II. METHODOLOGY

7. This paper presents a snapshot of current investment and financial flows based on available data. Future investment and financial flows are based on specific reference and mitigation scenarios.

8. It is important to note that the analysis in this paper does not provide for an estimate of total cost of climate change mitigation or of the total cost of adaptation to impacts of climate change.

2.1. INTERPRETATION OF INVESTMENT AND FINANCIAL FLOWS

9. The analysis presented in this paper uses the following definitions for investment and financial flows:

- *An investment flow* is the initial (capital) spending for a physical asset;
- *A financial flow* is an ongoing expenditure related to climate change mitigation or adaptation that does not involve investment in physical assets.

2.2. METHODOLOGY OVERVIEW

10. Conceptually, the methodology employed is simple. Relevant investment and financial flows are projected for selected scenarios. These future flows are compared with the current flows and the current sources of funds because projections of the sources of future flows are not available from the scenarios.

11. Investment and financial flows are analysed for the following mitigation and adaptation sectors:

- Mitigation sectors: energy supply, industry, transportation, buildings, waste, agriculture and forestry;
- Adaptation sectors: agriculture, forestry and fisheries (AFF); water supply; human health; natural ecosystems; coastal zone; infrastructure.

12. The analysis covers the investment and financial flows needed in 2030. This is an optimal time period for an analysis of investment flows. The level of detail available from published scenarios declines sharply as the time horizon is extended beyond 2030.

13. This analysis was disaggregated to the extent possible. Limited availability of data, especially in terms of regional detail, led to most of the results being compiled under the following regional groupings: Organisation for Economic Co-operation and Development (OECD) North America, OECD Pacific, OECD Europe, transition economies, developing Asia, Latin America, Africa and Middle East (see ANNEX I).

14. Unless otherwise specified, all monetary values have been converted to 2005 United States dollars (2005 USD).

2.3. SCENARIOS

15. Existing scenarios had to be used because the time and resources needed to develop new scenarios were not available. There is no single scenario that covers all GHG emissions and sinks for which climate impacts have been modelled. The scenarios were selected based on their suitability for the analysis, the detail they provide on estimated investment and financial flows, and how representative they are of the literature.

2.3.1. SCENARIOS USED FOR THE MITIGATION ANALYSES

16. Any analysis of future investment and financial flows requires a reference scenario and a mitigation scenario that reflects an international response to climate change. The mitigation analysis uses a scenario that would return emission level in 2030 to 2004 level.

17. The reference scenario used in this analysis consists of:

- The energy-related carbon dioxide (CO_2) emissions of the IEA World Energy Outlook (WEO) 2006 reference scenario (IEA, 2006);
- The baseline non-CO_2 emissions projections from the United States Environmental Protection Agency (US EPA) extrapolated to 2030 (US EPA, 2006);
- Current CO_2 emissions due to land use, land use change and forestry (LULUCF);
- Industrial process CO_2 emissions from the World Business Council on Sustainable Development (WBCSD) (WBCSD, 2002).

18. The mitigation scenario consists of:

- The energy-related CO_2 emissions of the IEA WEO 2006 Beyond The Alternative Policy Scenario (BAPS) scenario (IEA, 2006);
- The US EPA baseline non-CO_2 emissions projections minus the reductions possible at a cost of less than USD 30 per t CO_2 eq;
- Potential CO_2 sinks increases due to agriculture and forestry practices;
- Industrial process CO_2 emissions from WBCSD (WBCSD, 2002).

19. The WEO provides a comprehensive reference cenario of energy supply and demand and the associated GHG emissions and investments. With the cooperation of the IEA, the cumulative investment estimates were converted to annual investment flows. In addition, the OECD provided preliminary estimates of the projected investment flows in 2030 based on the OECD ENV-Linkages model calibrated to this scenario.[5]

20. The BAPS scenario is the most aggressive mitigation scenario considered by the IEA. It returns global energy-related CO_2 levels to current levels by 2030. With the cooperation of the IEA, the BAPS scenario was disaggregated into the same regions as those of the reference scenario and the cumulative investment estimates were converted to annual investment flows.

21. The reference and BAPS case do not consider the need for increased electricity access in developing countries. From the policies and the level of investment reflected in these scenarios the IEA estimates that about 1.4 billion people will remain without access to electricity in 2030. Universal electricity access by 2030 would require an additional annual investment of USD 25 billion.

22. The US EPA projections of non-CO_2 emissions are the most comprehensive available in the literature. The US EPA provides marginal abatement curves for the cost of reducing emissions of non-CO_2 gases by sector and by region. The marginal cost increases sharply after USD 30 per t CO_2 eq for most of the curves. Thus, the emissions reduction possible at a cost of less than USD 30 per t CO_2 eq is approximately the maximum.[6]

23. No baseline scenarios with forest use, rates of change and fluxes are available in the literature. Thus, the reference scenario assumes that GHG emissions from the forestry sector in 2030 are the same as in 2004. The mitigation scenario includes the potential sinks created through reduced deforestation, forest management and afforestation/reforestation.

