

### III. CURRENT AND REFERENCE SCENARIO INVESTMENT AND FINANCIAL FLOWS

33. As mentioned in [CHAPTER II](#), the investment flows analysed in this paper focus on capital spending for new physical assets, and financial flows relate to mitigation and adaptation activities that do not involve an investment in new physical assets. This chapter discusses how data for current investment flows were compiled and adjusted for purchases and sales of financial assets where appropriate. It then provides an overview of current investment and financial flows. Next, projected investment and financial flows under the reference scenario are summarized. Finally, interpretation of the estimates is addressed.

#### 3.1. DATA ON CURRENT INVESTMENT FLOWS

34. The investment in new physical assets during a given year is reported in the national accounts of countries as “gross fixed capital formation” (GFCF). The sources of the investment and the economic sectors in which the investments were made are also reported.

35. The sources reported in the national accounts are the entities – governments, corporations or households –

responsible for the investments, not the sources of the funds.<sup>7</sup> A government, for example, could fund an investment with tax revenue or with new debt in the form of bank loans or bonds. Similarly, a corporation could fund an investment from internal savings, new debt or new equity. The debt or equity can come from within the country or from other countries.

36. Data are also available on funds obtained from other countries during the year; specifically equity foreign direct investment (FDI), international debt, and official development assistance (ODA) in the form of grants and concessionary loans.<sup>8</sup> Data on how investors raise funds domestically – through internal savings, loans, or equity – are not available. The amount funded domestically is calculated by subtracting the foreign funds from the total investment (GFCF).

37. The data on GFCF, FDI, international debt, and ODA are discussed in turn. These data are all on a calendar year basis. The most recent year for which national accounts data is available for a large number of countries is 2000.

#### 3.1.1. GROSS FIXED CAPITAL FORMATION

38. GFCF is the most comprehensive and consistent measure of current investment in physical assets available. It is the spending on new physical assets in a country during a specified year.<sup>9</sup> Many countries report the sources and/or economic sectors of GFCF based on internationally agreed definitions; the four sources and 10 economic sectors are listed in [TABLE III-1](#).

**Table III-1. Sources and sectors for gross fixed capital formation**

Sources	Economic sectors
Households	Agriculture, hunting, forestry and fishing
Government	Mining and quarrying
Financial corporations	Manufacturing
Non-financial corporations	Electricity, gas and water supply
	Transport, storage and communications
	Financial intermediation real estate, renting and business activities
	Construction
	Wholesale retail trade, repair of motor vehicles, motorcycles, etc., hotels and restaurants
	Public administration and defence, compulsory social security
	Education, health and social work, other community, social and personal services

39. Total GFCF is available for almost all countries for 2000. Values for the remaining countries were estimated based on the country's gross domestic product (GDP) and per capita GDP. GFCF by source and by sector was reported by just over 50 countries for 2000, but those countries account for 85–90 per cent of global GFCF. For countries with incomplete or missing data for GFCF by sources or sectors, the values were estimated as described in ANNEX II.

40. The 10 economic sectors for which GFCF (and FDI) data are available do not always match the sectors used for the mitigation and adaptation analyses. Agriculture and forestry, for example, are analysed separately in this paper but are part of the same economic sector for GFCF and FDI data calculations. Those data issues are addressed in the respective mitigation and adaptation sector analyses.

### 3.1.2. HOUSEHOLDS

41. Households are individuals. They invest in housing, farms, vehicles and facilities for small businesses. Households are responsible for 15–35 per cent of total global investment, all of which is assumed to come from domestic sources. However, remittances by family members working in foreign countries are substantial for some countries and could help fund household investment in the recipient countries.

### 3.1.3. GOVERNMENTS

42. Governments are the national, provincial, state and local governments of a country.<sup>10</sup> They invest in long-lived assets that provide local public benefits, such as transportation infrastructure, water supply, schools and hospitals, coastal infrastructure, and natural ecosystems. They channel their investments into their most pressing development priorities. High social returns are sought, such as economic growth, jobs, improved national security, improved health of citizens and a cleaner environment. Governments often use a long timeframe to evaluate the expected returns from their investments. They often try to reduce the risk of an investment not performing as expected by relying on proven technologies.

