Pilot Environmental Performance Index

An Initiative of the
Global Leaders of Tomorrow Environment Task Force, World Economic Forum

Annual Meeting 2002

In collaboration with:

Yale Center for Environmental Law and Policy
Yale University

Center for International Earth Science Information Network
Columbia University

Global Leaders for Tomorrow Environment Task Force

Chair:
Kim Samuel-Johnson
Canada

Project Director:
Daniel C. Esty
United States

Members:

Manny Amadi
United Kingdom

Alicia Barcena Ibara
Chile

Ugar Bayar
Turkey

Matthew Cadbury
United Kingdom

Carlos E. Cisneros
Venezuela

Craig A. Cohon
United Kingdom

Colin Coleman
South Africa

Dominique-Henri Freiche
France

Thomas Ganswindt
Germany

Francisco Gutierrez-Campos
Paraguay

Guy Hands
United Kingdom

Molly Harriss-Olson
Australia

George M. Kailis
Australia

Shiv Vikram Khemka
India

Loren Legarda
The Philippines

Maria Leichner
Uruguay

Christopher B. Leptos
Australia

Philippa Malmgren
United States

John Manzoni
United Kingdom

Liavan Mallin
United States

Jonathan Mills
Australia

Rodrigo Navarro Banzer
Venezuela

Patrick Odier
Switzerland

Paul L. Saffo
United States

Simon Tay
Singapore

Kiyomi Tsujimoto
Japan

Yale Center for Environmental Law and Policy (YCELP)

Daniel C. Esty
Director

Ilmi M.E. Granoff
Project Director

Barbara Ruth
Administrative Associate

Marguerite Camera
Report Coordinator

Center for International Earth Science Information Network (CIESIN), Columbia University

Marc Levy
Associate Director

Bob Chen
Deputy Director

Kobi Ako Abayomi
Statistician

Maarten Tromp
GIS Specialist

Alex de Sherbinin
Research Associate

Francesca Pozzi
Research Associate

Antoinette Wannebo
Research Associate

Pilot Environmental Performance Index

An Initiative of the
Global Leaders of Tomorrow Environment Task Force, World Economic Forum

Annual Meeting 2002

The Pilot Environmental Performance Index was made possible by the generous support of the Samuel Family Foundation. The World Economic Forum, the Yale Center for Environmental Law and Policy, and the Center for International Earth Science Information Network are grateful to the Samuel Family Foundation for its visionary commitment to advancing our ability to measure environmental performance.

Global Leaders for Tomorrow
World Economic Forum
91-93 route de la Capite
1223 Cologny/Geneva Switzerland
(41-22) 869-1212
Fax (41-22) 786-2744
contact@weforum.org
www.weforum.org

Center for International Earth Science Information Network
Columbia University
PO Box 1000 61 Route 9W
Palisades, NY 10964 USA
(1-845) 365-8988
Fax (1-845) 365-8922
ciesin.info@ciesin.columbia.edu
www.ciesin.columbia.edu

Yale Center for Environmental Law and Policy
250 Prospect Street
New Haven, CT 06511 USA
(1-203) 203 432-3123
Fax (1-203) 432-3817
ycelp@yale.edu
www.yale.edu/envirocenter

This report is available on-line at http://www.ciesin.columbia.edu/indicators/ESI

Table of Contents

Executive Summary

We have constructed a Pilot Environmental Performance Index (EPI) designed to measure current environmental results at the national scale. The EPI derives from a collection of data sets aggregated into four core indicators that gauge air and water quality, greenhouse gas emissions, and land protection. These indicators provide measures of both current performance and rates of change. The carefully targeted, results-oriented EPI provides a valuable counterpoint to our Environmental Sustainability Index (ESI), which covers a much broader range of conditions aimed at measuring long-term environmental prospects. The EPI enables benchmarking of progress toward meeting immediate policy objectives, facilitates judgments about environmental performance, and can be used to identify important differences in performance that may warrant intervention or investigation.

Our main findings are as follows:

1. While environmental data sources have serious limitations, it is possible to construct illuminating performance measures. Despite the current constraints, efforts to develop useful environmental performance indicators offer great promise for shifting pollution control and natural resource management decisions onto firmer analytic underpinnings.
2. These performance measures permit useful inter-country comparisons. They shed light on how well governments are achieving important policy objectives and how they are handling tradeoffs among competing objectives.
3. The four categories we have examined – air, water, climate change and land – vary substantially in the degree to which countries that are underperforming at the present are improving over time. For air quality the laggards are improving the fastest, while for land protection (in particular recycling rates) the laggards seem to be falling further behind.
4. These indicators permit empirical investigation into the drivers of environmental performance. Such investigations constitute a vital area for future policy analysis if we are to improve our ability to achieve environmental goals across the board. Confirming recent studies, we find that governance indicators are helpful in explaining patterns of performance.
5. Some countries consistently outperform others in a large number of indicators. In particular, Nordic and alpine countries tend to score high (though climate change is a clear exception).
6. Severely limited data constrain our ability to make full use of the EPI as an analytic tool. Providing for systematic tracking of basic environmental performance measures over time ought to constitute a major priority for the international system.

Measuring Environmental Performance

Comparative national measures of environmental performance are surprisingly rare. In spite of the well-documented fact that performance measurement facilitates good decisionmaking (Esty 2002), comparative national environmental indicator efforts by and large overlook performance measures. Instead, the field is dominated heavily by large collections of wide-ranging environmental indicators with no effort to relate such indicators to common performance metrics. Recent work to produce indicators of environmental *sustainability* (World Economic Forum 2002, Levy 2002, Prescott-Allen 2001, Consultative Group for Sustainable Development Indicators 2001) has succeeded at aggregating these individual indicators so that they respond to demands for measures of sustainability trends. However, these broad sustainability indicators are no substitute for performance indicators that gauge current results in addressing pollution control and natural resource management challenges. They combine data that spans radically different time scales, underlying circumstances, sensitivity to policy intervention, and connection to specific outcomes.

Environmental performance indicators need to focus more narrowly on metrics that vary meaningfully year to year. They should target issues that are sensitive to intervention by decision-makers. To be useful, they must be tied to fairly specific outcomes of clear concern to governments and the public at large. Performance indicators can thus be useful as a mechanism to hold decisionmakers accountable for their choices and the results they deliver. Broad sustainability indicators are typically less well suited to this task.

Our Approach

We have created a Pilot Environmental Performance Index (EPI) that builds on our previous work to create the Environmental Sustainability Index (ESI). The EPI Initiative serves as a parallel effort with a related, though distinct purpose. Both the ESI and the EPI are direct responses to the wide gulf we observe between governmental commitments concerning environmental goals, on the one hand, and the weak ability to measure conditions with respect to those goals on the other hand. They differ in the following fundamental way. The ESI is aimed primarily at decision-makers, publics and analysts who wish to compare nations' long-term environmental trajectories. It makes use of the best available current data to determine which nations are comparatively well situated to achieve lasting environmental sustainability and which are not. The EPI, in contrast, meets a different need. It permits national comparisons on recent efforts to manage a narrow set of common policy objectives concerning air and water quality, climate change, and ecosystem protection.

Table 1 portrays the structure of the EPI in terms of the underlying indicators and variables.

Table 1. Components of the EPI

Indicator	Variables	Number of countries measured circa 1990	Recent past
Air Quality	Concentration of Sulfur Dioxide	30	24 (1997)
	Concentration of Nitrogen Oxide	27	26 (1997)
	Concentrations of Lead	18	16 (1997)
	Total Suspended Particulates	27	24 (1997)
Water Quality	Dissolved Oxygen	33	34 (1997)
	Phosphorous concentrations	30	30 (1997)
	Water pollution (Biological Oxygen Demand)	91	91 (1995)
Climate Change	Carbon Economic Efficiency (CO_2 emissions per GDP)	140	140 (1998)
	Carbon Lifestyle Efficiency (CO_2 per capita)	140	140 (1998)
Land Protection	Protected Areas (percent of territory)	--	220 (1998)
	Waste Disposal at Landfills per populated land area	--	29 (1992-97)
	Paper Recycling Rate	27	27 (1997)
	Glass Recycling Rate	24	23 (1997)

We chose these variables because they meet the following design criteria:

1. They correspond *substantively* to the domain in question (we tried to avoid use of "proxies").
2. The measured phenomena are directly relevant to environmental goal-setting and implementation; that is, they are relevant to processes of *accountability*.
3. Measures are available for at least twenty countries, to permit meaningful *comparison*.
4. Measures are available both for a recent year and for 1990, to permit tracking *improvement* (with the exception of protected areas and waste disposal at landfills, which meet the above criteria but for which earlier comparable data sets are not available).

The above variables were the only ones we could locate that met these criteria. In future work, we would like fill gaps in the data by working with data providers, environmental scientists, governments and international organizations to create new measures that meet these criteria.

