

## Overview

Much of the attention currently surrounding the global climate change negotiations focuses on whether mandatory reductions in greenhouse gas emissions<sup>2</sup> will be accepted by all major carbon-generating countries. However, recent research has posed more prosaic but potentially fundamental questions of whether national contributions to climate change are measured correctly. Should these be measured as greenhouse gases emitted by the countries in which they are produced—as is legally the case under the Kyoto Protocol and the UN Framework Convention on Climate Change (UNFCCC)? Or should they be “charged against” the countries in which the goods and services that generate these emissions are consumed?

This issue was highlighted earlier in May 2011 by a new study<sup>3</sup> that sought to measure the “consumption” of greenhouse gas emissions (or rather, of the planet’s increasingly overtaxed ability to absorb these gases without causing significant climate change) by examining “virtual carbon trade” flows. The authors estimated the carbon content of the import and export of goods and services for 95 countries—including some two dozen transition and developing economies from Europe and Central Asia—for the 1990-2008 period. Such estimates allow a country’s carbon consumption to be defined as the difference between the tons of greenhouse gases it emits (“carbon production”), as recorded in official national communications to the UNFCCC, and the carbon content of its exports and imports.

This study gives new impetus to questions like the following: *If a share of Country A’s greenhouse gas emissions can be accounted for by exports that are destined for consumption in Country B, shouldn’t these emissions be ascribed to Country B?*

Such questions are not an arcane academic concern. One blogger has argued that, when the emissions data are recalculated in terms of national carbon consumption rather than production, they show “a massive transfer of carbon from the poor world to the rich world”.<sup>4</sup> According to this argument, “the rich world has been ‘offshoring’ or ‘outsourcing’ its emissions” to developing countries—exploiting a loophole in the Kyoto framework to reduce reported emissions by surreptitiously exporting them to poorer countries.

Do such arguments, in fact, stand up? Is the rich world “gaming” the Kyoto system and frustrating global efforts to reduce greenhouse gas emissions? Should this shortfall be addressed

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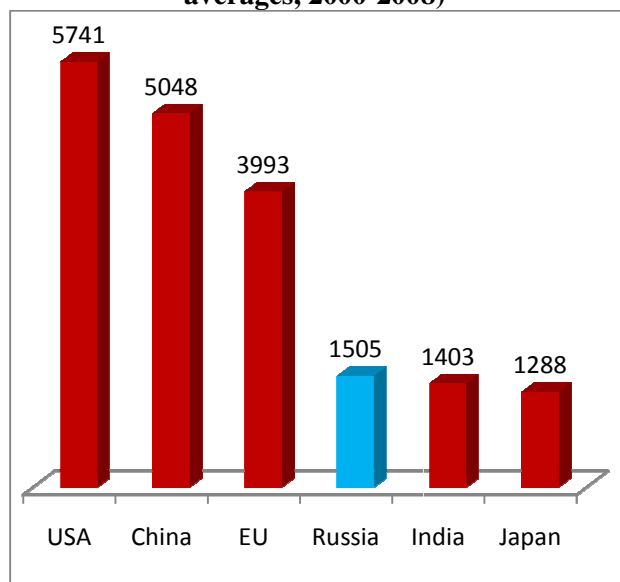
<sup>2</sup> In this paper, the terms “carbon” and “greenhouse gases” are used interchangeably, as synonyms for the carbon dioxide equivalents by which these gases are commonly measured.

<sup>3</sup> Peters *et al.*, “Growth in emission transfers via international trade from 1990 to 2008”, *Proceedings of the [US] National Academy of Sciences*, 2011, available at <http://www.pnas.org/content/108/21/8903.full.pdf+html>.

