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A hydrogen fuel cell-powered electric bus in service crossing Tower Bridge in London. Part of the Clean Urban Transport Europe (CUTE) demonstration project testing 27 such pollution-free buses in nine European cities.



3. Transportation

The transportation sector is a cornerstone of modern economies and an important source of jobs. Characterized by a heavy reliance on cars and trucks—and increasingly airplanes—for both passenger and freight movement, transportation is a major consumer of fossil fuels, an important source of urban air pollution, and a big contributor to climate change. Internal combustion engines accounted for 95 percent of world transport energy use in 2004, when the transport sector claimed 26 percent of total world energy use and was responsible for 23 percent of energy-related greenhouse gas emissions.³⁹⁸

The challenge to make transportation sustainable is rapidly magnifying. The sector's carbon emissions are projected to rise by more than 30 percent by 2010 compared with 1990 levels—the fastest increase of any economic sector.³⁹⁹ Ever-more cars on the world's roads are being driven ever-longer distances, and there is an ongoing shift from less fuel-intensive and less-polluting public means of transportation toward private cars and trucks. Air traffic is growing by leaps and bounds, but it is by far the most fuel-intensive mode—and thus extremely difficult to make more green at present or projected levels of activity. This section will address aviation briefly but will focus primarily on ground transport.

Aviation

On the passenger side alone, world air travel has exploded—rising from 28 billion passenger-kilometers in 1950 to 3,720 billion passenger-kilometers in 2005.⁴⁰⁰ Aviation fuel efficiency can be improved via better technology and air traffic management. New aircraft today are 60–70 percent more fuel-efficient than those designed 40 years ago.⁴⁰¹ A further 20 percent gain by 2015 over 1997 levels seems attainable, and perhaps a 40–50 percent gain by 2050. But the IPCC cautions that such improvements are insufficient in view of aviation's rapid annual growth of about 5 percent.⁴⁰² Additional changes are needed, including alternative fuels and lower aircraft speed. The International Air Transport Association (IATA) has called for 10 percent of aircraft fuel to be from alternative sources by 2017.⁴⁰³ The jobs of scientists and engineers who develop more efficient planes can be regarded as green, but given the massive energy use in comparison with all other modes of transportation, the bulk of the aviation sector's employment would be difficult to characterize as green even with additional efficiency gains.

During take-off, planes use a large share of fuel—up to 25 percent of the total fuel consumption on short flights—and produce the most harmful emissions. Yet it is precisely short-distance flights that are expected to account for 90 percent of all departures by 2023 (17,000 of 25,000 new planes to be built according to current plans are for short-haul purposes).⁴⁰⁴ A climate-sensitive transportation policy will need to reduce the number of such short flights and encourage passengers to switch to high-speed rail instead, which produces only a fraction of the emissions. Such priorities would give a boost to greener employment. Changes in priority need to be considered both by leisure travelers (especially short flights for weekend getaways and similar purposes) and business travelers.

Business travelers account for a substantial share of flights. In addition to making considered choices as to the mode of transportation when traveling to conferences and business meetings, they may be able to shift to increasingly capable virtual-conferencing services when face-to-face meetings are not essential. Such services also offer business and employment opportunities in their own right. Companies like Credit Suisse and Bell Canada are actively pursuing alternative options.⁴⁰⁵

In a sustainable economy, there will be fewer jobs in airplane manufacturing and air travel services than today. But from a macro-economic perspective, this is not necessarily a negative development. Many jobs in the aviation industry are effectively heavily subsidized, via exemptions from fuel duty, value-added tax, and duty-free rules. In the United Kingdom, where broadly defined up to 200,000 people are employed in the aviation industry, one study found that subsidies per aviation job run to about \$90,000 (£45,000) per year, or a total of \$18 billion (£9 billion). The foregone tax revenue would be sufficient to generate an equal number of jobs elsewhere in the economy. In fact, aviation subsidies finance job loss in other parts of the transport sector that do not benefit from equally generous treatment.⁴⁰⁶ A shift toward more sustainable transport is feasible, but it requires careful planning and transition measures.



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Lufthansa Technical Department. Turbine workshop. Philippines, Manila.

Road Transport

Road transport currently accounts for 74 percent of total transport CO₂ emissions and for the majority of transportation jobs.⁴⁰⁷ Thus, a move toward sustainability in this sector is especially critical.

Production of passenger cars and light trucks continues to surge, reaching 74 million units in 2007, up ninefold from 1950. North America, Western Europe, and Japan have long accounted for the bulk of motor vehicle production and ownership. In 2004, they had 552 million passenger and commercial vehicles, or two-thirds of the total world fleet of 826 million.⁴⁰⁸ The United States alone consumes nearly half of global motor gasoline use (44 percent in 2004).⁴⁰⁹

But developing countries are ratcheting up their involvement as well. China and India still account for only about 5 percent of the global fleet, but they are gearing up to boost their production and ownership. China's passenger car production has rapidly expanded from 100,000 in 1991 to 6.7 million in 2006, when it overtook Germany to become the third largest car producer, to 8.1 million in 2007.⁴¹⁰ India is currently the 11th largest producer, and its domestic passenger car sales have doubled to 1.4 million since 2002.⁴¹¹ At the beginning of 2008, Tata Motors introduced the Nano, billed as "the world's cheapest car"—though production runs are planned to be modest for now, this potentially brings car mobility within reach of hundreds of millions of people in India and perhaps elsewhere in the developing world.⁴¹²

A broad array of measures can help to reduce transportation's environmental footprint, ranging from relatively narrow technical changes to broad, systemic solutions. Alternative fuels, hybrid gasoline/electric vehicles, plug-in electric vehicles, and hydrogen/fuel cell-powered cars are in various stages of development.⁴¹³ Such technological developments could portend many job opportunities in the future.