For each of variables listed in Table 1 we use both the most recent year's value and a change term that measures the change since 1990. Each indicator can therefore be represented three different ways: current conditions, rate of change, and an overall measure that takes into account both current conditions and the rate of change.

Because very few countries had data across the entire range of performance indicators, we calculated each indicator separately, covering as many countries as possible. For a very small number of countries it is possible to aggregate the entire set to generate an overall measure of environmental performance (or EPI, see page 9), but the most meaningful comparisons are to be found within specific indicators, or across a select subset. Annex 2 provides tables showing overall scores for each of the indicators, as well as scores for current conditions and improvements in those conditions in the recent past. In calculating the overall indicator for each category, we combine information concerning the current level of performance with information about the rate of change in performance. We experimented with alternative methods to combine these measures, and selected an algorithm that weights the change term according to the value of the current performance term. The methodological annex (Annex 1) provides more details.

Key Results

At the broadest level, our findings can be summarized as follows:

- While environmental data sources have serious limitations, it is possible to construct illuminating performance measures. Despite the current constraints, efforts to develop useful environmental performance indicators offer great promise for shifting pollution control and natural resource management decisions onto firmer analytic underpinnings.
- These performance measures permit useful inter-country comparisons. They shed light on how well governments are achieving important policy objectives and how they are handling tradeoffs among competing objectives.
- The four categories we have examined – air, water, climate change and land – vary substantially in the degree to which countries that are underperforming at the present are improving over time. For air quality the laggards are improving the fastest, while for land protection (in particular recycling rates) the laggards seem to be falling further behind.
- These indicators permit empirical investigation into the drivers of environmental performance. Such investigations constitute a vital area for future policy analysis if we are to improve our ability to achieve environmental goals across the board. Confirming recent studies, we find that governance indicators are helpful in explaining patterns of performance (World Economic Forum 2002, Levy 2001).
- Some countries consistently outperform others in a large number of indicators. In particular, Nordic and alpine countries tend to score high (though climate change is a clear exception).
- Severe data limitations constrain our ability to make full use of the EPI as an analytic tool. Providing for systematic tracking of basic environmental performance measures over time ought to constitute a major priority for the international system.

Reviewing Performance

Tables showing indicator scores are found in Annex 2. Here we discuss the rankings of countries in each of the four core indicators.

Air Quality

This indicator is built on four measures: ambient concentrations of SO_2, NO_2, lead and total suspended particulates. Twenty-six countries have sufficient data to generate overall air quality scores (Table A2.1 on page 16). The Nordic countries scored very high on this measure. Poland also scores fairly high, but its high score can largely be explained by its improvement over the recent past. The United States ranks towards the middle, and Belgium, Japan and Greece are the three lowest scoring countries.

Water Quality

This indicator is built on three measures: dissolved oxygen, phosphorus concentrations, and biochemical oxygen demand. Twenty-two countries have sufficient data to generate overall water quality scores (Table A2.2 on page 17). Finland, Austria and Ireland scored highest on this indicator. China, Morocco and Indonesia score lowest. Each of these countries scores in the bottom 20th percentile for both current conditions and improvement.

Climate Change

This indicator is built on two measures: carbon economic efficiency (CO_2 emissions per unit GDP), and carbon lifestyle efficiency (CO_2 emissions per capita). Due to the careful tracking of carbon-dioxide emissions, the climate change indicator has relatively complete country coverage. A total of 137 countries are included. Table A2.3 (pages 18-20) shows that developing nations are the highest scoring. Former Eastern Bloc countries made the greatest improvements in CO_2 emissions per GDP and CO_2 emissions per capita. These countries have been undergoing major economic restructuring, which has resulted in the closing of many energy inefficient industries. However, some other large economies, like the UK, Finland and Canada, score surprisingly well, indicating gains in efficiency.

In terms of current conditions, the poorest developing countries have the highest scores (reflecting very low levels of fossil fuel use), whereas small countries and oil exporting countries score poorest. The United States, Australia and Russia are the only major industrialized countries that have consistently poor current performance on carbon-dioxide emissions. This can be explained in part by their large land areas (leading to higher transportation-related emissions), limited incentives for fuel efficiency, and a lack of policy attention.

Land Protection

This indicator is built on four measures: land-based protected areas as a percentage of national territory; municipal waste disposal at landfills per populated land area (i.e., territory populated at over five persons per square kilometer); paper recycling rates; and glass recycling rates. Twenty countries have sufficient data to generate overall land protection scores (Table A2.4 on page 21). Only the paper and glass recycling have comparable time series data that permit improvement scores.

In looking at the overall land protection scores, Northern European countries generally have high scores, largely due to their strong efforts on recycling and waste reduction. Austria and Denmark also have over 20 percent of their national territories in protected areas. The United Kingdom and the United States are at the bottom, largely as a result of low recycling rates.

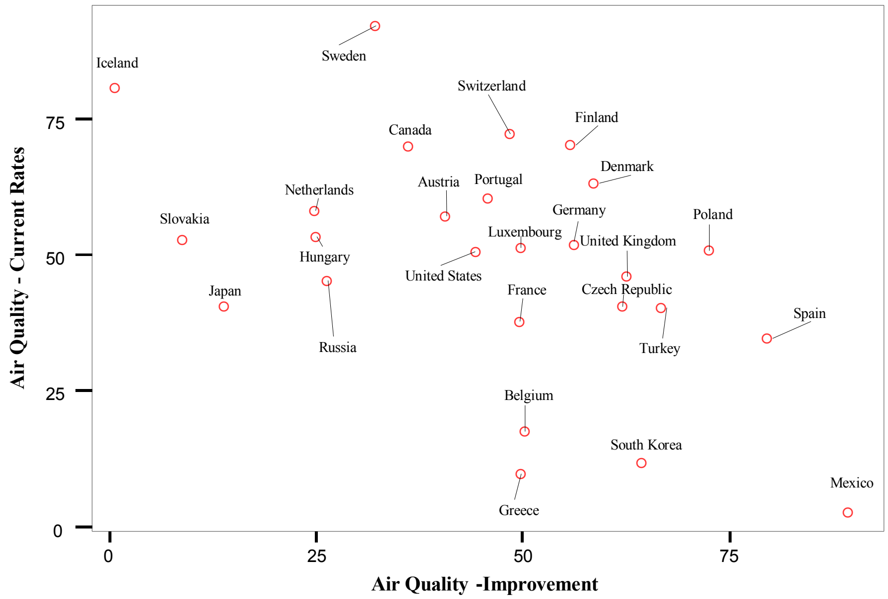
In terms of improvements, less well-developed OECD countries like Greece, Turkey, and Mexico are the lowest ranked. Italy also is at the bottom, ranking next-to-lowest on both current condition and improvement measures.

Are Laggards Improving?

From the perspective of collective well-being, it would be preferable for countries that are lagging in terms of current performance to be improving faster than high-performing countries. Creation of consistent performance indicators enables us to investigate whether this is so.

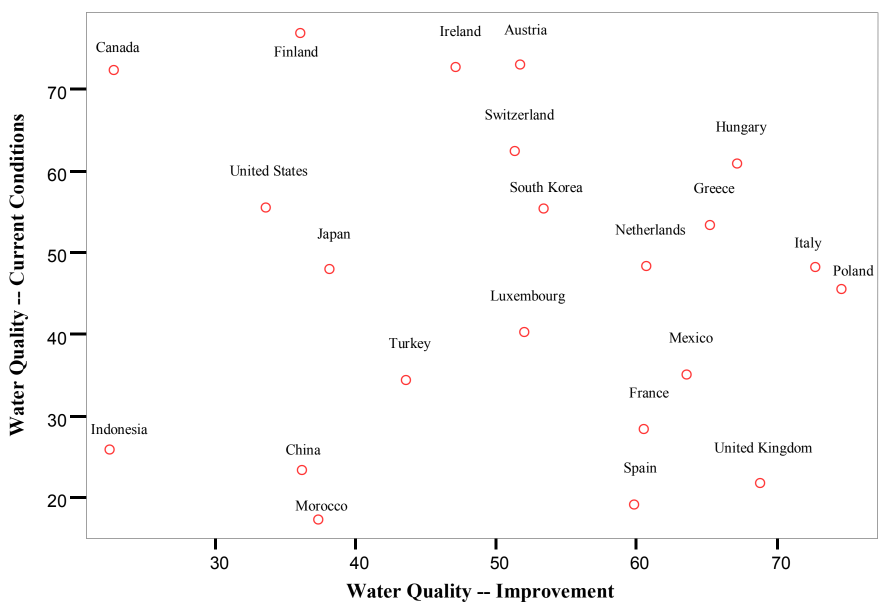
For air quality, the answer seems to be that by and large the low current performers are improving fastest over time. As Figure 1 shows, most of the countries that fall in the bottom half of current performance are in the top half for improvements over time. Mexico, for example, is at the bottom in terms of current conditions, but at the top in terms of improvements. Iceland, by contrast, has the second-highest score for the present and the lowest score for improvement.

