the carbon tax scenarios using some average market exchange rate of the currency to US dollar in the year 2010. In the case of Euro, the exchange rate varied between 1.22 USD to 1.43 USD per € over the course of 2010. We suggest choosing an exchange rate of 1.30 USD 2010 per € 2010 for the conversion. A similar average exchange rate occurred in the year 2005. For consistency, all price and cost figures from the models should be reported in the same unit, i.e USD 2010, for the submission of the scenario data.

- **Scenario naming convention:** All diagnostic scenario names begin with the identifier DIAG, followed by the individual scenario name. The no-policy baseline is called DIAG-Base, and the primary carbon price/budget scenarios based on the no-policy baseline are called DIAG-[*Identifier carbon price/budget scenario*]. ***This set of the scenarios is the exclusive focus of the ADVANCE open call on model diagnostics to the community.***

In principle, a secondary set of diagnostic carbon price/budget scenarios based on an alternative baseline assumption can be submitted by extending the proposed naming convention. These scenarios should be named DIAG-[*Identifier carbon price/budget scenario*]-[*Identifier alternative baseline*]. E.g., if the secondary set is based on the model default baseline, they would be named DIAG-[*Identifier carbon price/budget scenario*]-Def, or if based on a no-policy baseline with different GDP and population assumptions (e.g. SSP3 as identifier of the alternative baseline), they would be named DIAG-Base-SSP3 and DIAG-[*Identifier carbon price/budget scenario*]-SSP3. The naming convention for secondary sets of diagnostic runs can be extended to cover variations other than baseline variations. One example is the variation of technology availability, e.g. the limitation of bioenergy use, in the diagnostic scenario set-up. In this case, the diagnostic runs would be named DIAG-Base-LimBio and DIAG-[*Identifier carbon price/budget scenario*]-LimBio. However, we reiterate that such variations of baselines or other scenario characteristics are not the focus of the ADVANCE open call to the community.

#### 4. Definition of individual scenarios

##### 4.1. Mandatory scenarios (see Figure 1)

###### 1. Scenario: DIAG-Base

No policy baseline (see above)

###### 2. Scenario: DIAG-C30-const

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD}$

###### 3. Scenario: DIAG-C80-const

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD}$

**4. Scenario: DIAG-C30-gr5**

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD} * 1.05^{(t-2040)}$  (USD 30 reached in 2040)

**5. Scenario: DIAG-C80-gr5**

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD} * 1.05^{(t-2040)}$  (USD 80 reached in 2040)

**4.2. Recommended scenarios (see Figure A.1)**

**6. Scenario: DIAG-C0to30-const**

For  $t < 2040$ : Fix to DIAG-Base

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD}$

**7. Scenario: DIAG-C0to30-gr5**

For  $t < 2040$ : Fix to DIAG-Base

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD} * 1.05^{(t-2040)}$

**8. Scenario: DIAG-C0to80-gr5**

For  $t < 2040$ : Fix to DIAG-Base

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD} * 1.05^{(t-2040)}$

**9. Scenario: DIAG-C80-lin**

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD} + 2.5 \text{ USD} * (t-2020)$  (USD 80 reached in 2040)

**10. Scenario: DIAG-B700 (only for global models with time horizon until 2100)**

For  $t < 2020$ : Fix to DIAG-Base

Cumulative CO<sub>2</sub> emissions from fossil fuel combustion and industry are limited to 700 GtCO<sub>2</sub> over 2020-2100. The budget is chosen to reflect the upper range of budget values for scenarios reaching roughly 450 ppm from the AR5 DB (assuming approx. 320 GtCO<sub>2</sub> emissions in the period 2011-2019).

