



THE OECD ENVIRONMENTAL OUTLOOK TO 2050

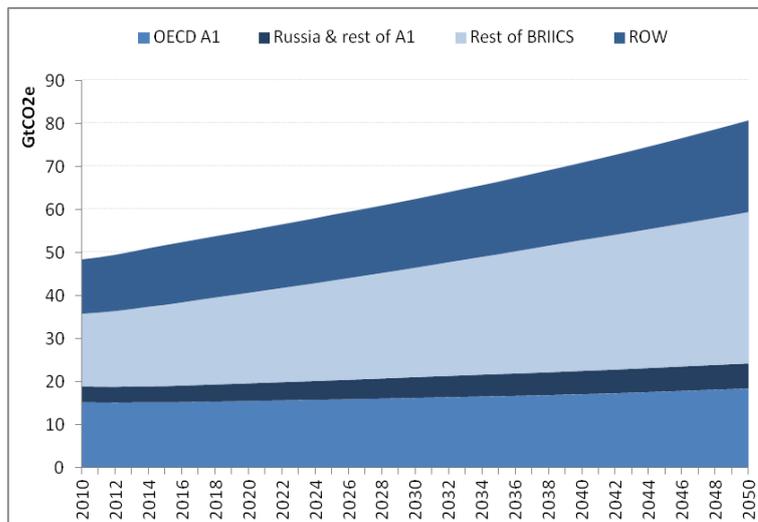
Key Findings on Climate Change

Trends and projections: we are far off course

Environmental state and pressures

 **Global greenhouse gas (GHG) emissions** continue to increase, and in 2010 global **energy-related carbon dioxide (CO₂) emissions** reached an all-time high of 30.6 gigatonnes (Gt) despite the recent economic crisis. The *Environmental Outlook Baseline* scenario envisages that without more ambitious policies than those in force today, GHG emissions will increase by another 50% by 2050, primarily driven by a projected 70% growth in CO₂ emissions from energy use. This is primarily due to a projected 80% increase in global energy demand. Transport emissions are projected to double due to a strong increase in demand for cars in developing countries and aviation. Historically, OECD economies have been responsible for most of the emissions. In the coming decades, increasing emissions will also be caused by high economic growth in some of the major emerging economies.

GHG emissions by region (in GtCO₂e): *Baseline* scenario



“Global GHG emissions are expected to grow by 50% between now and 2050, mostly driven by energy demand and economic growth in key emerging economies”

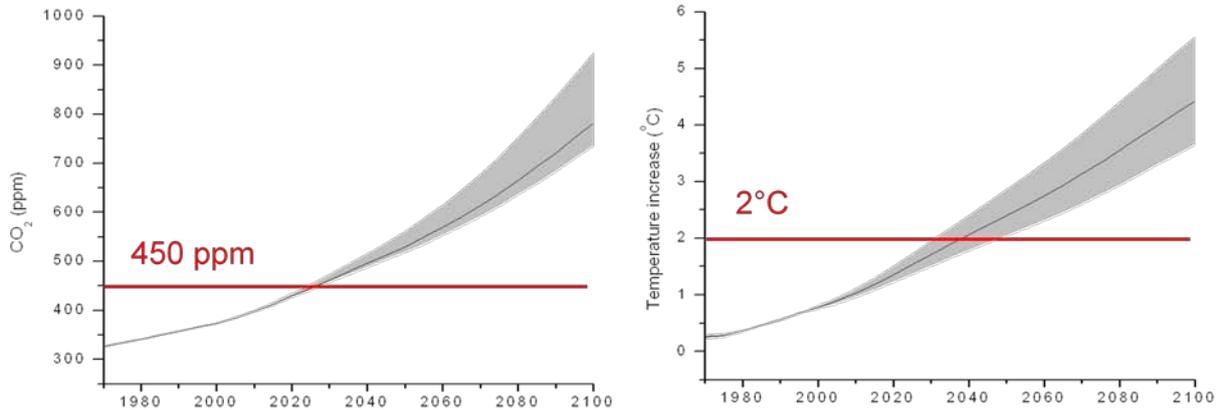
Note: GtCO₂e = Giga tonnes of CO₂ equivalent
ROW = Rest of the World