Greater fuel economy not only limits energy consumption, but translates directly into reduced emissions of carbon dioxide. It can also help to reduce a vehicle's air pollutants, although fuel economy and low emissions do not always go hand in hand.⁴¹⁴ Indeed, some vehicles are fuel-efficient but do not score well on emissions, and vice versa. This is only to a certain degree an issue of engine technology; producing cleaner fuels (especially with lower sulfur content) is also critical. Stringent standards to limit emissions of air pollutants are needed in both regards. Japan and the United States, followed by the European Union, have the most stringent emission limits. China is introducing regulations that echo those of the E.U. But high-sulfur fuels threaten to negate the benefits of these rules.⁴¹⁵



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*The Eta.Paholyotin Road, Chatujak, traffic
congestion. Bangkok, Thailand.*

A more fundamental change is a shift in transportation modes, reducing the reliance on cars and trucks and increasing the use of buses, trams, and light rail in urban or sub-urban settings, and railways for inter-city transportation. This will bring associated shifts in employment. Reorienting the transportation sector toward greater sustainability requires not only a different mix of transportation modes, but also far-reaching changes in land use and land-use planning. Denser cities and shorter distances reduce the overall need for motorized transportation. They also make alternatives like public transit, biking, and walking more feasible.

Even though a sustainable transportation policy may ultimately lead to fewer jobs in car and truck manufacturing and related fields such as fuel refining and distribution, it offers more jobs in manufacturing of buses, light rail, subways, and railways; in the provision of the required infrastructure for these modes of transportation (including tracks, signals, stations, etc.); and in planning, running, and maintaining transit systems (bus drivers, conductors, and other operators; route planners, maintenance staff, etc.). Public policy needs to address the inevitable transition from one to the other in order to smooth the process for those whose jobs will be reoriented or lost.

It is not always an either-or choice between automobiles and public transportation. A sophisticated modal mix suggests that there are proper roles for both. Initiatives have emerged in growing numbers of cities that offer an alternative to the strictly private automobile. Car-sharing programs offer individual mobility while reducing the number of vehicles in circulation. Managing car-sharing programs offers additional employment. At present, however, such efforts are still too limited in number and scale to permit any reliable projections of their future job potential. In Germany, car-sharing enterprises employed a marginal 250 people in 2004.⁴¹⁶

Hybrids and Diesels

As automakers and governments search for ways to reduce the environmental impact of transportation, the hunt is on for alternative fuels. This report has already discussed green job opportunities in biofuels. What follows here is a brief look at gasoline/electric hybrids and diesel vehicles, before assessing employment related to fuel efficiency more broadly.

Hybrid vehicles are generally seen as a key means to achieve higher fuel efficiency. In principle, they can certainly deliver on that promise, although driving cycles and habits can have a major influence on actual fuel-economy performance. Because hybrids encompass an electric engine in addition to a conventional gasoline motor (plus a battery to power the extra motor), these cars require additional inputs and thus their production entails more employment than a regular car.

In 2007, a total of 541,000 hybrids were produced worldwide, most of them by Toyota.⁴¹⁷ Following Toyota's success with the Prius (in the decade since introducing the model, the company has manufactured 1 million hybrids, increasing its production to a projected 2007 figure of 430,000), more and more manufacturers are joining the hybrid bandwagon, especially in the United States.⁴¹⁸ In the 2007 model year, 2.2 percent of U.S. light-duty vehicles were hybrids.⁴¹⁹ A forecast for 2015 projects that hybrids (850,000 vehicles) might account for 5 percent of total U.S. sales, or possibly

as much as 11 percent (2 million vehicles).⁴²⁰

It must be noted, however, that automobile companies are increasingly introducing so-called “muscle hybrids”—using the technology more to boost acceleration and horsepower than to improve fuel economy.⁴²¹ To the extent that this will be the dominant application of hybrid technology, the market penetration of hybrids can only within limits be regarded as a proxy for estimating green automobile production and jobs. In a similar vein, the IPCC has expressed concern that fuel economy technologies generally “can be used to increase vehicle power and size rather than to improve the overall fuel economy and reduce carbon emissions.”⁴²²

The development of hybrids and plug-in electric cars will likely be a boon for manufacturers of batteries (such as nickel metal hydride and lithium ion) as well as for companies involved in creating an infrastructure for recharging and servicing electric cars. If batteries can be made sufficiently cheap, reliable, safe, and recyclable, this may lead to the creation of a substantial number of jobs. Companies in this emerging industry include independents such as Ener1, A123 Systems, and Johnson Controls, but also subsidiaries of South Korea’s consumer electronics giant LG and Germany’s Continental, a tire producer.⁴²³



© Martin Bond / Still Pictures
Electric car charging station powered by solar energy. City Hall, Santa Monica, California, USA.

Diesel engines typically consume 30 percent less fuel than gasoline engines and emit 25 percent less CO₂. For that reason, it is not surprising that European countries (and also increasingly South Korea and India) are favoring diesel-powered vehicles. Diesel engines account for 50 percent of all cars sold in Europe.⁴²⁴ Consulting firm J.D. Power and Associates projects that global demand for diesel light vehicles will nearly double from 15 million in 2005 to 29 million in 2015.⁴²⁵

Diesel engines have long been notorious polluters. Existing fleets of heavy trucks and buses running on diesel remain major contributors to dangerous urban air pollution. Evolving engine technology and cleaner fuels have rendered diesel passenger cars substantially cleaner, especially

with regard to sulfur dioxide emissions. But they still emit far more nitrogen oxides and particulate matter than their gasoline counterparts.⁴²⁶ Diesel-powered vehicles continue to perform poorly on the American Council for an Energy-Efficient Economy's (ACEEE) annual ranking of vehicles due to the high levels of environmentally damaging nitrogen oxides and particulate matter they release, despite greater fuel efficiency.⁴²⁷

Although hybrids and modern diesels clearly are promising technologies, only under certain conditions can they be seen as unambiguous proxies for a greener auto industry. Strong rules and standards would appear to be critical in this regard.

