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Consumption, Not CO_2 Emissions: Reframing Perspectives on Climate Change and Sustainability

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Consumption,

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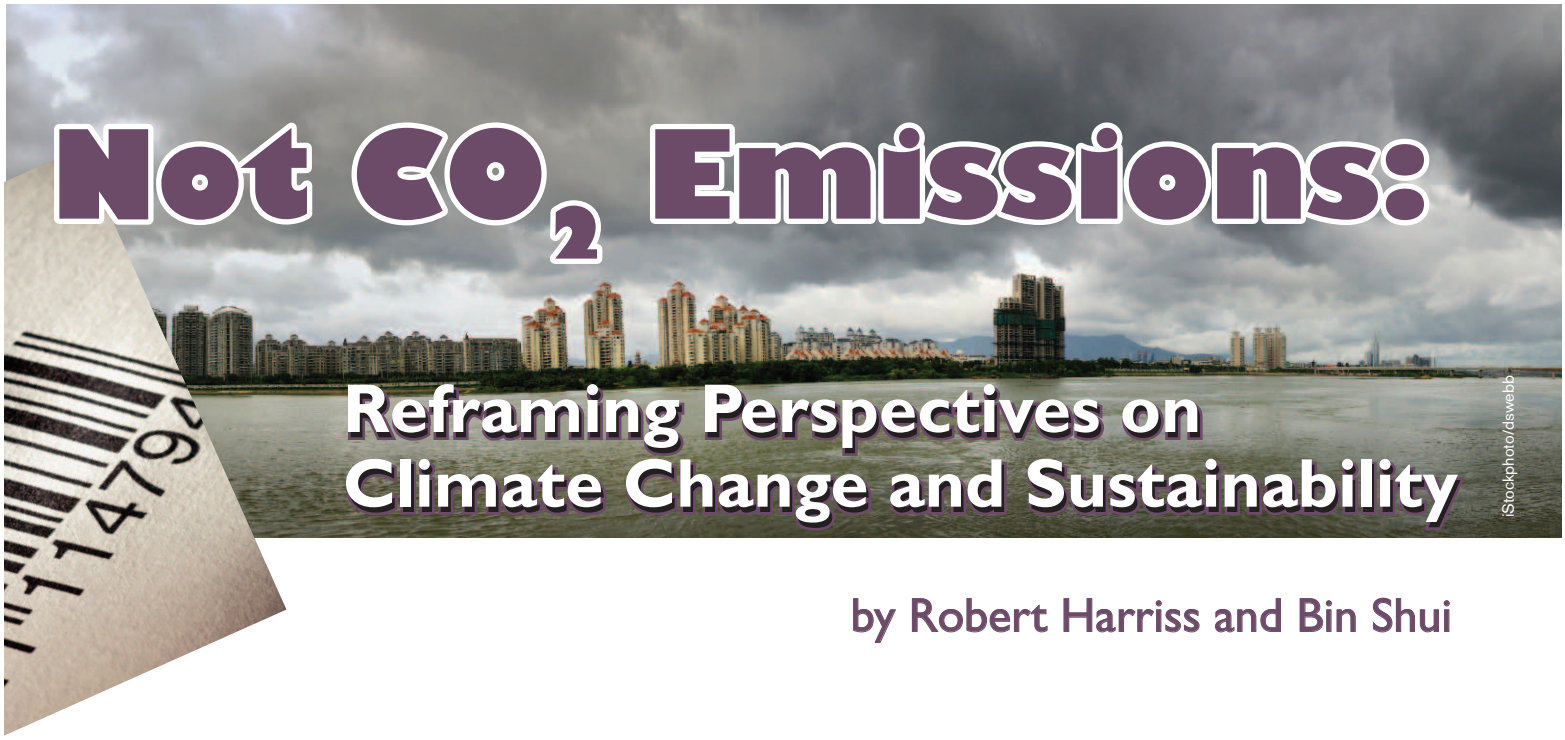
A stunning documentary film titled *Mardi Gras: Made in China* provides an insightful and engaging perspective on the globalization of desire for material consumption. Tracing the life cycle of Mardi Gras beads from a small factory in Fuzhou, China, to the streets of the Mardi Gras celebration in New Orleans, the viewer grasps the near-universal human tendency to strive for an affluent lifestyle. David Redmon, an independent filmmaker, follows the beads' genealogy back to the industrial town of Fuzhou, and to the factory that is the world's largest producer of Mardi Gras beads and related party trinkets. He explores how these frivolous and toxic products affect the people who make them and those who consume them. Redmon captures the harsh daily reality of working in this Chinese facility. Members of its workforce—approximately 500 young female workers and a handful of young male workers—live like prisoners in a fenced-in compound. These young people, often working 16-hour days, are constantly exposed to styrene, a chemical known to cause cancer—all for about 10 cents an hour. In addition to the indoor pollution, the decrepit coal-fired factory is also symbolic of China's fast rise to the world's top producer of carbon dioxide (CO_2) emissions.[1] The process of industrialization and modernization in China is happening at an unprecedented rate and scale.