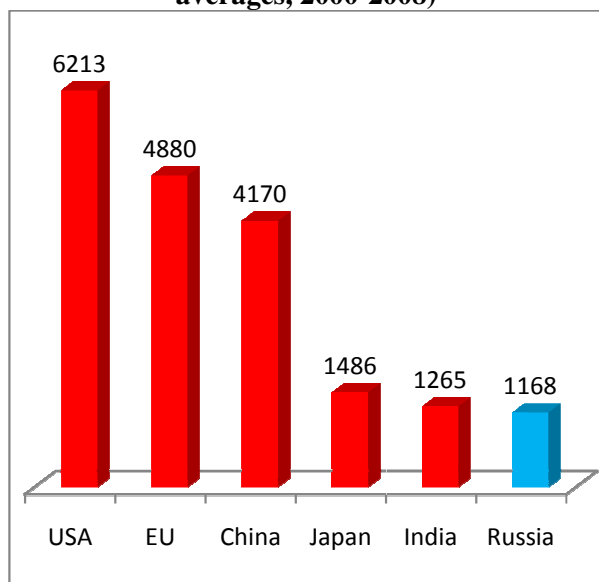
<sup>4</sup> Duncan Clark, “New data on imports and exports turns map of carbon emission on its head”, *The Guardian*, 3 May 2011, <http://www.guardian.co.uk/environment/datablog/2011/apr/28/carbon-emissions-imports-exports-trade/print>.

in the international climate change negotiations? Where do the transition and developing economies of Europe and Central Asia stand in light of these arguments?

**Chart 1—Greenhouse gases produced (annual averages, 2000-2008)**



**Chart 2—Greenhouse gases consumed (annual averages, 2000-2008)**



*In million tons of CO<sub>2</sub> equivalent. Source: Peters et al.<sup>5</sup>*