43. Governments are typically responsible for 10–15 per cent of total investment in physical assets in a country. Over 90 per cent of the funds that governments invest come from domestic sources such as the taxes and fees they collect. They may borrow funds from domestic or

foreign sources. International borrowing by governments amounts to less than 10 per cent of their investment in new physical assets.

44. Operational spending by governments such as health care spending and funding for energy research may also contribute to climate change adaptation or mitigation. The Government of India estimates that adaptation expenditures related to agriculture, water supply, health and sanitation, coastal zones, forests, and extreme weather events amounted to between 3 and 5 per cent of central government spending over the five years prior to fiscal year 2005/2006 and 8 per cent during that year.<sup>11</sup>

### 3.1.4. FINANCIAL CORPORATIONS AND NON-FINANCIAL CORPORATIONS

45. Financial corporations are entities such as banks and insurance companies that provide financial services to non-financial corporations, households and governments. They also invest in physical facilities, such as buildings, using funds raised domestically or from foreign sources. They are responsible for 1–7 per cent of the investment in new physical assets.

46. Non-financial corporations produce goods, such as fossil fuels, and non-financial services, such as communications services. They need physical facilities such as commercial buildings, industrial plants, and telecommunications facilities to provide the goods and services they offer.

47. Since investment in physical assets by financial corporations is small relative to the investment from other sources, it is combined with investment by non-financial corporations for the analysis. Together these sources are responsible for 50–75 per cent of the total investment in new physical assets. All FDI is assumed to go to corporations. FDI as a share of total investment by corporations varies widely across regions. International debt as a share of total investment by corporations also varies widely across regions.

### 3.1.5. FOREIGN DIRECT INVESTMENT

48. FDI tends to be made by multinational corporations seeking to establish or expand operations overseas. As it is an equity investment, lenders of FDI seek a higher return than most lenders, but also accept higher risks.

49. FDI is reported by several sources, which were compared and consolidated as discussed in ANNEX II. The data cover both equity investment by multilateral operating companies in new physical assets and acquisition of existing physical and financial assets. Globally, purchases and sales of existing assets are approximately equal. But for an individual country, purchases and sales of existing physical and financial assets can be a large component of FDI.<sup>12</sup>

50. Since the analysis focuses on investment in new physical assets, two values of total FDI are compiled for each country:

- Inward FDI as reported: equity investment in new physical assets and acquisition of existing physical and financial assets in the recipient country;
- Adjusted FDI: inward FDI as reported minus the value of international purchases in the recipient country, plus the value of international sales in the recipient country due to mergers and acquisitions (M&A).

51. Data on inward FDI, but not M&A, are available by sector. As a result, FDI estimates for some sectors or regions are either large or small relative to the investment in new physical facilities.

52. Data on inward FDI are not available by source, so it is assumed that all inward FDI goes to corporations.

### 3.1.6. INTERNATIONAL DEBT

53. International debt includes loans provided by commercial banks and the sales of bonds in the capital market. Commercial bank loans generally cover periods from a few days to a few years. Bonds generally have a longer maturity, ranging up to decades. Debt provides finance to borrowers that have a demonstrated capacity to repay the loan with interest. Lenders generally want little risk and are prepared to accept lower returns than equity investors.

54. Data on international debt are published by the Bank for International Settlements (BIS). They cover only debt issued by banks in 40 large lending countries, so total international debt is understated, but there is no basis for estimating the foreign borrowing not covered by this source. Data on new international debt borrowed or issued by governments and corporations are available for each year. Data on foreign borrowing are available by sectors.

55. There is no guarantee that international debt is invested in new physical infrastructure; the corporations and governments that borrow the money could use it for operating purposes. International debt represents almost 20 per cent of total global investment and a reasonable share of the total investment made by governments and corporations. Assuming that international debt is used for operational purposes would simply increase the funds raised from domestic sources.

### 3.1.7. OFFICIAL DEVELOPMENT ASSISTANCE

56. ODA is bilateral or multilateral assistance provided on concessional terms. Bilateral assistance is provided by the government of another country, as a grant that does not need to be repaid, or as a loan with concessional terms. Multilateral assistance usually takes the form of a loan with concessional terms from an IFI. The primary objective of ODA is to alleviate poverty but some of the funding is invested in new facilities or spent in ways that contribute to climate change mitigation or adaptation.