Lean and Clean

Leadership in pursuing fuel economy is essential to the future viability of the automotive industry. Companies that lag in this regard run the risk that their vehicles will increasingly fall short of fuel-economy mandates and, as fuel prices rise, lose favor with consumers. In the drive toward a greener economy, leading on fuel economy will increasingly help maintain and create jobs in the automotive sector; lagging behind endangers jobs.

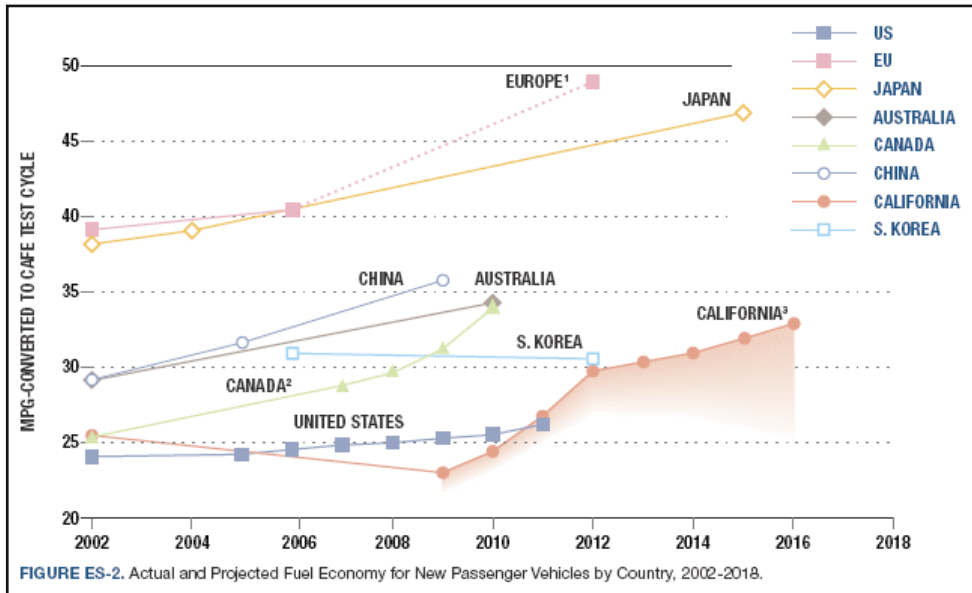
Most immediately, developing fuel-efficient engines and transmissions will be a boon for scientists and technicians that develop relevant technologies at car companies, suppliers, government laboratories, and universities.⁴²⁸

Beyond the field of R&D, however, how many of the world's auto-manufacturing jobs can be considered green in this context? Efficiency is a relative concept, with inherent difficulties in setting an unambiguous threshold that separates gas sippers from gas guzzlers. Current practice is by and large inadequate relative to the need to dramatically reduce transportation's environmental footprint. Thus, the threshold needs to be ambitious.

For a particular vehicle model to be considered efficient, it would have to perform well vis-à-vis best practice internationally. And over time, the threshold above which a vehicle (and by implication the jobs needed to build it) can be regarded a reasonable shade of green would have to be on an upward sliding scale—guided less by an “as is” approach than by “what could be.” The implication, of course, is that a job that may be considered green today may not be seen that way in the future as technological development opens up new vistas in terms of energy and materials efficiency and waste avoidance. “Green jobs” is a dynamic, ever-changing concept—at least until the economy is on a far more sustainable footing than is the case today.

A 2007 report by the International Council on Clean Transportation (ICCT) concludes that worldwide, Japanese and European car factories produce the most efficient vehicles available today. The United States ranks at the bottom—the result of corporate and consumer choices and a lack of governmental action, rather than technical obstacles.⁴²⁹ (See Figure II.3-1.) A number of countries, including China, South Korea, Canada, and Australia, range somewhere in between; China in particular is working to increase vehicle efficiency. Comparable fuel-efficiency data are not available for some other countries that rank among large or emerging producers, such as Brazil and India.⁴³⁰

Figure II.3-1. Actual and Projected Fuel Economy for New Passenger Vehicles, by Country, 2002–2018



Source: See endnote 429 for this section

Below, we offer calculations of jobs in the Japanese, European, South Korean, and U.S. auto industries that can be considered a shade of green. It is important to note the following:

- ❑ In the absence of global criteria, the calculations are based on national/regional standards and reporting categories. Using fuel economy as the key criterion may yield sharply different results than calculations based on air-pollutant emissions standards (as the example of Japan suggests, where we offer such figures).
- ❑ The calculations are focused on passenger cars only, which account for the large majority of motor vehicles worldwide. But similar assessments will need to be made for commercial vehicles as well, especially trucks that contribute heavily to air pollution.
- ❑ The calculations are based on the percentage of cars sold that meet certain fuel efficiency or other standards, and assume that an equivalent share of a country’s auto industry employment is required to produce these cars. Due to a lack of data, the calculations do not distinguish between domestic production and imports. If a larger share of a country’s fuel-efficient fleet is produced abroad than domestically, then the calculations offered here overstate that country’s number of green jobs.