Figure 1. The relationship between the improvement in Air Quality and the current level of Air Quality



The situation is different concerning water quality (Figure 2). Although there is a general tendency for low current performers to be improving most quickly, there is more spread than with air quality. The correlations are -.51 between the two air measures and -.42 between the two water measures. In particular, Indonesia, China and Morocco appear to be stuck in a low-performance equilibrium.

Figure 2. The relationship between the improvement in Water Quality and the current level of Water Quality



Climate change is such a recent policy issue that we did not expect there to be a consistent relationship between current performance and rates of improvement. This is what we find. As Figure 3 shows, the only clear pattern is that currently high-performing countries are demonstrating a more narrow range of change scores than the other countries.

Finally, the situation is most different when it comes to land protection, measured in terms of recycling rates (there are no time series data available for protected areas or municipal waste disposed of in landfills). As Figure 4 shows, the laggards are stuck as laggards, not improving in some cases at all, while the superior performers are increasing most rapidly. Although this is not a desirable situation given the benefits of increasing recycling rates in the under-performing countries, it may have a simple explanation. It could be, for example, that countries that invested seriously in recycling infrastructure in the past have built capacity for continued improvements, whereas countries that did not invest as seriously in such infrastructure find their ability to reap continued improvements limited. A country such as the U.S. that was only recycling 20% of its glass in 1990 (not a good score compared to other OECD countries) was only able to improve to 26% by 1997, whereas Germany, which was recycling 54% of its glass in 1990, was able to improve to 79% in 1997.

Figure 3. The relationship between the improvement in CO_2 Emissions and current levels of CO_2 Emissions

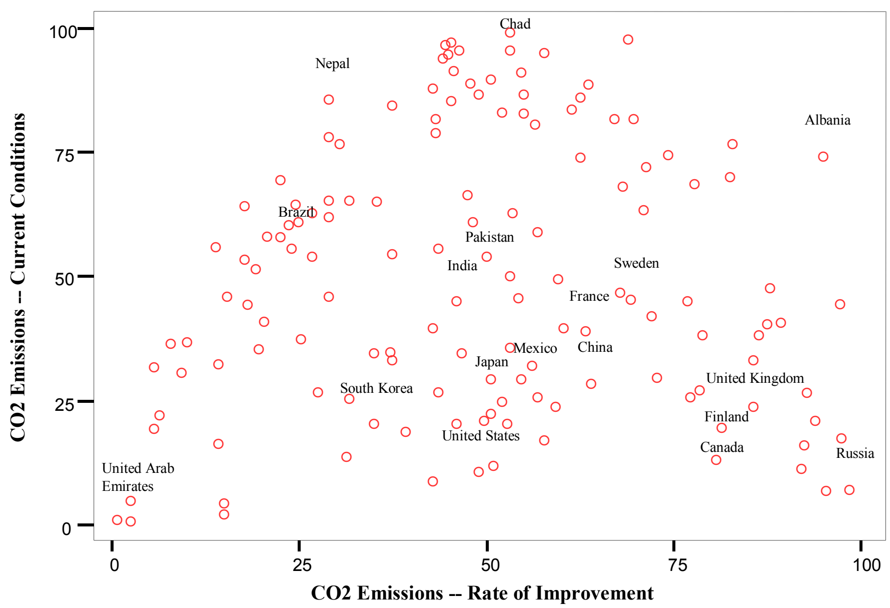
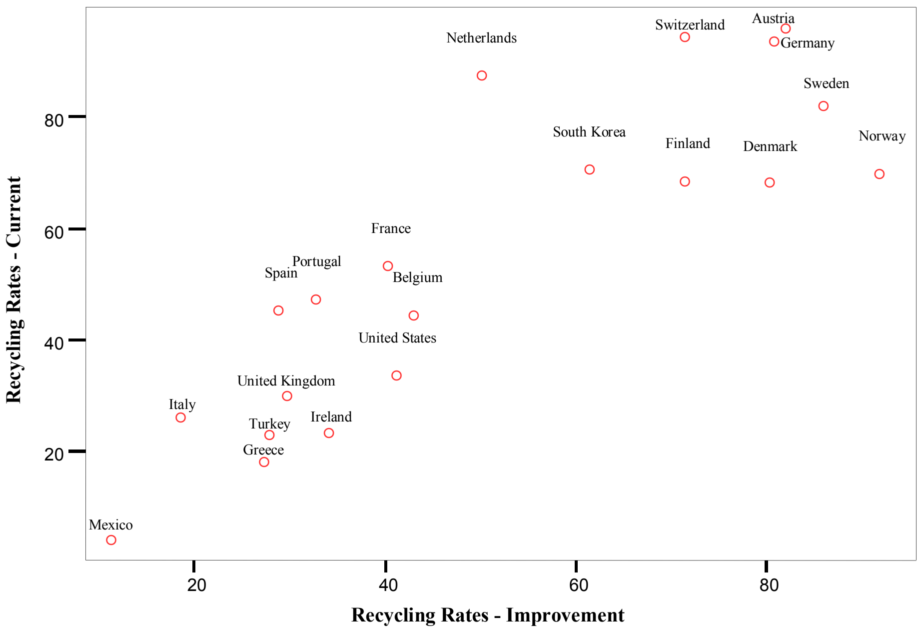


Figure 4. The relationship between the improvement in Recycling Rates and current Recycling Rates



Cross-National Comparisons

At the broadest level, the comparisons show that some countries are able to achieve environmental goals at consistently high levels. The Nordic countries and alpine countries tend to score higher than others. Middle-income countries such as Mexico and Turkey score consistently lower, and developing countries such as Indonesia and China tend to score lowest. Per-capita income is significantly correlated with each of the current conditions performance measures, but among the improvement measures only Land Protection shows up as being significant (see Table 3; for climate change the correlation is, expectedly, negative). However, these correlations are weak enough that it is clear that some countries make more effective use of their wealth in achieving environmental protection goals than others.

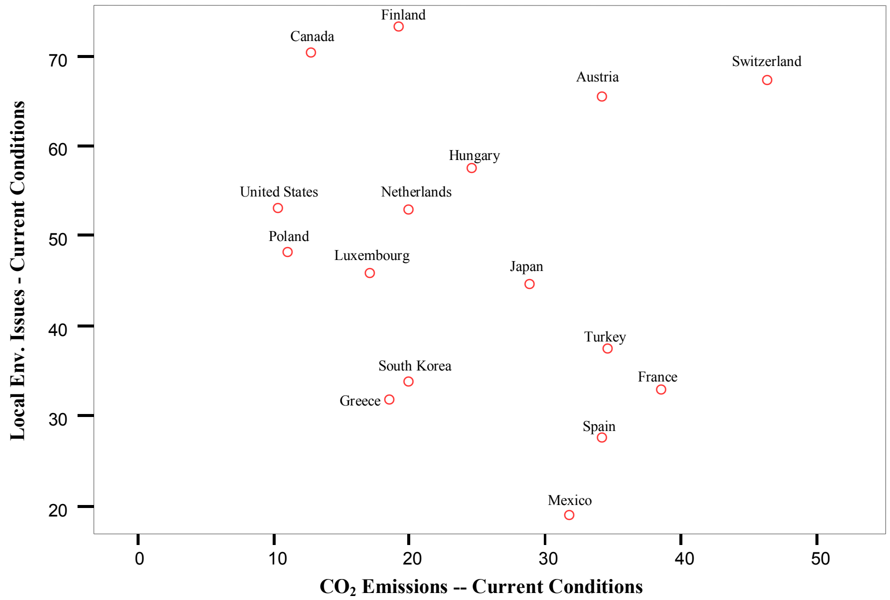
Very few countries have values for all four indicators, but we can calculate an aggregate Environmental Performance Index by averaging the indicators for those countries having values for at least three of the four categories. Twenty-three countries can be compared in this way, and the results are shown in Table 2.

Our indicators can also be used to evaluate how countries are managing the tradeoff between local environmental values such as air and water quality, and global issues such as climate change. It is quite striking that the best performers on local issues rank among the worst on global stewardship (i.e., protecting the international commons). There are some exceptions, as indicated in Figure 5. Switzerland, and to a lesser degree Austria, for example, have climate change results near the global median, and rank at the top of the scale in achieving local environmental protection.

