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**THE IMPLICATIONS OF GRADUATION:  
WHY DEVELOPING NATIONS WILL  
NEVER PRODUCE MORE GREENHOUSE  
GASES THAN DEVELOPED COUNTRIES**

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***Introduction***

Part of the opposition to accepting greenhouse gas (GHG) constraints in the United States and some other developed countries stems from concern that developing nations are not expected as well to undertake constraints in currently suggested regimes. It is pointed out by some U.S. policy makers and lobby groups that large developing states soon will be responsible for an important share of future global emissions and thus should commit to restraints as well.<sup>1</sup>

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Indeed, the idea that GHG emissions from developing countries as a group in the next few decades will equal and exceed those from developed nations is a nearly unquestioned facet of nearly all analyses of future GHG scenarios.<sup>2</sup> As we show here, however, this is simply not true and, furthermore, is unlikely ever to be true.

The most obvious way that this statement is false is that current GHG emissions are not good indicators of relative responsibility for global warming by individual countries. The responsibility for global warming at any time is actually better indicated by cumulative emissions or, rather, cumulative emissions depleted by the mostly natural processes that remove GHGs from the atmosphere over time. The degree to which states have put GHGs into the atmosphere faster than they are naturally removed is a better measure of the country's responsibility than emissions in any one year. This borrowing of the assimilative capacity of the environment has been termed "natural debt" in analogy to the financial resources borrowed from the future termed "national debt."<sup>3</sup>

Thus, although the annual GHG emissions of the set of countries presently called "developing" will likely exceed those of the currently developed nations by 2050, their natural debts will still be much smaller, i.e., their cumulative emissions will be smaller than those of the older industrial states.<sup>4</sup> This, of course, is because the developed countries at that time will have been industrialized far longer and thus borrowed substantially more assimilative capacity in total even though annual borrowing may have become equal. This difference in natural debts has been used in the policy debate to argue that industrialized nations largely have caused the current climate change problem; therefore, it is their responsibility to rectify the situation in line with the "polluter-pays" principle.<sup>5</sup>

In this paper, however, for the sake of argument we accept the common use of current annual emissions as the principal indicator of relative responsibility. Even in this case we shall show that developing countries are unlikely to ever produce more annual GHGs than developed nations. The reason is that as developing countries start to produce enough emissions to approach those of developed states, some of the more advanced developing economies will graduate to developed status, taking their emissions with them.

Perhaps the most fundamental international distinction applied to nations in the world today is between the development classifications variously called "developing and developed," "rich and poor," "first world and third world," and so on. For many purposes—analytical, economic, and political—the categorization of nations into development blocks is the primary determinant of how their performance is evaluated and their rights and responsibilities are defined. After age and sex, development status is perhaps the most common metric used to discriminate among populations. Unlike these other parameters,

however, there is no intrinsic objective way to make development distinctions and, as a result, no clear manner in which the development status can change, for example, that a nation can graduate from developing to developed status. The lack of a way to graduate, however, has potentially important implications for international cooperative agreements, particularly those that involve many countries at different levels of development over long periods. To illustrate some of the issues and potential problems of making and using development distinctions, we examine the issue of graduation with regard to negotiations surrounding one of the most pressing, long-term, and wide-ranging set of international negotiations—those directed toward reducing human-induced climate change.

Most international negotiations over climate change after the United Nations Framework Convention on Climate Change (UNFCCC) entered into force in 1994 have been limited to discussing greenhouse gas emission constraints for the developed set of countries or, more accurately, those in Annex I of the UNFCCC. In this respect, such negotiations follow the pattern set by other negotiated international arrangements in which developed nations bear the larger cost burden. In contrast, however, unlike the formula for paying U.N. dues, for instance, no structure has been agreed upon for determining how or when a state might change its status from non-paying to paying, i.e., to graduate to Annex I status in responsibility if not in name. As an example of the issues involved, we thus explore here under what criteria the currently developing (non-Annex) countries might graduate to paying status, that is, to begin to have requirements for GHG emission constraints.

### *UNFCCC Country Status*

As shown in figure 1, within Annex I is Annex II, containing most of the world's economically "rich" countries, including most members of the Organization for Economic Cooperation and Development (OECD) and the European Union (EU).<sup>6</sup> The remaining (non-Annex II) Annex I nations are mainly the former Soviet economies, which, although remaining substantially poorer than they were before the collapse of the Soviet Union, still retain some political status as developed. As a whole, therefore, Annex I is seen to represent most of the world's developed block. Oddly, in discussions to date, this division is often presented as static, that is, the distribution of countries between Annex I and non-Annex I (developed and developing) will be the same for the next 50 years.<sup>7</sup> Further, only ad hoc negotiations over which countries will make defined levels of GHG emissions cuts have taken place during the process of the UNFCCC and its subsequent Protocol, negotiated in Kyoto in 1997.<sup>8</sup> Although this lack of formal process is politically expedient at present, before long it may

hinder the agreement's effectiveness because a systematic approach in apportioning responsibilities for historic, present, and future GHG emissions between these groups is lacking.

This lack of process is compounded by the manner in which nations have been categorized in the Annexes. So far, there has been no defined process for apportioning countries into these Annexes, other than reliance on historic alliances. Again, while perhaps easier to implement in the short term, this arbitrary allocation has serious implications for future negotiations. Without an explicitly defined process to dictate when a country should enter the Annexes, confusion will result as to how much (if any) responsibility for limiting GHG emissions the currently non-Annex countries should bear and when.

Historic economic country groupings cause additional difficulties for formalizing this categorization process. The OECD, for instance, requires all its original members to sign the Convention, which has caused some dissension within its ranks. Turkey, for example, believes it is at an economic disadvantage compared with other stronger nations in this group.<sup>9</sup> Other anomalies are that Mexico (which belongs to the OECD, although not an original founding member) is not in either of the Annexes and Switzerland is in Annex II without being a member of the OECD, the EU, or even a formal member of the United Nations. South Korea was not an OECD member when it signed yet it had a developed-country-income status. After joining the OECD, however, South Korea's income fell to below developed-country status during the Asian economic crisis.

### ***Graduation Using the Traditional Development Criterion—Gross National Product***

Table 1 offers alternative economic and non-economic development indicators that could be used for defining developed and developing country status more objectively than membership in certain organizations. The main classification variable for economic development historically has been some version of gross national product (GNP) per capita, which was first developed in the late 1940s.<sup>10</sup> For example, this is the tool used by the World Bank Group<sup>11</sup> in assessing a country's qualifications for lower interest rates on loans or other forms of financial concessions.<sup>12</sup>

Today 15 to 20 percent of the global population lives in countries classified as having developed economies as determined by per-capita income, which roughly translates to the collection of countries of the International Institute for Applied Systems Analysis (IIASA) regional groupings of WEU, NAM, and PAO.<sup>13</sup> The three projected GNP per-capita scenarios shown in figures 2, 3, and 4 are derived from data modeled by the IIASA.<sup>14</sup> To indicate when graduation between

development categories may occur, figures 2 through 4 show the trends in per-capita GNP in the IIASA regional groupings over the period 2000-2050. The two horizontal lines indicate the levels at which countries graduate to “developed” status according to the cutoff points of \$9,600<sup>15</sup> and \$5,400 per-capita GNP.<sup>16</sup>

These graphs project that within the next 20 to 40 years graduation to developed status will occur for a number of these regional groups for scenario A1 (EEU, FSU, PAS) by the World Bank graduation point of GNP per capita of greater than \$9,600 and for scenarios A1 (CPA, EEU, FSU, LAM, MEA, PAS), scenario B (EEU, FSU, LAM, PAS), and scenario C1 (CPA, EEU, FSU, LAM, PAS).

Figures 5, 6, and 7 show the projected changes in development classification of the world’s population using these two graduation criteria (\$9,600 and \$5,400 per capita). Scenarios using the higher income cutoff (figures 5 and 6) initially show a slow decrease in the global fraction of population living in the currently developed economies. This is the result of lower population growth in North America (NAM), Japan (PAO), and Western Europe (WEU) compared to Africa (AFR), other Pacific Asia (PAS), and Latin America (LAM) where population growth rates have remained relatively high for several decades. As the former Soviet Union (FSU) and China (CPA) regional groups graduate in 2020, the proportion of the world’s population projected to live in developed-country status increases. This latter trend occurs at a much earlier point in time (starting in 2010) for the projections using the lower income cutoff (figure 7). Using this cutoff, Latin America, Eastern Europe, Pacific Asia, and China all have graduated by 2050, although the timing varies for the different scenarios. In scenario C1, the former Soviet Union also has graduated to developed status. In these scenarios, therefore, by 2050 over half the world’s population could be living in developed standard economies if these economic graduation values are used to make the classification of development.