The resulting numbers need to be understood as rough approximations. There is also a larger challenge: making individual vehicles use less fuel and emit fewer pollutants reduces their environmental impact, but if the number of vehicles on the world’s roads keeps growing, these gains will be reduced or nullified. Whether one can then still speak of green jobs is open to judgment. From a comprehensive point of view, such structural questions can be as important as more narrow fuel-economy technology questions.

Fuel Economy and Low-Emission Targets in Japan

The Japanese government established fuel-economy targets for passenger cars of 16.8 kilometers per liter (39.5 miles per gallon), to be reached by 2015.⁴³¹ This standard translates into CO₂ emissions of 125 grams per kilometer (g/km), according to the ICCT.⁴³² The average fuel economy of new cars manufactured in Japan rose from 12.4 kilometers per liter in 1996 to 15.5 kilometers per liter (36.5 miles per gallon) in 2006, exceeding the previous 2010 target of 15.1 kilometers per liter (equivalent to 153.8 g/km).⁴³³ In 2005, 86 percent of passenger cars sold met or surpassed the 2010 fuel efficiency target.⁴³⁴

According to the Japan Auto Manufacturers Association (JAMA), in fiscal year 2006 Japanese firms sold close to 89,000 hybrid passenger vehicles in Japan, plus another 7,000 alternative fuel vehicles. They also shipped close to 3 million vehicles that were certified as meeting air pollutant emission standards of 75 percent below 2005 limits—a category used in car labeling for Japanese consumers.⁴³⁵ The combined total represents 53 percent of all motor vehicles sold domestically that year.⁴³⁶ If that share is applied to Japan's automotive manufacturing workforce of 952,000, then as a rough approximation, Japan might be said to have 434,000 vehicle manufacturing jobs that are a shade of green.⁴³⁷ (See Table II.3-1.) However, as noted above, a car that meets fairly stringent air-pollutant limits does not necessarily fare as well with regard to carbon emissions. Hence, these figures need to be seen with caution (and, as additional calculations below suggest, are likely too generous as a proxy for green employment).

Table II.3-1. Estimated Jobs Producing Low-Emission Vehicles in Japan, 2006

	Vehicle Production/ Employment Number of vehicles produced*
Domestically-produced vehicles sold in Japan	5,618,499
Of which:	
Hybrid and alternative fuel vehicles**	95,945
Low-emission vehicles†	2,893,028
Subtotal, all clean vehicles	2,988,873
Share of hybrid & low-emission vehicles (percent)	53
	Number of employees
Automobile manufacturing workforce‡	952,000
Percent of hybrid & low-emission vehicles, pro-rated vis-à-vis workforce total	434,070

*Excluding motorcycles.

**Includes natural gas and diesel-alternative LPG vehicles.

†Highest-achieving group; vehicles with emissions 75 percent below Japan's 2005 exhaust emissions standard.

‡Includes employment in vehicle manufacturing, as well as parts and accessories production.

Source: See Endnote 437 for this section.

Carbon Limits in Europe

In 1998, the European Automobile Manufacturers Association (ACEA) entered into a voluntary agreement with the European Commission to reduce the amount of carbon emitted by new passenger cars. The objective was to reduce the 1995 level of 186 grams of CO₂ per kilometer to 140 grams per kilometer by 2008 (and optionally to 120 grams by 2012). The 2008 target is equivalent to a fuel efficiency level of about 5.8 liters per 100 kilometers (gasoline) and 5.25 liters per 100 kilometers (diesel). JAMA and the Korea Automobile Manufacturers Association (KAMA) agreed to meet this target by 2009.⁴³⁸

European Commission staff has issued reports monitoring the carmakers' commitment, and their findings are the basis for calculations here of the number of jobs in manufacturing cars for the E.U. market that could be considered a shade of green.⁴³⁹ Using thresholds of 120 and 140 grams of CO₂ per kilometer, this results in job numbers of 150,000 and 526,000, respectively, for model year 2004.⁴⁴⁰ (See Table II.3-2.)

Table II.3-2. Estimated Jobs Producing Fuel-Efficient Vehicles in Europe, 2004

	Vehicle Production / Employment Number of vehicles	
Vehicles sold in Europe by ACEA members	11,484,785	
Of which:	Vehicles emitting ≤ 120 gCO ₂ /km: 879,401	Vehicles emitting ≤ 140 gCO ₂ /km: 3,085,165
Share	7.5 percent	26.3 percent
	Number of Employees	
Passenger car manufacturing workforce	2,000,000	
Percentage share of "clean" vehicles, pro-rated vis-à-vis workforce total	150,000	526,000

Source: See Endnote 440 for this section.

According to the European Federation for Transport and Environment (EFTE), among European car companies French and Italian firms fared best in 2006 in terms of offering vehicles with higher fuel efficiency and lower carbon emissions, whereas German-produced vehicles actually had higher emissions than in 2005.⁴⁴¹

Some 6.3 percent of Japanese-made cars sold in the European Union in 2004 met the 120-gram limit. If we postulate that this ratio holds up for all Japanese cars, not just those sold in the EU, this would imply that about 62,000 Japanese auto-manufacturing jobs can be considered relatively green. Using the more lenient standard of 140 grams (which 21.4 percent of the cars met) yields a figure of about 204,000 jobs.⁴⁴²

Just 4.3 percent of South Korean cars sold in Europe met the 120-gram limit in 2004. Similar assumptions and calculations as for the European and Japanese carmakers suggest that just