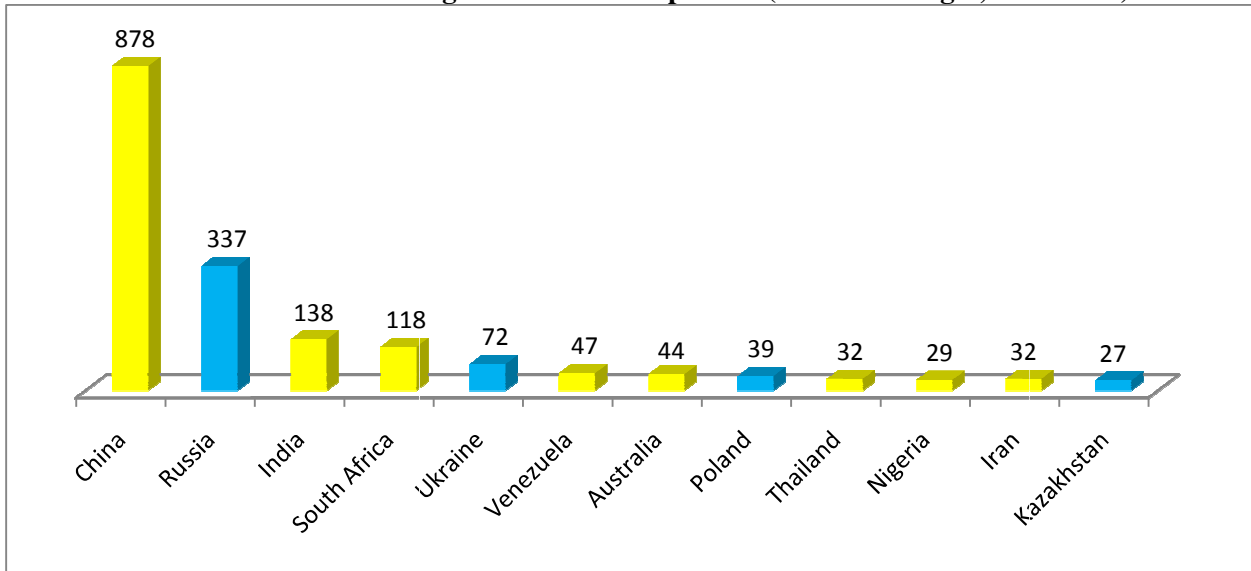
### Virtual carbon trade and transition

While none of the countries of this region other than Russia are large producers or consumers of greenhouse gases (Charts 1 and 2), the carbon trade data indicate that four of the world's 12 largest net carbon exporters during 2000-2008 were transition economies (Chart 3). In addition to Russia, these were Ukraine, Poland, and Kazakhstan. According to this study, Azerbaijan, Bulgaria, the Czech Republic, and Romania were also net carbon exporters during this time. (If they had been included in this study, Uzbekistan and Turkmenistan would have been likely to be classified as net carbon exporters, for reasons explained below.<sup>6</sup>) Likewise, Turkey was the only country from this region to be classified among the world's ten largest net carbon importers during this period (Chart 4).

<sup>5</sup> The data on which this analysis based is available at <https://spreadsheets.google.com/spreadsheet/pub?hl=en&hl=en&key=0AonYZs4MzIZbDEFUSFhxTWFMTev2Rmk1Z3d3dFJmOEE&output=html>.

<sup>6</sup> In addition to Turkmenistan and Uzbekistan, economies not covered in this study include Bosnia and Herzegovina, Kosovo, the Former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia, and Tajikistan.

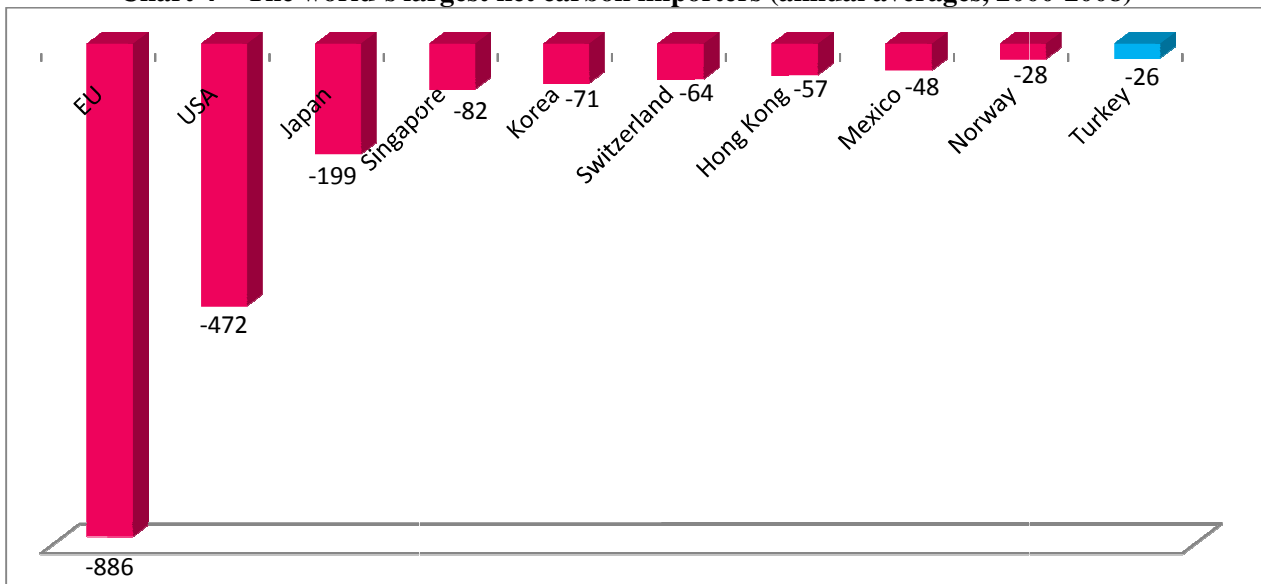
**Chart 3—The world’s largest net carbon exporters (annual averages, 2000-2008)**



*In million tons of CO<sub>2</sub> equivalent. Source: Peters et al.*

While China appears as the world’s largest net carbon exporter by far, these data indicate that the transition and developing economies of Europe and Central Asia accounted for about half of the world’s non-Chinese net carbon exports during 2000-2008. This suggests that proposals to change the metrics underpinning the Kyoto Protocol could be of interest to the countries of the region.