Table 2. Environmental Performance Index (EPI)

Rank	Country	EPI	Air	Water	Climate Change	Land Protection
1	Sweden	74.9	87.8	.	54.1	83.0
2	Switzerland	66.9	67.1	59.5	54.4	86.6
3	Finland	64.2	67.0	69.3	47.5	73.0
4	Austria	63.2	52.3	68.5	39.7	92.1
5	Denmark	60.6	62.1	.	39.3	80.3
6	Canada	56.2	62.1	61.6	44.9	.
7	Poland	54.6	58.2	55.9	49.7	.
8	Luxembourg	49.9	50.9	44.9	54.0	.
9	Netherlands	49.9	48.4	52.7	35.1	63.2
10	Hungary	48.1	44.5	62.8	36.9	.
11	France	47.3	42.5	42.0	48.4	56.3
12	United Kingdom	45.1	52.1	42.6	50.9	34.8
13	Ireland	44.7	.	67.2	32.1	34.7
14	United States	44.1	48.7	48.9	29.1	49.8
15	South Korea	43.3	36.7	54.8	27.2	54.6
16	Portugal	43.2	56.5	.	33.1	40.2
17	Spain	43.0	52.6	37.6	35.1	46.7
18	Italy	41.9	.	56.7	42.8	26.1
19	Belgium	41.1	32.6	.	47.9	42.8
20	Mexico	39.6	45.8	46.5	42.1	23.9
21	Turkey	38.8	50.4	38.3	36.1	30.3
22	Japan	38.0	30.8	44.7	38.5	.
23	Greece	35.5	29.1	57.3	28.4	27.2

Figure 5. The relationship between current CO2 Emissions and current local-level environmental stewardship (air and water quality and land protection)



Other Drivers of Performance

Although this is a preliminary effort, and serious investigation of performance drivers will require collection of additional data and refinements in the methodology, we have generated some initial results that are worth reporting. Looking at simple bivariate correlations, we find that governance measures do a better job at predicting performance outcomes than per-capita income. Rule of law, in particular (as measured by the World Bank's Aggregated Governance Indicators project), reveals a particularly strong correlation with environmental performance. We cannot, given data limitations, demonstrate a causal relationship, but these preliminary findings seem to suggest that investments in improved governance may well lead to better environmental results.

Table 3. Correlations Performance Indicators

Indicator	n	GDP per capita (1998, PPP)	Rule of Law	ESI 2002 Social and Institutional Capacity Measure
Current Water Performance	21	.57**	.54**	.57**
Current Air Performance	24	.42**	.58**	.61**
Current Climate Change Performance	110	-.59**	-.56**	-.27**
Current Land Protection	22	.53*	.73**	.78**
Water Improvement	21	.02	.08	.05
Air Improvement	24	-.28	-.17	-.24
Climate Change Improvement	110	.05	.00	.04
Land Protection Improvement	20	.55*	.73**	.75**
**=significant at .01 level * = significant at .05 level				

The impact of governance and other capacity measures is even more striking when one looks at the overall EPI. Per-capita income is correlated very loosely with the EPI (.34), whereas the Environmental Sustainability Index's Social and Institutional Capacity value is strongly correlated (.71). Comparing Figures 6 and 7 demonstrates the difference.

The ESI's Social and Institutional Capacity measure is comprised of five separate dimensions, and among these the one that has the strongest correlation to the EPI is Private Sector Responsiveness, which measures through a collection of variables the degree to which the private sector is developing effective responses to environmental challenges. This Private Sector Responsiveness indicator has a correlation coefficient of .72.

The conclusion is clear: environmental performance is strongly influenced by patterns of environmental governance, independently of levels of wealth. Furthermore, understanding the dynamics of environmental governance is enhanced by explicit consideration of the role of the private sector.

Figure 6. The relationship between GDP per capita and the Environmental Performance Index

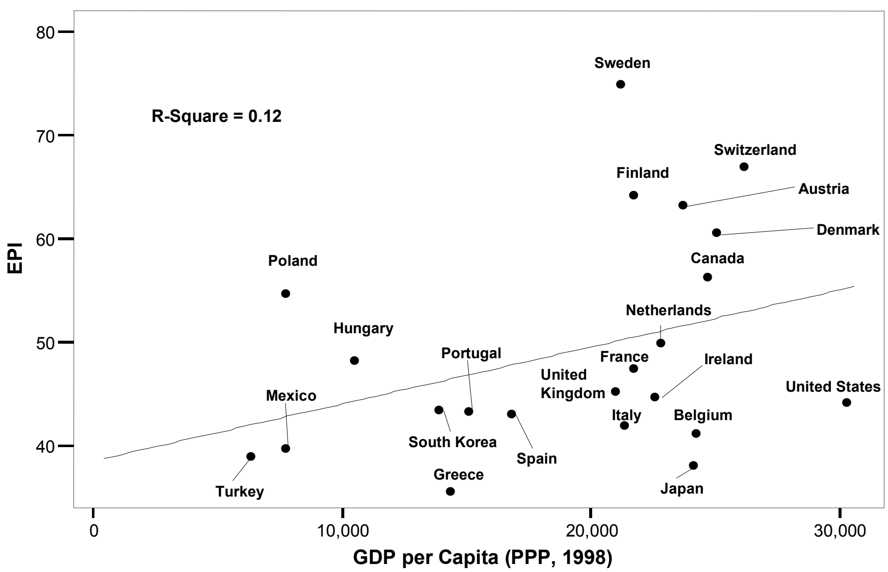
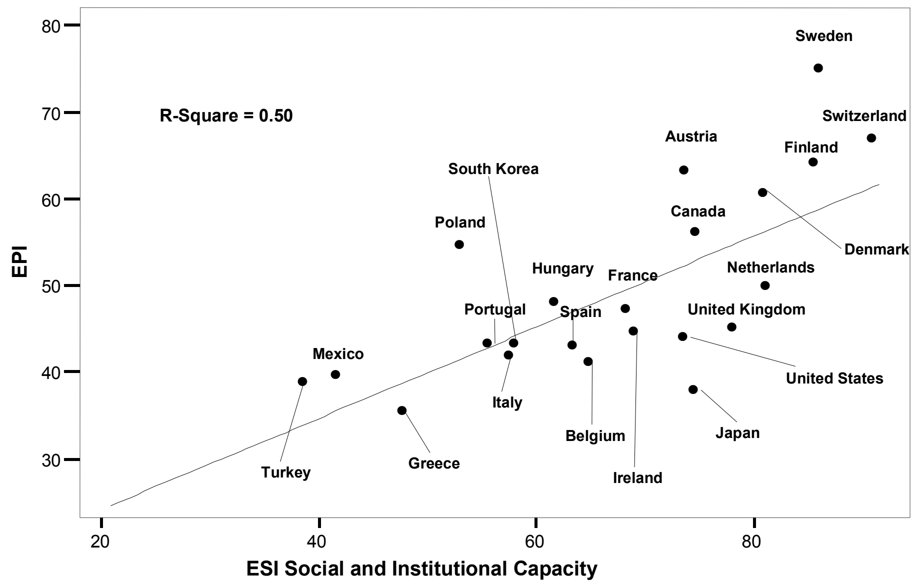


Figure 7. The relationship between the ESI's Social and Institutional Capacity Indicator and the Environmental Performance Index



Conclusions and Next Steps

The Pilot Environmental Performance Index responds to the need for comparable measures of pollution control and natural resource management results. We conclude that useful performance measures can be created, and that these measures shed valuable insights into patterns of performance. They identify consistent groupings of laggards and leaders. In some instances it appears that present laggards are catching up. But, in some cases, laggards are not improving, which is cause for concern. We have also shown the value of these indicators in probing drivers of performance, and demonstrated the plausibility of the claim that variations in governance patterns might in some cases represent more critical determinants of environmental results than variations in wealth.

This effort clearly needs refinement. In particular, the extremely limited supply of relevant data seriously hampers our ability to rely on current environmental performance indicators broadly or to test them rigorously. The world community would benefit from new investments in environmental data collection and analysis.

The Land Protection category is especially problematic because of the lack of good data over time. We hope that current efforts, such as the Millennium Ecosystem Assessment, will help fill some critical gaps in this area. An environmental performance measurement initiative would be a timely agenda item for the World Summit on Sustainable Development in Johannesburg in September 2002.

References

Consultative Group on Sustainable Development Indicators, "Dashboard of Sustainable Development Indicators," dataset dated 9 January 2002.

Esty, Daniel C., "Why Measurement Matters," in Daniel C. Esty, and Peter Cornelius, ed., *Environmental Performance Measurement: The Global Report 2001-2002*, New York: Oxford University Press, 2002.

Levy, Marc A., "Measuring Nations' Environmental Sustainability," in Daniel C. Esty, and Peter Cornelius, ed., *Environmental Performance Measurement: The Global Report 2001-2002*, New York: Oxford University Press, 2002.

Levy, Marc A. "Corruption and the 2001 Environmental Sustainability Index," pp. 300-302 Robin Hodess, ed., *Global Corruption Report 2001,* Berlin: Transparency International, 2001.

Prescott-Allen, Robert, *The Wellbeing of Nations*, Washington, DC: Island Press, 2001.

World Economic Forum (WEF), *2002 Environmental Sustainability Index*, produced in collaboration with the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network, 2002 (available at http://www.ciesin.columbia.edu/indicators/ESI).

