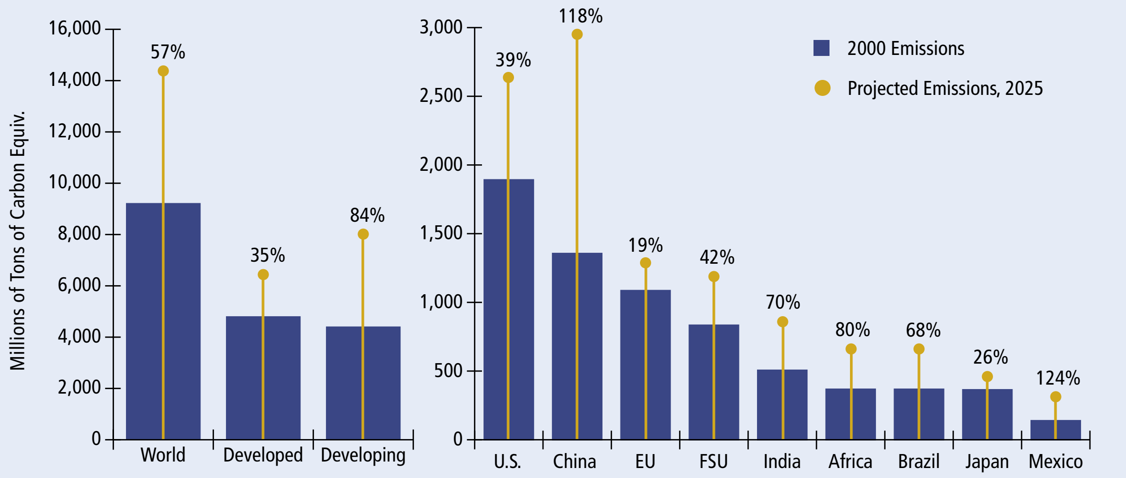
Emissions Projections

The central challenge of international climate change policy is to limit future emissions. Projections of long-term emissions growth depend heavily on assumptions about such critical factors as economic and population trends and the rate of technology development and diffusion. The IPCC has developed four "families" of scenarios incorporating different sets of assumptions.[15] Under these scenarios, global GHG emissions are projected to grow 39 to 89 percent by 2025, and 63 to 235 percent by 2050, depending on the underlying assumptions.[16] As with the decomposition analysis presented earlier, GDP and population are the strongest determinants of emissions trends in most scenarios. The wide range in projections reflects both differing assumptions, for instance with respect to future policy choices, and substantial uncertainties, particularly regarding economic forecasts.

Among the most widely cited emissions projections are those developed by the Energy Information Administration (EIA) of the U.S. Department of Energy.[17] Under EIA's mid-range or "reference case" scenario for CO_2 from fossil fuels, combined with estimates of future non-CO_2 emissions, global emissions are projected to rise 57 percent over the period from 2000 to 2025 (Figure 3.1). Projections from the International Energy Agency suggest similar future outcomes.[18] While growth is projected in all regions, there are significant differences, as shown in Figure 3.1:

- Among industrialized countries, projected increases to 2025 are relatively modest for the EU (19 percent) and Japan (26 percent), and higher for the United States (39 percent).
- The fastest growth until 2025 is projected in developing countries, whose collective emissions are projected to rise 84 percent (compared to 35 percent growth for industrialized countries). By 2025, the developing country share of global emissions is projected to be approximately 55 percent (compared to 48 percent in 2000).
- Among developing countries, the largest relative growth until 2025 is forecast for Mexico (124 percent) and for China (118 percent). China is projected to surpass the United States as the world's largest emitter.

Figure 3.1. Projected Emissions of GHGs in 2025



Sources & Notes: Projections are based on EIA, 2003 (reference case, CO_2 from fossil fuels) and POLES (non-CO_2 gases) (EC, 2003). GHGs do not include CO_2 from land use change. "FSU" is former Soviet Union.

Because emission projections require estimating factors such as population, economic growth, and technological change, they are inherently uncertain. Uncertainties are especially acute in developing country economies, which tend to be more volatile and vulnerable to external shocks. The large uncertainties in national-level projections are reflected in Figure 3.2. For Mexico, for example, one scenario envisions a 68 percent emissions growth by 2025, while another suggests a 215 percent increase. Particularly in large countries, these uncertainties amount to huge quantities of CO_2 emissions. In China, for example, the difference between the low (50 percent increase) and high (181 percent increase) estimates amounts to 1,025 MtC, a quantity that exceeds the *combined* current emissions of India, South Korea, Mexico, South Africa, and Brazil. The differences between low- and high-growth estimates are much smaller for industrialized countries, in part because economic growth is more stable and thus uncertainties are smaller.