To evaluate the impact of the practice of fixing groupings by historical alliances, figures 8, 9, and 10 show global projections to 2050 of carbon dioxide (CO<sub>2</sub>) emissions by both Annex I and all developed countries. Here, in developed nations, we include those today with more than \$5,400 per-capita GNP. This is the cutoff used for International Bank for Reconstruction and Development (IBRD) loans to developing countries. The initial difference between these groups in the year 2000 is due to the contribution of the former Soviet Republics, which are now undergoing transition to market economies. These countries belong to Annex I but do not have per-capita GNP over \$5,400. Figures 8 through 10 show that by 2050, significant percentages of CO<sub>2</sub> emissions will be emitted from non-Annex I countries with per-capita GNP over \$5,400. In scenario C1, this amounts to approximately 35 percent of the global CO<sub>2</sub> emissions by 2050. This would mean that in 2050 potentially over a third

of the global carbon dioxide emissions would not be regulated by the UNFCCC because they would be generated by countries without GHG commitments. Figures 8 through 10 demonstrate the importance of developing mechanisms that gradually include non-Annex countries in future, legally binding emissions-reductions targets, thereby enhancing the possibilities of a successful global greenhouse gas emissions reduction program.<sup>17</sup>

These projections indicate that the current definitions of developed countries (according to the Annex distinctions in the UNFCCC) will not adequately encompass a significant proportion of the global CO<sub>2</sub> emissions by 2050. This suggests that a mechanism for identifying when a country can be seen to graduate to developed status would be highly beneficial for negotiating the emissions restrictions under the UNFCCC and its Protocol.

### *Problems with Using GNP as a Measure of Development*<sup>18</sup>

There are several problems with using per-capita GNP to measure a country's economic development status.<sup>19</sup> Because there is substantial variance in the relative domestic purchasing power of different currencies, an indicator of GNP per capita can be quite misleading with regard to the relative welfare enjoyed by different populations. Instead, using purchasing power parity (PPP) as an economic measure is a way to help redress this problem by adjusting GNP to account for costs of living in different countries.<sup>20</sup> Table 2 shows the difference a switch from GNP to PPP or to the human development index (HDI) makes in the development status of some countries.<sup>21</sup> In general, international economic differences measured in PPP are less than those measured in GNP. If the PPP values for the countries' GNP were used to construct figures 2 through 4, most nations not seen as developed by either standard in 2000 would be developed by 2050. The differences in countries' development rankings are largest when nonincome factors, such as those measured in the HDI, are included in the assessment. This occurs because countries with a high standard of living (more accurately represented by the HDI) can have a medium or low GNP per capita.

It is unreliable to use the rate of development of a country's economy as an indicator of long-term trends because it is subject to short-term fluctuations. This has been demonstrated over the past decades during the economic crises of the breakup of the Soviet Union and the more recent Asian financial meltdown. Over these periods, per-capita GNP as a measure of economic development fluctuated greatly. This evidence suggests that any agreement for emissions control being tied to the country's GNP would be short sighted and unsatisfactory.

Another serious problem with the GNP as an indicator is that it does not account for the nontraded goods and the informal service sector of the economy,

which is usually substantial in developing countries. It excludes people who practice subsistence living and other individuals, such as the urban poor, who do not participate in the formal economy.<sup>22</sup> Even more fundamental problems have been identified with GNP as a measure of economic development. Many authors, for example, have noted the paradox in which negative events (such as the Exxon Valdez oil spill in 1989) can increase a country's GNP.<sup>23</sup>

Even if these issues could be addressed adequately, it may be best to avoid the temptation to use the classification of a country's *economic* development as a classification for its *overall* development status. Disentangling these two concepts makes defining development a thorny issue. An instance of this conflict can be seen within the work of different branches of the United Nations. The United Nations Department of Economic and Social Affairs (UNDESA) uses "economic growth" as its classification base to determine categories of "developed," "developing economies," and "economies in transition."<sup>24</sup> There is a key assumption that economic growth equals an improved standard of living in these nations, an assumption that has been challenged by many.<sup>25</sup> This approach is not followed by the United Nations Environmental Program (UNEP) or the United Nations Development Program (UNDP).

### *Alternative Development Measures*

Development measures other than per-capita GNP might be useful for a process that can govern changes in Annex status under UNFCCC. Although our purpose here is not to do an extensive review, it is valuable to mention briefly alternatives to GNP that measure well being more directly. H. Daly and J. and C. Cobb's text, *For the Common Good*, provides indicators of "social and economic welfare."<sup>26</sup> These indicators have shown a lack of correlation with per-capita GNP in countries such as the United States. This indicates a level of uncertainty about GNP reflecting quality of living. The United Nations' gender development index (GDI) is an example of another kind of index that focuses on specific issues, in this case gender disparities within a country.<sup>27</sup> This index stems from work on inclusive indicators that began in 1954.<sup>28</sup> Table 3 lists some of these alternative indicators.

The human development index (HDI) developed by the UNDP is another indicator that is widely recognized as an alternative development index.<sup>29</sup> Launched in 1990, it combines life expectancy, literacy rates, and PPP. The calculation procedure sets ranges between the global minimum equal to zero and maximum equal to one. Between these values it uses a nonlinear scale for measuring PPP, which is seen to rise rapidly up to the poverty line value and then slowly taper off. The HDI has been criticized from both ends of the political spectrum. One criticism arises from its trade-off of longevity with

income,<sup>30</sup> and another criticism is the aggregation of statistics that subsume important policy issues.<sup>31</sup> Its omission of environmental sustainability also has been highlighted by E. Neumayer and A. Sagar and A. Najam.<sup>32</sup> Nevertheless, it seems to have the advantage of representing some measure of human well being in addition to income. It thus at least partially reflects the view that economic growth is a means and not an end to development. For use as a graduation criterion, HDI has the problem that it is recalculated every year with the range between best and worst performers incorporated into the index for that year. Employment as a graduation criterion might involve developing a more stable version of HDI.

**Nonincome Graduation Criterion Number 1—Growth:** To elaborate on other important parameters of global development, we outline two other potential noneconomic indicators. The first employs population growth rates as an indicator of when developing countries graduate to developed status. Figure 11 shows that if a developed country is defined as having a zero population growth rate, then by 2050, 24 percent of the global population would fit into this category. If a figure of 0.5 percent population growth rate is used, then approximately 74 percent of the global population may be living in developed country standards by this time. For these calculations, estimations of the population of different groups are taken from U.N. data projections with regional population groupings taken from IIASA.<sup>33</sup> A potential difficulty with using population growth as a measure, however, is that it may lead to gaming in which countries promote pro-natalist policies to avoid graduation in status with its accompanying responsibilities. In addition, ways to deal with international migration would have to be adopted.

Contextualizing these figures is helpful in order to understand their relevance for a graduation criterion. Specifically, countries that currently have population growth rates of near zero percent are Italy, Germany, Poland, Portugal, Spain, and the United Kingdom. Nations that have population growth rates close to 0.5 percent are the Netherlands, Albania, Uruguay, Austria, Malta, and Cuba. These states have all undergone the demographic transition, with both birth and death rates falling, to reach a more sustainable replacement population level.<sup>34</sup> Work by key authors such as E. Boserup and G. Ranis and F. Stewart have led a stronger understanding of the nature of population change, human development, and economic development in various countries.<sup>35</sup>

**Nonincome Graduation Criterion Number 2—Natural Debt:** As noted in the introduction, natural debt is another way to assess the responsibilities of different countries to take up global actions to ameliorate global warming risks. One simple measure of natural debt is the carbon dioxide remaining from what has been released from the burning of fossil fuels and from cement production

over the last 50 years.<sup>36</sup> With natural sequestration rates of carbon dioxide accounted for, the final figure is given as tons of carbon dioxide per capita remaining in the atmosphere for each country. The results for this calculation for various nations are given in table 4.

The historic linkage between carbon emissions and economic development means that countries with the highest natural debts (those that have already industrialized using fossil fuels) are also likely to have higher levels of economic development. These are generally the states that have the strongest commitment targets for emission reductions under the UNFCCC, although not necessarily in the relative amounts dictated by a natural debt approach.<sup>37</sup> Use of natural debt (per capita) to define graduation would operationalize the polluter-pays principle in that it focuses on the way a nation's economic development has impacted the global environment. Using it to define responsibility would provide incentives to delink economic growth from carbon emissions.

To encourage developing countries to avoid the carbon-intensive development processes achieved by today's industrialized nations, it has been suggested to utilize carbon-intensity indicators rather than future emission caps in developing countries.<sup>38</sup> This measure should encourage the implementation of energy-efficiency policies and make the process of voluntary commitment targets more manageable for countries facing high or volatile rates of economic growth. This type of arrangement would be beneficial for nations such as China that, due to the restructuring of its economy, already has undergone significant improvements in its energy efficiency over the last 15 years.<sup>39</sup>

Further compounding the issue of who should take on emission restrictions, some of the less-developed Annex I countries do meet the higher levels of the CO<sub>2</sub> "natural debt" criteria for developed-country status. The Czech Republic, Kazakhstan, Belarus, Ukraine, Russia, and Uzbekistan are examples of states in this situation. In this case, countries of the former Soviet Union and those in Eastern Europe may be considered as part of the group that bears a greater historic responsibility for GHG emissions and, therefore, might be required to shoulder further financial burdens.<sup>40</sup> Some of the countries that are not included in either Annex have natural debts of carbon dioxide even higher than the other nations in these groups, including South Africa, South Korea, and Venezuela.<sup>41</sup>

Alone, responsibility measures such as natural debt may be difficult to operationalize as a means to allocate costs among countries, since it ignores current economic capabilities. It has been argued, nonetheless, that in combination with an "ability-to-pay" indicator, it could form a powerful tool in negotiations.<sup>42</sup>

### *Discussion*

This analysis has shown that the current categorization scheme placing countries into Annexes for the purposes of the UNFCCC will soon be inadequate to account for future changes in their development status. One implication of not having a formal process that identifies when a nation should graduate is the exacerbation of the noncompliance that currently afflicts Annex II countries. Within the next 50 years, a significant percentage of carbon dioxide emissions is projected from what are now called developing nations, but with the current classification scheme, many of these countries will no longer fit in the economic classification of “developing” but still will not have graduated.