The filming of Mardi Gras celebrations in New Orleans provides a startling contrast to the Fuzhou factory, showing indulgent, affluent Americans engaging in obnoxious exhibitionism. When questioned by the filmmaker, the partygoers are unaware of the origins of the Mardi Gras beads. In an early morning scene, after a night of Mardi Gras celebrations, the party crowd has disappeared and sanitation vehicles are seen sweeping up mounds of discarded beads for disposal in a New Orleans landfill. The party beads will ultimately decay, producing CO_2 and other pollutants—an invisible and unintended consequence from the perspective of both the Chinese factory workers and the American party crowd. The transformation of the Mardi Gras beads from objects of desire to trash in a matter of hours illustrates the complexities associated with human perceptions of sufficiency, conspicuous consumption, and present and future well-being.[2]

A Matter of Scale and Focus

For many people the transition from the human scale, as depicted in *Mardi Gras: Made in China*, to issues of global consumption and climate change poses a daunting cognitive challenge. Making the connection between the ongoing growth of a global consumer culture and global climate change has proven to be both an intellectual and institutional quagmire. The devil is in transitioning from knowing the local to imagining the global.

Reducing global emissions of CO_2 and other factors that contribute to climate change has been at the center of highly politicized and publicized global climate policy negotiations for almost two decades. Ongoing international negotiations under the auspices of the



Not CO_2 Emissions:

Reframing Perspectives on Climate Change and Sustainability

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by Robert Harriss and Bin Shui

UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have largely failed, especially in the area given greatest attention: mitigation of industrial CO_2 emissions.[3] The recent Copenhagen Accord was only able to get agreement on acknowledging the scientific view that the increase in global temperature should be kept below 2ºC, but without adequate commitments by nations to mitigate CO_2 emissions. While some experts remain cautiously positive about the UNFCCC process,[4] others think it is time to move beyond the intense focus on climate change as a physical threat.[5] A compelling case has been made for why it might be more productive to address the sociocultural dimensions that contribute to why we disagree on climate change.[6]

This article reviews evidence for a growing influence of international trade on global CO_2 emissions. We conclude that economic globalization as currently practiced will undermine future progress toward achieving the goals of the UNFCCC and post-Kyoto negotiations on reducing the growth of global CO_2 emissions and potential impacts of climate change. Our analysis adds to the growing evidence that a reframing of the climate change policy debate is urgently needed. We recommend a broader dialogue on strategies for a societal transition to long-term sustainability, recognizing that global warming is not the primary concern of many nations.