**Chart 4—The world’s largest net carbon importers (annual averages, 2000-2008)**



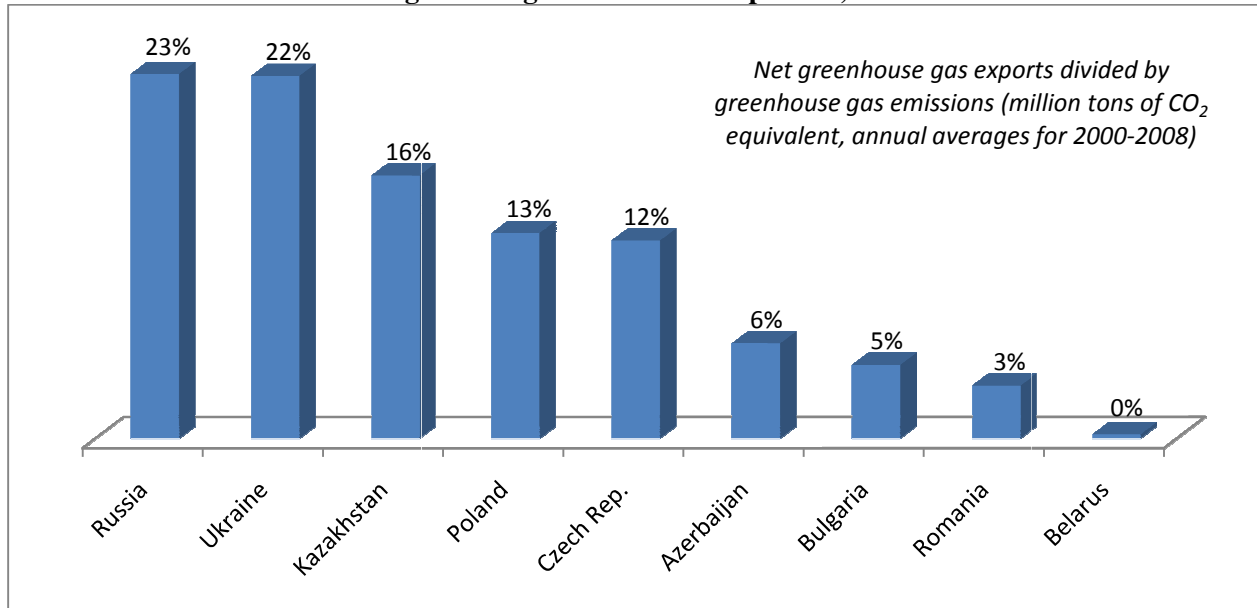
*In million tons of CO<sub>2</sub> equivalent. Source: Peters et al.*

## Relative carbon production, consumption, and trade

Aggregate measures of carbon emissions, consumption, and trade are influenced by the overall size of the economy in question. Because it has the region's largest GDP, Russia is likely to be among the region's leaders in terms of carbon production, consumption, and trade—irrespective of how these are measured. Likewise, the small open economies of the former Soviet Union (e.g., Armenia, Georgia, Kyrgyzstan), Southeast Europe (e.g., Albania, Croatia), or the new member states of the European Union (e.g., Slovenia, the Baltic states) will never appear as large carbon producers or consumers, or virtual carbon traders, in absolute terms.

But which of these countries are in fact net carbon consumers or producers? And how large are net carbon imports or exports for these countries, relative to their size? Answers to these questions could be important for understanding which countries could gain or lose the most (relatively speaking) from prospective changes in the accounting rules for greenhouse gases.