Indeed, as shown in figure 7,<sup>43</sup> if China graduates before 2050, as it likely will under most definitions of development, developing nations are unlikely ever to produce more emissions than the developed group no matter what the future course of development in the remaining poor countries. It seems that the only way that developing-country emissions might exceed those of developed states in this century would be if the latter drastically reduced emissions through massive emphasis on efficiency and decarbonization—a desirable but, unfortunately, unlikely prospect at present.

To fully explore how “development” might best be defined in the context of UNFCCC and possible successor conventions, it would be necessary to examine how each potential metric might operate in the international negotiating environment. In addition, if world development proceeds as we hope, eventually there will come a time when the terms “developed” and “developing” lose their meanings entirely. These issues are beyond the purview of this paper.

Directly addressing the graduation issue might be seen as a way to usefully apply a fully equitable “polluter-pays” principle in that it could be substantially easier to persuade current GHG polluters to accept their responsibilities if they are convinced that all other polluters, past and future, also will be required to pay on a similar basis. Ultimately, of course, widespread international cooperation will be needed so that all responsible parties agree to enforce commitments with respect to both their historic and the future GHG emissions.<sup>44</sup>

Historic groupings of regional country allegiances have provided convenient ways to categorize nations roughly into those with high environmental responsibility and those without, but recent work suggests that this connection is becoming less accurate. Because of this change, indicators that recognize economic and noneconomic factors of a country’s development should be considered for use in the UNFCCC. Intelligent application of development indicators, such as HDI, or responsibility indicators, such as per-capita natural debt, could serve as useful quantitative metrics to apply against graduation criteria or as continuous indicators with no sharp point of graduation.<sup>45</sup> Chosen well, such measures could provide valuable incentives for achieving a range of worthwhile global development goals.

## NOTES

<sup>1</sup>United States, The White House, “Text of a Letter from the President to Senators Hagel, Helms, Craig and Roberts,” available at <http://www.whitehouse.gov/news/releases/2001/03/20010314.html>.

<sup>2</sup>R. Watson, M. Zinyowera, R. Moss, and Intergovernmental Panel on Climate Change, Working Group II, *Climate Change, 1995: Impacts, Adaptations, and Mitigation of Climate Change, Scientific-Technical Analysis: Contribution of World Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom: Cambridge University Press, 1996).

<sup>3</sup>K. Smith, “Allocating Responsibility for Global Warming: The Natural Debt Index,” *AMBIO*, vol. 20 (1991), pp. 95-96.

<sup>4</sup>K. Smith, “The Natural Debt: North and South,” in *Climate Change: Developing Southern Hemisphere Perspectives*, eds. T. Giambelluca and A. Henderson-Sellers (New York: Wiley, 1996).

<sup>5</sup>P. Hayes and K. Smith, *Global Greenhouse Regime: Who Pays? Science, Economics and North-South Politics in the Climate Change Convention* (London: Earthscan Publications, 1993).

<sup>6</sup>Specifically, the first 20 members to join the Organization for Economic Cooperation and Development in 1961.

<sup>7</sup>J. Houghton, G. Jenkins, J. Ephraums, and Intergovernmental Panel on Climate Change, “Sustainability Indicators, 1999” available at <http://iisd.ca/cgsdi/dashboard.pdf>. [??2000??] Indeed, some presentations have even shown the current developed/developing status of countries projected back as far as 1900 and forward as far as 2200, apparently indicating 300 years of no progress at all—a profoundly depressing prospect.

<sup>8</sup>S. Agrawala, “Context and Early Origins of the Intergovernmental Panel on Climate Change,” *Climatic Change*, August 1998, pp. 605-20.

<sup>9</sup>During the negotiations in Buenos Aires in 1998, Turkey declared its desire to be deleted from Annex II (and Annex I) because it believed that it could not sign up to the UNFCCC with its incumbent GHG reduction commitments and the potential economic responsibilities that entails. In response, Europe commented that all OECD members should be in Annex I. During the talks, Turkey reiterated that it is an anomaly for it to be in Annex I and thus still has not ratified the Convention.

<sup>10</sup>Currently, GNP is more widely used than the gross domestic product (GDP) as a method of economic assessment. GNP is the total domestic and foreign output claimed by a resident of a country. It is comprised of the GDP plus incomes accruing to residents from abroad, less the income earned in the domestic economy accruing to persons abroad. M. Todaro, *Economic Development*, 6th edition (London: Longman, 1997).

<sup>11</sup>The World Bank Group consists of five closely associated institutions: the International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), International Finance Corporation (IFC), Multilateral Investment Guarantee Agency (MIGA), and the International Center for the Settlement of Investment Disputes (ICSID).

<sup>12</sup>This is the response by the World Bank to a query about how the initial classifications were made between the gross country groupings of developed and development nations.

The thresholds between the country groups were set many years ago, and *simply reflected*

*the general sense at the time of what people felt* were relatively poor, middle-income, and high-income countries. They determined the thresholds to generate groups that most users felt comfortable with. Since then the historically determined cutoffs are updated to reflect international inflation. This international inflation is measured by the annual change in the Special Drawing Rights (SDRs) deflator, which is essentially a weighted average of the inflation rate of the G-5 countries (France, Germany, Japan, United Kingdom, and the USA). M. Ward, Personal communication, 1999 (italics added for emphasis).

<sup>13</sup>The country groups are North America (NAM), Latin America and the Caribbean (LAM), Western Europe (WEU), Eastern Europe (EEU), former Soviet Union (FSU), Middle East and North Africa (MEA), sub-Saharan Africa (AFR), centrally planned Asia and China (CPA), South Asia (SAS), other Pacific Asia (PAS), and Pacific Organization for Economic Cooperation and Development members (PAO). N. Nakicenovic, A. Grübler, and A. McDonald, *Global Energy Perspectives* (New York: Cambridge University Press, 1998).

Since IIASA is the most prominent institution involved in developing scenarios for the Intergovernmental Panel on Climate Change report and other major international discussions, these arguably correspond most closely to current thinking on the subject.

<sup>14</sup>These scenarios are based on the work of IIASA in N. Nakicenovic, A. Grübler, and A. McDonald, op. cit. *Scenario AI* refers to “a future of impressive technological improvements and consequent high economic growth.” *Scenario B* refers to “a future with less ambitious, though perhaps more realistic, technological improvements, and consequently more intermediate economic progress.” *Scenario CI* refers to “an ecologically driven future. It includes both substantial technological progress and unprecedented internal cooperation centered explicitly on environmental protection and international equity.”

<sup>15</sup>The value was chosen because it is arguably the most stringent requirement for a potential graduation point using economic criteria. The World Bank, 1999, available at <http://www.worldbank.org/poverty/wdrpoverty/report/introind.pdf>

<sup>16</sup>Countries with annual average per-capita incomes less than \$5,445 are eligible for IBRD loans. When a country’s average annual per-capita income exceeds \$5,445, the process of “graduating” from the IBRD is triggered.

<sup>17</sup>It has been argued that developing countries are already playing their part in combating climate change via price control mechanisms. W. Reid and J. Goldemberg, “Developing Countries Are Combating Climate Change Emissions,” *Energy Policy*, 3, February 1998, pp. 233-37. For further discussion of this perspective, also see K. R. Smith, J. Swisher, R. Kanter, and D. R. Abuja, “Indices for a Greenhouse Gas Control Regime Incorporating Both Efficiency and Equity Goals,” in *Energy Investments and the Environment*, ed. C. Saddayao (Washington, D.C.: World Bank/Economic Development Institute, 1993), pp. 157-253.

<sup>18</sup>For discussion of alternative measures, see the web sites for the U.N. Commission on Sustainable development, available at <http://www.un.org/esa/sustdev/worklist.htm> and the Nongovernmental Organization, “Redefining Progress,” available at <http://www.rprogress.org/>.

<sup>19</sup>M. Gillis, *Economics of Development* (New York: W. W. Norton, 1983).

<sup>20</sup>The PPP measures the comparative price of a “basket of goods” in each country in comparison to the same basket of goods bought in the United States to avoid the problems created with using international exchange rates. In this way, the differences in lower living costs are mitigated to some degree.

<sup>21</sup>The human development index (HDI) will be discussed later in this article in the section on “Alternative Development Measures.”

<sup>22</sup>M. Waring, *Counting for Nothing: What Men Value and What Women Are Worth* (Wellington, New Zealand: Bridget Williams Books, 1993).