Figure 3.2. Uncertainty in Future CO_2 Emissions

	Projected Growth, 2000–2025 (%)		
Country	**Low Growth Estimate**	**High Growth Estimate**	**% Point Difference**
India	73	225	152
Mexico	68	215	147
China	50	181	131
Brazil	84	165	81
South Korea	43	117	74
Former Sov. Union	37	109	72
Japan	4	46	42
EU-15	-1	39	40
United States	20	52	32
World	**33**	**93**	**60**

Sources & Notes: Scenarios are drawn from EIA, 2004; POLES (EC, 2003); and IEA, 2004c. EU here includes Switzerland and Norway. Figures exclude CO_2 from international bunker fuels and land use change and forestry.

Furthermore, past projections have a weak success record. Figure 3.3 compares past projections with actual emissions for the year 2000. Projections were made in 1995 by the EIA, and include reference, low, and high scenarios.[19] In the countries and regions listed, none of the actual emissions in 2000 were even within the high-low range projections from a mere five years earlier. With the exception of the U.S. case, the EIA projections were all overstatements of eventual emissions. Thus, while the range of projections is larger in developing countries, even in industrialized countries it seems that projections often do not encompass the full spectrum of plausible outcomes.

Implications for International Climate Cooperation

Policy changes are needed in the near term to slow and reverse emission trends. As noted in Chapter 1, keeping the global average temperature from rising more than 2° C (3.6° F) will require worldwide emissions to peak around 2015 and subsequently decline by 40 to 45 percent by 2050 compared to 1990 levels.[20] Beyond this timeframe, additional reductions will also be needed. While uncertainty in future projections is pervasive, all forecasts examined here suggest very large increases in worldwide GHG emissions over the coming decades, meaning that significant increases in global atmospheric temperatures are very likely over this century. Significant delay in abatement efforts will either require steeper abatement in later years or lead to severe physical impacts from climate change.[21]

Policy changes in the near term, on the other hand, could begin to shift investment patterns in a manner that moves toward a lower carbon future, and avoids some of the most adverse impacts. As suggested in Chapter 2, policy changes within the largest-emitting countries are most important. To promote national-level policy change, international cooperation is likely to be needed, given that countries resist acting alone in response to a global-scale problem like climate change.

A one-size-fits-all approach to international cooperation is unlikely to succeed. In particular, fixed emission "caps" in developing countries may be impracticable. As discussed in Chapter 2, a successful international climate regime will need to encompass all major emitters, including developing countries. In response to their historical responsibility and financial and technological capabilities, most industrialized and transition countries have adopted fixed (i.e., absolute) emission targets under the Kyoto Protocol. A key future challenge is enabling participation of other major emitting countries, including developing countries.

Emissions in many developing countries, however, are growing at a rapid, unpredictable pace, which creates daunting challenges for Kyoto-style "caps" on national emissions.[22] Formulating caps given such large uncertainties can have detrimental environmental and economic consequences. Achieving a fixed level of emissions at some future year might be very easy under conditions of low economic growth and industrial stagnation but exceedingly difficult if economic growth were instead robust (even if, in this latter case, growth meant that additional resources would be available to fund mitigation efforts). Thus, fixed emission targets would entail widely varying levels of effort, depending on prevailing socio-economic dynamics (especially GDP growth) in any particular country.

Figure 3.3. Accuracy of Emission Projections

Comparing Past Projections to Actuals, 2000

Country	1995 Projected Emissions for 2000 ($MtCO_2$)			Actual 2000 Emissions	
	Reference	Low	High	$MtCO_2$	% Ref
United States	5,390	5,283	5,492	5,787	7
EU-15	4,232	4,071	4,481	3,442	-19
Japan	1,374	1,213	1,590	1,138	-17
For. Soviet Union	2,968	2,821	3,122	2,338	-21
Mexico	421	381	473	364	-14
China	3,459	3,081	3,855	2,861	-17

Sources & Notes: Projections for 2000 were made in 1995, by EIA (1995). Actual emissions are from EIA (2004). EIA (1995) did not include projections for India and other developing countries not shown here. "% Ref" means the percent difference between the "reference case" and actual emissions. "EU-15" includes other OECD countries in Western Europe. CO_2 data includes fossil fuels only.

For example, had China adopted a fixed emissions target in Kyoto, it probably would have been based, at least implicitly, on the kinds of "reference case" emission projections shown in Figure 3.3 (e.g., a modest deviation below the "business-as-usual" projection). The result could have been environmentally detrimental to the Kyoto Protocol. China's projections, as it turned out, were wildly off the mark over the five-year period from 1995 to 2000. Emissions in 2000 were almost 600 $MtCO_2$ lower than EIA's reference case, and more than 200 $MtCO_2$ below EIA's "low" projection. If China were permitted to trade its surplus emission allowances, along the lines established under the Kyoto Protocol, these allowances would have created significant amounts of "hot air," and might have effectively weakened the targets of other countries, which could use them to offset their own rising domestic emissions without pursuing domestic emissions reduction strategies.

More broadly, emission projections as well as cross-country differences in other indicators examined in this report, suggest that a one-size-fits-all approach, whereby all countries adopt the same form of commitments, is unlikely to successfully advance international cooperation on climate change.