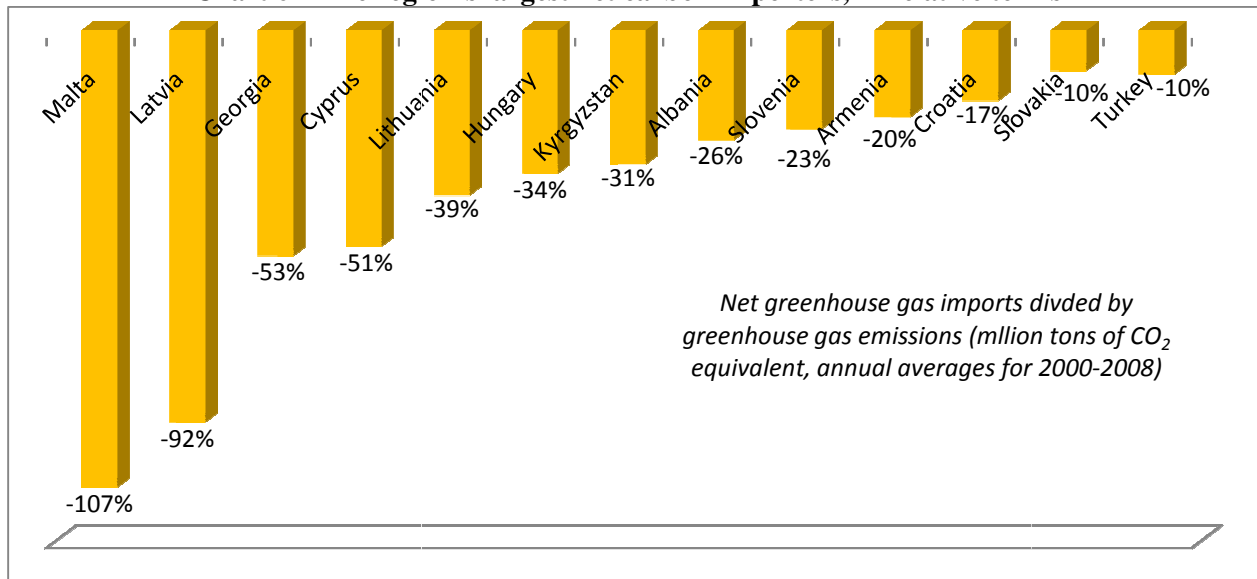
**Chart 5—The region's largest net carbon exporters, in relative terms**



UNDP calculations, based on data in Peters et al.

The data presented in charts 5 and 6, which show different countries' net carbon exports (imports) divided by their overall carbon emissions, show that—relative to the overall amount of greenhouse gases emitted—Ukraine was almost as large a net carbon exporter as Russia, during 2000-2008 (Chart 5). The ratio of net greenhouse gas exports to emissions was likewise above 10 percent for Kazakhstan, Poland, and the Czech Republic. Should the indicators used to measure greenhouse gases reflect carbon consumption as well as production, these countries would presumably benefit, in the form of lower carbon reduction targets. A smaller share of the climate change mitigation burden would fall on these countries than might otherwise be the case.

**Chart 6—The region’s largest net carbon importers, in relative terms**



UNDP calculations, based on data in Peters et al.

By contrast, carbon imports during 2000-2008 were much larger, in relative terms, for many of the region’s small open economies. On average, Malta imported more carbon than it emitted during 2000-2008; Latvia was close behind with a 92 percent ratio of greenhouse gas imports to emissions. Low- and lower-middle income countries of the former Soviet Union (Armenia, Georgia, Kyrgyzstan)—countries which, like the small new EU member states, are also net energy importers—likewise registered very high ratios of carbon imports to emissions. The EU accession and pre-accession countries included in this study (Albania, Croatia, and Turkey) were also net carbon importers, but relatively speaking, of smaller size. Should future metrics place a greater emphasis on carbon consumption, these countries could potentially face higher carbon reduction targets, and would therefore have to shoulder a greater share of the global mitigation burden.

### Who’s gaming who?

Which countries benefit the most from the current production-based greenhouse gas metrics? Which countries would benefit from measuring carbon consumption, as well as (or rather than) emissions? Definitive answers to such questions are elusive, in part because they contain subjective elements, in part because of data uncertainties. Nonetheless, a review of the data and analysis presented above suggest some initial conclusions.