<sup>23</sup>H. Daly, J. Cobb, and C. Cobb, *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1994).

<sup>24</sup>Based on GNP figures.

<sup>25</sup>Since economic growth rates are so variable in developing countries, the equating of GNP growth and an improved standard of living is not tenable.

<sup>26</sup>H. Daly, J. Cobb, and C. Cobb, op. cit.

<sup>27</sup>United Nations Development Program, 1995, available at <http://hdr.undp.org/statistics/faq.cfm#10>

<sup>28</sup>In this report, 12 possible components of “standard of living” for international comparison are suggested. United Nations, *Report on International Definition and Measurement of Standards and Levels of Living*, Doc. E.CN5/299 (New York: United Nations, 1954), quoted in S. Latouche, “Standards of Living,” in *The Development Dictionary*, ed. W. Sachs (London: Zed Books, 1996).

<sup>29</sup>United Nations Development Program, 1996, available at <http://hdr.undp.org/statistics/faq.cfm#1>

<sup>30</sup>M. Ravallion, “God and Bad Growth: The Human Development Reports,” *World Development*, May 1997, pp. 631-37.

<sup>31</sup>H. Henderson, “What’s Next in the Great Debate about Measuring Wealth and Progress,” *Challenge*, November/December 1996, pp. 50-56.

<sup>32</sup>E. Neumayer, “The Human Development Index and Sustainability—A Constructive Proposal,” *Ecological Economics*, October 2001, pp. 101-14 and A. Sagar and A. Najam, “The Human Development Index: A Critical Review,” *Ecological Economics*, June 1998, pp. 249-64.

<sup>33</sup>United Nations, Population Division, *Annual Populations* (New York: United Nations, 1996 Revision), median estimate.

<sup>34</sup>Obviously, caution would need to be used to avoid countries that have highly fluctuating population growth rates being placed in these categories. Examples of this problem included African nations that have had their populations severely reduced by AIDS.

<sup>35</sup>E. Boserup, *Population and Technological Change* (Chicago: The University of Chicago Press, 1981) and G. Ranis and F. Stewart, “Economic Growth and Human Development,” *World Development*, February 2000, pp. 197-219.

<sup>36</sup>K. Smith, “The Natural Debt: North and South,” in *Climate Change: Developing Southern Hemisphere Perspectives*.

<sup>37</sup>It is important to note that few of these countries are approaching their emissions targets set in the Kyoto Protocol, with the possible exception of the European Union.

<sup>38</sup>K. Baumert, R. Bhandari, and N. Kete, *What Might a Developing Country Climate Commitment Look Like?* (Washington, D.C.: World Resources Institute, 1999).

<sup>39</sup>W. Reid and J. Goldemberg, op. cit.

<sup>40</sup>In October 1999 Kazakhstan actually made a formal proposal to enter the Annex I of the Convention.

<sup>41</sup>It has been argued, however, that natural debt as a measure of “responsibility (who should pay)” must be combined with a measure of “capability (who can pay)” to determine the final allocation of costs. P. Hayes and K. Smith, op. cit.

<sup>42</sup>Ibid. and K. R. Smith, J. Swisher, R. Kanter, and D. R. Abuja, op. cit.

<sup>43</sup>For IIASA scenarios A1 and C1.

<sup>44</sup>A. Kinzig and D. Kammen, “National Trajectories of Carbon Emissions: Analysis of Proposals to Foster the Transition to Low-Carbon Economies,” *Global Environmental Change*, vol. 8 (1998), pp. 183-208.

<sup>45</sup>See, for example, the proposals available at <http://www.ecoequity.org/about.htm>.

Figure 1  
COUNTRY STATUS WITH RESPECT TO THE UNITED NATIONS FRAMEWORK  
CONVENTION ON CLIMATE CHANGE

***Non-Annex Parties***

Afghanistan, Albania, Algeria, Andorra, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Croatia,<sup>c</sup> Cuba, Cyprus, Korea, Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao, Lebanon, Lesotho, Liberia, Libya, Liechtenstein, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico,<sup>a</sup> Micronesia, Monaco,<sup>c</sup> Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Republic of Korea,<sup>a</sup> Moldova, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovakia,<sup>c</sup> Slovenia,<sup>c</sup> Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syria, Tajikistan, Thailand, Macedonia, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, United Arab Emirates, Tanzania, Uruguay, Uzbekistan, Vanuatu, Venezuela, Viet Nam, Yemen, Yugoslavia, Zambia, Zimbabwe.

***Annex I Parties<sup>c</sup>***

Belarus, Bulgaria, Czech Republic,<sup>a</sup> Estonia, Hungary,<sup>a</sup> Latvia, Lithuania, Poland,<sup>a</sup> Romania, Russian Federation, Ukraine.

***Annex II Parties<sup>a,c</sup>***

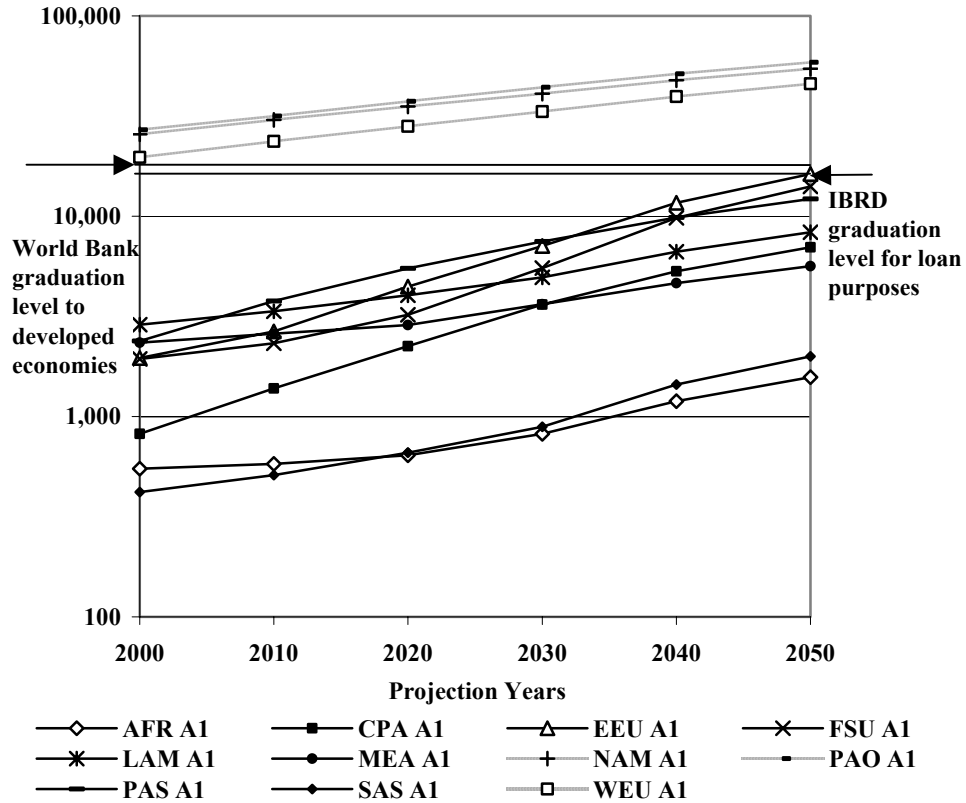
Austria,<sup>b</sup> Australia, Belgium,<sup>b</sup> Canada, Denmark,<sup>b</sup> Finland,<sup>b</sup> France,<sup>b</sup> Germany,<sup>b</sup> Greece,<sup>b</sup> Japan, Iceland,<sup>b</sup> Ireland,<sup>b</sup> Italy,<sup>b</sup> Luxembourg,<sup>b</sup> Netherlands,<sup>b</sup> New Zealand, Norway, Portugal,<sup>b</sup> Spain,<sup>b</sup> Sweden,<sup>b</sup> Switzerland, Turkey, United Kingdom,<sup>b</sup> United States.

<sup>a</sup>Member of the Organization for Economic Cooperation and Development (OECD).

<sup>b</sup>Member of the European Union (EU).

<sup>c</sup>Taken on quantified emission limitation or reduction commitment.