Annex 1: Methodology

Two fundamental tasks are central to the creation of performance metrics from the observed variables. The data must be *aggregated*, to create indicator values, and a method for calculating *change over time* is needed to identify rates of improvement or decline. In this section we describe the choices we made.

Aggregation

To be able to combine variables denominated in different units it is necessary to convert them to a unitless measure. There are three core alternatives from which to choose. One can *rescale* the variables so that they have the same range (typically from 0 to 100), preserving the shape of the distribution so that the ratio of a country's score with respect to the rescaled maximum is the same as the ratio of its observed value with respect to the observed maximum. Alternatively, one can *standardize* the values so that each variable has the same mean (zero) and the same standard deviation (one). Finally, one can calculate *percentiles* that evenly distribute countries in terms of their rank order. Table 4 illustrates these alternatives with a hypothetical set of values.

We ruled out rescaling values to a 0-100 range because such a decision rule makes the aggregation very sensitive to differences in means. If two variables are both rescaled to a 0-100 scale and then averaged to calculate an indicator, the variable with the higher average value will have a bigger weight in the calculated indicator than the other variable. indicator than the other variable. Standardized values and percentiles do not have this feature, because they always have the same means.

In choosing between standardized values and percentiles, the chief difference is that standardized values maintain the same general shape of the original distribution of values, whereas percentiles evenly array countries from high to low. The consequence of this difference is that aggregating standardized values increases the de facto weight of variables with greater variance. Aggregating percentiles does not have this effect.

We chose to aggregate using percentiles to avoid having a variable's variance affect its weight on the indicator. This rule assumes that the magnitude of the difference between two countries' values matters less than the difference in rank. Our judgment is that this assumption is only seriously violated when examining an individual variable, but that it does make sense when averaging multiple variables. In our data tables we therefore report the observed values for individual variables, even though we rely on percentiles to calculate the indicators.

We tested the sensitivity of the EPI indicators to this decision rule and found that for most indicators the effect is negligible. It makes the biggest difference on the climate change indicator, but then only for a small number of countries.

Table 4. Hypothetical Illustration of Alternative Aggregation Schemes

Observed values	Rescaled Values (0-100)	Standardized Values	Percentiles
1.5	0.0	-0.90	20
2	4.8	-0.78	40
5	33.3	-0.07	60
6	42.9	0.17	80
12	100.0	1.59	100

Measuring Change Over Time

For each variable we sought to compare measures from circa 1990 to recent values. We evaluated two alternative schemes for doing so.

We rejected a method that divided the magnitude of the change by the 1990 levels. Although this is a common way to express change (e.g, "emissions are down 10%") it was a difficult metric to incorporate into an index that aggregated measures across multiple variables and countries. In particular, we observed that in a number of cases countries with very low starting values had very large increases or decreases when calculated this way, whereas countries with higher starting values simply had no realistic possibility of swings as large. Although in some circumstances this consequence may be helpful, in our case we judged it to be distorting.

Instead, we measured change by establishing a high-performance benchmark and a low-performance benchmark for each variable, and measuring the movement within that range in terms of percentages. In most cases the high-performance benchmark was set to 0. The low-performance benchmark was set by examining the empirical record and choosing the worst observed value, rounded. (Because we convert all variables to percentiles before aggregating, the final results are identical regardless of what actual benchmarks are chosen, though making them fit the empirical record gives them more intuitive salience.) For example, the highest observed value of CO_2 emissions per capita is 28.8 tons (a feat achieved by Qatar in 1963). We therefore set the low-performance benchmark for that variable to 30 and the high-performance benchmark to 0.

We then take the change in observed values and divide it by the range between the low and high performance benchmarks. A country emitting 8 tons of CO_2 per capita in 1990 and 10 tons in 1998 would be characterized as having experienced a change of –6.7.

Combining Current Levels with Rates of Improvements

In calculating an overall indicator for each category, we combine information concerning the current level of performance with information about the rate of change in performance. We experimented with alternative methods to combine these measures, and selected an algorithm that weights the change term according to the value of the current performance term.

A simple average of the two is not desirable because it unfairly penalizes countries that are performing extremely well but not improving, or only improving slightly. We therefore use a weighted average of the two values. The weight of the current performance indicator does not change; the weight applied to the improvement indicator is inversely proportional to the current performance indicator. This means that the higher a country's current performance, the less improvement matters in determining its aggregate score. Intuitively this makes sense. Countries that are closer to the maximum level of performance will have more difficulty making major improvements, and each additional incremental improvement matters less in terms of the health of ecosystems and human well being than larger improvements in lower performing countries.

Annex 2: Performance Indicators

The tables in this annex provide the overall score for each indicator (Air Quality, Water Quality, Climate Change, and Land Protection), followed by the scores for current performance and improvement over the recent past. The overall scores are an average of the scores for current conditions and improvements, with a weight applied to the improvement score that is inversely proportional to the score for current conditions (see Annex 1 for more information).

Table A2.1. Air Quality Indicators

Country	Overall Air Quality
Sweden	87.8
Iceland	68.0
Switzerland	67.1
Finland	67.0
Canada	62.1
Denmark	62.1
Poland	58.2
Portugal	56.5
Germany	53.4
Spain	52.6
Austria	52.3
United Kingdom	52.1
Luxembourg	50.9
Turkey	50.4
Czech Republic	48.8
United States	48.7
Netherlands	48.4
Mexico	45.8
Hungary	44.5
France	42.5
Slovakia	38.8
Russia	38.8
South Korea	36.7
Belgium	32.6
Japan	30.8
Greece	29.1

Country	Current Air Quality
Sweden	92.1
Iceland	80.8
Switzerland	72.1
Finland	70.1
Canada	69.8
Denmark	63.1
Portugal	60.4
Netherlands	58.0
Austria	57.1
Hungary	53.3
Slovakia	52.7
Germany	51.8
Luxembourg	51.2
Poland	50.9
United States	50.5
United Kingdom	46.0
Russia	45.3
Czech Republic	40.5
Japan	40.5
Turkey	40.3
France	37.7
Spain	34.6
Belgium	17.5
South Korea	11.7
Greece	9.9
Mexico	2.7

Country	Improvement in Air Quality
Mexico	90.1
Spain	80.2
Poland	73.3
Turkey	67.4
South Korea	65.0
United Kingdom	63.3
Czech Republic	62.8
Denmark	59.2
Germany	56.8
Finland	56.4
Belgium	50.9
Greece	50.5
Luxembourg	50.4
France	50.3
Switzerland	49.1
Portugal	46.5
United States	45.0
Austria	41.3
Canada	36.8
Sweden	32.8
Russia	27.0
Hungary	25.6
Netherlands	25.4
Japan	14.5
Slovakia	9.4
Iceland	1.3

Table A2.2. Water Quality Indicators

Country	Overall Water Quality
Finland	69.3
Austria	68.5
Ireland	67.2
Hungary	62.8
Canada	61.6
Switzerland	59.5
Greece	57.3
Italy	56.7
Poland	55.9
South Korea	54.8
Netherlands	52.7
United States	48.9
Mexico	46.5
Luxembourg	44.9
Japan	44.7
United Kingdom	42.6
France	42.0
Turkey	38.3
Spain	37.6
China	29.1
Morocco	26.6
Indonesia	24.6

Country	Current Water Quality
Finland	76.9
Austria	72.9
Ireland	72.6
Canada	72.3
Switzerland	62.4
Hungary	60.9
United States	55.6
South Korea	55.3
Greece	53.4
Netherlands	48.3
Italy	48.2
Japan	48.0
Poland	45.5
Luxembourg	40.4
Mexico	35.2
Turkey	34.5
France	28.5
Indonesia	25.9
China	23.4
United Kingdom	21.9
Spain	19.3
Morocco	17.4

Country	Improve-ment in Water Quality
Poland	75.1
Italy	73.2
United Kingdom	69.2
Hungary	67.6
Greece	65.6
Mexico	64.0
Netherlands	61.2
France	61.0
Spain	60.3
South Korea	53.8
Luxembourg	52.4
Austria	52.2
Switzerland	51.7
Ireland	47.5
Turkey	44.0
Japan	38.6
Morocco	37.8
China	36.5
Finland	36.5
United States	34.0
Canada	23.1
Indonesia	22.9

