Diagnostic indicators for integrated assessment models

Scenario Specifications

The model simulations for diagnostic purposes consist of runs with **harmonized baseline assumptions** for population and GDP growth as specified in the supplementary online material (Appendix A) of the article Diagnostic indicators for integrated assessment models of climate policy.

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 be policy relevant.

General specifications
The following specifications hold for all diagnostic scenarios:
- **No-policy baseline:** The (shadow) price of greenhouse gas emissions should be zero in the no-policy baseline. This implies that all climate policies that would otherwise be implemented in the models should be removed if feasible.
- **Initial year of the carbon tax:** Since the choice of base year varies across models, the carbon tax scenarios are specified from 2010 onwards, with 2010 the first year of imposing a carbon price. The 'no-policy baseline' is not expected to match the 2006-2010 greenhouse gas emissions, since the observed quantities are already affected by current climate policies or the expectations thereof in some regions.
- **Time horizon:** Carbon tax scenarios are specified for the period until 2100, but they are also applicable to models with a shorter time horizon, e.g. to the year 2050. It is expected that all models participating in AMPERE cover the time period until 2050. Models with a time horizon shorter than 2100 should adopt the carbon tax scenarios until their particular end year. Models with a time horizon extending beyond 2100 should fix the carbon tax at the value reached in the year 2100 for later periods.
- **Where and what flexibility:** The carbon tax should be imposed on all regions and all Kyoto gases represented in the model by using 100 yr Global Warming Potentials (GWPs) as specified in the 4th Assessment Report of the IPCC as conversion factors (See Table 2.14 in Chapter 2.10.2 of the Working Group I contribution. The table can be accessed at www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html).
- **Currency:** All carbon tax scenarios are specified in US 2005 dollars. Models using a different monetary unit should convert the carbon tax scenarios using some average market exchange rate of the currency to US dollar in the year 2005. In the case of Euros, the exchange rate declined from 1.36 USD to 1.18 USD per € over the course of 2005. We suggest choosing an exchange rate of 1.30 USD 2005 per € 2005 for the conversion.

Diagnostic scenarios:
The carbon tax scenarios where specified according to the following criteria:
- Two scenarios with a constant low (50 USD per ton CO2) and a high (200 USD per ton CO2) carbon tax
- Two scenarios with an exponentially growing carbon tax, one starting at a low carbon price (12.50 USD per ton CO2), the other one at a higher value in 2010 (50 USD per ton CO2).
- The low (high) constant and low (high) exponentially growing scenario cross in the year 2045.

AMPEREd-Baseline:
This is the no policy baseline scenario. The baseline does not include any climate mitigation policies and thus no price on greenhouse gas emissions after 2012, and all direct and indirect constraints leading to non-zero (shadow) price of greenhouse gas emissions should be removed after 2012.

AMPEREd-CarbonTax$12.50-increasing:
This is the exponentially growing tax scenario starting at a low level of 12.50 USD per ton CO2, reaching approx. 50 USD per ton CO2 in 2045.

Formula: For t in [2010, 2100]: Tax(t) = 12.50 USD * $1.04^{(t-2010)}$

AMPEREd-CarbonTax$50-constant:
This is the low constant tax scenario maintaining a 50 USD per ton CO2 carbon tax throughout the 21st century.

Formula: For t in [2010, 2100]: Tax(t) = 50.0 USD

AMPEREd-CarbonTax$50-increasing:
This is the exponentially growing tax scenario starting at a higher level of 50 USD per ton CO2, and reaching approx. 200 USD per ton CO2 in 2045.

Formula: For t in [2010, 2100]: Tax(t) = 50.0 USD * $1.04^{(t-2010)}$

AMPEREd-CarbonTax$200-constant:
This is the high constant tax scenario maintaining a 200 USD per ton CO2 carbon tax throughout the 21st century.

Formula: For t in [2010, 2100]: Tax(t) = 200.0 USD

Numerical values of the carbon tax in the years 2010, 2015, ..., 2100 are summarized in the table below.

	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055
$12.50-incr	12.50	15.21	18.50	22.50	27.40	33.30	40.55	49.30	60.00	73.00
$50-const	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
$50-incr	50.00	60.85	74.00	90.05	109.55	133.30	162.15	197.30	240.05	292.05
$200-const	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00

	2060	2065	2070	2075	2080	2085	2090	2095	2100
$12.50-incr	88.80	108.10	131.50	160.00	194.65	236.80	288.10	350.55	426.50
$50-const	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
$50-incr	355.35	432.30	526.00	639.95	778.60	947.25	1152.50	1402.20	1706.00
$200-const	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00