



Investment and Financial Flows Needed to Address Climate Change

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About the 'Breaking the Climate Deadlock' Initiative

'Breaking the Climate Deadlock' is an initiative of former UK Prime Minister Tony Blair and independent not-for-profit organisation, The Climate Group. Its objective is to build decisive political support for a post-2012 international climate change agreement in the lead up to the 2009 UN Climate Change Conference in Copenhagen. Its particular focus is on the political and business leaders from the world's largest economies, particularly the G8 and the major developing countries. The initiative builds on Mr Blair's international leadership and advocacy of climate change action while in office, and The Climate Group's expertise in building climate action programmes amongst business and political communities.

This briefing paper and its companions were commissioned by the Office of Tony Blair and The Climate Group to support the first Breaking the Climate Deadlock Report – 'A Global Deal for Our Low Carbon Future' – launched in Tokyo on June 27th 2008. Written by renowned international experts and widely reviewed, the papers' purpose is to inform the ongoing initiative itself and provide detailed but accessible overviews of the main issues and themes underpinning negotiations towards a comprehensive post-2012 international climate change agreement. They are an important and accessible resource for political and business leaders, climate change professionals, and anyone wanting to understand more fully, the key issues shaping the international climate change debate today.

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Executive Summary

- Provision of financial resources and investment to support action in developing countries will be a key component of a post-2012 agreement. Many in the developing world consider that existing financial obligations of developed countries under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol remain unfulfilled. As a consequence, developing countries are unlikely to support a new agreement without guaranteed increases in financial flows. This is reflected in the Bali Action Plan recognition that additional financial resources are needed for mitigation and adaptation and technology cooperation in developing countries.
- Addressing climate change will require significant shifts and an overall net increase in global investment and financial flows. The additional investment and financial flows needed are estimated at \$249 to \$381 billion in 2030. While this is large in absolute terms, it is only 1.1 percent to 1.7 percent of projected global investment in 2030.
- Approximately half of the shifts and net increase in investment and financial flows occur in developing countries. Mitigation investments are more cost-effective in developing countries. Developing countries suffer more damage due to climate change as a percentage of GDP.
- Corporations and households are likely to make most of the additional investment, although this is likely to require government policies and incentives. Additional government investment will be required, primarily for adaptation. Developing countries, especially the poorest and those most vulnerable, will need substantial international financial support for mitigation and adaptation and technology cooperation.
- The current financial mechanisms will likely be unable to provide financial assistance to developing countries on the scale required.

Recommendations

- A post-2012 agreement will need significantly larger financial resources, tens of billions of dollars per year, on a sustained basis for mitigation and adaptation and technology cooperation. An expanded Clean Development Mechanism (CDM) can supply a substantial part of the funding needed for mitigation measures. Adaptation, technology cooperation and some mitigation measures will require financial transfers to developing countries.
- Numerous options to raise the additional financial resources have been proposed. The proposals fall into three categories: larger financial contributions by developed country governments; sale of a share of the developed country targets; and levies on international aviation and shipping emissions. Those proposals need to be evaluated further.

Investment and Financial Flows Needed to Address Climate Change

This paper is split into four sections. The first two cover the incremental investment requirements for mitigation and adaptation respectively. Data are provided at global, sector, and in some cases country levels. The third section identifies the likely sources of incremental mitigation and adaptation investment, while the final section discusses how the additional funds needed by developing countries could be raised.

The UN Framework Convention on Climate Change (UNFCCC) Secretariat prepared a report on Investment and Financial Flows to Address Climate Change. The report covers mitigation, adaptation and energy research, development and demonstration over the period to 2030.

[Mitigation investment](#)

Total investment is estimated for both a reference scenario and a mitigation scenario.¹ A comparison of those scenarios indicates the mitigation investment needed to address climate change. The scenarios are a composite of several sources covering energy-related emissions, industrial process CO₂ emissions, non-CO₂ emissions, and agriculture and forest sinks. Under the reference scenario global emissions rise from 38.87 GtCO₂e in 2000 to 61.52 GtCO₂e in 2030; about 1.5 percent per year.² Most of the growth occurs in developing countries. Under the mitigation scenario, global emissions peak in 2015 at 41.81 GtCO₂e and then decline to 29.11 GtCO₂e in 2030; 25 percent below 2000 emissions.