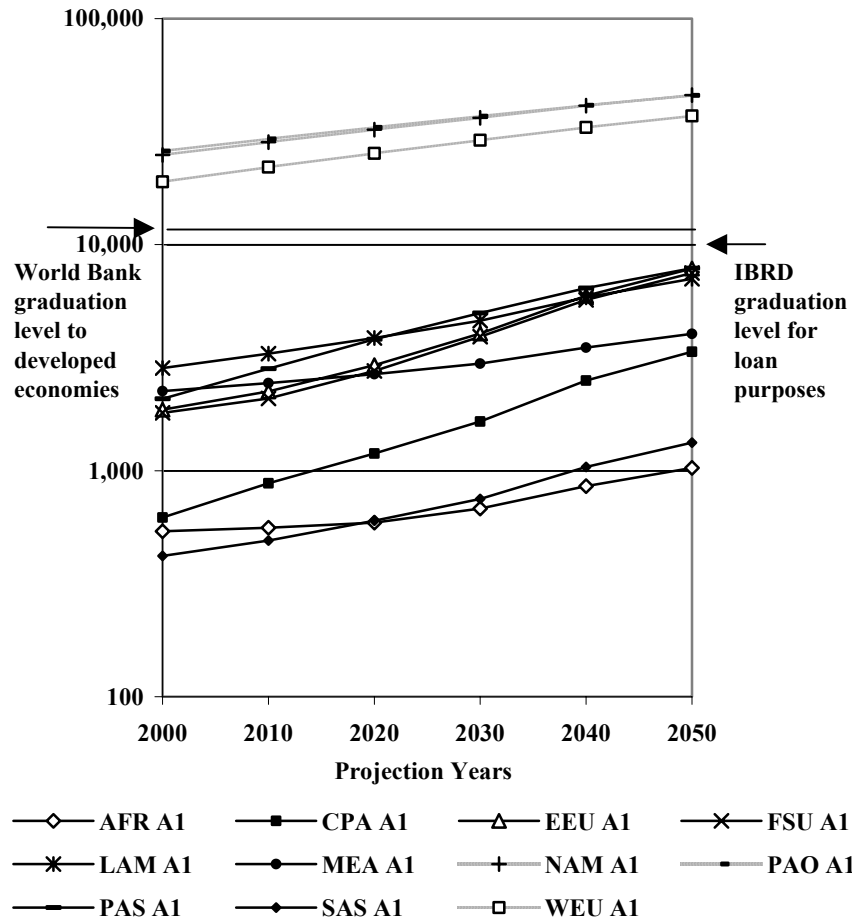
Figure 2  
 INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA)  
 PROJECTIONS FOR GROSS NATIONAL PRODUCT (GNP) PER CAPITA BY  
 WORLD REGION (SCENARIO A1), 2000-2050<sup>a</sup>  
 (in U.S. dollars per capita)



<sup>a</sup>AFR = sub-Saharan Africa, CPA = centrally planned Asia and China, EEU = Eastern Europe, FSU = former Soviet Union, LAM = Latin America and Caribbean, MEA = Middle East and North Africa, NAM = North America, PAO = Pacific members of the Organization for Economic Cooperation and Development, PAS = other Pacific Asia, SAS = South Asia, and WEU = Western Europe.

Source: Scenarios from the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, from N. Nakicenovic, A. Grübler, and A. McDonald, *Global Energy Perspectives* (New York: Cambridge University Press, 1998).

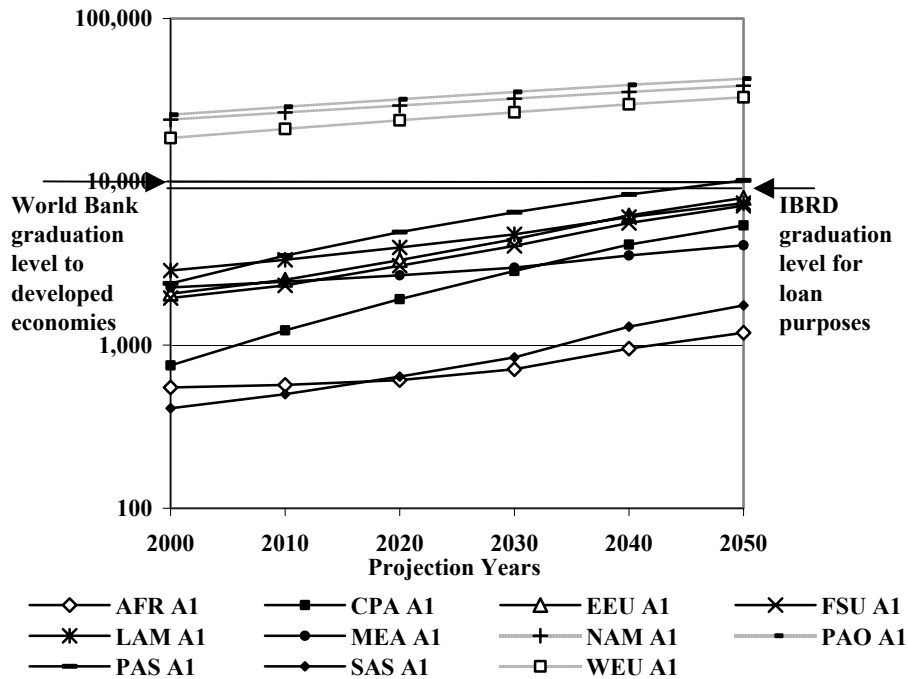
Figure 3  
 INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA)  
 PROJECTIONS FOR GROSS NATIONAL PRODUCT (GNP) PER CAPITA BY  
 WORLD REGION (SCENARIO B), 2000-2050<sup>a</sup>  
 (in U.S. dollars per capita)



<sup>a</sup>AFR = sub-Saharan Africa, CPA = centrally planned Asia and China, EEU = Eastern Europe, FSU = former Soviet Union, LAM = Latin America and Caribbean, MEA = Middle East and North Africa, NAM = North America, PAO = Pacific members of the Organization for Economic Cooperation and Development, PAS = other Pacific Asia, SAS = South Asia, and WEU = Western Europe.

Source: Scenarios from the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, from N. Nakicenovic, A. Grübler, and A. McDonald, *Global Energy Perspectives* (New York: Cambridge University Press, 1998).

Figure 4  
 INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA)  
 PROJECTIONS FOR GROSS NATIONAL PRODUCT (GNP) PER CAPITA BY  
 WORLD REGION (SCENARIO C1), 2000-2050<sup>a</sup>  
 (in U.S. dollars per capita)



<sup>a</sup>AFR = sub-Saharan Africa, CPA = centrally planned Asia and China, EEU = Eastern Europe, FSU = former Soviet Union, LAM = Latin America and Caribbean, MEA = Middle East and North Africa, NAM = North America, PAO = Pacific members of the Organization for Economic Cooperation and Development, PAS = other Pacific Asia, SAS = South Asia, and WEU = Western Europe.

Source: Scenarios from the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, from N. Nakicenovic, A. Grübler, and A. McDonald, *Global Energy Perspectives* (New York: Cambridge University Press, 1998).

Figure 5  
 PROJECTIONS OF WORLD POPULATION LIVING IN DEVELOPED STATUS  
 USING GROSS NATIONAL PRODUCT (GNP) PER CAPITA OF \$9,600, 2000-2050  
 (in percentage of total population living in “developed” standard economies)

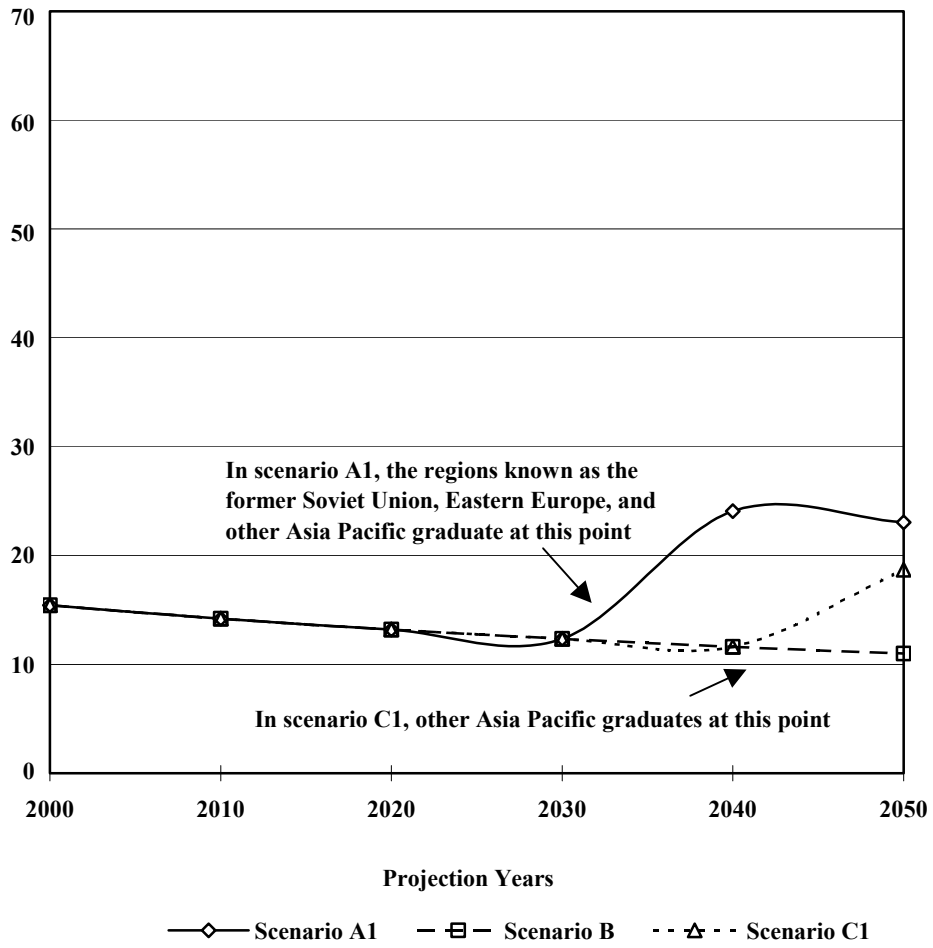


Figure 6

PROJECTIONS OF WORLD POPULATION LIVING IN DEVELOPED STATUS  
 USING PURCHASING POWER PARITY (PPP) PER CAPITA OF \$9,600, 2000-2050  
 (in percentage of total population living in "developed" standard economies)

