THE OECD ENV-LINKAGES MODELLING FRAMEWORK

Projecting economy-environment interactions in the coming decades

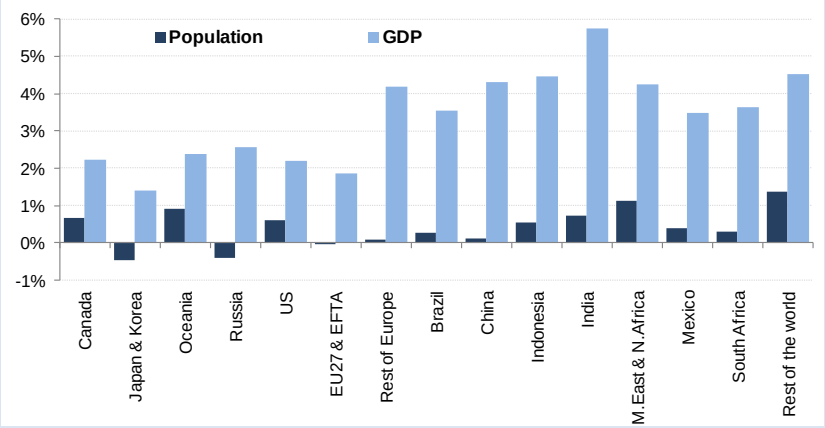
Background

The OECD has been working on environmental economics and its policies for more than 4 decades. Over these years economic models and quantitative assessments have been used to inform policy makers of the costs, benefits and potential tradeoffs of environmental policies. Currently, the main environmental-economic modelling work of the OECD relies on ENV-Linkages, a recursive dynamic neo-classical computable general equilibrium model (CGE). ENV-Linkages is the successor to the OECD GREEN model and is now hosted by the OECD Environment Directorate. The modelling work based on ENV-Linkages aims to assist governments in identifying least-cost policies or policy mixes on a range of environmental issues, including mitigation of climate change, phasing out fossil fuel subsidies and other green growth policies, such as environmental tax reform.

Projecting economic growth

The ENV-Linkages model is calibrated to macroeconomic projections of the OECD's ENV-Growth model (Chateau et al., 2013a). GDP growth is explained by changes in demographic trends such as population aging, education levels and human capital, physical capital investments, international trade flows and – not least – productivity improvements.

Average annual growth rates of population and GDP between 2010 and 2050 as projected by ENV-Linkages & ENV-Growth



Source: Population: UN World Population Prospects (2009);
GDP: OECD *Environmental Outlook to 2050*; *Baseline* projections.

Economic modelling of environmental policies

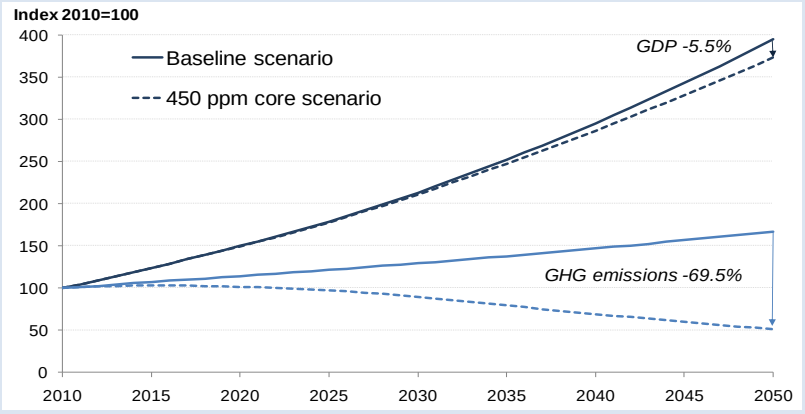
ENV-Linkages describes economic activities in different sectors and regions and how they interact. It is a global economic model built on a consistent set of data describing the behaviour of production sectors and consumers in different regions, with a focus on energy and international trade.

The model also links economic activity to environmental pressures, specifically to greenhouse gas (GHG) emissions. The model projects economic activities and emissions several decades into the future to shed light on the medium- and long-term impacts of environmental policies.

Mitigating climate change by reducing GHG emissions

The ENV-Linkages model is used extensively in the *Environmental Outlook to 2050* (OECD, 2012) to project socio-economic developments in absence of environmental policies (the Baseline scenario) and to assess the consequences of climate change mitigation policies aimed at stabilising greenhouse gas concentrations

Effects of a scenario stabilising GHG concentrations at 450 ppm



Source: OECD *Environmental Outlook to 2050*; ENV-Linkages model.