The lower emissions under the mitigation scenario are due to major changes to energy demand and supply and to shifting forests and agriculture from a source to a large sink. Energy demand is about 15 percent lower in 2030 due to aggressive implementation of energy efficiency measures by energy consumers – industry, buildings and transportation – and by electric utilities. Under the mitigation scenario electricity generating capacity is about 10 percent lower in 2030 and the mix of sources used is less carbon-intensive.

The changes to the investment and financial flows in 2020 and 2030 for climate change mitigation are shown in Exhibits 1 and 2 respectively. Investment in fossil fuel supply and associated infrastructure is almost 20 percent lower in the mitigation scenario in 2030 due to the increased energy efficiency. However, global fossil fuel consumption and investment is still about 30 percent higher in 2030 than in 2000.

The mitigation scenario entails less investment in fossil-fired, mainly coal, generation capacity and transmission and distribution. However, the mitigation scenario projects additional investment for carbon capture and storage (CCS) for coal- and gas-fired generation, renewables, nuclear and hydro. The result is almost the same annual investment for power supply under the reference and mitigation scenarios, but a substantial shift in the mix of power supply investment.

Increased energy efficiency requires additional investment for electrical and stationary fuel equipment in industry and buildings. Some CCS is also projected for the industrial sector. Improved vehicle efficiency, including hybrid vehicles, increases energy efficiency in the transportation sector. Small incremental investments are also projected to reduce emissions of non-CO₂ gases and emissions from waste (landfills and wastewater treatment plants).

Annual spending on energy research, development and demonstration is projected to double from the current level. Most of this research is undertaken in a few developed countries; what share of the additional research, development and demonstration will be conducted in developing countries in 2030 is difficult to predict.

The agriculture sector offers opportunities to reduce nitrous oxide (N₂O) emissions from soils (fertilizer use) and manure management, as well as methane emissions from animals, manure management and rice cultivation. The annual cost of such measures is estimated at \$20 billion in 2030, mostly (\$13 billion) in developing countries. Agroforestry offers the potential to increase carbon sinks; expanding agroforestry by 19 million ha/year would require an annual investment of about \$15 billion, with virtually all of this potential in developing countries.

Deforestation and forest degradation currently lead to emissions of 5.8 GtCO₂ per year globally, all from developing countries. Halting those emissions would cost an estimated \$12 billion per year. In addition, forest management – reducing harvest rates and harvest damage – could increase the forest carbon stock in developing countries. The estimated annual cost of such measures is \$8 billion per year. The forest carbon stock can also be increased through afforestation and reforestation of cleared land, but the potential is relatively small and the associated annual investment is less than \$0.5 billion annually.

Globally the incremental annual investment for climate change mitigation is about \$200 billion in 2030. That includes a substantial reduction in the investment for fossil fuel supply and a large shift in the mix of power supply investment. Approximately half of the incremental investment, apart from energy research and development, is projected for developing countries. This reflects the relatively rapid economic growth projected for those countries, and the cost-effective emission reduction opportunities available to them.

[Adaptation investment](#)

The global cost of adaptation to climate change is difficult to estimate, largely because adaptation measures will be widespread and heterogeneous. Due to the limited literature available, the UNFCCC estimates of the investment and financial flows for adaptation in different sectors are based on different scenarios. Each sector estimates the incremental adaptation investment in 2030 for a single reference scenario.³ For water supply and coastal zones, adaptation costs are the capital costs of measures designed for the projected climate over the life of the facility, to 2050 and 2080 respectively.

The estimated additional investment and financial flows needed for climate change adaptation in 2030 are shown in Exhibit 3. The agriculture, forestry and fisheries sector is estimated to need an additional investment of \$11 billion annually in new capital such as irrigation systems, equipment for new crops and fishing practices, and relocation and modification of processing facilities. An additional \$3 billion will be needed annually for research and extension activities to facilitate adaptation. About half of the total requirement will be for developing countries.

The capital cost of the water supply infrastructure needed to meet the projected population and economic growth to 2030, given the projected climate in 2050, is about \$800 billion. A little over 25 percent of this – \$225 billion – is due to climate change. Spreading the capital cost over the 20 year life of the facilities, leads to an annual adaptation cost of \$11 billion.⁴ About 85 percent of the additional investment would be needed in developing countries.

For human health the adaptation cost is estimated as the cost of the additional cases of diarrhoeal disease, malnutrition and malaria due to climate change in developing countries. This cost is estimated at \$5 billion per year for 2030, all in developing countries.