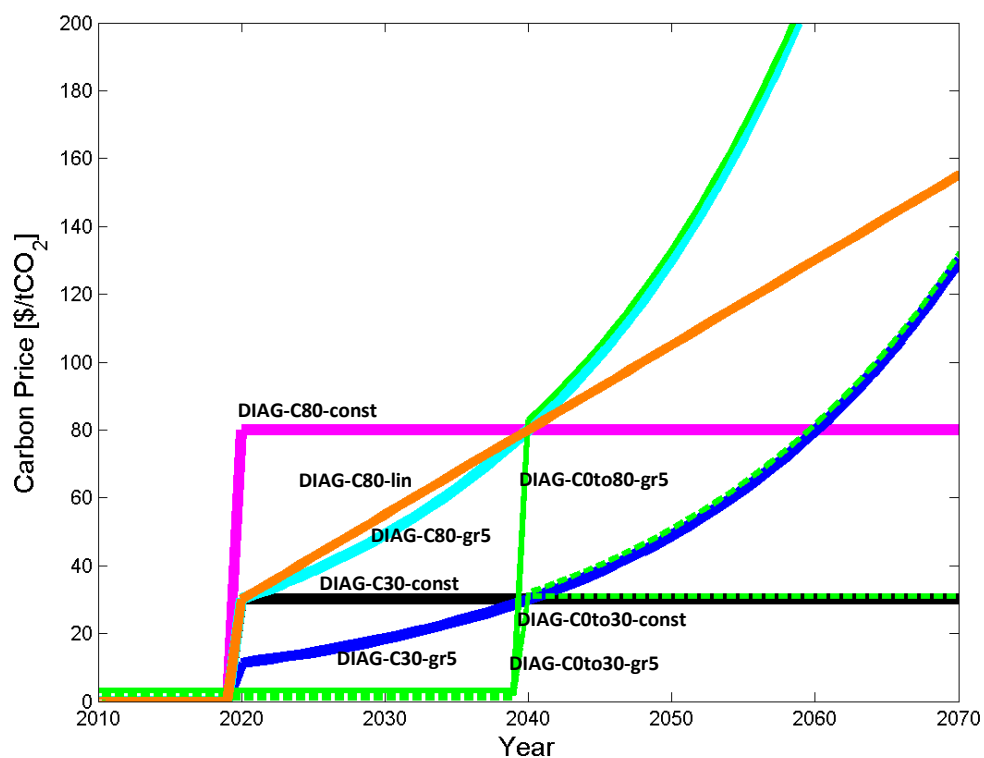


Figure A.1: Mandatory and recommended diagnostic scenarios (shown is a close-up of for the period 2010-2070).

#### 4.3. Optional scenarios:

##### 11. Scenario: DIAG-Base-Def

Model default baseline if different from no policy baseline (see above)

##### 12. Scenario: DIAG-C0to80-const

For  $t < 2040$ : Fix to DIAG-Base

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD}$

##### 13. Scenario: DIAG-C0to80-ant (only for models with foresight)

For  $t < 2020$ : Fix to DIAG-Base

For  $t$  in  $[2020, 2039]$ :  $\text{Tax}(t) = 0 \text{ USD}$  (but allow anticipation of jump in 2040)

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD} * 1.05^{(t-2040)}$

##### 14. Scenario: DIAG-C0to80-late (only for models with time horizon until 2100)

For  $t < 2060$ : Fix to DIAG-Base

For  $t$  in  $[2060, 2100]$ :  $\text{Tax}(t) = 80 \text{ USD} * 1.05^{(t-2060)}$

##### 15. Scenario: DIAG-C30-hybrid (only for models with time horizon until 2100)

For  $t < 2040$ : Fix to DIAG-C30-const

For  $t$  in  $[2040, 2100]$ :  $\text{Tax}(t) = 30 \text{ USD} * 1.05^{(t-2040)}$

##### 16. Scenario: DIAG-B1400 (only for global models with time horizon until 2100)

For  $t < 2020$ : Fix to DIAG-Base

Cumulative CO<sub>2</sub> emissions from fossil fuel combustion and industry are limited to 1400 GtCO<sub>2</sub> over 2020-2100. The budget is chosen to reflect a mean budget values for scenarios reaching roughly 550 ppm from the AR5 DB (assuming approx. 320 GtCO<sub>2</sub> emissions in the period 2011-2019).