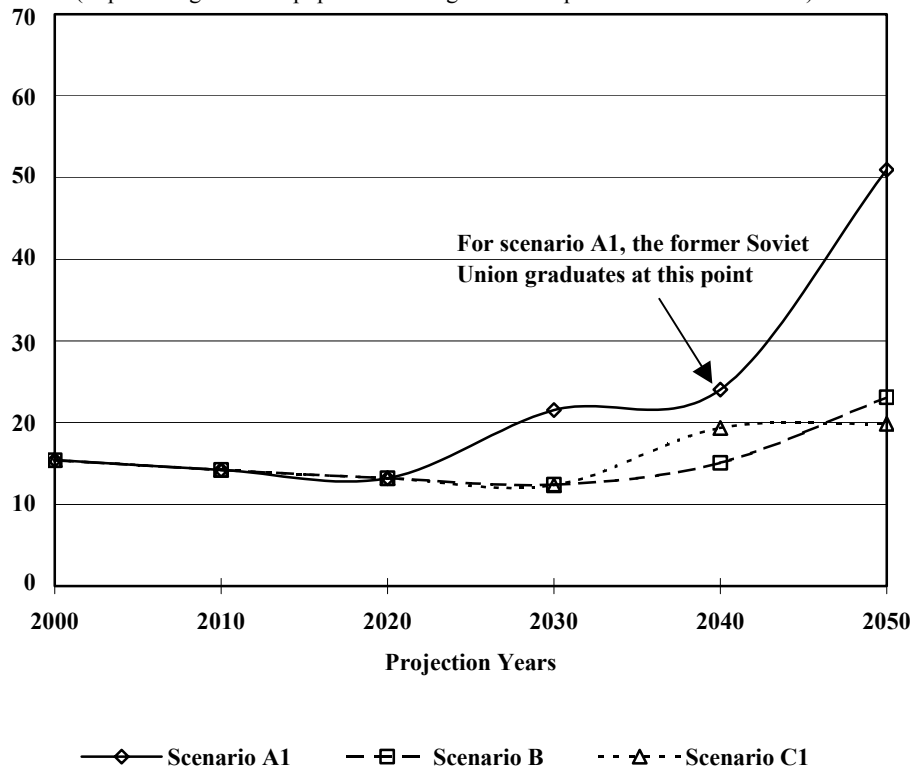


Figure 7  
 PROJECTIONS OF WORLD POPULATION LIVING IN DEVELOPED STATUS  
 USING GROSS NATIONAL PRODUCT (GNP) PER CAPITA OF \$5,400, 2000-2050  
 (in percentage of total population living in “developed” standard economies)

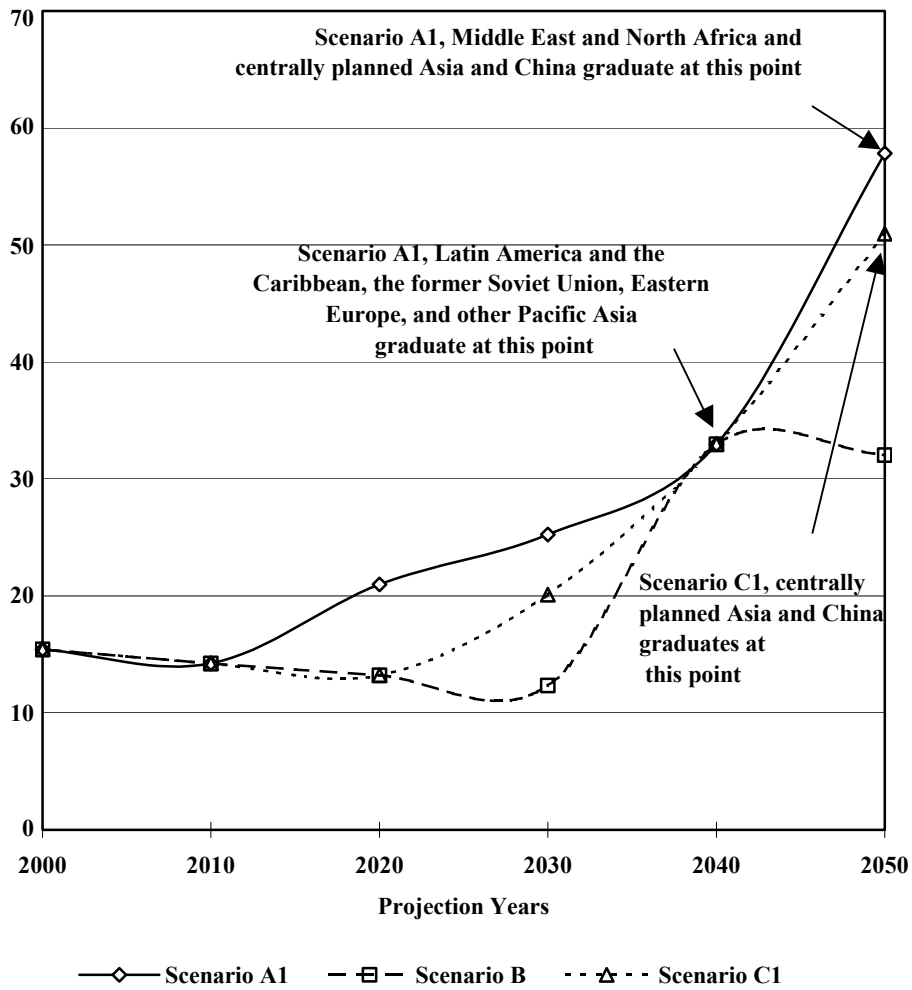


Figure 8

PERCENTAGE OF CARBON DIOXIDE (CO<sub>2</sub>) EMISSIONS FROM ANNEX I COUNTRIES AND COUNTRIES WITH GROSS NATIONAL PRODUCT (GNP) PER CAPITA GREATER THAN \$5,400 USING INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA) (SCENARIO A1), 2000-2050

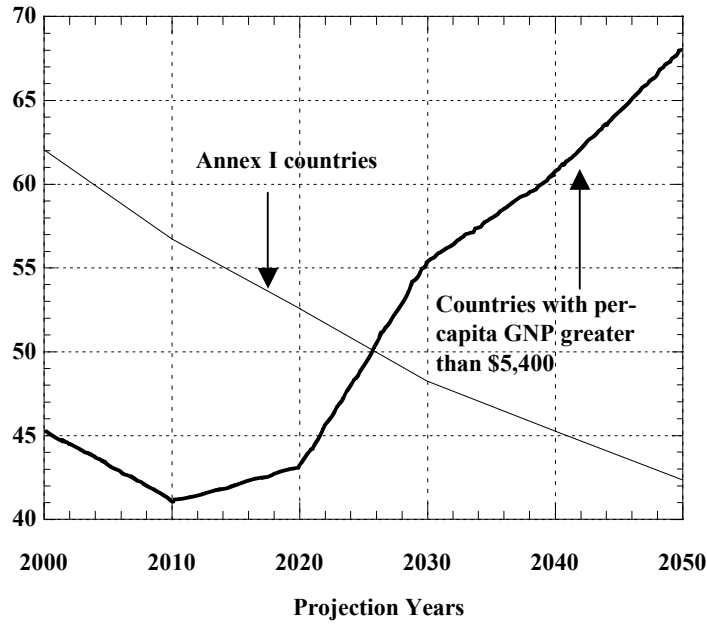


Figure 9  
 PERCENTAGE OF CARBON DIOXIDE (CO<sub>2</sub>) EMISSIONS FROM ANNEX I COUNTRIES AND COUNTRIES WITH GROSS NATIONAL PRODUCT (GNP) PER CAPITA GREATER THAN \$5,400 USING INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA) (SCENARIO B), 2000-2050