Source: OECD Environmental Outlook Baseline; ENV-Linkages model

 Without more ambitious policies, the *Baseline* projects that **atmospheric concentration of GHG** would reach almost 685 parts per million (ppm) CO₂-equivalents by 2050. This is well over the concentration level of 450 ppm required to have at least a 50% chance of stabilising the climate at 2 degrees (2°C) global average **temperature increase**, the goal set in 2010 at the UN Framework Convention on Climate Change (UNFCCC) conference in Cancún. Under the *Baseline* projection, global average temperature is likely to exceed this goal by 2050, and by 3 to 6°C higher than pre-industrial levels by the end of the century. Such a high temperature increase

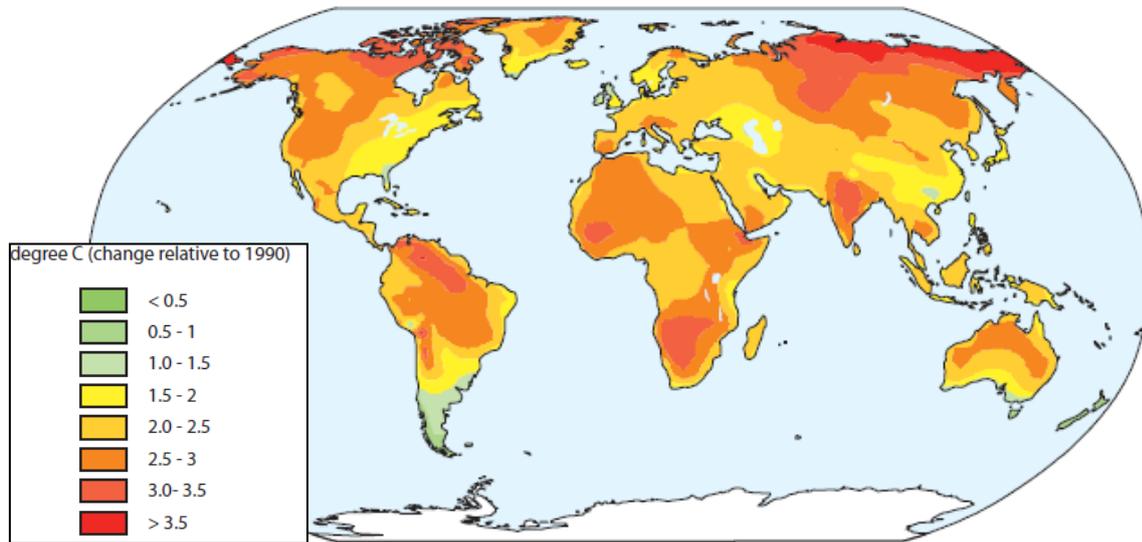
would continue to alter precipitation patterns, melt glaciers, cause sea-level rise and intensify extreme weather events to unprecedented levels. It might also exceed some critical “tipping-points”, causing dramatic natural changes that could have catastrophic or irreversible outcomes for natural systems and society.

Long-run CO₂ concentrations and temperature increase: *Baseline*, 1980-2100



Source: The OECD Environmental Outlook Baseline projections; IMAGE model

Change in annual temperature 1990-2050: *Baseline* scenario



Source: The OECD Environmental Outlook Baseline projections; IMAGE model



Technological progress and structural shifts in the composition of growth are projected to improve the **energy intensity of economies** in the coming decades (*i.e.* achieving a relative decoupling of GHG emissions growth and GDP growth), especially in OECD and the emerging economies of Brazil, Russia, India, Indonesia, China and South Africa (BRIICS). However, under current trends, these regional improvements would be outstripped by the increased energy demand worldwide.



Emissions from **land use, land use change and forestry (LULUCF)** are projected to decrease in the course of the next 30 years, while carbon sequestration by forests increases. By 2045, net CO₂ emissions from land use are projected to become negative in OECD countries – *i.e.* become a net emissions sink. Most emerging economies also show a decreasing trend in emissions from an expected slowing of deforestation. In the rest of the world, land use emissions are projected to increase to 2050, driven by expanding agricultural areas, particularly in Africa.