57. The OECD collects extensive data on bilateral and multilateral ODA. Only the investment component of ODA is included in the investment flows; analyses of financial flows consider all of the relevant ODA flows. ODA data are available by sector. While some ODA funds go to non-governmental entities, all ODA is assumed to go initially to governments in the recipient countries. The investment component of ODA amounts to between 1 and 7 per cent of total investment in new physical assets in developing country regions.

58. Analyses of financial flows consider the relevant ODA flows, not just the investment component.

<sup>7</sup> Determining the sources of funds is complex. For example, a household may use a mortgage from a bank to help fund its purchase of a house. The bank could be considered the source of the mortgage funds, but the bank gets those funds from deposits by households and corporations.

<sup>8</sup> The carbon markets, which were negligible source of investment funds in 2000, have grown rapidly since discussed in CHAPTER VII.

<sup>9</sup> GFCF also includes the net change in inventories during the year. This is excluded where it is reported separately. It is usually of the order of 1 or 2 per cent of the total, so where it cannot be excluded it does not greatly distort the figures.

<sup>10</sup> Financial and non-financial corporations, such as oil companies or electric utilities, owned wholly or in part by governments are included in those source categories.

<sup>11</sup> Presentation "India: Adaptation Approaches and Strategies" made by R. Ray, Deputy Secretary, Ministry of Environment and Forests, Government of India, during the third workshop of the dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention (22 May 2005), see: [http://unfccc.int/files/meetings/dialogue/application/pdf/india\\_-\\_adaptation.pdf](http://unfccc.int/files/meetings/dialogue/application/pdf/india_-_adaptation.pdf).

<sup>12</sup> For example, in a small country with a large international financial sector, FDI can be much larger than the GDP. In such cases, the FDI is obviously not all invested in new physical assets in the country.

59. The original data are reported by the 22 members of the Development Assistance Committee (DAC) of the OECD and by the European Commission (EC) to the Creditor Reporting System (CRS) Aid Activity database. The CRS also includes data from multilateral organizations, although these are not obligated to report to the OECD.

60. Some donors do not supply data to the OECD. The major gaps in bilateral ODA reporting post 1999 come from Japan and the EC. The former does not report technical co-operation activities; the latter does not report activities financed through its budget.

### 3.1.8. DOMESTIC FUNDS

61. Most of the funds invested in new physical assets are raised domestically; 50–90 per cent in most regions. Systematic data on the sources of these funds are not available. Instead, the domestic funds invested by households, governments and corporations are estimated.

62. All investment by households is assumed to originate domestically from savings or as debt from friends or financial institutions.

63. Over 90 per cent of the funds invested by governments are raised domestically. These funds may come from tax or other revenue, be borrowed from domestic financial institutions or come from the sale of bonds in the domestic market.

64. Although corporate investment includes substantial amounts of foreign equity and international debt, over half of the funds that corporations invest globally originate from commercial loans or the sale of bonds or equity in domestic financial markets. Corporations and their domestic sources of funds are adjusted to the country risk and have first-hand knowledge of the local market. They may also find it easier to raise funds domestically since they are known to the local financial community.

### 3.1.9. OVERVIEW OF CURRENT INVESTMENT FLOWS

65. [TABLE III-2](#) provides an overview of the investment flow data available, together with the sources of the data and the key assumptions. The same information, apart from the adjusted FDI and adjusted domestic sources, is available for each of the 10 economic sectors in [TABLE 35-ANNEX V](#).

66. The sources of global investment flows in 2000 are summarized in [TABLE III-3](#). Total global investment in 2000 was USD 7,750 billion, or about 21 per cent of global GDP. Almost 60 per cent of the funds invested were raised domestically, with FDI and foreign debt accounting for just over and just under 20 per cent respectively. ODA fund invested in physical assets represent less than 1 per cent of the total investment.

67. The regional distribution of current investment is presented in [TABLE 3-ANNEX V](#). Governments provide a higher than average share of the investment in Africa, while households provide less. Investment funded through ODA accounts for over 6 per cent of the total in least developed countries (LDCs), 2 per cent in Africa and about 1 per cent in other developing country regions. Foreign debt is significant in Latin America and OECD regions. FDI is significant in OECD regions, Latin America and developing Asia. Adjustments for purchases and sales makes the most difference in OECD regions.