Economic Globalization and CO_2 Emissions

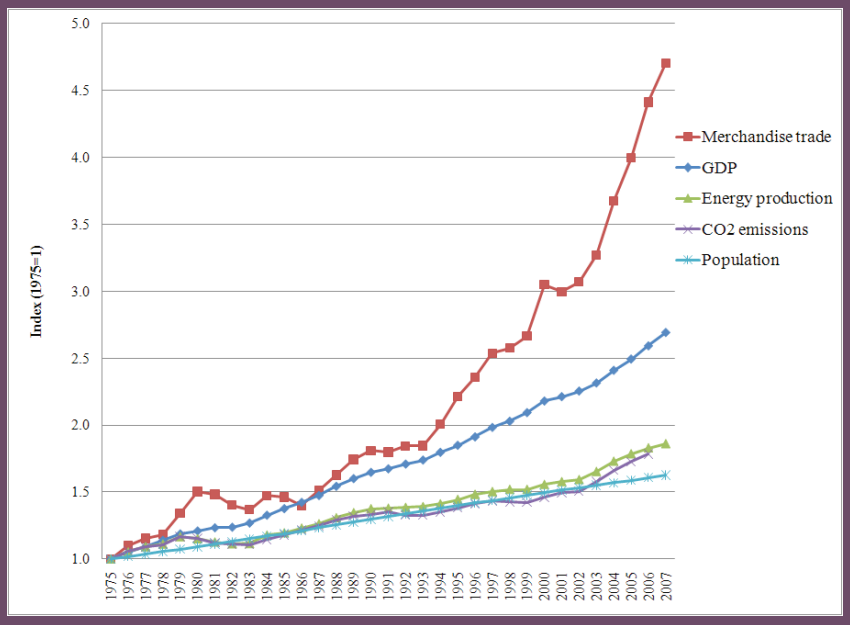
For the past several decades, growth in international trade has outpaced the growth of global gross domestic product (GDP), energy consumption, and world population (see Figure 1). This surge of economic globalization has resulted in a dynamic shifting in the geographic patterns of production and consumption of consumer goods, and consequently the fossil fuels and CO_2 emissions needed to make them.

Economic globalization reflects the logic of increasing the production of consumer goods at the lowest possible costs while maintaining the qualities and quantities that buyers demand. Estimating the net benefits and costs of economic globalization is a contentious and widely debated topic. An unintended consequence of economic globalization has been a shifting of the burden of additional CO_2 emissions and other environmental pollutants from developed consumer to developing producer countries. This process is also known as "offshoring" the emissions of CO_2 and other pollutants by wealthy countries. This large-scale geographical separation of material production and consumption has raised fundamental policy questions concerning responsibility for CO_2 emissions.

Scientific comparisons of production-based versus consumption-based national CO_2 emission inventories have illustrated that economic globalization is undermining the validity of using the national emissions inventory methodologies as the sole basis allocating responsibility for CO_2 emissions.[7] The UNFCCC/Kyoto Protocol process has based negotiations on CO_2 emissions that originate within national boundaries (i.e., national emissions inventories). Developing countries that are large CO_2 emitters, like China, have recently argued that national emission inventories do not represent a true measure of a country's consumption, the fundamental culprit driving global climate change. They are recommending the use of consumption-based measures of CO_2 in the cases where emissions were generated during the manufacturing of a commodity in a developing country and the commodity was subsequently exported for use or consumption in a developed country.

Chinese officials have noted the "common but differentiated responsibility" criteria declared in Article 3 of the UNFCCC as a basis for their concerns about the allocation of responsibility for CO_2 emissions. China's Presi-

Figure 1. Growth of global trade in goods, gross domestic product (GDP), energy use, CO_2 emissions, and global population, 1975–2007. Data obtained from World Bank Development Indicators (2010).



dent Hu Jintao, who spoke at the G-8 meeting held in summer 2008 in Japan, stated that "as a result of changes in international division of labor and manufacturing location, China faces mounting pressure of international transferred emissions."[8] At a meeting in Washington, D.C., in March 2010, Dr. Gao Li, who heads the climate change department of the Chinese National Development and Reform Commission, met with top U.S. policymakers and their counterparts from the European Union (EU), Japan, and Mexico. In his message to the gathering, he said that his country was "at the low end of the production line for the global economy ... We produce products and these products are consumed by other countries, especially the developed countries." Li estimated that the CO_2 emitted in China during the manufacture of exports to the United States and other countries accounted for some 15 to 25 percent of his country's total emissions. He submitted that "[T]his share of emissions should be taken by the consumers, not the producers." He then predicted that this would be a "very important item" in reaching a fair post-Kyoto global agreement on greenhouse gas reductions.[9]