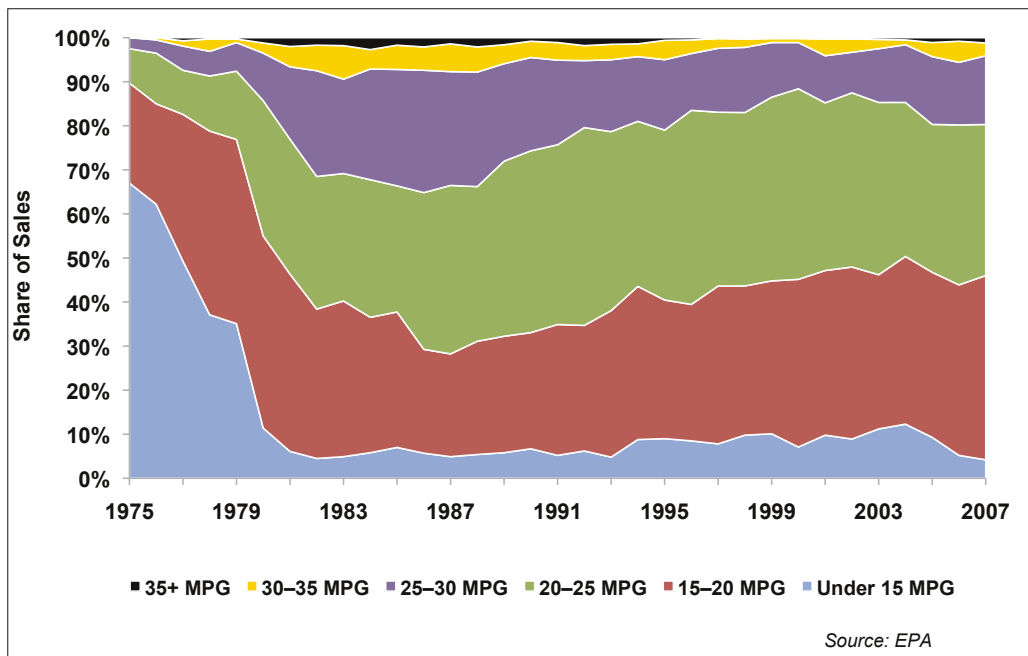
over 10,000 out of South Korea's 247,000 auto industry jobs could be seen as green. Under the 140-gram limit (met by 29.1 percent of South Korean cars), the number would rise to close to 72,000 jobs.⁴⁴³

The United States: Lagging Behind

The United States is among the leaders in setting tough norms for vehicle air-pollutant emissions. In sharp contrast, however, the country has scorned higher fuel efficiency for more than two decades, and its automakers have churned out vehicles with ever growing weight, horsepower, and acceleration.⁴⁴⁴ The U.S. corporate average fuel economy (CAFE) standard for new cars has remained essentially unchanged at 27.5 miles per gallon since the mid-1980s; the standard for new "light trucks" (which includes so-called sport utility vehicles, or SUVs) is at 21 mpg.⁴⁴⁵

Figure II.3-2 illustrates these developments.⁴⁴⁶ Following the first oil crisis of the early 1970s, the number of cars sold that achieved no more than 15 miles per gallon declined dramatically—from 67 percent in model year 1975 to just 4.5 percent in 1982. The bulk of car sales were in the 15–20 mpg interval in 1978–1985, and in the 20–25 mpg interval until 2003. But vehicle sales in higher-efficiency groups remained very limited. And low gasoline prices and the introduction of SUVs led even to a partial reversal of earlier gains.⁴⁴⁷

Figure II.3-2. U.S. Light Vehicle Sales, by Fuel Economy Segment, 1975–2007



Note: MPG = miles per gallon.
See endnote 446 for this section

How many U.S. auto industry jobs can be regarded as green? A 2007 study for the American Solar Energy Society (ASES) defines vehicles that score at least 10 percent better than the CAFE standards as energy-efficient. About 15 percent of U.S. car production meets that requirement, and on that basis the report counts 380,000 direct and indirect vehicle-manufacturing jobs as part of the energy-efficiency industry.⁴⁴⁸ However, in light of much higher Japanese and European achievements and seen against the tremendous need to boost fuel economy from current levels, a 10 percent premium on top of CAFE would not appear to be a meaningful gauge.

An analysis by the U.S. Environmental Protection Agency (EPA) shows that just 1.2 percent of all U.S. light vehicles in the 2007 model year could be categorized as truly fuel-efficient—that is, achieving at least 35 miles per gallon. (None of the cars sold in 2007 fell into the 35–40 mpg interval; 0.2 percent achieved 40–45 mpg, and 1 percent achieved 45–50 mpg.) For passenger cars alone, excluding SUVs, the share of cars above 35 mpg was 2.3 percent.⁴⁴⁹ Using this percentage as a proxy for gauging the number of auto-manufacturing jobs that could be considered green, we arrive at a more realistic estimate of about 13,000 (direct jobs only).⁴⁵⁰

Are the calculations presented here—based on carbon limits and fuel economy, respectively—comparable to each other? As mentioned above, a fuel economy level of 39.5 mpg translates into CO₂ emissions of 125 grams per kilometer. Thus, the most efficient 1.2 percent of cars sold in the United States in 2007 can be assumed to meet the European threshold of 120 grams. Hence, the calculations of green jobs are roughly comparable.

One limitation of the U.S. data is that the EPA fuel efficiency analysis does not distinguish between cars produced in the United States and those imported. Differences between domestically produced cars and those sold in the United States by foreign companies have narrowed in recent years. On average, the sales-weighted corporate average fuel economy for passenger cars is very similar for domestic and foreign manufacturers.⁴⁵¹ However, one of the most efficient models sold in the United States, the Toyota Prius, is produced in Japan only, and thus the back-of-the-envelope calculation presented here may even somewhat overstate U.S. employment in manufacturing fuel-efficient cars.