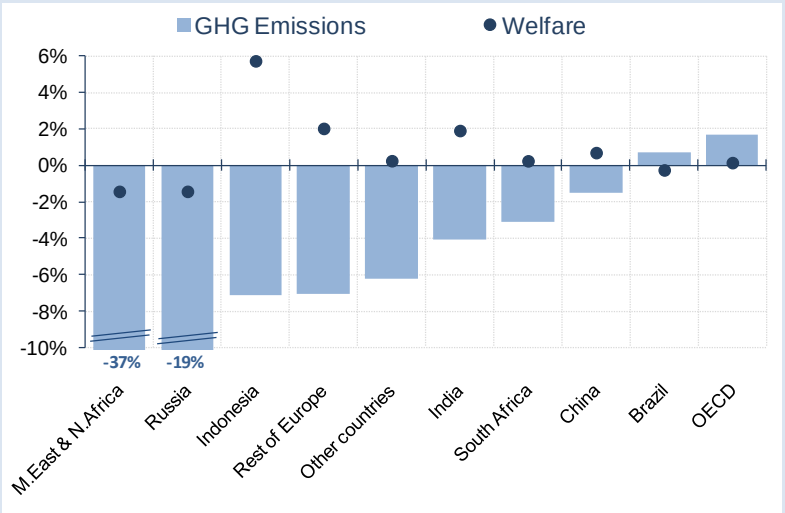
Applied work carried out with the model has been reported in various chapters of the OECD *Environmental Outlooks* (OECD, 2008; 2012). A detailed overview of the version of ENV-Linkages used for the OECD *Environmental Outlook to 2050* is provided in Chateau et al. (2013b), while Chateau et al. (2011) provide details on the associated baseline projection. In order to perform numerical simulations, it is necessary to keep the size of the model limited.

In the *Environmental Outlook to 2050*, 15 regions are distinguished, including 6 OECD regions, 6 major emerging economies and 3 other country groupings. All economic activity within a region is aggregated into 22 economic sectors (in addition, 7 distinct electricity production technologies are included). Regional and sectoral aggregation of the model can be varied by project, depending on the focus of the study and the availability of data.

Phasing out fossil-fuel consumer subsidies

Multilateral phase-out of fossil fuel consumer subsidies in selected emerging and developing countries can reduce global emissions and enhance welfare in most reforming countries. The modelling framework captures the indirect effects of the policy reform, including carbon leakage and export losses in fuel exporting countries.

Multilateral phase-out of fossil-fuel subsidies in selected countries



Source: OECD *Environmental Outlook to 2050*; ENV-Linkages model.

The advantages of multi-sectoral, multi-regional dynamic CGE models such as ENV-Linkages include their global dimension, their overall consistency and their rigorous micro-economic foundations. These models are best suited for analysing the medium- and long-term implications of policy shifts that require significant reallocation across sectors and countries, as well as the associated spill-over effects. In that sense, these models are the tool of choice for assessing e.g. climate change policies.

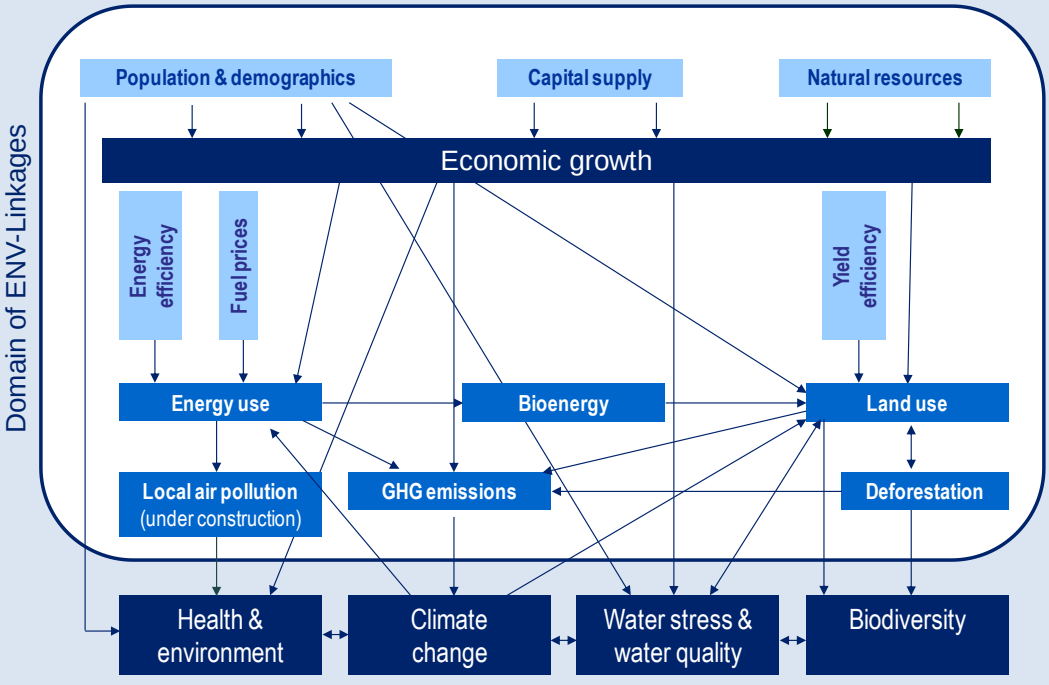
Linking ENV-Linkages to other models for integrated assessment