Measuring Embodied Carbon in International Trade

Recent advances in consumption-based accounting provide an opportunity to quantitatively determine the importance of international trade as a factor in shifting the burden of CO_2 emissions from developed to developing nations. For example, if a computer manufactured in China resulted in one ton of CO_2 emissions and the computer is exported and sold in the United States, which country should be responsible for this ton of CO_2? In a consumption-based accounting methodology, the one ton of CO_2 emissions associated with manufacturing the computer, and the emissions produced by the international transport of the computer from China to a U.S. port of entry, would be the American buyer's responsibility. Consumption-based accounting is focused on the consumer as the driver of emissions. The widely employed IPCC national inventory methodologies focus on emissions generated within countries' territorial boundaries. In the extreme, a wealthy country with an economy based on financial and similar relatively non-polluting services could purchase all of its manufactured goods from a developing country at low cost, thereby avoiding the industrial pollution.

CO_2 emission associated with the production and export of goods in international trade is most commonly characterized as "carbon embodied in trade." The terms "embedded carbon in trade" and "virtual carbon in trade" have also been used in the same context.

Consumption-based accounting methodologies capable of estimating CO_2 emissions associated with manufacturing a product were initially of particular interest to scientists and engineers advancing the science of life-cycle analysis and "green" design and manufacturing. A pioneering example of life-cycle analysis software is the Economic Input–Output Life Cycle Assessment (EIO-LCA) methodology for assessing the environmental impacts of products developed at Carnegie Mellon University in the 1990s by researchers at the Green Design Institute. A public Web site provides a comprehensive overview of the EIO-LCA methods and access to online tools and guidance.[10]

Briefly, conventional economic input–output (EIO) tables map the monetary values of basic materials or goods traded between countries. The life-cycle assessment (LCA) of a product estimates emissions associated with the entire cycle of going from raw materials to a finished product. In a comprehensive assessment, the LCA also includes environmental impacts from product uses and any human or environmental health factors associated with a product from its production origins to final disposal.

Currently, there is no agreed-upon standard methodology for estimating embodied carbon in internationally traded goods. Input–output approaches and emerging multi-region input–output

(MRIO) models are research tools that provide a state-of-the-art methodological framework for estimating embodied carbon in trade at national and supranational scales.[11] Further improvements are needed in data availability and quality and in assessing the precision and accuracy of MRIO modeling.[12] There is little doubt that if consumption-based accounting attains official status as a methodology for the estimation of embodied carbon in international trade, the MRIO models will become an important methodology. However, the data requirements and complexity of training a wide range of international users in both the private and public sectors will be a challenge.

How Important Is Embodied Carbon in International Trade?

A state-of-the-art analysis of embodied carbon in international trade published in the *Proceedings of the National Academy of Sciences* (PNAS) reports that the embodied carbon in goods and services imported for consumption in the United States was equivalent to transferring about 11 percent of U.S. national CO_2 inventory emissions to the exporting countries, which is approximately 2.4 tons of CO_2 per American citizen.[13] In other words, the American gets the benefit of the purchased goods while the exporting country gets credited with the CO_2 emissions produced during manufacturing. This transaction has currently little economic significance because the United States and its major trading partners are not fully engaged in an international agreement that places a price on carbon emissions, but it illustrates that the magnitude of embodied carbon in international trade is certainly not trivial. Japan's imported goods were equivalent to nearly 18 percent of domestic emissions, and European nations reduced their national CO_2 emissions 20 to 50 percent as a result of importing goods rather than manufacturing the goods within their national territories.

The PNAS study used published international trade data to create a global model of the flow of products, and estimated embodied CO_2 emissions across 57 industry sectors and 113 countries or regions. Most of the imports to wealthy countries were produced in developing countries. Small wealthy nations, such as Switzerland, avoided the largest quantities of CO_2 emissions by importing most of their manufactured goods. On the flip side, nearly 25 percent of China's CO_2 emissions, for example, were dedicated to making goods for export and consumption in other countries (see Figure 2).