## 7. Appendix B: ADVANCE Diagnostic Database Instructions

The following section provides instructions for scenario submissions to the ADVANCE Diagnostic Database which can also be found on the *About* page of the web-database<sup>4</sup>.

### Registration

Access to the database requires prior registration of model and users. Further, the registration procedure demands information about the regional composition of the model to be registered and how the native model regions map to set of predefined regions. The following steps are necessary to submit scenario data to the ADVANCE Diagnostic Database:

1. A [registration form](#) needs to be completed by each modeling team and sent via e-mail to [ADVANCE Diagnostic Database Administrator](#). The registration form contains the model name, the model's regional composition, how the native model regions map to set of [predefined regions](#) and meta data about the main characteristics of the model. In addition, basic user-related information to set up user accounts for the modeling groups is asked for. Please consult the *instructions* tab in the registration form for detailed instructions and additional guidance on the region mapping.
2. After successful registration of the model and its users, a confirmation e-mail will be sent to the users after which scenario results can be submitted to the web-database using a standardized IAMC [data template](#). In addition to time-series data for the scenarios, it is required to submit scenario-specific meta data which is important for classifying the scenarios along several dimensions.
3. After uploading a template with scenario data, you will receive an e-mail confirmation about the status of the submission and eventually log file with a detailed description of potential issues that were encountered in the import procedure. The log file should be carefully inspected and you may also want to use the visualization capabilities of the web-database to visually check the uploaded scenario results. Please consult the *instructions* tab in the data template as well as the [Database tutorial](#) on this page for further details on the procedure.

As guidance for completing the registration form and data template, here are a [sample registration form](#) and a [sample data template](#) with mandatory global data for one scenario from IIASA's MESSAGE modeling team.

A short tutorial on the use of the web database can be found below. If you experience technical problems with this database, please contact the [ADVANCE Diagnostic Database Administrator](#).

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<sup>4</sup> <https://tntcat.iiasa.ac.at:8743/ADVANCEWP1DB/dsd?Action=htmlpage&page=about>

## A short tutorial on the use of the database

### The Navigation tabs

At the upper end of the browser window five navigation tabs can be found that provide different functionality of the web database. These five tabs are described in more detail in the following section.

### About tab

The **About** tab provides information about the database and gives instructions on how to use the database. With exception of the **About** tab which can be viewed without special permissions, all other tabs require a valid user account (login and password) for the database. After entering the credentials the four additional tabs to navigate the database can be accessed. Which scenarios can be viewed depends on the individual user permissions (see [User account](#)). The difference between these three tabs for viewing is the way how scenario data can be combined for viewing.

### Common Features of the Sectors, Series, and Scatter tabs

In all three view tabs the following selections can be made in the navigation bars on the upper left-hand side of the browser window:

(1.) **Regions:** In the upper left area of the screen is a field named *Regions*. Depending on the tab (see above) you may select one or multiple regions for which the data is shown on the screen. Generally the regions are organized in the two folders *Compare* and *Model Name*. While in the *Compare* folder you can find regions that are (approximately) defined across many models (World, five macro regions and seven countries commonly compared in modeling comparison exercises, see [Region definitions](#)), the *Model name* folder contains the native regions that you report to the database.

(2.) **Scenarios:** This field includes the list of scenarios from which one or more scenarios can be selected. In addition to scenarios, for a number of variables historical and base year data can be shown to compare with scenario results. Note that historical data is only available for the regions in the *Compare* folder (see also previous paragraph) and that currently only some emission and energy variables are covered. Further, displaying historical data is at the moment restricted to the Sectors tab.

(3.) **Variables:** In this field the variables can be selected for which the data is shown on the screen. Note that in the Sectors tab it is necessary to not only required to tick one or multiple variables for selection, but also to mark a variable name (highlighted in blue) for the graph on the right hand side to be updated. It is not important which variable or variable category is marked to initiate the graph update.