The additional investment needed for coastal protection was estimated using the DIVA (dynamic interactive vulnerability analysis) model, which analyses adaptation options for more than 12,000 segments of the world's coasts. The model was run with and without sea level rise. It estimates the costs of beach nourishment, the costs of building dykes, land loss costs, number of people flooded, and losses from flooding. Only the extra costs of beach nourishment and dykes were counted as climate change adaptation costs. The annual investment in 2030 was estimated at \$11 billion, of which \$5 billion is in developing countries.⁵

Infrastructure, such as buildings and roads, may be damaged due to severe weather events, flooding or other impacts of climate change. New infrastructure can be adapted to the impacts of the projected climate. To estimate the adaptation cost for new infrastructure, the share of infrastructure vulnerable to the impacts of climate change was estimated by region based on historical data for damages due to extreme weather events. Adapting the vulnerable infrastructure to the projected impacts of climate change was estimated to increase the capital cost by 5 to 20 percent. The adaptation cost for infrastructure in 2030 is estimated at \$8 to \$130 billion globally, of which \$2 to \$41 billion is in developing countries.

The incremental investment and financial flows needed to adapt to climate change are estimated to be \$49 to \$171 billion globally in 2030, with \$28 to \$67 billion of this total being needed in developing countries. Other recent estimates of adaptation costs for developing countries include: World Bank (\$9–41 billion)⁶, Oxford Institute for Energy Studies (\$2–17 billion)⁷, Oxfam (greater than \$50 billion)⁸, and UNDP (\$86 billion)⁹. These estimates differ in terms of their scope and approach, and hence are not directly comparable.

The additional investment and financial flows needed for climate change mitigation and adaptation in 2030 is \$249 to \$381 billion. While that figure is large in absolute terms, it is only 1.1 to 1.7 percent of projected global investment in 2030.

Sources of investment

Most (60 percent) investments are made by corporations, with the balance being made by households (26 percent) and governments (14 percent); see Exhibit 4. The household investments are for homes, farms, and small businesses and are financed by the owner.¹⁰ Corporate investments are financed by foreign direct investment (37 percent), domestic sources (35 percent) and foreign loans (28 percent). Government investments are financed mainly from domestic sources (91 percent) with some foreign loans (8 percent) and official development assistance (1 percent). Official development assistance provides 30 percent of the government investment in least developed countries.

Most of the additional investment and financing needed for climate change mitigation and adaptation is expected to be financed by corporations, although this may require government policies and incentives. Electric utilities are usually government-owned or regulated private corporations. Changing the mix of generation facilities they build may require government policies. Facility owners should make the extra investment for energy efficiency in industry and buildings because it will yield an attractive return, but policies may be needed to address the well-known market barriers faced by energy efficiency. Households will bear the higher initial cost of efficient vehicles, but policies are likely to be needed to drive manufacturers to implement efficiency improvements in their new vehicles. Governments play a significant role in funding research, development and demonstration.

Governments are likely to play a larger role in providing the additional funds needed for adaptation. While most of the additional investment needed for agriculture, forestry and fisheries will be provided by households and corporations, a substantial part of the additional research and extension activity will be funded by government. Most water supply systems and coastal protection measures are funded by governments. Health care relies on a mix of public and private funding that varies widely across countries. Most infrastructure is privately owned, but government policies may be needed to ensure that new facilities are well suited to the future climate.

Raising the funds needed

Developing countries, especially the poorest and those most vulnerable to the adverse impacts of climate change, will need substantial international financial support for mitigation and adaptation. The current financial mechanisms will likely be unable to provide financial assistance to developing countries on the scale required. Currently support for mitigation and technology cooperation is provided by the Clean Development Mechanism (CDM) and funds established under the UNFCCC. The Convention funds and

the Adaptation Fund under the Kyoto Protocol support adaptation measures in developing countries.

The CDM, and possible new market mechanisms, could supply a substantial part of the funding needed for renewables and non-CO₂ emission reduction measures in developing countries under a post-2012 agreement. Due to the scale of the potential reductions and the marginal costs of reduced emissions from deforestation and degradation (REDD) and from CCS, it may be better to provide direct financial support for those measures.

Numerous options to raise the additional financial resources have been proposed. The proposals fall into three categories:

- Larger financial contributions by developed country governments: some proposals suggest funding sources, such as a carbon tax, while others focus on the amount that should be contributed by developed countries through their budgets
- Sale of a share of the developed country assigned amount: this has the effect of making the developed country commitments (their assigned amount) more stringent, but has the advantage of relieving governments of the responsibility to raise the funds
- Revenue collected through regulation of international aviation and shipping emissions: an emissions fee and/or auctioned emissions allowances would help regulate these rapidly growing emissions and raise revenue

The only proposals likely to generate sufficient revenue are the proposal to auction a share of the assigned amount, and an emissions tax or auctioned allowances for international aviation and shipping.