Policy responses



Pledging action to achieve national GHG emission reduction targets and actions under the UNFCCC at Copenhagen and Cancún was an important step by countries in finding a global solution. However, **the mitigation actions** pledged by countries are not enough to be on a least-cost pathway to meet the 2°C

“Copenhagen/Cancun pledges are not enough.”

goal. Limiting temperature increase to 2°C from these pledges would incur substantial additional costs after 2020 to ensure that atmospheric concentrations of GHGs do not exceed 450 ppm by the end of the century. More ambitious action is therefore needed now and post-2020. For example, 80% of the projected emissions from the power sector in 2020 are inevitable, as they come from power plants that are already in place or are being built today. The world is locking itself into high-carbon systems more strongly every year. Prematurely closing plants – at significant economic cost – would be the only way to reverse this “lock-in”.



Progress has been made in developing national strategies for **adapting to climate change**. These also encourage the assessment and management of climate risk in relevant sectors. However, there is still a long way to go before the right instruments and institutions are in place to explicitly incorporate climate change risk into policies and projects, increase private-sector engagement in adaptation actions and integrate climate change adaptation into development co-operation.

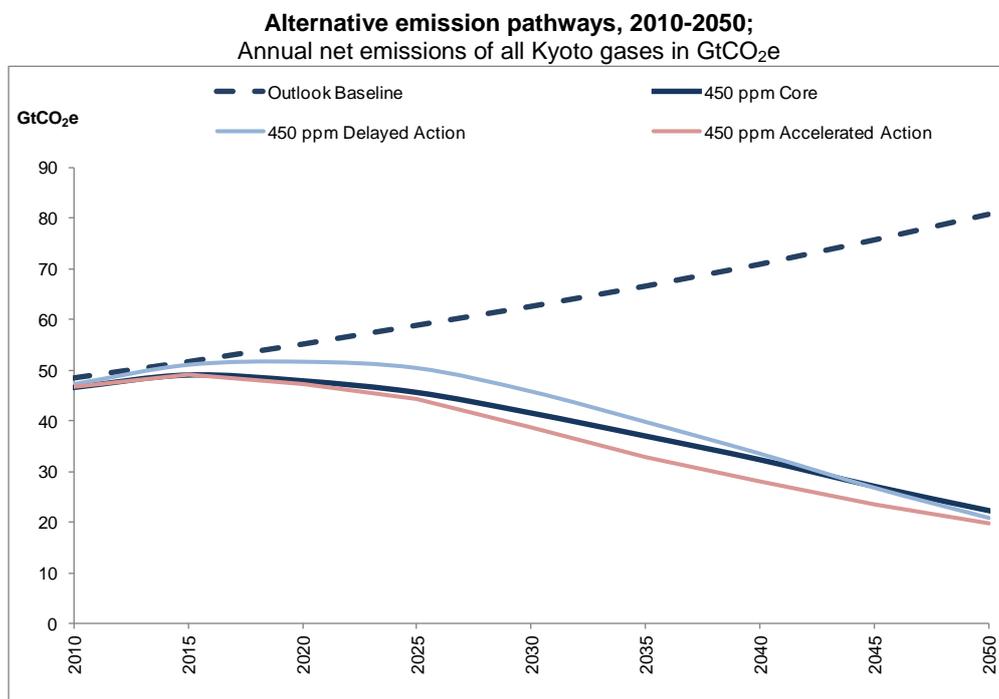
How can we avoid the grim prospects?

We must act now to reverse emission trends projected under the *Baseline* scenario in order to stabilise GHG concentrations at 450 ppm CO₂e and increase the chance of limiting the global average temperature increase to 2°C. Delayed or only moderate action up to 2020 (such as going no further than implementing the Copenhagen/Cancún pledges, or waiting for better technologies to come on stream) would be more costly. It would increase the pace and scale of efforts needed after 2020, and also entail higher environmental risk.