68. [TABLE 1-ANNEX V](#) summarizes commercial financing by sector and region for 2000 and 2005. The data cover projects partly funded by loans from commercial banks. Such projects represent almost 30 per cent of the investment in the electricity, gas distribution and water supply sector and about 15 per cent of the transportation, storage and communications sector. The table shows the debt: equity ratio for projects in each sector. [TABLE 2-ANNEX V](#) shows the same data by region for 2000.

**Table III-2. Overview of investment flow data**

Source		Total/Sector	Notes
Households	Total investment	A GFCF data	Assumed to be entirely domestic
Corporations	Total investment	B GFCF data	
	Domestic funds	C Calculated (B – D – G)	
	FDI	D UNCTAD data	Assumed to be all non-financial corporations
	Adjusted domestic funds	E Calculated (B – F – G)	
	Adjusted FDI	F UNCTAD data	Adjusted for mergers and acquisitions; not available by sector
	Foreign debt	G BIS data	
Government	Total investment	H GFCF data	
	Domestic funds	I Calculated (H – J – K)	
	Foreign debt	J BIS data	
	ODA	K OECD data	Assumed to be all government
Total	Total investment	A + B + H	
	Domestic funds	A + C + I	
	FDI	D	
	Adjusted domestic	A + E + I	
	Adjusted FDI	F	
	Foreign debt	F + J	
	ODA	K	

*Abbreviations:* BIS= Bank for International Settlement, FDI = Foreign Direct Investment, GFCF = Gross fixed capital formation, ODA = Official Development Assistance, OECD = Organisation for Economic Co-operation and Development, UNCTAD = United Nations Conference on Trade and Development.

*Note:* Please refer to ANNEX II and TABLES 1–4-ANNEX V for detailed information on the above definition and calculation.

**Table III-3. Sources of investment in 2000**

Source		Amount (2000 USD billion)	Amount (2005 USD billion)	Share of total (in percentage)
Households	Total investment	1,814	2,045	26
Corporations	Domestic funds	1,429	1,611	21
	FDI <sup>a</sup>	1,540	1,736	22
	Foreign debt	1,156	1,303	17
	Total investment	4,125	4,649	60
Government	Domestic funds	850	959	12
	Foreign debt	71	80	1
	ODA	16	18	0
	Total investment	937	1,056	14
Total	Domestic funds	4,093	4,614	60
	FDI <sup>a</sup>	1,540	1,736	22
	Foreign debt	1,226	1,382	18
	ODA	16	18	0
	<b>Total investment</b>	<b>6,875</b>	<b>7,750</b>	<b>100</b>

*Source:* Estimations by UNFCCC secretariat based on data from UNSTAT, National Accounts Database; BIS, 2007; World Bank, 2006, World Development Indicator; OECD, CRS.

<sup>a</sup> May not include all international equity investments by financial corporations, organizations, funds, limited partnerships and other entities, for example through project finance.

### 3.2. CURRENT FINANCIAL FLOWS

69. Current financial flows are specific financial flows relevant to climate change mitigation or adaptation that do not involve investment in physical assets. Information on financial flows supported by climate change funds established by the Convention and its Kyoto Protocol can be found in [CHAPTERS VII](#) and [VIII](#). Information on current financial flows relevant to specific mitigation or adaptation measures is discussed in the analysis for the relevant sector.

### 3.3. INVESTMENT FLOWS NEEDED IN 2030

70. Projections of future investment flows are available by economic sector, but not by source. Projections of future FDI, international debt and ODA are also not available. In addition, the economic sectors for which current and future investment flows are available do not always coincide with those relevant to the analysis of climate change mitigation and adaptation. This means that the future investment flow projected for a sector was assessed on the basis of the current sources of investment for the sector.