A2.3 Climate Change Indicators

Country	Overall Climate Change
Chad	99.0
Ethiopia	97.3
Cambodia	95.7
Burundi	95.2
Mali	94.0
Uganda	93.7
Zaire	93.3
Laos	92.2
Central Af. Rep.	91.1
Mozambique	88.1
Rwanda	87.9
Burkina Faso	86.1
Comoros	86.1
Cameroon	84.9
Tanzania	83.3
Guinea	83.2
Madagascar	83.1
Malawi	82.5
Niger	80.5
Cape Verde	80.3
Swaziland	80.0
Vanuatu	79.6
Gambia, The	78.9
Benin	78.9
Nepal	78.7
Albania	78.7
Haiti	78.5
Zambia	78.1
Ghana	76.9
Bangladesh	76.0
Solomon Islands	74.7
Papua New Guinea	73.0
Togo	72.8
Angola	72.1
Equatorial Guinea	71.7
Fiji	71.0
Sierra Leone	69.5
Senegal	68.4
Sri Lanka	68.2
French Polynesia	65.8
Gabon	63.6
Guinea-Bissau	61.9
Zimbabwe	61.6
Peru	60.5
Nigeria	59.1
Paraguay	58.8
Nicaragua	58.5
Congo	58.2
St. Lucia	57.7
Mauritius	57.5
Kenya	56.9
Mauritania	56.9
Ivory Coast	56.5
Costa Rica	56.2
Romania	54.9
Bahamas, The	54.5
Guatemala	54.4
Switzerland	54.4
Sweden	54.1

Country	Overall Climate Change
Iceland	54.0
Luxembourg	54.0
Mongolia	53.5
Malta	53.4
Dominica	53.3
Belize	53.2
Uruguay	53.2
Pakistan	52.9
El Salvador	52.3
Colombia	52.2
Russia	51.5
Indonesia	51.3
Bulgaria	51.3
Bhutan	51.2
United Kingdom	50.9
Philippines	50.1
Brunei	49.9
Poland	49.7
Morocco	49.5
New Caledonia	49.1
Argentina	49.0
France	48.4
Belgium	47.9
Jordan	47.8
Norway	47.7
Honduras	47.6
Finland	47.5
Maldives	47.4
Brazil	46.2
India	45.6
St. Kitts and Nevis	45.6
Canada	44.9
China	43.6
St. Vincent & Gren.	43.4
Italy	42.8
Macau	42.5
Mexico	42.1
Grenada	41.2
Egypt	41.1
Hong Kong	40.3
Antigua & Barbuda	40.1
Austria	39.7
Syria	39.5
Denmark	39.3
Japan	38.5
Hungary	36.9
Turkey	36.1
Suriname	35.9
Panama	35.6
Chile	35.2
Botswana	35.2
Iran	35.1
Netherlands	35.1
Spain	35.1
Cyprus	34.2
Lebanon	34.0
Tunisia	33.7
Portugal	33.1
Ireland	32.1

Country	Overall Climate Change
South Africa	30.5
Guyana	29.5
United States	29.1
New Zealand	28.4
Greece	28.4
Algeria	27.4
South Korea	27.2
Bolivia	26.7
Dominican Rep.	25.6
Ecuador	25.4
Australia	25.4
Venezuela	22.4
Barbados	22.2
Thailand	21.5
Israel	15.8
Malaysia	15.6
Jamaica	13.5
Singapore	9.9
Trinidad & Tobago	8.9
Saudi Arabia	4.1
Bahrain	2.0
United Arab Em.	1.2

A2.3. Climate Change Indicators (continued)

Country	Current Climate Change
Chad	99.3
Ethiopia	97.9
Cambodia	97.1
Burundi	96.8
Mali	95.7
Uganda	95.7
Zaire	95.0
Laos	94.6
Central Af.Rep.	93.9
Rwanda	91.4
Mozambique	91.1
Comoros	89.6
Cameroon	88.9
Burkina Faso	88.6
Madagascar	87.9
Guinea	86.8
Malawi	86.8
Tanzania	86.1
Nepal	85.7
Cape Verde	85.4
Haiti	84.6
Niger	83.6
Benin	83.2
Gambia, The	82.9
Swaziland	81.8
Vanuatu	81.8
Bangladesh	81.8
Ghana	80.7
Togo	78.9
Sierra Leone	78.2
Zambia	76.8
Sri Lanka	76.8
Solomon Islands	74.6
Albania	74.3
Equatorial Guinea	73.9
Angola	72.1
Papua New Guinea	70.0
Paraguay	69.6
Fiji	68.6
Senegal	68.2
Guinea-Bissau	66.4
Kenya	65.4
Costa Rica	65.4
Mauritius	65.0
Guatemala	64.6
El Salvador	64.3
French Polynesia	63.6
Peru	62.9
Dominica	62.9
Uruguay	62.1
St. Lucia	61.1
Bhutan	61.1
Philippines	60.4
Nicaragua	58.9
Maldives	58.2
Honduras	57.9
St. Vincent & Gren.	56.1
Colombia	55.7
Brazil	55.7
Morocco	54.6
Pakistan	53.9
St. Kitts and Nevis	53.9
Macau	53.6
Grenada	51.4
Indonesia	50.0
Belize	49.6
Zimbabwe	47.5
Switzerland	46.8
Hong Kong	46.1
Panama	46.1
Argentina	45.7
Sweden	45.4
Ivory Coast	45.0
India	45.0
Gabon	44.6
Botswana	44.3
Malta	42.1
Tunisia	41.1
Nigeria	40.7
Congo	40.4
Norway	39.6
Egypt	39.6
France	38.9
Iceland	38.2
Mauritania	38.2
Portugal	37.5
Bolivia	36.8
Dominican Republic	36.4
Italy	35.7
Guyana	35.4
Turkey	35.0
Spain	34.6
Austria	34.6
Chile	33.2
Bahamas, The	33.2
Ecuador	32.5
Mexico	32.1
Thailand	31.8
Barbados	30.7
Jordan	29.6
Japan	29.3
Antigua & Barbuda	29.3
China	28.6
New Caledonia	27.1
Cyprus	26.8
Algeria	26.8
Romania	26.4
Denmark	25.7
Belgium	25.7
New Zealand	25.4
Hungary	25.0
Syria	23.9
United Kingdom	23.9
Iran	22.5
Malaysia	22.1
Mongolia	21.1
Lebanon	21.1
South Korea	20.4
Netherlands	20.4
Ireland	20.4
Finland	19.6
Jamaica	19.3
Greece	18.9
Luxembourg	17.5
Suriname	17.1
Israel	16.4
Bulgaria	16.1
Venezuela	13.9
Canada	13.2
South Africa	11.8
Poland	11.4
United States	10.7
Australia	8.9
Russia	7.1
Brunei	6.8
Saudi Arabia	5.0
Singapore	4.3
Trinidad & Tobago	2.1
United Arab Em.	1.1
Bahrain	0.7

A2.3. Climate Change Indicators (continued)

Country	Improvement in Climate Change
Russia	99.3
Luxembourg	98.2
Gabon	97.9
Brunei	96.1
Albania	95.7
Mongolia	94.6
Romania	93.6
Bulgaria	93.2
Poland	92.9
Nigeria	90.0
Zimbabwe	88.6
Congo	88.2
Mauritania	87.1
Bahamas, The	86.4
United Kingdom	86.4
Zambia	83.6
Papua NG	83.2
Finland	82.1
Canada	81.4
Iceland	79.6
New Caledonia	79.3
Fiji	78.6
Belgium	77.9
Ivory Coast	77.5
Solomon Islands	75.0
Jordan	73.6
Malta	72.9
Angola	72.1
French Polynesia	71.8
Swaziland	70.4
Sweden	70.0
Ethiopia	69.6
Senegal	68.9
Switzerland	68.6
Vanuatu	67.9
China	64.6
Burkina Faso	64.3
France	63.9
Tanzania	63.2
Equatorial Guinea	63.2
Niger	62.1
Norway	61.1
Belize	60.4
Syria	60.0
Zaire	58.6
Suriname	58.6
Nicaragua	57.5
Denmark	57.5
Ghana	57.1
Mexico	56.8
Guinea	55.7
Gambia, The	55.7
Mozambique	55.4
Antigua & Barbuda	55.4
Argentina	55.0
Peru	54.3
Chad	53.9
Mali	53.9
Indonesia	53.9
Italy	53.9
Netherlands	53.6
Benin	52.9
Hungary	52.9
South Africa	51.8
Comoros	51.4
Japan	51.4
Iran	51.4
Pakistan	50.7
Lebanon	50.4
Malawi	49.6
United States	49.6
St. Lucia	48.9
Cameroon	48.6
Guinea-Bissau	48.2
Austria	47.5
Uganda	47.1
India	46.8
Ireland	46.8
Rwanda	46.4
Cambodia	46.1
Cape Verde	46.1
Laos	45.7
Burundi	45.4
Central Af. Rep.	45.0
Colombia	44.3
Cyprus	44.3
Bangladesh	43.9
Togo	43.9
Madagascar	43.6
Egypt	43.6
Australia	43.6
Greece	40.0
Chile	38.2
Haiti	38.2
Morocco	38.2
Turkey	37.9
Mauritius	36.1
South Korea	35.7
Spain	35.7
Kenya	32.5
New Zealand	32.5
Venezuela	32.1
Sri Lanka	31.1
Nepal	29.6
Sierra Leone	29.6
Costa Rica	29.6
Uruguay	29.6
Hong Kong	29.6
Algeria	28.2
Dominica	27.5
St. Kitts & Nevis	27.5
Portugal	26.1
Bhutan	25.7
Guatemala	25.4
Brazil	24.6
Philippines	24.3
Paraguay	23.2
Honduras	23.2
Maldives	21.4
Tunisia	21.1
Guyana	20.4
Grenada	20.0
Botswana	18.9
El Salvador	18.6
Macau	18.6
Panama	16.1
Singapore	15.7
Trinidad & Tobago	15.7
Ecuador	15.0
Israel	15.0
St. Vincent & Gren.	14.6
Bolivia	10.7
Barbados	10.0
Dominican Rep.	8.6
Malaysia	7.1
Thailand	6.4
Jamaica	6.4
Saudi Arabia	3.2
Bahrain	3.2
United Arab Em.	1.4