This *Outlook* explores three different scenarios for stabilising emissions at 450 ppm by the end of the 21st century:

- **450 ppm Core scenario:** least-cost timing of action (immediately tapping into less costly mitigation options in all sectors, regions and gases; use of low-cost mitigation technologies e.g. biomass energy with carbon capture and storage [BECCS] that become available later this century), start pricing carbon in 2013.
- **Accelerated Action scenario:** assumptions as in the *450 Core* scenario, but with steeper mitigation efforts between 2013 and 2030 to reduce reliance on emerging new technologies like BECCS in later decades.
- **Delayed Action scenario:** mitigation action limited to Cancún and Copenhagen pledges to 2020; fragmented regional carbon markets between 2013 and 2020; requires rapid, costly and significant

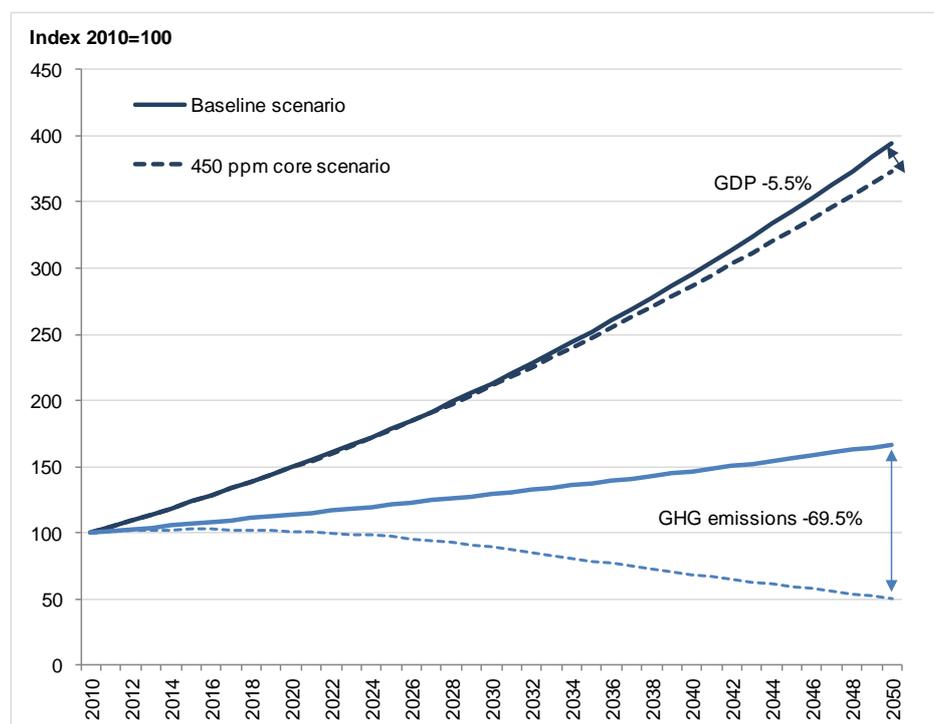
“catch up” after 2020 involving premature scrapping or retrofitting of existing fossil energy infrastructure that are “locked in”.



These stylised pathways modelled for this *Environmental Outlook* have at least an even chance of limiting global temperature increase to 2°C and suggest that:

- **Emissions must peak before 2020.** The *Delayed Action* scenario shows a short delay before global emission levels start reducing, implying that after 2025 there would need to be a rapid reversal of current trends to still achieve the 2°C goal with an even chance.
- **To avoid excessive costs, an overshoot of the targeted concentration level (450 ppm) has now become inevitable** in the middle of the century, before falling to reach the target concentration by the end of the century. However, overshooting may have environmental impacts by causing higher rates of temperature change in the coming decades. The *Accelerated Action* scenario, though more costly, reflects a lesser degree of overshoot than the other two scenarios hence a limited environmental risk.
- **A significant carbon price is needed to induce technological change.** The *450 Core* scenario assumes a global carbon price gradually increasing rapidly to USD 325/tCO₂e in 2050. Energy use grows to 2020, but thereafter emissions would be reduced primarily by energy efficiency improvements as well as decarbonisation in the power generation, transport sector, and existing dirty energy use by consumers (*e.g.* use of cooking fuels) replaced with more efficient electricity-based technologies.
- **Ambitious mitigation action substantially lowers the risk of catastrophic climate change.** Global GHG emissions could be 70% lower than in our no-new- policy *Baseline*. (Or 52% below 2005 levels). This could be achieved at a **cost of action to global GDP of about 5.5% in 2050** by which time GDP is projected to have quadrupled. It would hence slow down global average GDP growth from 3.5% to 3.3% per year (by 0.2 percentage points) in this period. This cost does not include the co-benefits of climate mitigation on health and biodiversity for instance, and has to be compared with the costs on inaction which could be over 14% of average world consumption per capita (Stern, 2006).