**Data issues.** Questions about the accuracy of the carbon content of imports and exports have been associated with this “virtual carbon trade flows” literature since its inception; the study that has generated the data discussed here is no exception. A key issue is the sectoral breadth of these measures, which tend to emphasize the carbon content of manufactures as opposed to other tradable goods and services. The authors of this study admit, for example, that “We focus on CO<sub>2</sub> emissions from fossil-fuel combustion, cement production, and gas flaring

because of the absence of detailed time-series data on land-use change and other greenhouse gas emissions with the necessary detail”.<sup>7</sup> As long as it is easier to measure the emission of greenhouse gases than to estimate the carbon content of trade flows, emissions seem destined to remain the dominant climate change indicator.

A second data issue concerns the fact that virtual carbon trade balances are heavily influenced by trade balances overall. For economies like China and Russia which typically report very large trade surpluses (i.e., overall exports significantly exceed imports), it is hard to imagine how the imports of carbon-intensive goods could be larger than the exports of such goods. Likewise, for carbon-importing economies like Georgia or Kyrgyzstan whose overall imports are much greater than their exports, it is difficult to imagine how the exports of carbon-intensive goods could be larger than the imports of such goods.

**“Outsourcing” is not the whole story.** Divergences between the production and consumption of carbon can not be ascribed solely to the “outsourcing” of carbon-intensive production from developed to developing economies. Outsourcing may account for China’s large carbon exports, due to rapid growth in China’s production of carbon-intensive goods which are exported to developed countries. To the extent that this production used to occur in developed countries (as opposed to other developing economies) and then migrated to China, the “outsourcing” story holds water.

However, Russia’s, Ukraine’s, and Kazakhstan’s relatively large carbon exports are clearly driven by a different logic—that of the export of carbon-intensive energy (oil and gas), metallurgical, chemical, and other energy-intensive primary products. These exports largely reflect these countries’ natural resource endowments, rather than a “leakage” of carbon-intensive manufacturing away from developed economies. Because they are richly endowed in the hydrocarbons that dominate their commodity composition of trade (like their Caspian basin neighbours Kazakhstan and Azerbaijan), Turkmenistan and Uzbekistan seem likely to be significant net carbon exporters (relatively speaking) as well.

**Carbon-intensive activities are “supposed” to migrate from developed to developing economies.** The current global climate governance framework explicitly encourages the migration of carbon-intensive industries from developed to developing economies. Because China, India, Brazil, and other G77 countries are considered to be developing economies that can not bear the burdens of mitigation as well as developed economies, their obligations to reduce greenhouse gas emissions are less demanding than those facing wealthier countries.<sup>8</sup> When carbon-intensive production migrates from a developed country to a developing one, greenhouse gas emissions fall in the former and rise in the latter. So does GDP, employment, tax revenues, and other benefits associated with economic activity (carbon-intensive or otherwise). While advocates of more rapid reductions in greenhouse gas emissions may find this approach problematic, it is not without its internal logic.