Table A2.4. Land Protection Indicators

Country	Overall Land Protection Status
Austria	92.1
Belgium	42.8
Denmark	80.3
Finland	73.0
France	56.3
Germany	75.6
Greece	27.2
Ireland	34.7
Italy	26.1
Mexico	23.9
Netherlands	63.2
Norway	75.1
Portugal	40.2
South Korea	54.6
Spain	46.7
Sweden	83.0
Switzerland	86.6
Turkey	30.3
United Kingdom	34.8
United States	49.8

Country	Current Land Protection Status
Austria	92.8
Switzerland	88.3
Sweden	82.3
Denmark	80.2
Germany	74.1
Finland	73.2
New Zealand	72.5
Norway	69.9
Netherlands	67.4
France	62.2
Spain	54.6
United States	53.5
Slovakia	52.1
South Korea	51.0
Portugal	44.1
Belgium	42.4
United Kingdom	37.7
Ireland	34.7
Mexico	32.1
Turkey	31.7
Italy	31.0
Greece	26.8

Country	Improvement in Land Protection Status
Norway	92.4
Sweden	86.4
Austria	82.5
Germany	81.3
Denmark	80.9
Switzerland	71.9
Finland	71.9
South Korea	62.0
Netherlands	50.6
Belgium	43.6
United States	41.7
France	40.9
Ireland	34.6
Portugal	33.2
United Kingdom	30.1
Spain	29.3
Turkey	28.4
Greece	27.9
Italy	19.0
Mexico	11.8

Annex 3: Variable Data

Table A3.1. Air Quality

Units: All measurements are in micrograms per square meter (ug/m3).

COUNTRY	NO_2 (1997)	NO_2 (1990)	SO_2 (1997)	SO_2 (1990)	TSP* (1997)	TSP* (1990)	Lead (1997)	Lead (1990)
Austria	34.3	42.4	11.9	9.0	38.1	47.3	.	.
Belgium	43.7	50.8	17.0	26.2	80.3	81.4	0.2	0.3
Canada	32.0	40.2	10.6	16.0	36.1	39.1	0.0	0.0
Czech Republic	33.9	37.8	21.1	37.2	48.2	70.1	0.0	.
Denmark	38.5	43.0	3.0	10.9	50.3	68.5	0.0	0.1
Finland	30.3	42.1	3.0	9.3	47.4	72.2	0.0	0.1
France	42.1	46.0	20.1	34.0	26.0	24.0	0.2	0.8
Germany	44.2	44.2	11.7	55.0	36.2	45.9	0.0	0.1
Greece	55.8	63.1	27.3	39.5	53.9	48.2	0.2	0.5
Hungary	36.1	32.9	14.3	20.8	37.8	.	.	0.2
Iceland	30.5	14.8	2.0	2.1	27.1	14.4	.	0.1
Japan	41.0	38.9	16.9	19.0	41.2	42.0	0.1	0.1
Luxembourg	42.8	51.3	14.7	28.4	15.0	15.0	0.1	0.1
Mexico	184.7	239.8	30.1	72.2	107.6	.	.	.
Netherlands	34.5	38.1	.	17.1	39.2	.	0.0	0.1
Poland	29.2	36.0	16.9	36.0	28.2	44.0	0.1	0.5
Portugal	28.5	18.0	10.2	27.9	52.7	65.4	.	.
Russia	45.2	41.0	11.0	18.0	.	81.9	0.0	0.1
Slovakia	24.1	.	28.1	29.2	55.3	53.9	0.0	0.0
South Korea	48.2	42.6	34.0	96.5	74.2	136.6	0.1	.
Spain	56.9	80.1	13.7	35.7	40.5	55.8	.	.
Sweden	21.2	26.3	4.2	6.5	4.4	7.3	.	.
Switzerland	28.5	37.5	6.2	12.0	34.0	36.8	0.0	0.1
Turkey	26.1	22.0	59.5	158.0	48.1	80.4	.	.
United Kingdom	43.5	56.7	22.2	35.4	11.5	16.9	.	0.1
United States	39.0	44.2	15.1	22.9	24.1	30.0	0.1	0.1

*Total Suspended Particulates

Source: Organization for Economic Cooperation and Development, *OECD Environmental Data Compendium 1999*, Tables 2.4A-2.4D, Paris: OECD, 1999.

Table A3.2. Water Quality

Units: Dissolved Oxygen and Phosphorus concentrations are measured in milligrams of O_2 and P per liter, respectively. Biochemical Oxygen Demand (BOD) is measured in kilograms of BOD emissions per cubic kilometer of water.

Country	Dissolved Oxygen (1994-96)	Dissolved Oxygen (1988-90)	Phosphorus (1994-96)	Phosphorus (1988-90)	Biochemical Oxygen Demand (1995)	Biochemical Oxygen Demand (1990)
Austria	11.0	10.9	0.1	0.2	891.3	1052.2
Canada	9.4	10.3	0.0	0.0	110.8	124.9
China	8.0	8.9	0.3	1.2	3347.6	2536.1
Finland	10.7	11.3	0.0	0.0	681.0	776.2
France	8.9	8.6	0.4	0.5	2515.3	2770.4
Greece	11.5	11.1	0.4	0.5	1342.2	1446.5
Hungary	10.3	10.1	0.1	0.4	1157.3	1533.0
Indonesia	3.3	3.0	0.6	0.2	319.6	202.5
Ireland	10.9	10.4	0.1	0.1	680.3	691.6
Italy	9.9	9.0	0.2	0.3	2996.5	3016.1
Japan	9.6	9.8	0.1	0.1	4470.3	4667.1
Luxembourg	9.8	9.9	0.5	0.5	690.1	762.3
Mexico	7.2	6.3	0.3	0.4	385.4	458.0
Morocco	6.3	5.7	0.3	0.3	7606.3	4086.7
Netherlands	9.9	9.5	0.2	0.3	1336.3	1426.8
Poland	10.5	10.2	0.3	0.4	5554.4	6878.1
South Korea	10.1	9.6	0.1	0.0	6231.5	6719.2
Spain	8.3	6.8	0.5	0.6	3631.8	3371.2
Switzerland	10.8	10.6	0.1	0.1	3113.4	3498.5
Turkey	8.3	8.9	0.3	0.4	1007.5	1040.4
United Kingdom	9.3	9.3	0.9	1.3	3496.7	4078.6
United States	10.0	9.7	0.2	0.1	1127.9	1137.6

Sources: Organization for Economic Cooperation and Development, *OECD Environmental Data Compendium 1999*, Tables 3.4A-3.4B, Paris: OECD, 1999; World Bank, *World Development Indicators 2001*, Washington: World Bank, 2001.

Table A3.3. Climate Change

Units: CO_2 Economic Efficiency is in Metric Tons of Carbon Dioxide Emissions per US$10,000 GDP; CO_2 Lifestyle Efficiency is Metric Tons of Carbon Dioxide Emissions per Person