24. The A1 scenario in the WBCSD report Towards a Sustainable Cement Industry (WBCSD, 2002) is adopted as the reference scenario for the analysis on industrial process CO_2 emissions. Within the literature, a 7 per cent worldwide technical potential by 2020 was identified, of which the responding emissions were selected for as mitigation scenario of industrial process CO_2 emissions in this paper.

2.3.2. SCENARIOS USED FOR THE ADAPTATION ANALYSES

25. The analysis of investment and financial flows needed for adaptation to climate change was based on emissions scenarios for which climate change impacts could be inferred and responses to the climate impacts could be projected, so that the associated investment and financial flows could be estimated. The scenarios were selected based on their suitability for the analysis, the detail they provide on estimated investment and financial flows, and how representative they are of the literature. The following scenarios have been used for different sectors:

- IPCC SRES A1B and B1 scenarios are used for the water supply and coastal zones sectors (Nakićenović N. and Swart R. (eds). 2000);
- For the human health sector, the scenarios used were based on variations from the IPCC IS92a: a scenario resulting in stabilization at 750 ppmv CO_2 eq by 2210 (s750), and a scenario resulting in stabilization at 550 ppmv CO_2 eq by 2170 (s550) (Leggett *et al.*, 1992). These scenarios were used in the context of a World Health Organization (WHO) study on the global and regional burden of disease (GBD) (McMichael AJ *et al.,* 2004);
- Projected investment in physical assets for 2030 from the OECD ENV-Linkage model were used as the basis for estimating additional investment and financial flows needed in the agriculture, forestry and fisheries (AFF) and infrastructure sectors. The projected investment in physical assets for 2030 based on the OECD ENV-Linkage model corresponds to the projection of the IEA WEO reference scenario.

[5] OECD. ENV-Linkages Model calibrated to the IEA WEO 2006 Reference scenario. Personal communication with Philip Bagnoli at OECD. For information, see CHAPTER III.3.

[6] At a cost of USD 60 per t CO_2 eq the reduction would be only a slightly larger.

2.4. PROJECTED GREENHOUSE GAS EMISSIONS

26. FIGURE II-1 shows the GHG emissions by sources for the reference (RS) and mitigation (MS) scenarios used in the mitigation analysis. Global emissions rise from 38.91 Gt CO_2 eq in 2000 to 61.52 Gt CO_2 eq in 2030 under the reference scenario. The mitigation scenario reduces the projected emissions in 2030 to 29.11 Gt CO_2 eq. Energy-related emissions account for 65.9 per cent of the total in 2030 under the reference scenario; industrial process CO_2 (3 per cent), non-CO_2 gases (21.7 per cent) and LULUCF (9.4 per cent) make up the balance. The mitigation scenario reduces energy-related emissions projected under the reference scenario by 35 per cent, industrial process CO_2 emissions by 11 per cent, non-CO_2 gases emissions by 25 per cent and LULUCF emissions by 252 per cent (see TABLE 5-ANNEX V).

27. FIGURE II-2 shows total energy supply and the related GHG emissions under the reference and mitigation scenarios used in the mitigation analysis. Energy efficiency is a major component of the mitigation scenario; energy demand in 2030 is 15 per cent lower than under the reference scenario, representing a 6 Gt CO_2 eq reduction in annual emissions. Decarbonisation of energy supply, including the use of renewables, nuclear energy and CO_2 capture and storage (CCS), also plays a major role in returning emissions to the 2004 level in 2030 under the mitigation scenario, reducing annual emissions by 8 Gt CO_2 eq.

Figure II-1. **Total greenhouse gas emissions under reference and mitigation scenarios**