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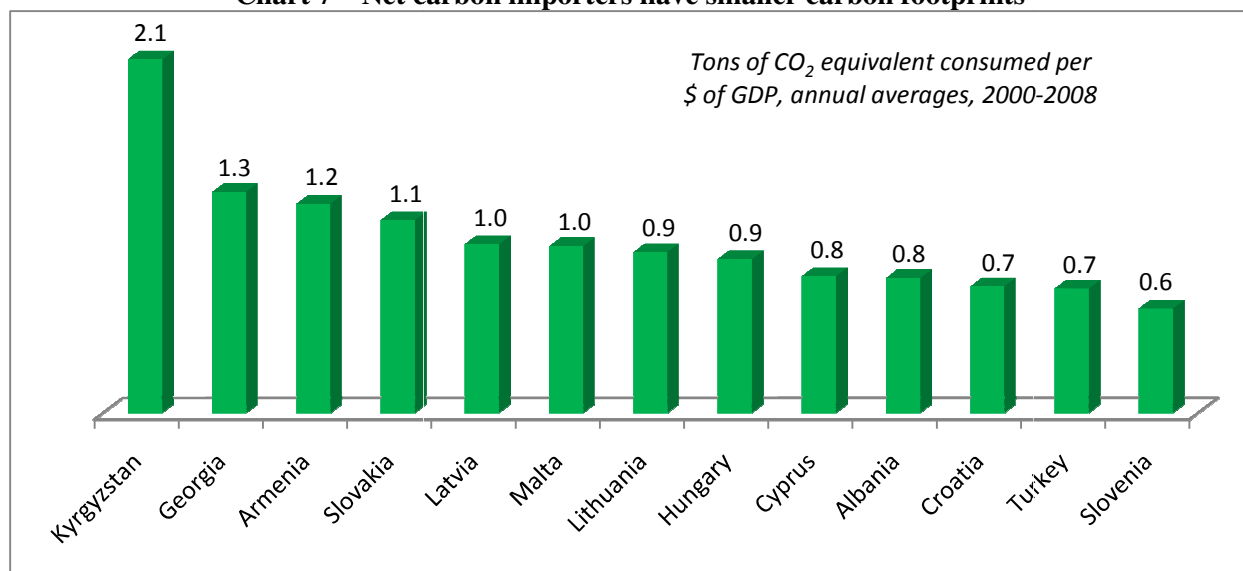
<sup>7</sup> Peters *et al.*, p. 2.

<sup>8</sup> Prior to the 2009 Copenhagen accord, developing economies did not face international obligations to reduce greenhouse gas emissions. On the other hand, developing economies may participate in the clean development mechanism and benefit from other forms of carbon finance, as well as introduce nationally appropriate mitigation actions. Many developing countries have included mitigation targets in national legislation

This suggests that the “outsourcing” criticism can be answered by what might be called “carbon dumping” counter-arguments, which are analogous to developed country concerns about “environmental” or “social dumping” by developing countries. Unemployed European workers in carbon-intensive sectors who blame job losses on “unfair competition” from the developing countries that do not have to play by “green” rules may regard themselves as victims of environmental double standards. Similar “unfair competition” concerns are apparent in US unwillingness to ratify the Kyoto Protocol.<sup>9</sup>

*Net carbon exporters are also larger carbon consumers.* The “outsourcing” argument implies that net carbon exporting countries are doing the dirty work for carbon importers, who should be dissuaded from permitting such “carbon leakage”.

**Chart 7—Net carbon importers have smaller carbon footprints**



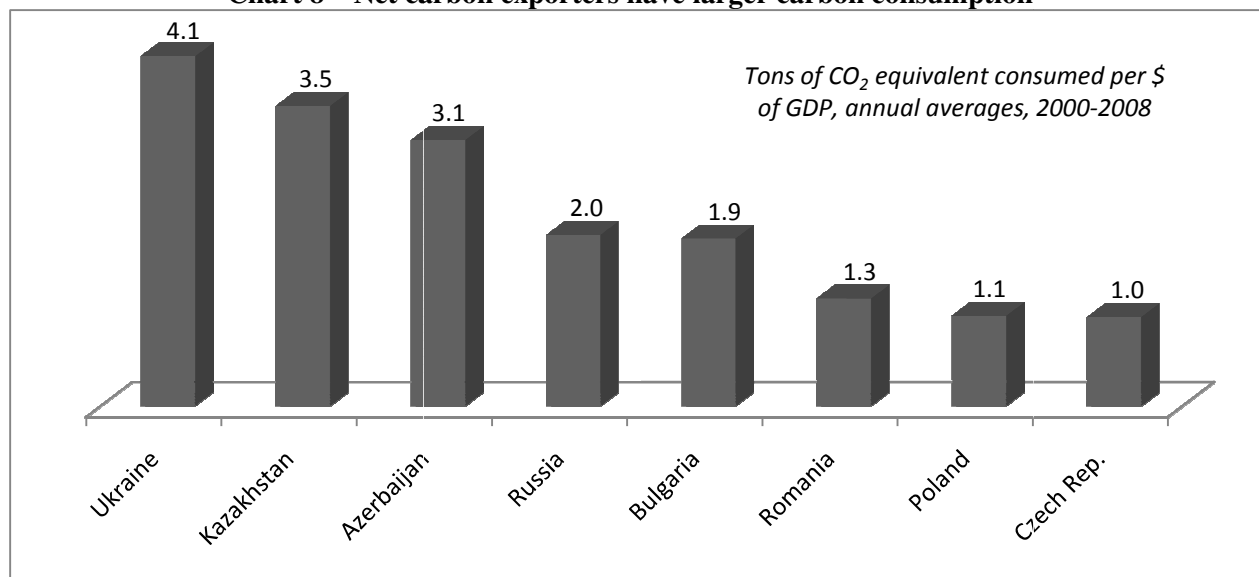
UNDP calculations, based on the carbon data in Peters et al., and on the GDP data (calculated at market exchange rates) presented in the IMF’s April 2011 World Economic Outlook.