71. The reference scenario used for the mitigation analysis includes the IEA WEO 2006 reference scenario and, as shown in [CHAPTER II](#), the WEO scenario is close to most of the scenarios used in the adaptation analysis. Preliminary estimates of new investment calibrated to the WEO scenario are available from the OECD's ENV-Linkages model. The projected investment in new physical assets in 2030 from that calibrated model is USD 22,270 billion. This means that total investment, adjusted for inflation, is projected to grow at a rate of 4 per cent per year, which is high by historical standards, due to economic growth over the period.

72. Global investment by sectors for 2000 and 2030 is summarized in [TABLE III-4](#). The data for 2000 come from the sources described earlier in this chapter, while the 2030 figures come from the OECD ENV-Linkages model. The OECD ENV-Linkages model projects investment for 26 economic sectors, which do not match exactly the 10 economic sectors for which current investment flows are available.

73. The proportion of investment made in primary sectors – agriculture, forestry, fishing and mining – is projected to decline although the amount invested will increase substantially: a typical pattern for economic growth. The apparent decline in the proportion of investment made in electricity supply, gas distribution

and water supply will be analysed further in the energy supply chapter ([CHAPTER IV.4.1](#)). Significant increases in investment are projected for the transportation, storage and communications sector and the financial intermediation, real estate, renting and business activities sector.

74. The sectoral distribution indicates that the principal sources of GHG emissions and the focus of mitigation efforts – i.e. the agriculture, forestry, mining (oil and gas production), manufacturing, electricity generation, gas distribution, and transportation sectors – receive less than one-third of total investment. It is more difficult to estimate the share by sector of total investment involved in adaptation to climate change, but the agriculture, forestry, fishing, water supply and health care sectors probably receive less than 10 per cent of the total. Buildings and other infrastructure that might be damaged by the impacts of climate change may receive 20–40 per cent of total investment.

75. The relationship between investment and GDP and population by region is shown in [TABLE III-5](#). The shares of population and GDP differ widely, leading to recognized differences in per capita GDP across regions. However, investment in new physical assets is closely related to GDP; in other words, investment as a share of GDP is approximately the same for all regions.

76. There are substantial differences across regions in the sectoral distribution of investment, as shown in [TABLE III-5](#). Overall, developing Asia's share of global investment rises sharply between 2000 and 2030, reflecting its projected rapid growth. The slower economic growths of OECD regions causes their share of global investment to fall. Investment in primary sectors (AFF, and mining and quarrying) declines, as is typical with economic growth. The proportion of investment in primary sectors is highest in Africa (see [TABLE 4-ANNEX V](#)). The fastest growing sectors in all regions are transportation and communications and the service sectors.

77. Current and projected investment flows by region for each sector are presented in [TABLE 4-ANNEX V](#). The sectoral pattern is broadly similar across all regions, except that primary sectors attract a larger share of the investment in developing country regions, such as Africa.



**Table III-4. Global investment by sector in 2000 and 2030 (percentage)**

	2000	2030
Agriculture, hunting, forestry; fishing	2.26	1.20
Mining and quarrying	1.80	0.83
Manufacturing	16.78	15.46
Electricity, gas and water supply	3.32	1.65
Construction	11.47	9.45
Transport, storage and communications	8.02	
Financial intermediation; real estate, renting and business activities	5.65	19.06
Wholesale retail trade, repair of motor vehicles, motorcycles, etc.; hotels and restaurants	33.69	
Public administration and defense; compulsory social security	8.03	39.94
Education; health and social work; other community, social and personal services	8.98	
Dwellings	N.A.	12.41
<b>Total in billion USD</b>	<b>7,750</b>	<b>22,270</b>

Source: Estimations by UNFCCC secretariat based on data from UNSTAT, National Accounts Database; BIS, 2007; World Bank, 2006, World Development Indicator; OECD, CRS; OECD, ENV-Linkages Model.