The United States could do far better. Back in 2001, a study by the American Council for an Energy-Efficient Economy (ACEEE) showed that aggressive implementation of even conventional technologies could raise average new car and light truck fuel economy in the United States to 41 mpg—at a cost far less than the value of the fuel saved.⁴⁵² The Apollo Alliance suggested in 2004 that a concerted strategy to build highly efficient cars might yield close to 130,000 jobs.⁴⁵³

Investing in fuel efficiency offers economic benefits that reach beyond jobs in the automobile sector itself. For instance, a 2007 Union of Concerned Scientists (UCS) report assesses the impacts of moving toward a fleet average of 35 mpg in the United States. Such a policy could generate 241,000 more jobs throughout the economy by 2020. Greater fuel efficiency offers substantial savings to consumers (annual net savings rise to \$37 billion by 2020, after taking into account the higher purchasing cost of more efficient cars). These savings are assumed to be spent in sectors of the economy that are more labor-intensive than the energy industry, thus leading to a net job

gain. The UCS study finds that 23,900 new jobs would be created in the automotive industry itself, via investments in tools and machinery to produce more efficient engines, transmissions, lighter auto bodies, better tires, and so on.⁴⁵⁴

The Global Picture

The estimates presented here for U.S., European, Japanese, and South Korean car manufacturers cannot, of course, be directly compared with each other, as the calculations are based on different standards, calculations, and test cycles used to monitor performance. But the calculations above suggest that relatively green auto-industry jobs may number about a quarter million (and possibly on the order of 800,000, under more lenient definitions). Either figure is still quite small relative to the automobile manufacturing industry's global employment: 8.4 million jobs.⁴⁵⁵

Other countries that account for large chunks of the world's vehicle production and employment include China (with 1.6 million employees), Russia (755,000), Brazil (289,000), and India (270,000).⁴⁵⁶ But similar calculations for them do not seem feasible at the moment. China and India are targeting small car production (with China's Chery compact model reportedly achieving a fuel rate of 27 km/l, equivalent to 63 mpg).⁴⁵⁷ Both are following European emission standards, though with a time lag of some years.⁴⁵⁸ And gasoline and diesel fuels are much dirtier, and thus more polluting, than those available in the United States, Japan, and Europe.

Given that, among the global leaders, jobs in producing the most efficient and cleanest cars available account for single-digit shares of total employment, it would appear that green jobs in other countries are still extremely limited at the moment. But there is considerable room for improvement and for creating more sustainable jobs in many countries. Thailand, for instance, has launched a promising initiative.⁴⁵⁹ (See Box II.3-1.)

To create large numbers of greener jobs in the auto industry, a concerted international fuel-efficiency strategy is needed—with mandatory targets, accelerated technology diffusion mechanisms so that the most efficient and cleanest engine designs are introduced in timely fashion, incentives for consumers to purchase the most efficient models, and large-scale investment to generate additional breakthroughs in cleaner engine technologies and fuels.

Automotive Materials

Another aspect of cars' environmental footprint—and thus the question which jobs in the present or in future can be considered green—concerns the multitudes of materials that are incorporated in today's vehicles. An ACEEE report points to impacts associated with the extraction of raw materials; production of plastics, batteries, and steel; and disposal after a car has been scrapped: "Large quantities of materials of many types are used in the production of every car, and this results in significant air and water pollution. Mercury and other toxic materials are used in quantities sufficient to make cars a significant source of those materials and a hazard for workers."⁴⁶⁰

Box II.3-1. Thailand's Eco-Car Initiative

Thailand's government decided in June 2007 to grant tax incentives to auto manufacturers that produce small, fuel-efficient "eco-cars." The excise tax rate was set at 17 percent (compared with the typical 30–50 percent), and eco-car manufacturers will receive up to eight years of exemption from corporate income tax payments and machinery import duties. In order to receive tax breaks, a company must produce cars that do not surpass a certain engine size (1,300 cubic centimeters for gasoline engines and 1,400 cc for diesels), consume 5 liters per 100 kilometers (47 miles per gallon) or less, generate no more than 120 grams of CO₂ per kilometer, and meet Euro-4 emissions standards. Companies must make a minimum investment, produce at least 100,000 cars by the fifth year of production, and produce at least 80 percent of parts domestically.

Japanese companies Suzuki and Nissan are planning to produce 138,000 and 120,000 such cars, respectively per year. Honda is planning to double its production to 240,000 units. Thailand's Board of Investment (BOI) is to consider similar proposals from Mitsubishi Motors, Toyota (which was initially skeptical about this initiative), Volkswagen, and India's Tata Motors in January 2008. The cars are to be sold not only on the domestic Thai market, but also in other Asian countries, Australia, and Africa. Thailand could thus become a regional hub of "eco-car" production. Sudjit Inthaiwong, deputy secretary-general of BOI, says, "We are hoping the eco-car will be our next global niche."

Having seen output and sales boom since the late 1990s, Thailand produced some 299,000 cars and 896,000 commercial vehicles (mostly small pickup trucks) in 2005. But domestic demand weakened in 2006 and 2007. While partly designed to overcome the slump and attract new investment, this initiative has the potential to green a substantial share of the country's car industry and thus a portion of the 182,000 jobs in the sector.

The degree of greening will depend on whether the new eco-cars (whose retail prices would be reduced by the preferential excise tax rate) will displace conventional vehicle sales (a fear expressed by several companies) or will simply boost car ownership rates in Thailand. It appears that pickup trucks, which are taxed at a far lower rate than eco-cars, will remain popular. This raises the question whether an eco-car initiative is best focused on small cars only, or would better be applied to a broader class of vehicles.

Source: See Endnote 459 for this section.