An estimated 23 percent of total global CO_2 emissions—or 6.8 billion tons (6.2 billion metric tons) of CO_2—was associated with international trade in 2004, with most of the exported goods originating from low-income countries and being consumed in middle- and high-income countries. China was identified as the largest exporter of embodied carbon in exported goods, followed by Russia, the Middle East, South Africa, Ukraine, and India. The largest trade flows of embodied carbon were from China to the United States, Europe, and Japan. The embodied carbon flows from Russia to Europe and from countries in the Middle East to the United States and the European Union were also significant, as was the trade between the United States and the European Union.

"We produce products and these products are consumed by other countries, especially the developed countries."

Imports from Russia, China, and India were significantly higher in CO_2 per U.S. dollar spent than imports from European countries. The reasons for these differences can arise from a combination of the larger fraction of coal in the producer country energy mix, the lower energy efficiency of manufacturing, and the market valuation of the products being exported.

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A Mardi Gras float passes through a crowd waving for beads in New Orleans.

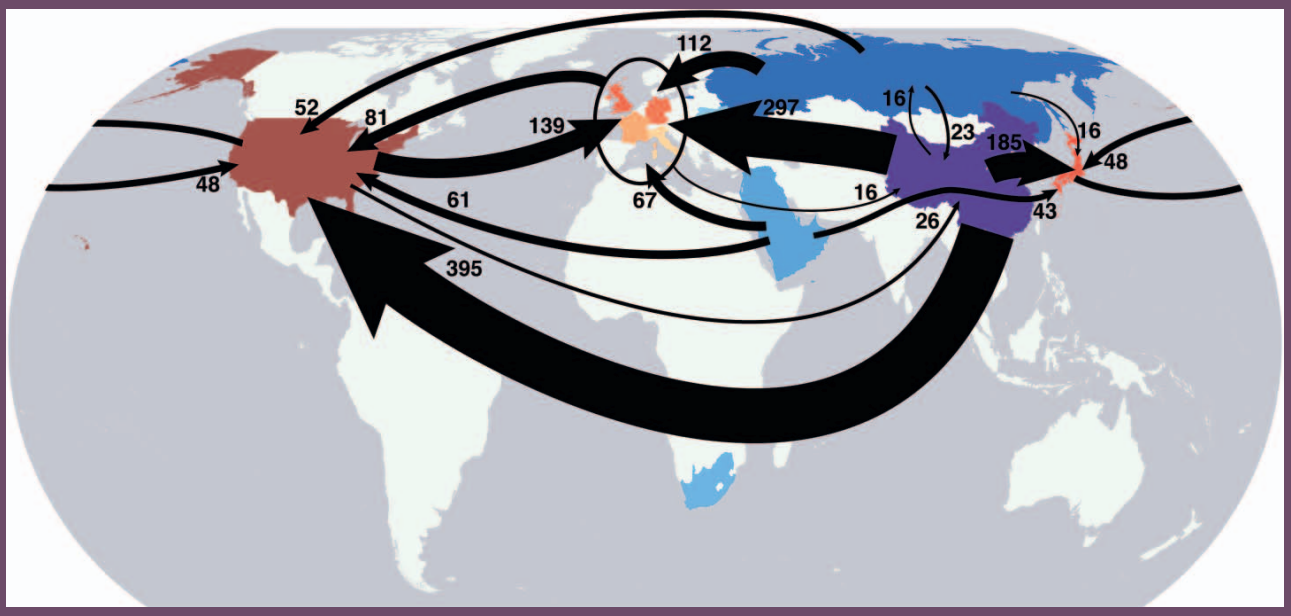
An early morning shot of one of the factory districts in Shanghai illustrates the source of CO_2 pollution.