The Chart Preview on the upper right-hand side of the browser window shows the graph of the selected data (variable + scenarios + regions). In addition, the horizontally oriented *Query Results* area in the middle of the screen shows the data in tabular format.

It is possible to export the data either into Excel or two different graphical formats (PNG = portable network graphics, SVG = scalable vector graphics). In order to do so, select one of the options in the *Output Options* window at the bottom of the browser window. The field titled *Notes* shows additional information or explanatory text for the selected variables. The availability of notes is still under development and ultimately the contents will depend on input from modeling teams.

## Manage tab

The **Manage** tab provides an overview of the scenarios that are currently in the database, shows logs of scenario operations (additions and deletes) and allows users with sufficient permissions to upload and delete scenarios from the database.

Uploads can be initiated in the upper part of the **Manage** tab by means of a file selector that shows up when clicking the *Browse...* button. In the file selector a valid template in Microsoft Excel 2003 (\*.xls) or 2007 (\*.xlsx) formats can be chosen. By clicking the *Upload file* button the upload procedure is started. After the successful upload, a short message is shown above the file selector that acknowledges whether the upload itself has been successful and which next steps have been taken. If the uploaded file is a valid template, the import procedure will be initiated and a message in a green frame is shown. This "green" acknowledgment does not imply that the whole procedure was successful, but just means that the file upload was successful and the file has a format readable by the database import algorithm. In case the upload itself did not work or if the file has a format that is not supported by the import algorithm (e.g. Excel 1997 format which also has the \*.xls extension), an error message with more details on the problem surrounded by a red frame is shown. As the import procedure, depending on the size of the template and the number of regions and scenarios, can take several minutes, you will be acknowledged about the progress by e-mail. Therefore it is important that your account information (see details about [User account](#) below) is up-to-date. The e-mail will contain information on whether the import was in general successful and the most important warnings (e.g. unknown variable names, variables not provided) and errors in its main text. A more extensive log file is attached to the e-mail. It is important that you check the log file carefully to ensure that not just the overall import was successful, but also that all data you provided made it to the database. Please note that uploading a scenario with the name of an existing scenario results in overwriting the previously existing scenarios. Upon successful import of the scenario(s), you can view the data using the three view tabs described above. It is strongly recommended to have a look at the data, making use of the online visualization capabilities of the database.

Below the upload section of the **Manage** tab, you can find the list of scenarios that are currently in the database. In case you are a modeling group member, you will only see the scenarios of your own model. If you are a project coordinator scenarios from multiple models will be shown here. If you have upload permissions a *Delete* button will be shown behind the scenario name. Clicking this button will delete the scenario from the database which cannot be reversed.

Further below the scenario table, a log section is displayed. The log section includes the date and time of successful imports, the user who uploaded the scenario(s), both model and scenario



name, a link to original template file that was uploaded and a link to the log file of the respective import procedure (the same log file that was sent by e-mail).

## User account

There are three types of database users:

- Modeling group members who can view scenarios of their model.
- Modeling group members who can view and upload scenarios of their model.
- Project coordinators who can view all scenarios of all models that belong to a specific comparison exercise.

The [My account](#) link in the right lower corner of the browser window allows you to change your user account data (password, e-mail address and other contact details) with the exception of the login name. It is recommended to change the password upon first login. Keeping the e-mail address up-to-date is particularly important, because the results of the import procedure will be sent via e-mail.

## Log file and data quality control

When uploading a scenario data template, a log file is automatically generated and sent to the user who initiated the upload by e-mail. The log file contains important information about the upload procedure and should be checked carefully to evaluate whether the upload can be considered successful. The log file consists of 6 sections.