Lightweight, high-strength materials (such as aluminum, plastics, magnesium, and certain types of steel) can be of enormous help in reducing fuel consumption. At the same time, the production of such materials has its own environmental impacts. In 2004, a typical car sold in the United States weighed roughly 2 tons. About 55 percent of the weight was accounted for by a variety of steels; iron, aluminum, and plastics accounted for about 8 percent each.⁴⁶¹ Automotive materials use accounted for 28 percent of total U.S. aluminum consumption in 2005, 25 percent of iron, 22 percent of zinc, 14 percent of steel, 11 percent of copper and copper alloys, and 5 percent of plastics.⁴⁶² Because vehicles elsewhere are typically less heavy, for most other countries these shares are likely to be considerably smaller.

The bulk of automotive materials is produced by industries that are among the most energy-intensive—and least labor-intensive. Measures to reduce energy use, as well as the generation of toxics and other wastes, in supplier industries is critical in the quest for greener transportation-

related jobs. Scrap or recycled materials accounted for 25 percent of the aluminum industry's worldwide production in 2004, limiting its energy use and thus its environmental footprint. However, that is a lower share than was prevalent during the 1980s and 1990s. The rate of recycling in the steel industry, meanwhile, has risen quite remarkably in recent years, accounting for about a third of world production.⁴⁶³

Vehicle weight is an important consideration in fuel-efficiency. To some extent, this means a shift from conventional steel to high-strength varieties and growing reliance on aluminum and plastics. But to the extent that lighter, more efficient vehicles translate into less demand for various materials overall, it also means a degree of job loss in some supplier industries.

Transportation and the Wider Economy

Many more jobs are found in servicing and maintaining motor vehicles than in manufacturing the vehicles themselves. Leaving aside public transportation (discussed further below), they include fuel refining, wholesaling, and retailing; trucking and other freight services; and automobile sales, rentals, parking, and repair services. Their relative importance varies widely from country to country. In a heavily automobile-dependent country like the United States, these jobs add up to roughly 6.5 million jobs, compared to about 1 million in vehicle and parts manufacturing. In Japan, they amount to about 4 million.⁴⁶⁴

Jobs in refining and fuel wholesaling/retailing may never qualify as green jobs, although a switch to cleaner fuels (low sulfur content, etc.) might lend at least a tinge of green. With regard to many other transportation jobs such as vehicle retailers or truckers, their hue of green depends strongly on the degree to which the vehicles themselves are efficient and clean.

Particularly with regard to trucking services, however, there is a need to reassess the way in which the global economy is developing. So-called “just-in-time” production systems are biased toward frequent, precisely timed deliveries of materials and parts to factories instead of warehousing of supplies. And both production and consumption now depend on shipments of raw materials, intermediate goods, and final products over ever-longer distances. Highly complex production, shipping, and retailing networks have emerged on an increasingly global scale, with varied impacts on employment, wage levels, and the economic viability of communities and regions.

The onslaught of ever-growing transportation volumes threatens to overwhelm gains from improving fuel efficiency and limiting pollutants on a per-vehicle basis. Companies like Wal-Mart (with its policy of global sourcing and especially its policy of searching for cheap products, with potential negative impacts for labor and the environment) are major drivers and symptoms of this phenomenon. When products are shipped around the world in “sending coals to Newcastle” fashion, improving the fuel efficiency of vehicles or planes—or improving the energy efficiency of stores, as Wal-Mart has pledged to do—can only have limited impact.⁴⁶⁵ Ultimately, a more sustainable economic system will have to be based on shorter distances and thus reduced transportation needs. This is not so much a technical as a fundamental systemic challenge.

Urban Mobility

Sustainability in the transportation sector will require a transition to greater reliance on public transport; that is, a modal shift away from the heavy and unbalanced reliance on cars and trucks. In urban settings, investment in transport infrastructure—light rail and tram tracks, bus lanes, stations, platforms, bike paths, traffic signals, etc.—creates construction and maintenance jobs. But as the International Labour Organization explains, “while the short-term boost to employment is welcome, especially in high unemployment regions, it is not the primary objective of investment in transport infrastructure, which is to secure long-term gains in the form of increased competitiveness and the creation of durable employment. Second, efficient transport systems are essential for the operation of the labor market to ensure the widest access of workers to employment. Some of the unemployment in many countries derives from poor planned transport systems which can be an obstacle to the mobility of workers even over comparatively short distances—for example, within a single urban centre.”⁴⁶⁶



© M. Renner, 2005
Motorcycles in Medan, Indonesia.

Likewise, in a 2005 report by its Africa division, the World Bank emphasizes that well-functioning and sustainable transportation services are crucial for economic development and job generation throughout much of the economy: “An efficient and effective urban transport system is a powerful tool for improving the efficiency and accessibility of the labor market, and providing better access to education and health services.” However, many cities in developing countries, particularly in sub-Saharan Africa, lack reliable and affordable urban transport systems.⁴⁶⁷ In fact, inadequate transport can be a major drag on family incomes and livelihoods. Elsewhere, the Bank concludes that, “between 8 and 16 percent of urban household income is typically spent on transport, although this can also rise to more than 25 percent for the poorest households in very large cities.”⁴⁶⁸

In developed countries as well, transport investment priorities and settlement patterns have a huge impact in terms of people’s access to jobs and economic opportunity. Addressing the situation in the United States, the Apollo Alliance notes that, “sprawl and urban disinvestment have separated low income and minority residents from areas of job growth and drained resources for education, government services, and maintenance of existing neighborhoods.”⁴⁶⁹

As this statement makes clear, under the right circumstances, transportation can be the lifeblood of cities. But the wrong transportation choices can drain vitality and employment from communities.