450 ppm Core scenario: global emissions and cost of mitigation



Source: OECD Environmental Outlook Baseline; ENV-Linkages model.

Policy steps to build a low-carbon, climate-resilient economy

A prudent response to climate change calls for both an ambitious mitigation policy to reduce further climate change, and timely adaptation policies to limit damage from the impacts that are already inevitable. In the context of tight government budgets, finding least-cost solutions and engaging the private sector will be critical to finance the transition. Costly overlaps between policies must also be avoided. The following actions are a priority:

- **Adapt to inevitable climate change.** The level of GHG already in the atmosphere means that some changes in the climate are now inevitable. The impact on people and ecosystems will depend on how the world adapts. Adaptation policies will need to be implemented to safeguard the well-being of current and future generations worldwide.
- **Integrate adaptation into development co-operation.** The management of climate change risks is closely intertwined with economic development – impacts will be felt more by the poorest and most vulnerable populations. National governments and donor agencies have a key role to play and integrating climate change adaptation strategies into all development planning is now critical. This will involve assessing climate risks and opportunities within national government processes, at sectoral and project levels, and in both urban and rural contexts. The uncertainty surrounding climate impacts means that flexibility is important.
- **Set clear, credible, more stringent and economy-wide GHG mitigation targets** to guide policy and investment decisions. Participation of all major emission sources, sectors and countries would reduce the costs of mitigation, help to address potential leakage and competitiveness concerns and could even out ambition levels for mitigation across countries.

Adaptation options and potential policy instruments

Sector	Adaptation options	Potential policy instruments
Agriculture	Crop insurance; investment in new technologies; removal of market distortions; change crops and planting dates; yield-development of yield-improving crops (e.g. heat and drought resistant crops).	Price signals/markets; insurance instruments; microfinance; R&D incentives and other forms of public support.
Fisheries	Installations to prevent storm damage; techniques to deal with temperature stress; breeding technology innovations; improved food sourcing away from reliance on fish; reduced antibiotic use; ecosystem approach to fisheries; aquaculture.	R&D incentives and other forms of public support; regulatory incentives, marine spatial planning
Coastal zones	Coastal defences/sea walls; surge barriers; sediment management; beach nourishment; habitat protection; land use planning; relocation.	Coastal zone planning; differentiated insurance; PPPs for coastal defence schemes.
Health	Air conditioning, building standards; improvements in public health; vector control programmes; disease eradication programmes; R&D on vector control, vaccines, disease eradication.	R&D incentives and other forms of public support; regulatory incentives (e.g. building codes); insurance; heat alert and response systems; air quality health indices.
Water resources	Leakage control; reservoirs; desalination; risk management to deal with rainfall variability; water permits, water pricing; rational water use, rainwater collection.	Price signals/markets; regulatory incentives; financing schemes; R&D incentives and other forms of public support.
Ecosystems	Reduce <i>Baseline</i> stress; habitat protection; change in natural resource management; market for ecological services; facilitate species migration; breeding and genetic modification for managed systems.	Ecosystem markets; land use planning; environmental standards; microfinance schemes; R&D incentives and other forms of public support.
Settlements and economic activity	Insurance, weather derivatives; climate-proofing of housing stock and infrastructure; zone planning, location decisions.	Building standards; insurance schemes; adjustments to infrastructure PPPs, direct public support.
Extreme weather events	Insurance; flood barriers; storm/flood-proof infrastructure, housing stock; early warning systems; enhanced disaster management; land use planning; green infrastructure or ecosystems based adaptation.	Building codes, land use planning; private finance or PPPs for defence structures