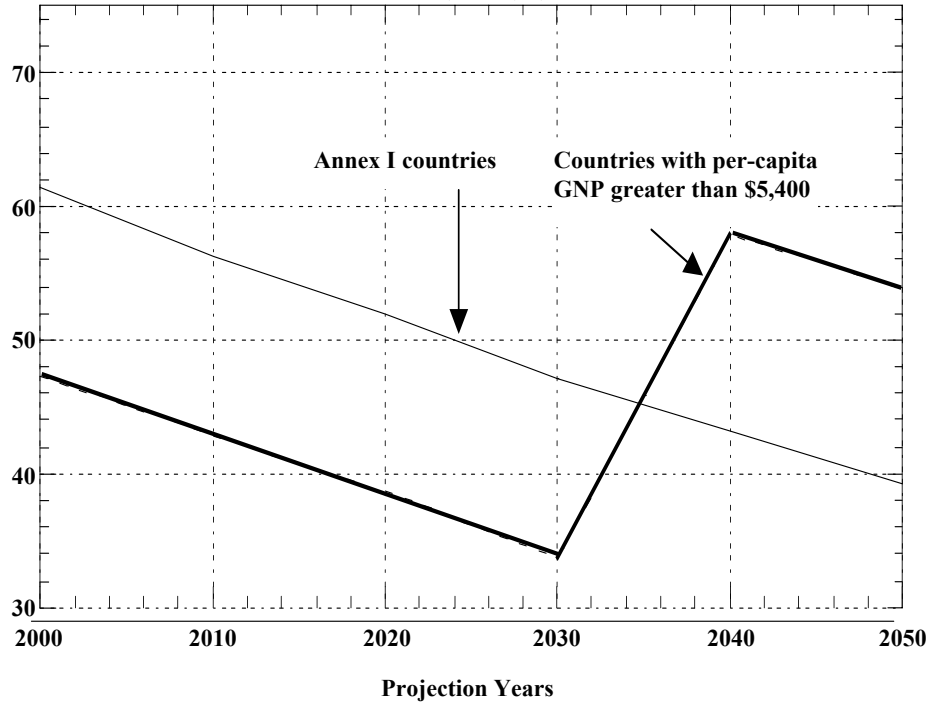


Figure 10  
PERCENTAGE OF CARBON DIOXIDE (CO<sub>2</sub>) EMISSIONS FROM ANNEX I COUNTRIES AND COUNTRIES WITH GROSS NATIONAL PRODUCT (GNP) PER CAPITA GREATER THAN \$5,400 USING INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS (IIASA) (SCENARIO C1), 2000-2050

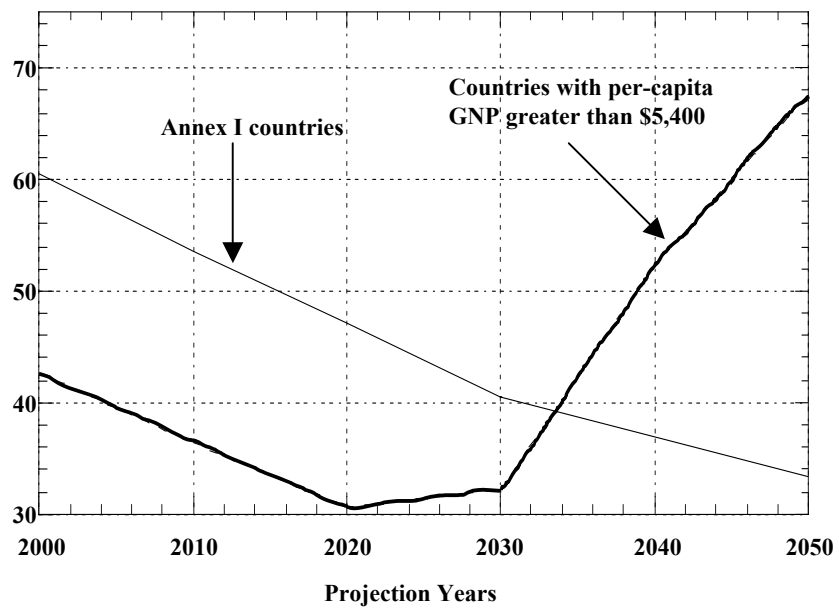


Figure 11  
 PERCENTAGE OF GLOBAL POPULATION PROJECTED TO LIVE IN  
 “DEVELOPED” COUNTRIES USING POPULATION GROWTH  
 RATES AND AN INDICATOR OF DEVELOPMENT, 2000-2050  
 (in percentage of global population living in “developed-country” status)

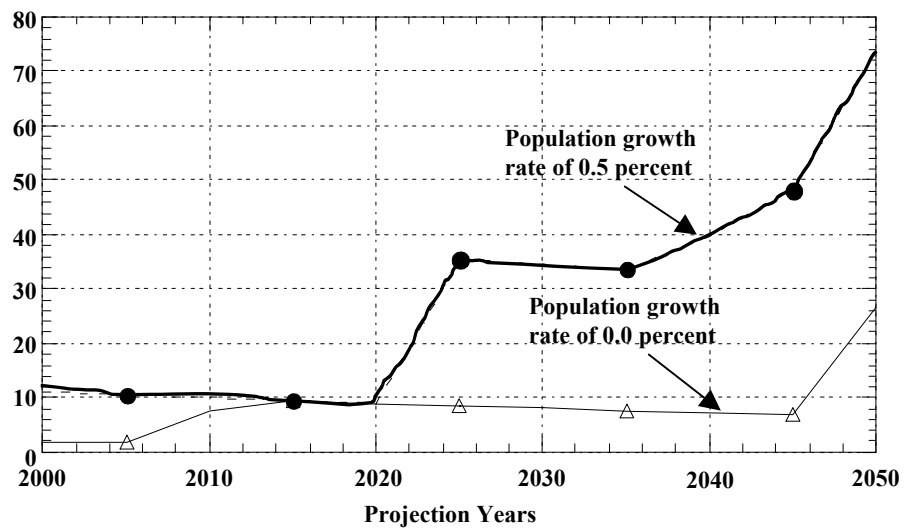


Table 1  
ALTERNATIVE ECONOMIC AND NON-ECONOMIC DEVELOPMENT INDICATORS

Classifying Group	Type of Classification	Categories in Classification	Primary or Derived Grouping
World Bank	Atlas method gross national product (GNP) per capita (1996 GNP level used); purchasing power parity (PPP) per capita (1996 GNP level used) <sup>a</sup>	Low income < U.S. \$785 = "developing"; lower middle income \$786 - \$3,115 = "developing"; upper middle income \$3,116 - \$9,635 = "developing"; high income > \$9,636 = "developed"	Primary grouping
World Bank	Percentage of population living on less than \$1 a day (PPP) <sup>b</sup>	High = above \$1 a day Low = below \$1 a day	Primary grouping
IDA/IBRD <sup>c</sup>	Per-capita income (PCI) (1996 \$ rate)	IDA loans for PCI < \$925 IDA/IBRD blend loan for countries with PCI < \$1,506 IBRD loan for PCI < \$5,445	Primary grouping
U.N. Department of Economic and Social Affairs	Economic growth [measured from a country's output and rates of growth of real gross domestic product (GDP)]	Developing countries are those countries that do not fit into either of the other two classifications, namely, countries in transition (i.e., in transition to a market-based economy such as in the former Soviet Union) and developed countries (members of the OECD and EU) <sup>c</sup>	Uses OECD, former Soviet Union (FSU), and EU groups <sup>c</sup>
UNFCCC <sup>c</sup>	Annexes	Non-Annex (G77/China group) Annex I (OECD + EU + economies in transition) Annex II (OECD +EU)	Uses OECD, G77, and EU groups <sup>c</sup>
UNDP <sup>b</sup>	Human development index (HDI); other classifications include gender empowerment measure (GEM) and gender development index (GDI)	Low level < 0.5; medium level 0.5-0.8; high level > 0.8	Primary grouping

(continued)

Table 1 (continued)  
ALTERNATIVE ECONOMIC AND NON-ECONOMIC DEVELOPMENT INDICATORS

Classifying Group	Type of Classification	Categories in Classification	Primary or Derived Grouping
Natural Debt <sup>d</sup>	Absolute categories	Low level < 29 tons carbon dioxide (CO <sub>2</sub> ) per capita; medium level = 29-54 tons CO <sub>2</sub> per capita; high level > 54 tons CO <sub>2</sub> per capita	Primary grouping
Various	Birth rates	Low level < 0 percent; replacement level = 0 percent; medium level < 0.5 percent; high level > 0.5 percent	Primary grouping

<sup>a</sup>PPP estimates of GNP and gross domestic product per capita are calculated by converting GNP to U.S. dollars using purchasing power parities instead of exchange rates as conversion factors. The resulting estimates are expressed in international dollars.

<sup>b</sup>UNDP = United Nations Development Program; see World Bank, 1990, available at [http://hdr.undp.org/reports/global/2002/en/indicator/indicator.cfm?File=index\\_indicators.html](http://hdr.undp.org/reports/global/2002/en/indicator/indicator.cfm?File=index_indicators.html)

<sup>c</sup>IDA/IBRD = International Development Association/International Bank for Reconstruction and Development, parts of the World Bank Group; EU = European Union; OECD = Organization for Economic Cooperation and Development; UNFCCC = United Nations Framework Convention on Climate Change; G-77 = developing-country signatories of the 1964 "Joint Declaration of the Seventy-Seven Countries," now expanded to 133 nations: Afghanistan, Algeria, Angola, Antigua and Barbuda, Argentina, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, North Korea, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kenya, Kuwait, Laos, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Micronesia, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Palau, Palestine, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Romania, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, United Arab Emirates, Tanzania, Uruguay, Vanuatu, Venezuela, Viet Nam, Yemen, Yugoslavia (cannot participate in the activities of G-77), Zambia, and Zimbabwe.

<sup>d</sup>See K. Smith, "The Natural Debt: North and South," in *Climate Change: Developing Southern Hemisphere Perspectives*, eds. T. Giambelluca and A. Henderson-Sellers (New York: Wiley, 1996).