Exhibit 1

Annual Investment and Financial Flows for Climate Change Mitigation in 2020 (billions of 2005 US dollars)

	World	Developed Countries	United States	Japan	OECD Europe	Developing Countries	Brazil	China	India	Other Developing Asia	Other Latin America	Africa and Middle East
Fossil fuel supply												
Coal	-4	-2				-3	--	-2	--	--	--	--
Oil	-18	-8				-11	-1	-2	--	-1	-1	-5
Natural gas	-13	-6				-7	--	+1	--	-2	-2	-4
Total	-36	-16				-20	-2	-2	--	-3	-3	-10
Power Supply												
Coal-fired generation	-55	-23	-12	--	-8	-32	0	-17	-9	-4	--	-2
Oil-fired generation	-1	--	--	--	--	--	--	--	0	--	0	--
Gas-fired generation	-2	--	+5	--	--	-3	--	+3	+1	-2	-3	-2
Nuclear power	+17	+10	+4	+1	--	+7	--	+4	+3	--	--	--
Hydropower	+14	+3	--	--	+1	+11	-2	+4	+3	+1	+2	+3
Renewables	+34	+18	+4	+2	+8	+16	--	+7	+2	+3	+1	+3
CCS for coal-fired plants	+7	+4	+2	0	+2	+3	0	+2	--	--	--	--
CCS for gas-fired plants	+7	+5	+2	--	+1	+2	0	--	--	--	--	+1
Transmission, distribution	-82	-49	-17	--	-18	-33	-2	-13	-4	-7	-3	-5
Total	-68	-36	-15	--	-16	-30	-3	-9	-4	-8	-4	-2
Industry												
Electrical equipment												
Fuel consuming equipment												
CCS												
Non-CO ₂ gases												
Total												
Buildings												
Electrical equipment												
Fuel consuming equipment												
Total												
Transportation												
Hybrids, vehicle efficiency												
Biofuel												
Total												
Waste												
Energy RD&D												
Agriculture												
Non-CO ₂ gases	19	7				12						
Agroforestry	15	0				15						
Grassland management	N.A.	N.A.				N.A.						
Total	34	7				27						
Forestry												
Reduced deforestation												
Forest management												
Afforestation and reforestation												
Total												
Total												

Exhibit 2

Annual Investment and Financial Flows for Climate Change Mitigation in 2030 (billions of 2005 US dollars)

	World	Developed Countries	United States	Japan	OECD Europe	Developing Countries	Brazil	China	India	Other Developing Asia	Other Latin America	Africa and Middle East
Fossil fuel supply												
Coal	-8	-3				-5	--	-3	-1	--	--	--
Oil	-29	-12				-17	-2	-3	--	-2	-2	-7
Natural gas	-23	-11				-12	-1	+2	--	-2	-3	-8
Total	-59	-27				-32	-3	-3	-1	-5	-5	-16
Power Supply												
Coal-fired generation	-51	-24	-9	--	-12	-28	0	-13	-8	-4	--	-1
Oil-fired generation	-1	-17	--	--	--	--	--	--	--	--	--	--
Gas-fired generation	-3	+18	+7	--	-1	-4	--	+3	+1	-3	-3	-3
Nuclear power	+25	+14	+5	+1	+1	+11	--	+6	+4	--	--	--
Hydropower	+22	+5	+1	--	+1	+18	-2	+6	+4	+2	+3	+5
Renewables	+38	+20	+5	+3	+9	+18	--	+8	+2	+4	+1	+3
CCS for coal-fired plants	+40	+20	+17	0	+1	+21	0	+16	+3	+1	--	--
CCS for gas-fired plants	+23	+17	+9	--	+5	+6	--	+1	--	+1	--	+4
Transmission, distribution	-101	-54	-20	-2	-19	-48	-3	-18	-7	-9	-4	-7
Total	-7	-2	+15	+1	-3	-6	-4	+7	--	-7	-4	+1
Industry												
Electrical equipment	+11	+7				+4						
Fuel consuming equipment	+9	+6				+3						
CCS	+14	+3				+11						
Non-CO ₂ gases	+2	+1				+1						
Total	+36	+17				+19						
Buildings												
Electrical equipment	+42	+32				+10						
Fuel consuming equipment	+9	+5				+4						
Total	+51	+37				+14						
Transportation												
Hybrids, vehicle efficiency	+79	+47				+32						
Biofuel	+9	+5				+4						
Total	+88	+52				+36						
Waste												
	+1	--				+1						
Energy RD&D	+35 to 45					?						
Agriculture												
Non-CO ₂ gases	+20	+7				+13						
Agroforestry	+15	--				+15						
Grassland management	N.A.					N.A.						
Total	+35	+7				+28						
Forestry												
Reduced deforestation	+12	--				+12						
Forest management	+8	--				+8						
Afforestation, reforestation	--	--				--						
Total	+20	--				+20						
Total	200 - 210					80						