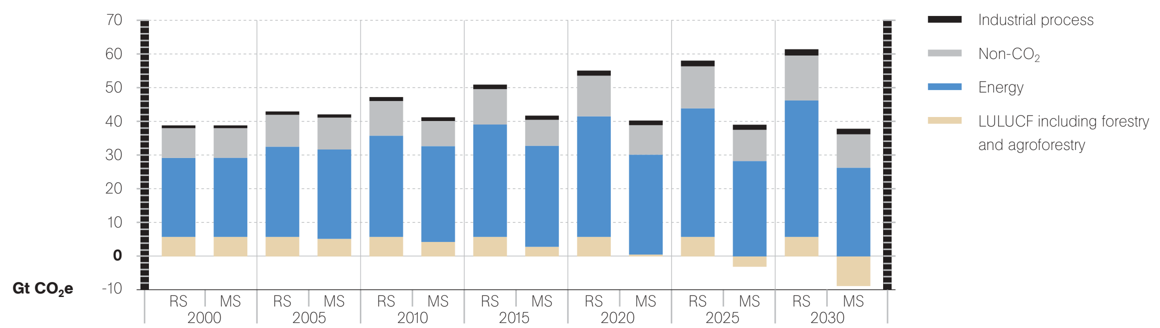
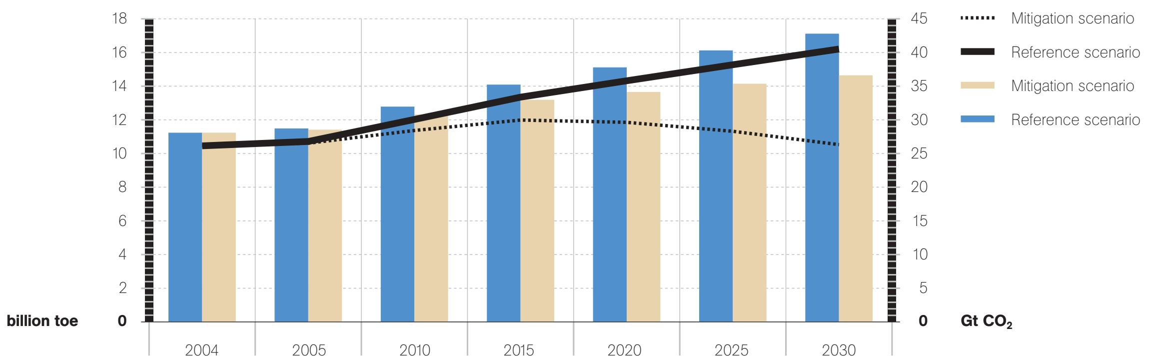


Figure II-2. **Energy supply and related greenhouse gas emissions under the reference and mitigation scenarios**



2.5. COMPARISON WITH THE SCENARIO LITERATURE

28. Figures II-3 and II-4 compare the emissions and driving forces of the scenarios used for the analysis.

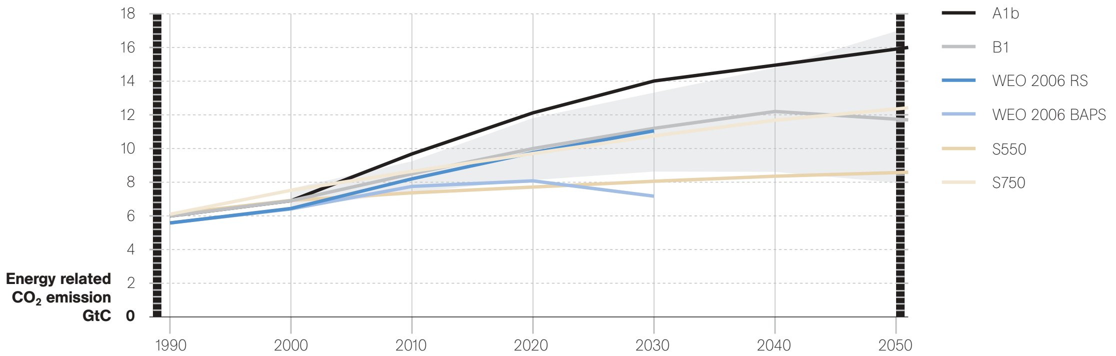
29. As shown in figure II-3, emissions under IEA WEO reference scenario, the IPCC SRES B1 scenario and the 750 parts per million by volume (ppmv) stabilization scenario (s750) used in the GBD study are close to each other in 2030. The shaded area in figure II-3 represents the standard deviation of the scenarios available in the literature. The emission path of the three scenarios mentioned above lies in the middle of this shaded area and can thus be considered moderate estimates.

30. Under the reference scenario used for the mitigation analysis, the stabilization of atmospheric concentration of CO_2 will occur at over 650 ppmv. Figure II-3 also shows that, the WEO 2006 BAPS case used for the mitigation analysis results in emission levels equivalent to current levels, this corresponds to a the stabilization of atmospheric concentration of between 550 and 450 ppmv.

31. The IPCC SRES A1B and the 550 ppmv stabilization scenarios (s550) from the GBD study used in the adaptation analysis for some sectors result in emission levels that are respectively higher and lower than the level of the B1 scenario.

32. Figure II-4 shows the variation in the driving forces of the different scenarios used. The driving forces for the WEO reference scenario are virtually identical to those for the B1 scenario, as might be expected since the emissions of those scenarios are virtually identical (see figure II-3). The A1B scenario has higher per capita income than the WEO reference scenario, which leads to more energy use and higher emissions as shown in figure II-3. The WEO 2006 BAPS case has the same population and per capita income as the reference scenario, but lower energy intensity and lower carbon intensity, leading to less energy use and lower GHG emissions.

Figure II-3. **Emissions projections of the scenarios used for the analyses and the scenario literature**



Note: Based on IEA 2006; Nakićenović *et al.*, 2006; IPCC, 2007c.

Figure II-4. **Comparison of the main driving forces of greenhouse gas emissions under different scenarios in the literatures**