Table 2  
 CLASSIFICATION OF COUNTRIES THAT CHANGE CATEGORIES WITH VARIOUS  
 DEVELOPMENT INDICATORS<sup>a</sup>

GNP/PPP Categories	GNP	PPP	HDI	HDI Categories
High income	—	C <sup>b</sup>	A,B <sup>b</sup>	High
Upper middle income	A,C <sup>b</sup>	D <sup>b</sup>	—	Middle
Lower middle income	B,D <sup>b</sup>	—	—	

<sup>a</sup>GNP = gross national product; PPP = purchasing power parity; HDI = human development index. Note that table only includes countries that move between categories for the different indicators examined.

<sup>b</sup>A = Argentina, Uruguay, Slovakia, Venezuela, Hungary, Mexico, Poland; B = Costa Rica, Panama, Fiji, Colombia, Thailand, Latvia, Russian Federation, Armenia, Azerbaijan, Albania, Honduras, Nicaragua, Vietnam, Zimbabwe; C = Czech Republic, Chile, Malaysia; D = Dominica, Panama, Grenada, Belize, Russian Federation, Costa Rica, Fiji, Peru, Latvia, Colombia, Lithuania, Namibia, Belarus, Tunisia, Paraguay, Iran, Dominican Republic, Ecuador, Jordan, Jamaica, Guatemala, Algeria, Swaziland, Romania, Kazakhstan, Morocco, Philippines, Maldives, Bulgaria, Indonesia, Equatorial Guinea, China.

Table 3  
ALTERNATIVE DEVELOPMENT INDICATORS

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The United Nations lists a number of other indicators including:

- SNA = U.N. System of National Accounts<sup>a</sup>
- Sustainable Agriculture and Rural Development Indicators<sup>b</sup>
- African Development Indicators<sup>c</sup>
- SNI = Sustainable National Income<sup>d</sup>
- FISD = Framework for Indicators of Sustainable Development
- The United Nations Commission on Sustainable Development (U.N. CSD), currently has 134 indicators for sustainable development (social, economic, environmental, institutional).<sup>e</sup>

Other indicators that have been suggested include:

- Core Set of Environmental Indicators<sup>f</sup>
- CFI = Country Futures Indicators<sup>g</sup>
- GSI = Genuine Saving Index<sup>h</sup>
- GPI = Genuine Progress Indicators<sup>i</sup>
- HSI = International Human Suffering Index<sup>j</sup>
- Indicators of Environmental Sustainable Development<sup>k</sup>
- ISEW = Indicator of Social and Economic Welfare<sup>l</sup>
- MEW = Measure of Economic Welfare<sup>m</sup>
- MIPS = Material Input Per Service Unit<sup>n</sup>
- SPI = Social Progress Index<sup>o</sup>
- Sustainability Index<sup>e, p</sup>
- WDI = World Development Indicator<sup>q</sup>
- Wealth Index<sup>r</sup>

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<sup>a</sup>United Nations Development Program (UNDP), 1993, available at <http://unstats.un.org/unsd/sna1993/introduction.asp> Hereafter the United Nations Development Program will be cited as UNDP.

<sup>b</sup>UNDP, SARD Indicators Project (New York: UNDP, 1994).

<sup>c</sup>UNDP and World Bank, *African Development Indicators* (New York: World Bank, 1992).

<sup>d</sup>UNDP, 1996, available at <http://www.unep.org/unep/products/eeu/ecoserie/ecos3/ecos33.htm>

<sup>e</sup>The United Nations Environmental Assessment Program is coordinating the sustainable development indicators among U.N. Agencies, the World Bank, and the World Resources Institute. These indicators are developed with a pressure-state-response framework or, as the CSD describes, a driving force-state-response framework. Sixteen countries, including China, Kenya, United Kingdom, Brazil, and Costa Rica, have volunteered to measure and track these indicators (1997-2000) that include environmental, social, economic, and institutional components. "GDP Hegemony," *Global Futures Bulletin*, #61996.

<sup>f</sup>Organisation for Economic Cooperation and Development (OECD), *Environmental indicators: A Preliminary Set* (Paris: OECD, 1991).

<sup>g</sup>H. Henderson, *Redefining Wealth and Progress: The Caracas Report on Alternative Development Indicators* (New York: TOES Books published by Bootstrap Press, 1990).

<sup>h</sup>World Bank, 1990, available at [http://www.wri.org/wri/wr-96-97/ei\\_b1.html](http://www.wri.org/wri/wr-96-97/ei_b1.html)

<sup>i</sup>Cobb C, T Halstead and J Rowe 1995 *The Genuine Progress Indicator: Summary of Data and Methodology*. (Redefining Progress:San Francisco)

<sup>j</sup>Population Action International (PAI), *The International Human Suffering Index* (Washington, D.C.: PAI, 1992).

<sup>k</sup>World Bank, *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable*

*Development* (Washington, D.C.: The World Bank, 1997)

<sup>1</sup>H. Daly, J. Cobb, and C. Cobb, *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1994) and E. Neumayer, "The ISEW: Not An Index of Sustainable Economic Welfare," *Social Indicators Research*, September 1999, pp. 77-101.

<sup>2</sup>J. Tobin and W. Nordhaus, "Is Growth Obsolete?" in *Economic Growth*, National Bureau of Economic Research (New York: Columbia University Press, 1972).

<sup>3</sup>F. Schmidt-Bleek, *The Fossil Makers—Factor 10 and More* (Basel, Boston, and Berlin: Birkhäuser, 1994).

<sup>4</sup>M. Desai, "Income and Alternative Measures of Well-Being," in *Monitoring Social Progress in the 1990s*, eds. W. G. and G. D. Brookfield (New York: United Nations Research Institute for Social Development, 1993).

<sup>5</sup>Incorporating indicators from World Wildlife Fund's Living Planet Index, the World Bank, U.N. Commission on Sustainable Development's Blue Book, and United Nations Human Development Index. J. Houghton, G. Jenkins, J. Ephraums, and Intergovernmental Panel on Climate Change, "Sustainability Indicators, 1999," available at <http://www.iisd.org/cgsdi/dashboard.htm>

<sup>6</sup>World Development Indicators presents 600 indicators in 83 tables, organized in six sections: worldview, people, environment, economy, states and markets, and global links. World Bank, *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development* (Washington, D.C.: The World Bank, 1997) and 1997, available at [http://publications.worldbank.org/ecommerce/catalog/product?item\\_id=631625](http://publications.worldbank.org/ecommerce/catalog/product?item_id=631625)

<sup>7</sup>This is measured by a combination of natural capital (natural environmental resources)—20 percent, produced assets (factories, infrastructure, financial assets)—20 percent, human resources (educated, healthy productive people)—30 percent, and social capital (families, communities, institutions)—30 percent. Kunte, A, K Hamilton, J Dixon and M Clemens 1998 Estimating National Wealth: Methodologies and Results. Environment Department Paper, Environmental Economics Series (World Bank: Washington DC) which is available at [http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1998/11/17/000009265\\_3981013134540/Rendered/PDF/multi\\_page.pdf](http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1998/11/17/000009265_3981013134540/Rendered/PDF/multi_page.pdf)

Table 4  
CLASSIFICATION OF COUNTRIES BY THEIR NATURAL DEBTS OF CARBON  
DIOXIDE (CO<sub>2</sub>)

Country	Natural Debt (starting from base year 1950-1991)
United States, <sup>a</sup> Canada, <sup>a</sup> Belgium, <sup>a</sup> Norway, <sup>a</sup> Denmark, <sup>a</sup> United Kingdom, <sup>a</sup> Australia, <sup>a</sup> Poland, <sup>a</sup> Germany, <sup>a</sup> Hungary, <sup>a</sup> Netherlands, <sup>a</sup> Finland, <sup>a</sup> Bulgaria	High level is greater 54 tons CO <sub>2</sub> per capita
Sweden, <sup>a</sup> France, <sup>a</sup> Austria, <sup>a</sup> Japan, <sup>a</sup> Ireland, <sup>a</sup> Saudi Arabia, Korea D.R., Italy, <sup>a</sup> Switzerland, <sup>a</sup> Venezuela, New Zealand, <sup>a</sup> Libya	Medium level is 29 to 54 tons CO <sub>2</sub> per capita
Greece, <sup>a</sup> Spain, <sup>a</sup> Israel, Argentina, Portugal, <sup>a</sup> Cuba, Malaysia, Iran, Mexico, Chile, Iraq, Algeria, Syria, China, Colombia, Thailand, Zimbabwe, Tunisia, Ecuador, Brazil, Egypt, Peru, Dominican R., Azerbaijan, Bolivia, Morocco, Indonesia, Nigeria, Philippines, India, Yemen, Angola, Cote D'Ivoire, Guatemala, Pakistan, Paraguay, Benin, Tajikistan, Sri Lanka, Georgia, Vietnam, Senegal, Kenya, Ghana, Sudan, Burma, Bangladesh, Ethiopia.	Low level is less than 29 tons CO <sub>2</sub> per capita

<sup>a</sup>Member of Annex II.