Emerging Policy Perspectives on Embodied Carbon

The issue of embodied carbon in goods traded internationally was first raised well over a decade ago. A study of the carbon embodied in the manufactured goods imported by the six largest Organization for Economic Cooperation and Development (OECD) countries between 1984 and 1986 warned as early as 1994 that policies predicated on the reduction of greenhouse gas emissions at home might not be effective if imports were contributing significantly to domestic consumption. [14]

This brief review of recent advances in methodologies and published case studies indicates that consumption-based emission inventories can provide reliable scientific assessments of embodied carbon in international trade. The policy relevance of embodied carbon in trade is a more contentious issue. There are valid arguments that policy applications of consumption-based emissions would reduce concerns about carbon leakage, provide a quantitative basis for reducing emission responsibilities for some developing countries, increase options for mitigation, support the design of financial penalties based on environmental externalities, and encourage the international diffusion of low-carbon technologies.[15] On the other hand, national emission inventories based on the IPCC methodologies are relatively well accepted, especially in the case of CO_2 emissions. There would undoubtedly be resistance in the

Figure 2. Interregional movements of embodied carbon in trade from dominant net exporting countries (purple and blue) to dominant net importing countries (red) in 2004. Source: Davis and Calderia.[13] (The units are megatons CO_2 per year, which is millions of metric tons of CO_2 per year.)



UNFCCC to changing a fundamental technical procedure, given the tenuous nature of the ongoing COP (Conference of the Parties) negotiations.

As would be expected, the early proponents for using embodied carbon in trade and consumption-based emission inventories as important metrics in the ongoing climate change negotiations are China and other major exporting countries in the developing world. The opponents of a consumption-based emissions approach, which include the EU's chief climate negotiator, Artur Runge-Metzger, doubt that asking importers to accept responsibility for embodied carbon in purchased goods would work. In addition to the logistical difficulties involved in regulating embodied CO_2 emissions in the country of destination, Runge-Metzger has noted, importing countries would then "like to have jurisdiction and legislative powers in order to control and limit emissions in the exporting country and I'm not sure whether my Chinese colleagues would agree on that particular point."[9]

In what appears to be a defensive move, some importing countries are discussing a border tax on the carbon content of imported goods from China and other exporting countries that are major emitters of CO_2. This notion assumes that manufacturing goods with high-carbon fuels like soft coal offers an economic competitive advantage. A policy research working paper issued from the World Bank reinforced this idea, stating that "a border tax adjustment based on carbon content in domestic production, especially if it applies to both imports and exports, would broadly address the competitiveness concerns of producers in high income countries and less seriously damage developing country trade."[16] A working paper recently published by the Stockholm Environment Institute contradicts the World Bank results.[17] This paper concludes that "China's success in trade is based on low labor costs, not on embodied carbon emissions; there is literally no correlation between the amount of CO_2 emissions emitted per unit of product and revealed comparative advantage within the Chinese economy today." It is also likely that the use of border taxes to penalize developing countries with high CO_2 emissions could escalate to the point of undermining the effectiveness of the World Trade Organization and the importance of trade to the reduction of global poverty.

Shanghai's skyline stagnates under pollution at dawn.

Economic globalization also has important and well-documented environmental consequences on air quality, water quality, and land use at local and regional environmental scales in developing countries.[18] The United States and other developed countries should view China and other developing countries as important markets and research opportunities for advancing environmental technologies. Actions to improve air quality often have the co-benefit of reducing CO_2 emissions as a result of fuel switching from coal to natural gas, nuclear power, or renewable energy sources. This "stealth" technology-sharing approach to reducing developing country embodied carbon is likely to gain far more political traction in many developing countries than a penalty approach (e.g., border tax). Given current knowledge, it is now certain that the fastest and most effective path to concurrently reducing most environmental pollutants is to accelerate the transition to clean energy technologies. However, the transitions of major technologies have historically taken 50 to 100 years. The transition from fossil fuels to clean energy technologies will require a wide range of new infrastructures, regulatory frameworks, and enormous financial investments. The challenge of achieving the focus and scale necessary to avert serious consequences of global warming will remain daunting.

What's Next?

