EarthTrends: Featured Topic

Title: Wasting the Material World: The Impact of Industrial Economies
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What does it take to produce the goods and services that underpin our lives? A detailed study of Germany, Japan, the Netherlands, and the United States shows that for highly industrialized economies, the total volume of natural resources required can be staggering—in the range of 45 to 85 metric tons of material per person each year (Adriaanse et al. 1997:iv).

That value is relevant today because industrialization is proceeding rapidly in many nations and will play a large part in the four- or fivefold expansion of the global economy expected over the next 50 years. But is it sustainable? The kind of resource-intensive production that is commonplace in developed countries probably cannot be replicated in a large number of other countries without causing serious environmental harm (Adriaasne et al. 1997:iv-v).

Specifically, this type of production often requires moving or processing large quantities of primary natural resources that do not end up being used in the final product. For example, fabricating the automobiles and other metal-intensive products for which Japan is well known requires mining and processing a yearly per capita equivalent of about 14 metric tons of ore and minerals (1) (Adriaasne et al. 1997:15). Growing the food required to feed a single U.S. resident causes about 15 metric tons of soil erosion annually. In Germany, producing the energy used in a year requires removing and replacing more than 29 metric tons of coal overburden for each German citizen, quite apart from the fuel itself or the pollution caused by its combustion (Adriaasne et al. 1997:15).

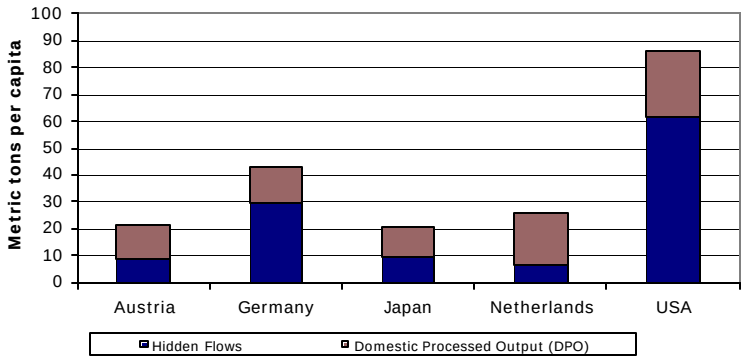
These hidden material flows from mining, earth moving, erosion, and other sources—which together account for as much as 75 percent of the total materials that industrial economies use—are easy to ignore. Because they do not enter the economy as commodities bought or sold, they are not accounted for in a nation's gross domestic product. Hidden material flows like soil or rock may not be as toxic or environmentally harmful on a weight-for-weight basis as many industrial wastes, but they are important in terms of the total environmental impact of industrial activities, since they represent a truly massive scale of environmental alteration (Adriaasne et al. 1997:6). (See Figure 1)

Significantly, the resulting impacts from these hidden flows, including water pollution and landscape disturbance, are often felt far from the economies that benefit from them, since industrial economies import many raw materials from afar. More than 70 percent of the materials that flow through the Dutch economy, for example, never touch Dutch soil. This includes the mine tailings, eroded soil, logging debris, and excavated earth and rock associated with extracting the raw materials used in nearly all Dutch industrial processes. Likewise, 50 percent of the material flows contributing to the Japanese economy take place offshore (Adriaasne et al. 1997:13). This raises real concerns about environmental equity and the global economy, since the benefits and costs of this kind of industrial production are not equally shared. While these concerns are not new, the scale of the material flows puts them in a new light.

Material outflows from industrial economies

Documenting the material *inputs* to industrial economies and their total material requirement only provides a picture of half the material cycle. A complete picture

Out of Sight and Out of Mind: Hidden Material Flows are Massive
Figure 1: Total Domestic Output in Five Industrial Nations, 1996



Source: Matthews et al. 1997

requires an analysis of the material *outputs* from economies to the environment, too. In a 2000 study of the material outputs of five countries—Austria, Germany, Japan, the Netherlands, and the United States—WRI found that waste outputs rose relatively little on a per capita basis and actually fell on a per unit GDP basis between 1975 and 1996 (Matthews et al. 2000:vi). But waste flows into the environment continued to grow. Total quantities of conventional wastes, emissions, and discharges in the five study countries increased by between 16 percent and 29 percent (Matthews et al. 2000:vii). Despite the rapid rise of e-commerce and the shift over several decades from heavy industries to knowledge-based and service industries, there is no evidence of an absolute reduction in resource throughput in any of the countries studied. One half to three quarters of annual resource inputs to industrial economies are returned to the environment as wastes within a year (Matthews et al. 2000:xi).

Material outputs to the environment from economic activity in the five study countries range from 11 metric tons per person per year in Japan to 25 metric tons per person per year in the United States. When hidden flows are included, total material outputs to the environment range from 21 metric tons per person in Japan to 86 metric tons per person in the United States (Matthews et al. 2000:xi).