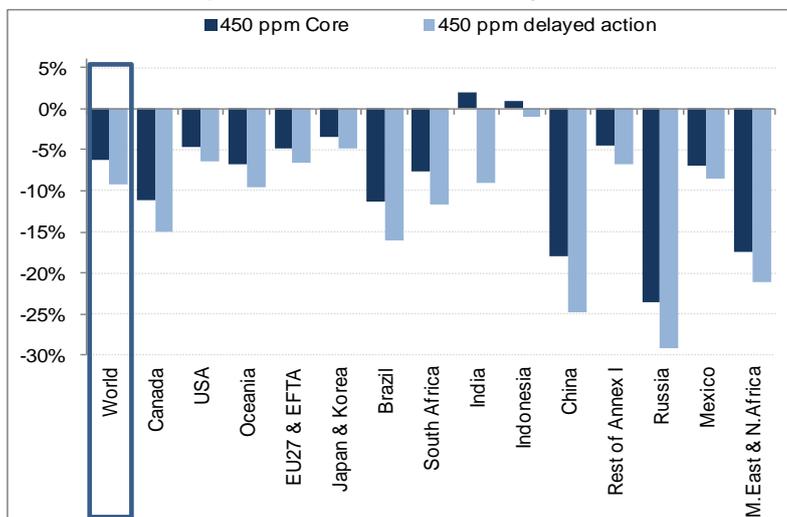
Source: adapted from OECD (2008a), Economic Aspects of Adaptation to Climate Change. Costs, benefits and policy instruments, OECD, Paris.

- **Set clear, credible, more stringent and economy-wide GHG mitigation targets** to guide policy and investment decisions. Participation of all major emission sources, sectors and countries would reduce the costs of mitigation, help to address potential leakage and competitiveness concerns and could even out ambition levels for mitigation across countries.
- **Put a price on carbon.** This can be done most effectively by using market-based instruments like carbon taxes or emission trading schemes. These can provide a dynamic incentive for innovation and private investment in low-carbon, climate-resilient infrastructure, plant and equipment. These can also generate revenues to ease tight government budgets and potentially provide new sources of public funds.
- **Act now. Delay is costly and could become unaffordable.** The further we delay action, the costlier it will be to stay within 2°C. 450 ppm is still achievable, but the costs are rising every day, month and year that passes to compensate for the increased emissions. In the longer run to 2050, the *450 Delayed Action* scenario requires costly mitigation efforts to bring

“If the Copenhagen/Cancun pledges and actions for Annex I countries were to be implemented as a carbon tax or a cap-and-trade scheme with fully auctioned permits, in 2020 the fiscal revenues would amount to more than 250 billion USD, i.e. 0.6% of their GDP.”

concentration levels back down to 450 ppm before the end of the century.

Regional real income impacts, 450 Core vs. 450 Delayed Action scenarios: % change from Baseline, 2050

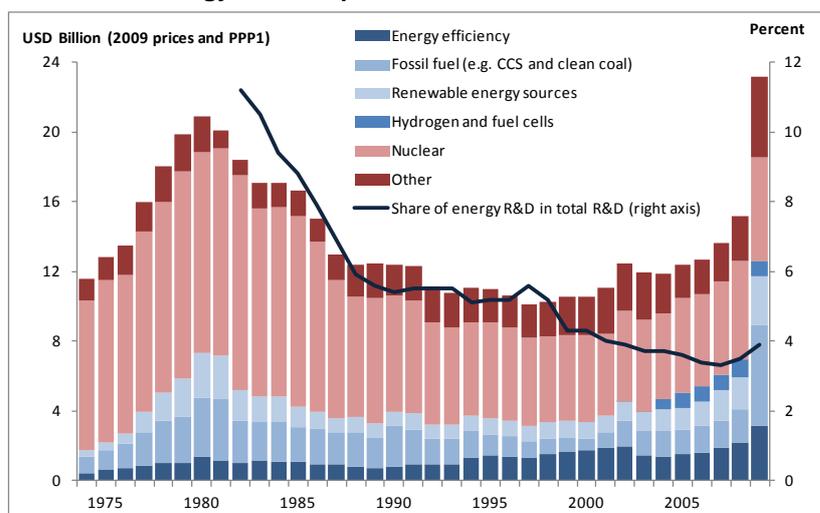


“Delaying action would increase the global cost of mitigation by nearly 50% by 2050”