The UNFCC COP-16 will convene in Mexico in December 2010. The modest gains achieved in the Copenhagen Accord do not bode well for the future of UNFCCC-COP negotiations on climate change. Each disappointing COP meeting has enhanced the broader perception of the process being in a state of "slow-motion failure," and heading for an eventual "multilateral zombie" outcome or "death by climatocracy."[19] The zombie scenario would have the process stagger along piteously, never making much progress, while never quite

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dying either. The more likely scenario of death by climatocracy is potentially more dangerous in imagining success on reaching an agreement that subsequently fails due to inadequate attention paid to institutions necessary for effective implementation.

The recent failure of the U.S. Congress to take action on climate and energy legislation and China's lack of interest in discussing binding commitments are clear signals that further negotiations on the mitigation of climate change will be wasted time. A focus on a selected group of issues that concern both developed and developing countries is urgently needed to break the current gridlock. Some progress may be possible on issues related to rebuilding trust in the IPCC science process, the reducing of emissions from deforestation and forest degradation (REDD), increasing research on the deployment of low carbon technologies, and international support for climate adaptation actions in developing countries.

The increasingly relevant question is how long the UNFCCC-COP process can survive without substantial progress on a realistic agenda for international accountability at a scale appropriate to the global climate change problem. The COP process has become locked into a classic free-rider problem where each country wants everyone else to do the "right thing" while that country benefits from being the exception. Unfortunately, the history of these negotiations gives the appearance that there are few disincentives for failure. The important question is what comes next if the UNFCCC process fails.

Prosperity Without Conspicuous Consumption

The prosperity of the United States has benefited from more than a century of its status as a world leader in the manufacturing and production of goods based, in part, on access to cheap fossil fuels and ignorance of the climate consequences of emitting CO_2. The consumption of goods and services now accounts for more than two-thirds of United States economic activity. The Chinese and American economies together accounted for a third of global economic output and two-fifths of worldwide economic growth from 1998 to 2007. As a result of the "Chimerican" symbiosis, China quadrupled its gross domestic product from 2000 to 2008, increased exports by a factor of five, imported Western technology, and created tens of millions of manufacturing jobs for the rural poor.[20] American overconsumption meant that from 2000 to 2008, the United States consistently outspent its national income, leading to an unsustainable increase in the national debt. Goods imported from China accounted for about a third of that overconsumption.

Given the magnitude and trajectory of China's likely continued economic expansion, we are experiencing only the initial phase of this nation's potential impact on the global environment, geopolitics, and society at large. India and other developing nations are not far behind China with similar aspirations

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to improve the well-being of their millions of impoverished people. Indeed, it seems likely that we are in the midst of an acceleration of globalization and consumption of considerable historic importance.

The pursuit of a consumption-based approach to measuring CO_2 emissions reveals questions central to climate change and sustainable development. For example, what are the geopolitical implications of China and other emerging economies becoming increasingly formidable competitors in world markets and in the competition for energy and other strategic resources? And, perhaps most importantly, what will the emergence of China, India, and other developing countries as the world's largest consumer economies mean for an already fragile global environment?

We see the UNFCCC and IPCC as being too narrowly focused on climate change. A comprehensive and integrated climate and sustainability strategy that acknowledges the need to account for both the impacts of conspicuous consumption in wealthy countries and unmet basic needs in developing countries is urgently needed. Various publications have appeared in recent months that offer innovative ideas for reframing the global change narrative.[21]

One certainty is that consumption-based accounting of carbon, nitrogen, water, and other environment factors associated with international trade will be important to addressing both climate change and sustainable development challenges that lie ahead. The information derived from consumption-based accounting, together with attention to physical and cultural needs, will provide a framework for dialogues on sufficiency versus conspicuous consumption. This approach would also better integrate climate change into the larger suite of issues associated with sustainable development.

Sustainable development, as reflected in the United Nations Millennium Development Goals, proposes a broad set of policy challenges for stabilizing the world's population growth, narrowing the well-being gaps between the rich and poor, and protecting the environment.[22] While it is obvious that climate change and sustainable development are intimately intertwined, a sustainability strategy will be more likely to gain wide acceptance among all nations by focusing initially on the moral basis and practical pathways to a future world based on principles of sufficiency in meeting basic material needs, nonviolence, and global common goods.

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