The virtual carbon trade data from the developing and transition economies suggest a different story, however. As the data in Charts 7 and 8 show, carbon exporting countries tend to have the larger carbon footprint (measured as carbon consumption). The reason for this almost certainly lies in the fact that the carbon exporting countries in this region are large exporters of carbon-intensive energy, metallurgical, and chemical products. They tend to have carbon consumption levels per dollar of GDP that are 50-100 percent above those of carbon-importing

<sup>9</sup> In 2008, IFCC data indicate that China was responsible for 23 percent of global greenhouse gas emissions; India was responsible for another 6 percent. As robust economic growth in these countries has since continued while the developed economies fell into recession in 2009, these two countries together may now account for a third of global carbon emissions.

countries in the region—which, as a rule, are net importers of energy and many primary products.<sup>10</sup>

**Chart 8—Net carbon exporters have larger carbon consumption**



*UNDP calculations, based on the carbon data in Peters et al., and on the GDP data (calculated at market exchange rates) presented in the IMF's April 2011 World Economic Outlook.*

With a few exceptions (e.g., Kyrgyzstan), the net carbon- and energy-importing countries in the region have had to come to terms with higher domestic energy prices able to cover the costs of energy imports, production, and supply. By contrast, the net carbon- and energy-exporting countries are more likely to permit domestic energy prices to lag behind world energy prices, in order to subsidize domestic energy consumption. Lower levels of energy efficiency result. However the social dimensions of such policies are viewed, as a framework for conserving energy and promoting climate change mitigation, they clearly leave something to be desired. While there is nothing about being a net carbon exporter that forces countries to adopt policies that encourage energy inefficiency, their correlation with carbon exporting status does not appear to be coincidental.

As explained above, the possible adoption of climate change metrics that place a greater emphasis on carbon consumption (as opposed to emission) would have the effect of making it easier for energy-inefficient carbon exporters to meet relevant carbon reduction targets. More energy-efficient carbon importers would likewise find it more difficult to meet relevant carbon reduction targets. In terms of promoting energy efficiency and encouraging global reductions in greenhouse gases at the lowest possible cost, the possible adoption of carbon consumption-based climate change metrics could be counter-productive.

<sup>10</sup> New EU member states like Poland and the Czech Republic, which have permitted domestic energy prices to rise to European levels but are nonetheless net carbon exporters, are exceptions to this argument. This is apparent in their low ratios of greenhouse gas emissions to GDP (Figure 8).

## **Conclusion**

Carbon production, not consumption, seems likely to remain the basic metric on which the global climate governance framework will rely for the foreseeable future. In addition to facing important data and methodological challenges, more heavy reliance on consumption-based carbon metrics could reward countries for inefficient energy use and reduce incentives to adopt climate change mitigating technologies.

Rather than accusing those developed countries (in Europe) that have significantly reduced their greenhouse emissions (per dollar of GDP) of fobbing their carbon off on the developing world, emphasis should instead be placed on helping developing economies achieve similar reductions—without imperiling their longer-term development prospects.