Source: OECD Environmental Outlook projections; ENV-Linkages model

- Reform fossil fuel support policies.** Support to fossil fuel production and use in OECD countries is estimated to have been about USD 45-75 billion a year in recent years; developing and emerging economies provided USD 410 billion in fossil fuel consumer subsidies in 2010. Phasing out fossil fuel subsidies in emerging and developing countries could reduce global GHG emissions by 6% globally by 2050, compared with the *Baseline*, and by over 20% in Russia and the Middle East and North-Africa region. Fossil fuel subsidy reforms should be implemented carefully by addressing potential negative impacts on households through appropriate measures.
- Foster innovation and support new clean technologies.** OECD work shows that the cost of mitigation could be significantly reduced if R&D could come up with new breakthrough technologies. For example, emerging technologies – such as bioenergy from waste biomass and carbon capture and storage – have the potential to absorb carbon from the atmosphere. Perfecting these technologies, and finding new ones, will require a clear price on carbon, targeted government-funded R&D, and policies to foster investment in new low-carbon technologies and their deployment.

Government energy RD&D expenditures in IEA member countries: 1974-2009

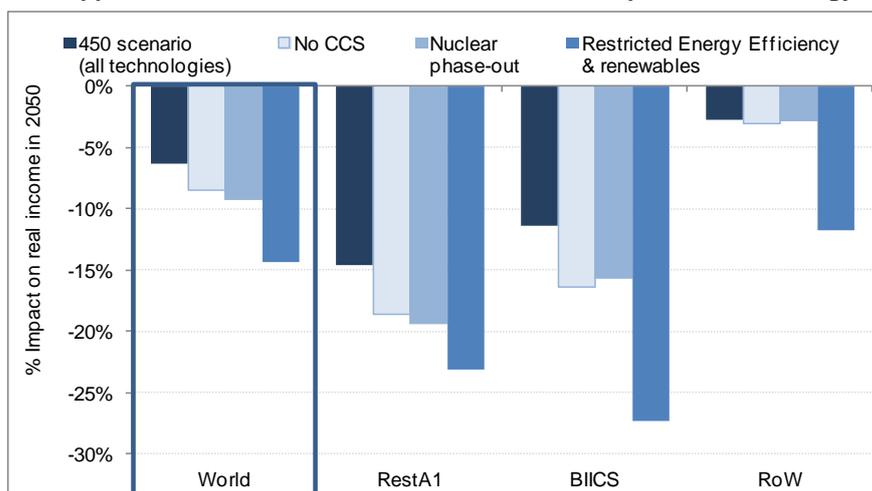


“Except for the 2009 green stimulus, public RD&D on energy as share of total R&D budgets has declined in real terms over the last 35 years.”

Notes: ¹PPP= Purchasing Power Parities. The Czech Republic, Poland and Slovak Republic not included. Source: IEA (2011a), CO₂ Emissions from Fuel Combustion: Highlights, OECD/IEA, Paris

The Environmental Outlook’s 450 mitigation scenarios assume all energy technology options (e.g. nuclear, Carbon Capture and Storage (CCS), energy efficiency measures, renewables) to be available. If policies constrain some of technology options, the cost of mitigation would be higher (see below). The impact of technology choices is limited in the short run. In the long run, sufficient flexibility in energy systems will protect regions against sudden unexpected changes in the availability of technologies or increased costs.

450ppm Accelerated Action scenario: Economic impacts of technology choices in 2050



“Leaving out any single technology, such as nuclear or carbon capture and storage (CCS), will make the costs of the transition higher.”

Source: OECD Environmental Outlook Baseline; ENV-Linkages model

- Complement carbon pricing with well-designed regulations.** Carbon pricing and support for innovation will not be enough to ensure all that energy efficiency options are adopted or accessible. Additional targeted regulatory instruments (such as fuel, vehicle and building efficiency standards) may also be required. If designed to overcome market barriers and avoid costly overlap with market-based instruments, they can accelerate the uptake of clean technologies, encourage innovation and reduce emissions cost-effectively. The net contribution of the instrument “mix” to social welfare, environmental effectiveness and economic efficiency should be regularly reviewed.

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The *OECD Environmental Outlook to 2050* (2012) was prepared by a joint team from the OECD and the PBL Netherlands Environmental Assessment Agency. The *Outlook* includes chapters on: socioeconomic developments, climate change, biodiversity, water, and health and environment.

www.oecd.org/environment/outlookto2050

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