



THE WOODS HOLE RESEARCH CENTER

149 Woods Hole Road · Falmouth, MA 02540-1644 USA
Telephone 508.540.9900 · Fax: 508.540-9700 · www.wbrc.org

Linking Climate Policy with Development Strategy in Brazil, China, and India

Synopsis Presented by the Project Team at the Bali UNFCCC COP/MOP, 10 December 2007

The project in summary: The Woods Hole Research Center has been working since late 2005 - with funding from the William and Flora Hewlett Foundation and in cooperation with partner institutions in Brazil, China, and India - to identify, analyze, and promote technical options and associated policies to reduce greenhouse-gas (GHG) emissions in those three countries while simultaneously advancing other aspects of sustainable development (such as improving access to basic services while lowering costs, reducing conventional pollution, improving health, and increasing rural employment).

Collaborating Institutions and Lead Researchers

- U.S. lead institution: The Woods Hole Research Center (John P. Holdren, Daniel Nepstad, Kirk R. Smith, Joan Diamond)
- U.S. collaborating institution: Belfer Center for Science and International Affairs, Harvard Kennedy School of Government (Kelly Sims Gallagher, Hongyan He Oliver, ZHAO Lifeng, Ambuj Sagar)
- Brazil lead institution: Instituto de Pesquisa Ambiental da Amazônia (IPAM) (Paulo Moutinho)
- China lead institution: Institute of Environmental Economics, Renmin University (ZOU Ji)
- China collaborating institutions: Institute of Engineering Thermophysics, Chinese Academy of Sciences (WANG Bo); Chinese Automotive Technology and Research Center (TIAN Dongmei).
- India lead institution: Energy Systems Department, Indian Institute of Technology - Bombay (Rangan Banerjee)
- India collaborating institutions: The Energy and Resources Institute - Delhi (W. N. Kishore), Indian Institute of Management - Ahmedabad (P. R. Shukla), Indian Institute of Science - Bangalore (N. H. Ravindranath).

International Steering Committee

John P. Holdren (USA), Jose Goldemberg (Brazil), ZOU Ji (China), Ajay Mathur (India)

Key findings from the Brazil case study

- We find that carbon emissions from tropical deforestation and forest degradation in Brazil (the largest or second largest source of such emissions in the world, depending on year) could be reduced to close to zero over a 10-yr time horizon at a cost between \$100 million and \$600 million per year.
- This result suggests that the cost of reductions in emissions from deforestation and forest degradation (REDD) is much lower than previously estimated using global partial equilibrium economic models.
- In Brazil, it appears to be feasible to achieve this reduction for a cost that is lower than the opportunity cost of foregone profits from deforestation -dependent agriculture and ranching, since most deforestation leads to cattle ranching of very low profit levels.
- Brazil would benefit in a number of ways from these reductions in emissions, including through increased income and improvements in livelihoods of indigenous and traditional forest people, greater security for the rainfall system



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of the Brazilian grain belt and hydroelectric network, and \$10 to 80 million per year of diminished fire-related damages to health, agriculture, and forestry.

Key findings from the China case study:

- Analysis of three scenarios for future coal-fired electricity generation in China - Business as Usual, Advanced Technology (emphasizing ultra-super-critical power-plant technology), and Very Advanced Technology (emphasizing carbon capture and sequestration) - shows that the Very Advanced Technology scenario offers by far the largest GHG emissions reductions but is too costly under current circumstances and will not materialize absent drastic changes in economics and/or policy.
- A more likely early path, modeled by the Advanced Technology scenario, entails accelerating the diffusion of ultra-super-critical coal technology, promoting commercialization of fluidized-bed and integrated-gasification combined-cycle technologies, and increasing R&D on carbon capture and sequestration. Achieving even this much will require significant strengthening of relevant policies and still will be not enough to reduce absolute GHG emissions under expected electricity growth.
- China's passenger-vehicle sector likewise presents enormous challenges in relation to reducing GHG emissions. Scenarios explored in our study show that full implementation of the passenger-vehicle fuel-economy standards currently projected for China will lead to some reduction in CO₂ emissions compared to "business as usual", but the absolute increase would still lead to more than a doubling by 2020.
- Larger reductions in the vehicle sector would require much stronger measures. These would have a variety of co-benefits (e.g., in reduced conventional pollution and reduced oil imports, compared to business as usual), but many barriers experienced and perceived by a variety of stakeholders will need to be overcome for such measures to be realized.

Key findings from the India case study:

- India's GHG emissions could be reduced by as much as 520 million tonnes per year of carbon-dioxide-equivalent year (Mt/yr CO₂-eq) by 2025 via improvements in coal-power-generation efficiency achieved by deployment of advanced generation technology, reductions in the large losses currently sustained during transmission and distribution, and electricity-saving programs in agricultural pumping, lighting, and solar water heating.
- Rapid deployment of current biomass-gasifier technologies for small industries and power generation, together with large-scale development and deployment of newly developed but not yet widely used advanced biomass-cooking technologies, could reduce greenhouse-gas emissions by about 120 Mt/yr CO₂-eq by 2025, based on fossil fuel substitution.



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- Significant development benefits in terms of local and national energy security, rural employment, women's and children's health, and general environmental quality can also be achieved with these measures, above all in the biomass sector where the link between GHG emissions and damage from current inefficient usage is strongest.
- Improvements in the power sector, particularly to reduce losses and enhance billing through better management of transmission and distribution, will not only save money and reduce GHG emissions but will help bring the state power utilities into sustainable operation, a major development benefit.
- There are significant barriers to the deployment of these technologies, however, especially for technologies that need to be deployed at the household level where it is not possible to rely completely on commercial dissemination because of low incomes and high effective discount rates. Deployment strategies must be carefully designed to overcome these barriers.