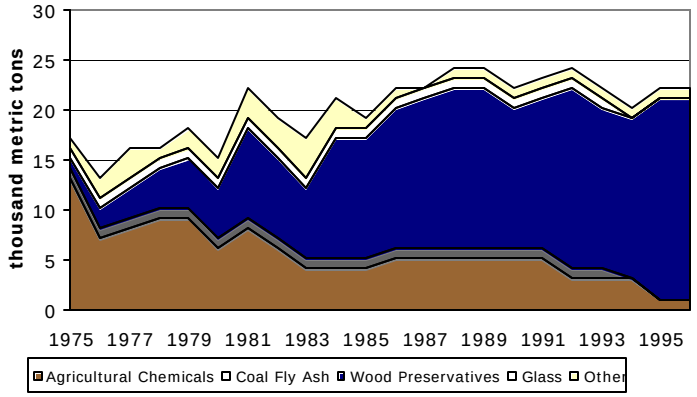
Outputs of some of the materials known to be dangerous to human health or damaging to the environment have been regulated and successfully reduced or stabilized. Examples include sulfur emissions to air, lead from gasoline, phosphorus in detergents, and some heavy metals. Quantities of municipal solid wastes sent to landfills have also stabilized or declined in all countries studied—in some cases by 30 percent or more (Matthews et al. 2000:vi).

However, many other hazardous or potentially hazardous flows are increasing, especially when they occur during material extraction (for example, mining) or during product use and disposal, which are outside the traditional area of regulatory scrutiny. Many potentially hazardous flows in the United States increased by 25 to 100 percent between 1975 and 1996 (Matthews et al. 2000:xi). For example, while applications of arsenic in agriculture have declined, use of arsenic as a wood preservative—currently unregulated—rose nearly 25-fold (Matthews et al. 2000:119). (See Figure 1). Arsenic in treated wood is believed to pose a threat to soil and water quality when wood products such as fences and flooring are chipped or burned at the end of their useful life.

The atmosphere is by far the biggest dumping ground for the wastes of industrial economies. Output flows are dominated by the extraction and use of fossil energy resources: when bulky flows like water, soil erosion, and earth moving are excluded, carbon dioxide accounts for, on average, 80 percent by weight of material outflows in the five study countries (Matthews et al. 2000:vi).

Regulation Curbs Agricultural Arsenic, but not Overall Use

Figure 2: Potential Arsenic Outputs to the U.S. Environment, 1975-1996



Source: Matthews et al. 2000:119

Becoming less material intensive

Progress toward environmentally sustainable industrial economies clearly will require reducing the volume of the hidden material flows that precede industrial processes—the front end of the industrial materials cycle—rather than just cleaning up the wastes that result from actual production. This has important implications for environmental policies. For example, it makes the benefits of recycling quite clear. Every ton of iron recycled not only replaces a ton that would have been mined but also avoids the creation of several tons of mine tailings or overburden, as well as ore-processing wastes.

Yet, not everything can be recycled. Coal or oil, for instance, can be burned only once. Unfortunately, fossil fuels and the hidden material flows associated with them make up a large percentage—between 26 and 46 percent—of the total materials used in the most industrialized countries (Adriaanse et al. 1997:17). (See Figure 2: Total Domestic Output, 1996)This means that reducing fossil fuel use is crucial to reducing the total

impact of industrial production. Other global benefits such a reduction would bring are improved air quality and lower greenhouse gas emissions.

Likewise, more sustainable cultivation methods are essential to stem the significant soil loss associated with modern intensive agricultural systems. Erosion, for example, accounts for 17 percent of the total materials requirement of the United States. This number has come down in recent years largely because the United States instituted a policy—embodied in the Conservation Reserve Program—to curtail agricultural production in erosion-prone areas. The program's success shows that such policies can significantly reduce the environmental impacts of industrial society (Adriaanse et al. 1997:11,17).

This and other hopeful signs show that it might be possible to transform industrial economies. Over the past two decades, the overall economies of Germany, Japan, the Netherlands, and the United States grew slightly faster than did their use of natural resources. If this modest trend toward decoupling natural resource use and economic activity were to intensify, it might indicate that future economic growth could take place without increasing the already heavy burden these economies place on the planet.

Realizing this goal is still a long way off, however. At present, it takes about 300 kilograms of natural resources, including hidden material flows, to generate US$100 of income. The member countries of the Organisation for Economic Co-Operation and Development (OECD) (2), which collectively represent a large percentage of the world's industrial base, have set a preliminary target of reducing this ratio by a factor of ten—to 30 kilograms per US$100 income—over the next several decades. Without major progress toward this goal, there seems little prospect for reducing the scale of environmental impacts worldwide, especially as developing nations increase their use of natural resources to expand their economies and improve their lifestyles (Adriaanse et al. 1997:2).

REFERENCES

Adriaanse, A. et al. 1997. *Resource Flows: The Material Basis of Industrial Economies* (a joint publication of the World Resources Institute (WRI); the Wuppertal Institute; the Netherlands Ministry of Housing, Spatial Planning, and Environment; and the National Institute for Environmental Studies, Washington, DC).

Beard, J, ed. 1992. . *The Environmental Impact of the Car* (Greenpeace, Seattle).

Matthews, E. et al. 2000. *The Weight of Nations: Material Outflows from Industrial Economies* (a joint publication of the World Resources Institute (WRI); the Wuppertal Institute; the National Institute for Environmental Studies; the Institute for Interdisciplinary Studies of Austrian Universities; and the Centre of Environmental Science, Leiden University, Washington, DC).

NOTES

1. Further, a typical car contains nearly 900 kg of metals (Beard 1992:42).

2. The member countries of the OECD include: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.