**Table III-5. Total current and projected investment by region**

Regions <sup>a</sup>	Current (2000)			Reference scenario (2030)		
	Percentage of world investment	Percentage of world GDP	Percentage of world population	Percentage of world investment	Percentage of world GDP	Percentage of world population
Africa	1.52	1.84	13.37	2.18	2.88	17.60
Developing Asia	10.37	8.23	52.69	27.93	19.71	46.13
Latin America	4.28	4.76	7.01	2.97	4.29	7.19
Middle East	1.80	2.04	2.44	3.57	2.80	3.66
OECD Europe	32.10	28.23	8.68	21.63	21.38	13.16
OECD North America	26.67	35.18	6.83	26.18	36.22	6.50
OECD Pacific	21.87	18.12	3.27	13.32	10.87	2.46
Other Europe	0.02	0.02	0.001	0.25	0.26	0.12
Transition Economies	1.35	1.58	5.71	1.97	1.59	3.18
World	100.00	100.00	100.00	100.00	100.00	100.00
AI Parties	77.60	79.34	20.36	56.65	64.30	20.13
NAI Parties	21.34	19.68	79.07	39.96	32.55	75.14
Least developed countries	0.51	0.56	11.08	N.A.	N.A.	N.A.
<b>World total (billion)</b>	<b>7,750<sup>b</sup></b>	<b>35,440<sup>b</sup></b>	<b>6.0<sup>c</sup></b>	<b>22,270<sup>b</sup></b>	<b>79,558<sup>b</sup></b>	<b>8<sup>c</sup></b>

Sources: UNSTAT, National Accounts Database; World Bank, 2006, World Development Indicator; OECD, ENV-Linkages Model.

Abbreviations: AI Parties = Parties included in ANNEX I to the Convention, GDP = gross domestic product, NAI Parties = Parties not included in ANNEX I to the Convention, OECD = Organisation for Economic Co-operation and Development.

<sup>a</sup> Please see ANNEX I for definitions on regional grouping

<sup>b</sup> United States dollars

<sup>c</sup> Number of people

### 3.4. FINANCIAL FLOWS NEEDED IN 2030

78. For the analysis of future financial flows needed for mitigation, the reference scenario assumes no new international agreement to address climate change. Thus, the reference scenario has no future financial flows – recurrent expenditures – to reduce emissions or enhance sinks. For the mitigation scenario, current and future financial flows are estimated by sector, specifically for reduction of non-CO<sub>2</sub> emissions in agriculture, reduced deforestation, forest management, extension services for agriculture, and technology research, development and deployment.

79. Climate change would occur under any of the scenarios selected for the analysis of investment and financial flows needed for adaptation. In order to respond to the impact of climate change, additional financial flows would be needed for each sector analyzed but in particular for human health and for R&D in the AFF sector.

### 3.5. INTERPRETATION OF THE ESTIMATES OF INVESTMENT AND FINANCIAL FLOWS

80. Estimates of investment and financial flows are for a given calendar year. The investments flows estimated correspond to the capital cost of new physical assets. The investments do not include the operating and maintenance costs of the new assets over their lifetime, because the focus is on investment flows and the timing of the operating and maintenance expenditures differs from that of investment.

81. The investment in a new asset is not the same as the annual cost of financing a given asset. For instance, if a water supply system with a capital cost of USD 100 million is needed in 2030, the investment during 2030 is estimated as USD 100 million. However, if that system is financed with a loan repayable over 20 years with a 5 per cent interest rate, the total cost would be USD 160 million and the payments during 2030 would be approximately USD 8 million. The figure used in this analysis is USD 100 million.

82. The analyses in this paper do not provide an estimate of the total cost of climate change mitigation. A comparison of the reference and mitigation scenarios indicates differences in the total investment needed for various types of physical infrastructure and the financial flows needed for various mitigation measures. The sum of those differences is not an estimate of the cost of mitigating climate change nor the cost of adapting to climate change. The analysis does not provide an estimate

of the total cost of the adaptation neither. It assesses the order of the magnitude of the additional investment and financial flows that could be needed in 2030 to adapt to the adverse impact of climate change in selected sectors.

83. The change in the total investment and financial flows in measures that affect GHG emissions between the reference and mitigation scenarios should be taken as an estimate of mitigation cost. The scenarios cover only the capital costs and specified financial flows. Operating and maintenance costs of the physical assets are not included. Offsetting savings, such as reduced energy costs, are also not considered. Thus, the mitigation cost could be higher or lower than the investment and financial flows.

84. To estimate the cost of adapting to climate change it is necessary to define a 'base' current or pre industrial climate from which change is measured. Neither is a meaningful option, since further changes to the current climate are already committed. In that case an operational definition of adaptation would be needed, and this is not available in the literature.