Exhibit 3

Annual Investment and Financial Flows for Climate Change Adaptation in 2030 (billions of 2005 US dollars)

	Global	Developed Countries	Developing Countries
Agriculture	14	7	7
Water supply	11	2	9
Human health	5	0	5
Coastal protection	11	6	5
Infrastructure	8 to 130	6 to 89	2 to 41
Total	49 to 171	21 to 104	28 to 67

Source: UNFCCC, 2007, Table IX-65, p. 177.

Exhibit 4

Sources of Investment in 2000

	Global Amount (2000 US\$)	Global Share of total (%)	Developed Countries Share of total (%)	Developing Countries Share of total (%)	Least Developed Countries Share of total (%)
Households					
Total investment	1,184	26	29	19	18
Corporations					
Domestic funds	1,429	21	21	13	57
Foreign direct investment	1,540	22	22	24	12
Foreign debt	1,156	17	17	20	--
Total investment	4,125	60	60	57	69
Governments					
Domestic funds	850	12	13	9	15
Foreign debt	71	1	1	2	--
Official development assistance	16	0	0	1	6
Total investment	937	14	14	12	21
Total					
Domestic funds	4,093	60	55	85	82
Foreign direct investment	1,540	22	24	12	12
Foreign debt	1,226	18	21	2	--
Official development assistance	16	0	0	1	6
Total investment	6,875	100	100	100	100
Share of global investment in the region (%)			77.6	21.3	0.5

Source: UNFCCC, 2007, Table 3, pp. 212-213 and Table III-5, p. 33.

Endnotes

¹ An investment is the initial (capital) cost of a new physical asset with a life of more than one year, such as the capital cost of a gas-fired generating unit or a water supply system. A financial flow is an ongoing expenditure related to climate change mitigation or adaptation that does not involve physical assets, such as research or health care.

² UNFCCC, (2007). *Investment and Financial Flows to Address Climate Change*, Table 5, p. 216 UNFCCC, Bonn.

³ The differences in temperature, precipitation and sea level rise between a reference and mitigation scenario would be quite small in 2030.

⁴ These estimates do not include the cost of sanitation facilities, storm water management, or flood protection. They also do not include the cost of meeting Target 10 of the Millennium Development Goals – halving the number of people without sustainable access to safe drinking water and basic sanitation by 2015 – which is estimated to require an annual expenditure of \$10 billion over that period.

⁵ Flood and land losses are climate change damages. In practice, adaptation costs would be incurred in responding to those damages, so the adaptation costs are under estimated.

⁶ World Bank, (2006). *Clean Energy and Development: Towards an Investment Framework*. DC 2006-0002, Table K.1. Current needs, based on share of investment estimated to be climate sensitive. World Bank, Washington, DC, USA.

⁷ Müller, Benito and Cameron Hepburn, (2006). *IATAL — an outline proposal for an International Air Travel Adaptation Levy*, p. 14. Current needs, based on extrapolations of LDC National Adaptation Programmes of Action (NAPAs). Oxford Institute for Energy Studies, EV 36, Oxford, UK, October 2006, www.OxfordClimatePolicy.org

⁸ Oxfam, (2007). “Financing adaptation: why the UN’s Bali Climate Conference must mandate the search for new funds,” p. 3. Current needs, based on extrapolations of NAPAs, Oxfam Briefing Notes, 4 December 2007 http://www.oxfam.org.uk/resources/policy/climate_change/downloads/bn_bali_adaptation.pdf

⁹ UNDP, 2007. *Human Development Report 2007/2008: Fighting climate change. Human solidarity in a divided world. Needs in 2015*. UNDP, New York. <http://hdr.undp.org/en/reports/global/hdr2007-2008/>

¹⁰ The household may borrow funds from financial institutions, but the financial institution would get the money from deposits by households and corporations. The available data do not allow the sources of domestic funding to be tracked.

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