ENV-Linkages is an economic model that links economic activity to drivers of environmental pressure. It is fully consistent with the macroeconomic projections of the OECD's ENV-Growth model (Chateau et al., 2013a).

An integrated assessment can be achieved by linking ENV-Linkages to models that describe the biophysical consequences of environmental pressure. Such linking has been done in the OECD *Environmental Outlooks*, where ENV-Linkages was coupled to the IMAGE suite of models operated by PBL Netherlands Environmental Assessment Agency.

ENV-Linkages is also successfully coupled to the World Energy Model of the International Energy Agency for the World Energy Outlook.

The modelling framework for the OECD Environmental Outlook to 2050 (OECD, 2012)



Potential new uses of ENV-Linkages

Expansions and new applications of the ENV-Linkages model will include analysing distributional issues of green growth policies and studying the long-term consequences of environmental policy inaction on economic growth (the CIRCLE project), with focus on climate change, impacts of local air pollutants on health, scarcity of natural resources and land use competition between food and bioenergy.

Selected publications featuring the modelling work

Burniaux, J. and J. Chateau (2011), "Mitigation Potential of Removing Fossil Fuel Subsidies: A General Equilibrium Assessment", *OECD Economics Department Working Papers* 853.

Burniaux, J., Chateau, J. and Duval, R. (2010), "Is there a Case for Carbon-Based Border Tax Adjustment?: An Applied General Equilibrium Analysis", *OECD Economics Department Working Papers* 794; published in 2013 in *Applied Economics*.

Burniaux, J, J. Chateau and J. Sauvage (2011), "The trade effects of phasing out fossil-fuel consumption subsidies", *OECD Trade and Environment Working Papers* 2011/05.

Chateau, J., R. Dellink, E. Lanzi and B. Magné, (2013a), "The ENV-Growth model: global reference scenarios for future economic growth", *OECD Working Paper*, forthcoming.

Chateau, J., R. Dellink, E. Lanzi and B. Magné (2013b), "An overview of the OECD ENV-Linkages model – version 3", *OECD Environment Working Papers* forthcoming.

Chateau, J., C. Rebolledo and R. Dellink (2011), "The ENV-Linkages economic baseline projections to 2050", *OECD Environment Working Papers* 41.

Chateau, J., A. Saint-Martin and T. Manfredi (2011), "Employment impacts of climate change mitigation policies in the OECD", *OECD Environment Working Papers* 32; published in 2013 in *International Economics*.

Dellink, R., G. Briner and C. Clapp (2010), "Costs, Revenues, and Effectiveness of the Copenhagen Accord Emission Pledges for 2020", *OECD Environment Working Papers* 22; published in 2012 in *Climate Change Economics*.

Dellink, R., S. Jamet, J. Chateau, and R. Duval (2010), "Towards Global Carbon Pricing: Direct and Indirect Linking of Carbon Markets", *OECD Environment Working Papers* 20; published in 2013 in *OECD Economic Studies*.

Lanzi, E., D. Mullaly, J. Chateau and R. Dellink (2013), "Addressing Competitiveness and Carbon Leakage Impacts Arising from Multiple Carbon Markets: A Modelling Assessment", *OECD Environment Working Papers* 58; published in 2012 in *Energy Economics*.

OECD (2008), *OECD Environmental Outlook to 2030*, OECD, Paris.

OECD (2009), *The Economics of Climate Change Mitigation: Policies and Options for Global Action Beyond 2012*, OECD, Paris.

OECD (2012), *OECD Environmental Outlook to 2050*, OECD, Paris.

Further information:

www.oecd.org/environment/modelling

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