Country	CO_2 Economic Efficiency (1998)	CO_2 Economic Efficiency (1990)	CO_2 Lifestyle Efficiency (1998)	CO_2 Lifestyle Efficiency (1990)
Albania	0.44	2.21	0.14	0.60
Algeria	2.02	1.98	0.97	0.88
Angola	0.54	0.83	0.13	0.14
Antigua and Barbuda	1.41	1.71	1.38	1.28
Argentina	0.82	1.19	1.03	0.92
Australia	2.07	2.48	4.88	4.30
Austria	0.90	1.07	2.14	2.04
Bahamas, The	1.08	1.43	1.65	2.09
Bahrain	5.76	5.52	8.58	6.52
Bangladesh	0.36	0.38	0.05	0.04
Barbados	1.15	1.01	1.60	1.14
Belgium	1.10	1.42	2.73	2.76
Belize	0.94	1.17	0.47	0.45
Benin	0.37	0.46	0.03	0.03
Bhutan	1.09	0.66	0.05	0.02
Bolivia	1.76	1.25	0.41	0.23
Botswana	1.02	0.95	0.66	0.46
Brazil	0.71	0.67	0.49	0.37
Brunei	2.79	4.22	4.75	6.18
Bulgaria	3.15	4.07	1.55	2.36
Burkina Faso	0.28	0.43	0.02	0.03
Burundi	0.16	0.13	0.01	0.01
Cambodia	0.12	0.14	0.02	0.01
Cameroon	0.22	0.22	0.03	0.04
Canada	1.69	2.10	4.17	4.21
Cape Verde	0.19	0.23	0.08	0.07
Central African Rep.	0.17	0.17	0.02	0.02
Chad	0.05	0.09	0.00	0.01
Chile	1.26	1.48	1.11	0.74
China	2.03	4.14	0.68	0.57
Colombia	0.75	0.78	0.45	0.44
Comoros	0.24	0.25	0.03	0.03
Congo	2.50	3.35	0.18	0.25
Costa Rica	0.51	0.50	0.36	0.26
Cyprus	1.19	1.46	2.09	1.86
Denmark	1.08	1.38	2.76	2.69
Dominica	0.61	0.57	0.32	0.22
Dominican Republic	1.31	1.08	0.67	0.36
Ecuador	1.85	1.59	0.59	0.44
Egypt	1.45	1.57	0.44	0.37
El Salvador	0.65	0.47	0.27	0.14
Equatorial Guinea	0.41	0.87	0.16	0.09
Ethiopia	0.15	0.33	0.01	0.02
Fiji	0.54	0.79	0.25	0.31
Finland	1.28	1.63	2.82	2.90
France	0.78	0.96	1.72	1.72
French Polynesia	0.32	0.46	0.67	0.85
Gabon	1.01	3.66	0.66	1.95
Gambia, The	0.34	0.38	0.05	0.06
Ghana	0.36	0.46	0.06	0.06
Greece	1.51	1.73	2.19	1.93
Grenada	0.84	0.77	0.54	0.36
Guatemala	0.68	0.56	0.24	0.16
Guinea-Bissau	0.86	0.84	0.05	0.06
Guinea	0.25	0.32	0.05	0.05

Country	CO_2 Economic Efficiency (1998)	CO_2 Economic Efficiency (1990)	CO_2 Lifestyle Efficiency (1998)	CO_2 Lifestyle Efficiency (1990)
Guyana	1.52	1.42	0.53	0.39
Haiti	0.31	0.25	0.04	0.04
Honduras	0.93	0.70	0.23	0.14
Hong Kong	0.68	0.75	1.47	1.25
Hungary	1.47	1.63	1.58	1.54
Iceland	0.78	1.02	2.06	2.16
India	1.39	1.54	0.29	0.22
Ireland	1.23	1.83	2.84	2.32
Israel	1.51	1.51	2.75	2.03
Italy	0.91	1.10	1.97	1.91
Ivory Coast	1.46	1.78	0.25	0.28
Jamaica	3.29	2.62	1.18	0.92
Japan	1.00	1.19	2.45	2.37
Jordan	2.16	2.61	0.60	0.60
Kenya	0.85	0.70	0.09	0.07
Laos	0.14	0.17	0.02	0.02
Lebanon	2.45	3.66	1.40	0.97
Luxembourg	1.24	3.58	4.97	7.09
Macau	0.60	0.54	0.97	0.75
Madagascar	0.30	0.27	0.02	0.02
Malawi	0.36	0.41	0.02	0.02
Malaysia	1.92	1.75	1.54	0.85
Maldives	0.76	0.66	0.33	0.19
Mali	0.18	0.23	0.01	0.01
Malta	0.86	1.45	1.28	1.28
Mauritania	2.00	3.07	0.31	0.35
Mauritius	0.46	0.53	0.41	0.30
Mexico	1.33	1.57	1.07	1.00
Mongolia	5.45	7.18	0.82	1.23
Morocco	0.91	0.92	0.32	0.27
Mozambique	0.28	0.37	0.02	0.02
Nepal	0.30	0.10	0.04	0.01
Netherlands	1.23	1.58	2.85	2.74
New Caledonia	1.11	1.33	2.31	2.63
New Zealand	1.19	1.32	2.16	1.91
Nicaragua	0.91	1.08	0.19	0.19
Niger	0.39	0.50	0.03	0.04
Nigeria	2.12	3.30	0.20	0.28
Norway	0.74	1.05	2.07	2.04
Pakistan	1.14	1.26	0.18	0.16
Panama	1.02	0.92	0.57	0.36
Papua New Guinea	0.60	1.08	0.14	0.17
Paraguay	0.54	0.37	0.24	0.15
Peru	0.67	0.84	0.31	0.27
Philippines	0.77	0.59	0.28	0.20
Poland	2.84	4.22	2.27	2.49
Portugal	0.97	1.04	1.51	1.17
Romania	1.81	2.93	1.12	1.82
Russia	3.84	6.78	2.66	6.82
Rwanda	0.21	0.22	0.02	0.02
Saudi Arabia	3.60	3.27	3.83	3.03
Senegal	0.73	0.90	0.10	0.11
Sierra Leone	0.60	0.26	0.03	0.02
Singapore	2.93	2.94	6.46	3.79
Solomon Islands	0.53	0.77	0.11	0.14
South Africa	2.56	2.73	2.38	2.34
South Korea	1.51	1.73	2.15	1.54
Spain	1.00	1.16	1.70	1.47
Sri Lanka	0.38	0.30	0.12	0.06
St. Kitts and Nevis	0.61	0.69	0.72	0.43
St. Lucia	0.64	0.75	0.36	0.33

Country	CO_2 Economic Efficiency (1998)	CO_2 Economic Efficiency (1990)	CO_2 Lifestyle Efficiency (1998)	CO_2 Lifestyle Efficiency (1990)
St. Vincent & Gren.	0.78	0.57	0.39	0.21
Suriname	3.60	5.08	1.41	1.23
Swaziland	0.25	0.42	0.11	0.15
Sweden	0.70	0.85	1.50	1.55
Switzerland	0.61	0.72	1.56	1.70
Syria	2.68	3.53	0.90	0.79
Tanzania	0.39	0.54	0.02	0.02
Thailand	1.50	1.23	0.87	0.47
Togo	0.39	0.39	0.05	0.05
Tunisia	1.17	1.14	0.65	0.44
Turkey	1.31	1.45	0.86	0.70
Uganda	0.15	0.18	0.02	0.01
United Arab Emirates	4.92	4.46	10.23	8.65
United Kingdom	1.17	1.62	2.52	2.70
United States	1.77	2.25	5.43	5.17
Uruguay	0.53	0.56	0.49	0.34
Vanuatu	0.28	0.44	0.09	0.12
Venezuela	3.04	3.16	1.82	1.59
Zaire	0.18	0.23	0.01	0.03
Zambia	0.58	1.03	0.05	0.09
Zimbabwe	1.14	1.98	0.34	0.46

Sources: Carbon dioxide data from the Carbon Dioxide Information Analysis Center at http://cdiac.esd.ornl.gov/pns/pns_main.html; GDP data from the World Bank, World Development Indicators 2001, Washington, DC: World Bank, 2001; Population data from the United Nations Population Division, 2000.

Table A3.4. Land Protection

Units: All values in percentages, except Landfill per Populated Land Area, which is in metric tons per square kilometer of land area that is populated above the threshold of 5 persons per square kilometer.

Country	Percentage of glass recycled (1997 or MRYA)	Percentage of glass recycled (1990)	Percentage of paper recycled (1997 or MRYA)	Percentage of paper recycled (1990)	Protected Areas as Percent of Total Area (1998)	Waste Disposal in Landfills per Populated Land Area (1997 or MRYA)
Austria	88	60	69	52	29.2	10.7
Belgium	75	55	16	13	2.8	28.6
Denmark	70	35	50	35	23.9	8.1
Finland	62	36	57	43	8.4	9.9
France	52	41	41	34	9.0	17.4
Germany	79	54	70	44	25.2	54.3
Greece	26	15	29	28	0.9	27.6
Ireland	38	23	12	10	0.9	20.8
Italy	34	53	31	27	7.3	81.6
Mexico	4	4	2	2	5.7	22.4
Netherlands	82	67	62	50	10.8	52.1
Norway	76	22	44	20	6.3	14.7
Portugal	44	27	40	40	5.7	39.7
South Korea	68	46	57	44	7.0	126.1
Spain	37	27	42	39	8.4	23.5
Sweden	76	22	62	46	8.3	5.3
Switzerland	91	65	63	49	18.0	15.1
Turkey	20	31	36	27	1.2	24.9
United Kingdom	26	21	40	33	17.7	90.2
United States	26	20	41	28	20.1	23.8

MRYA = Most Recent Year Available

Sources: OECD (1999). *Environmental Data Compendium 1999*, Waste Recycling Rates (Glass), 1980-1997, Table 7.4B; OECD (1999). *Environmental Data Compendium 1999,* Waste Recycling Rates (paper & cardboard), 1980-1997, Table 7.4A; Data from UN List of Protected Areas, 1998, accessed at: http://www.unep-wcmc.org/protected_areas/data/un_annex.htm