1. Parse DATA section: general information on the import process of the "data" sheets included in the uploaded template
2. Check REGIONS section: information on region names used in the template that are not known to the import algorithm, i.e. which are among the pre-defined regions or the regions registered for the specific model
3. Check VARIABLES section: information on variable names which are not known to the import algorithm or which are part of the original template, but have not been submitted in the upload
4. Check HISTORY section: comparison of the submitted base year scenario data with available statistical data (see details [below](#))
5. Run DIAGNOSTICS section: run diagnostic indicators (see details [below](#))
6. IMPORT into database section:
7. Parse COMMENTS section: summary information on the scenarios that were imported into the database

## Comparison of historical and scenario data

When importing scenario data into the database, some quality data control routines are in place that compare submitted base year data with available statistics. The relevant information of the comparison can be found in the log file that is sent to you after uploading new scenarios to the

database. Currently statistical data is only available for the following categories: Population, GDP (MER and PPP), Primary Energy, Secondary Energy|Electricity, Final Energy, and Fossil and Industrial CO2 emissions for the World. Historical data is from various sources, i.e. from UN (population), the World Bank (GDP), the IEA Energy Balances (energy) and CDIAC (CO2 emissions). The comparison will be performed for the first year submitted which is assumed to be the base year a model is calibrated to. The following rules are applied to global level data in the comparison at present:

- An information (INFO) or warning (WARN) is issued if the model's base year data is outside the range of a factor of  $1/(1 + f)$  to  $1 + f$  around the historical value where  $f$  is - depending on the variable - 10 to 25%.
- An error (ERROR) is issued if the model's base year data is outside the range of a factor of  $1/(1 + f)$  to  $1 + f$  around the historical value where  $f$  is - depending on the variable - 25 to 50% which in many cases will hint at a unit issue or similar. An error will lead to the rejection of the scenario submission.

Please have a look at the "Check HISTORY section" of the log file and check for these types of messages. Please keep in mind that different sectoral aggregation or variable definitions that do not match the definition as supplied in the template can be responsible for the deviations as well. A list of the data sources used for historical data and the exact  $f$  values used for the various variables can be found [here](#). Feedback that helps improving the algorithm is very much welcome.

## Running Diagnostic Indicators

After checking a scenario submission (for REGION, VARIABLES, HISTORY; see above) a couple of diagnostic indicators is generated. In version 1.0 of the ADVANCE Diagnostic Database (2014-07-01) the diagnostic tests run are:

1. 'MetaCheck' - Check whether required scenario meta data are submitted. In case they are missing file will be **rejected**
2. 'magicc6' - Run magicc6 climate model on input data
3. 'tiPE' - Transformation Index (Primary Energy)
4. 'tiFE' - Transformation Index (Final Energy)
5. 'rai' - Relative Abatement Index
6. 'cioei' - Carbon Intensity over Energy Intensity
7. 'cav' - Costs per Abatement Value

In case all required variables are submitted and the indicator calculations run smooth an INFO is issued to let the user know that the indicator has been generated. Otherwise an ERROR message is issued to let you know what's missing and/ or has gone wrong. Please note that in case a required scenario meta data entry is missing the scenario will be rejected.

2014-06-26 17:42:15,887 INFO:

=====

2014-06-26 17:42:15,889 INFO: Run DIAGNOSTICS section

2014-06-26 17:42:15,889 INFO:

=====

2014-06-26 17:42:15,890 INFO: run 'MetaCheck' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsMetaDataCheck)

2014-06-26 17:42:15,894 INFO: run 'magicc6' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsMagicc6)

2014-06-26 17:42:24,661 INFO: run 'tiPE' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsTransformationIndex)

2014-06-26 17:42:24,668 INFO: run 'tiFE' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsTransformationIndex)

2014-06-26 17:42:24,672 INFO: run 'rai' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsRelativeAbatementIndex)

2014-06-26 17:42:24,676 INFO: run 'cioei' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsCloverEI)

2014-06-26 17:42:24,681 INFO: run 'cav' diagnostics

(class=at.ac.iiasa.kolp.iamc.database.diagnostics.DiagnosticsCostsPerAbatementValue)

## Region definitions

The consolidated results in the database are shown at regional aggregations of the World, five macro regions and seven individual countries/regions that are commonly used in scenario analysis. These regions are defined as follows:

### Aggregation on the five region level

**OECD90** = Includes the OECD 90 countries.

Australia, Austria, Belgium, Canada, Denmark, Fiji, Finland, France, French Polynesia, Germany, Greece, Guam, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Caledonia, New Zealand, Norway, Portugal, Samoa, Solomon Islands, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States of America, Vanuatu

**REF** = Countries from the Reforming Economies of Eastern Europe and the Former Soviet Union.

Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Malta, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, Slovenia, Tajikistan, TFYR Macedonia, Turkmenistan, Ukraine, Uzbekistan, Yugoslavia

**ASIA** = The region includes most Asian countries with the exception of the Middle East, Japan and Former Soviet Union states.

Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, China Hong Kong SAR, China Macao SAR, Democratic People's Republic of Korea, East Timor, India, Indonesia, Lao People's Democratic Republic, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan,

Papua New Guinea, Philippines, Republic of Korea, Singapore, Sri Lanka, Taiwan, Thailand, Viet Nam

**MAF** = This region includes the countries of the Middle East and Africa.

Algeria, Angola, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kenya, Kuwait, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Oman, Qatar, Reunion, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Syrian Arab Republic, Togo, Tunisia, Uganda, United Arab Emirates, United Republic of Tanzania, Western Sahara, Yemen, Zambia, Zimbabwe

**LAM** = This region includes the countries of Latin America and the Caribbean.

Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Suriname, Trinidad and Tobago, Uruguay, Venezuela

### **Seven individual countries/regions commonly used in scenario analysis**

**Brazil** = Federative Republic of Brazil

**China** = People's Republic of China

**India** = Republic of India

**EU** = European Union (27 member countries)

**Japan** = State of Japan

**Russia** = Russian Federation

**USA** = United States of America

### **Frequently Asked Questions (under development)**

1. Do I need to register different model version separately?  
Yes, in case you want to upload scenarios that have been generated with different versions of your model, all model version need to be registered separately, because they will most likely have different features on the "meta\_model" tab of the registration form (e.g., different number of regions, different technology coverage). Please make sure to add a version tag to the model name, which then needs to be in all "Model" columns in the registration form, including the "user\_data", "meta\_model", "model\_regions" and the "region\_aggregation" tabs and in the data templates.
2. What happens if I resubmit a previously submitted scenario?  
The previously submitted version of the scenarios gets fully replaced by the new version, i.e. it is first deleted and a new import is started.
3. Can I submit a scenario batch in multiple files?  
Yes, multiple scenarios can be submitted either in a single file (on a single "data" tab or

in multiple tabs the names of which start with "data", such as "data2", "data3", etc.) or in several files (e.g. one scenario per file). Note, however, that it is not possible to submit data belonging to the same scenario in multiple files, because the last file with data belonging to the scenario will always overwrite existing data of that scenario. For diagnostic scenarios, it is important that a the corresponding baseline scenario has either been submitted prior to the other scenarios or that the baseline is part of the scenario batch.

4. Why do I get an error message that states that I am not allowed to submit scenario data for my model?

Several reasons exist for such an error message, (i) you may have been registered as a user without submission rights, i.e. you can view scenario data, but not submit, (ii) the model name may include a typo (e.g. different capitalization than in the registered version), (iii) sometimes rows that appear empty are left at the bottom of the data block on the "data" tab which trigger an error about model ".".

5. I am going to submit several scenarios in a single file. How should I provide accompanying information on the "meta\_scenario" tab?

Please use multiple rows in the "meta\_scenario" tab by copying the existing row 3 in the tab as often as needed. Please note that it is mandatory to submit meta data for all scenarios that are included in a template.

6. Does the order of the variables on the "data" tab matter?

No, the variable order is absolutely arbitrary, but it is important that each row is completed correctly. Model, scenario, region and variable name need to be provided in each row, since the information is processed automatically. Please note that no spelling information of the model, region and variable names are tolerated.