Sprawl not only has tremendous environmental consequences. Low population densities and other circumstances tend to render labor union organizing far more difficult, thus undermining worker strength and wages. So-called “smart growth” strategies can help preserve farmland and open space, keep transportation manageable and housing affordable.⁴⁷⁰

Public Transport

Although there are no comprehensive global employment statistics, public transportation—and in particular urban transit—is a major employer. In the United States, transit agencies employed about 367,000 people in 2005, up from 311,000 people in 1995.⁴⁷¹ New York City alone has some 47,000 employees operating the bus and metro system. In Paris, RATP (Régie Autonome des Transports Parisiens de France) employs 43,600 people. STIB (Société Transport Intercommunale de Bruxelles) in Brussels, Belgium, employs more than 6,000 people.⁴⁷²

According to the International Association of Public Transport (UITP), an estimated 900,000 people are employed in urban public transport in the 25 member states of the European Union. UITP has 2,900 members from 90 countries, and national statistics from these countries suggest that the number of direct jobs in public transport amounts to about 1–2 percent of total employment. In European economies, public transit investments seem to have a multiplier effect of 2 to 2.5. But in countries that focus intensely on public transport, such as Switzerland, every direct job is linked to as many as 4.1 indirect jobs. Studies in Europe and the United States show that about 30 jobs are created for each \$1.4 million (€1 million) invested in public transport infrastructure, and 57 jobs for the same level of investment on the transit operations side.⁴⁷³

Public transit is less energy- and carbon-intensive than automobiles.⁴⁷⁴ (See Table II.3-3.) Seen from this perspective, jobs in public transit (and in manufacturing trams, buses, and rail equipment) can, in principle, be regarded as green.

Table II.3-3. Energy Use by Urban Transport Mode

Transport Mode	Vehicle Production	Fuel Use	Total
(megajoules per passenger-kilometer)			
Light Rail	0.7	1.4	2.1
Bus	0.7	2.1	2.8
Heavy Rail	0.9	1.9	2.8
Car (Gasoline)	1.4	3.0	4.4
Car (Diesel)	1.4	3.3	4.7

Source: See Endnote 474 for this section.

However, many cities rely on old and highly polluting diesel buses. This is especially true in developing countries. A 2005 survey of about 170 cities by the International Association of Public Transport found that even in the European Union, diesels account for about 90 percent of all urban buses. (Alternatives are particularly prevalent in Helsinki and Athens (CNG), Vienna (LPG), and Luxembourg (biodiesel, hybrids).⁴⁷⁵ CNG offers pollution-reduction benefits and is already fairly widely used outside of Europe. China leads the way with more than 32,000 CNG-powered buses, followed by India (12,000) and South Korea (11,400). Egypt, Iran, and Japan also have sizable fleets.⁴⁷⁶ Authorities in India's capital, New Delhi, announced that 6,100 new CNG buses would be introduced between late 2007 and 2009 and that 18,000 new jobs were expected to be created.⁴⁷⁷

Switching to cleaner diesel fuel also offers substantial reductions in air-pollutant emissions.⁴⁷⁸ And in principle, there are also many job opportunities in retrofitting buses, which reduces particulate matter from diesel dramatically (although very old models are best retired from service altogether). To make these alternatives happen at a meaningful level and in timely fashion requires substantial financing.

In developed countries, the growing preference for private automobiles and the associated sprawl and lengthening of travel distances crowds out public transit. As ridership declines, cities are often forced to cut back on service or density of available networks. In developing countries, public transportation systems struggle with an onslaught from two sides. One, there is a proliferation of private automobiles that serve only a relatively small share of the population but take over growing amount of space. Two, various two- and three-wheeled for-hire taxis owned by licensed and unlicensed private operators are crowding the streets even more, siphoning off passengers from bus and light-rail lines and massively contributing to air pollution.⁴⁷⁹

A green transportation strategy can create many new manufacturing and operating jobs, but it will require massive investments in public transit. One promising response to these challenges are so-called Bus Rapid Transit systems—which, if set up and managed appropriately, can be an important part of green transport employment.

Bus Rapid Transit, or BRT, systems offer a sustainable solution to many cities' traffic and air pollution challenges. Originating in Curitiba, Brazil, BRT systems now exist in more than 70 cities around the world, including Beijing, Bogota, Glasgow, Jakarta, Los Angeles, Mexico City (see Box II.3-2), Sydney, and Toronto.⁴⁸⁰ Many more are planned for cities like Accra, Cape Town, Lagos, Medellin, New Delhi, and Shanghai. Key BRT features typically include dedicated or preferential bus-only lanes, special boarding platforms, high-capacity vehicles using clean propulsion technologies, integration with other routes and transit services, and focused urban development planning. By providing efficient and clean transportation, successful BRT systems around the world have stimulated economic development and job creation along their routes.⁴⁸¹

Box II.3-2. BRT in Mexico City

In May 2002, Mexico City authorities committed to set up a Bus Rapid Transit (BRT) system with the assistance of EMBARQ—WRI Center for Sustainable Transport, the Global Environment Facility (GEF), the Japanese government, and other institutions. Called Metrobus, the BRT system was initiated in a corridor along one of the busiest thoroughfares in the capital, Insurgentes Avenue. Seeking a low-energy, low-emissions solution, the city tested new bus engines and fuels, and it supported a pilot project to retrofit diesel-powered buses with pollution-control devices.

So far, some \$70 million has been spent on buses, infrastructure, planning, and design. The cost is a fraction of what a metro line with equivalent passenger capacity might cost. By 2006, Metrobus operated 80 new buses along a 20-kilometer line with 36 stations. It provides faster and better service than conventional buses, with less pollution. Drivers who used to work for private bus concessionaires before becoming Metrobus drivers now belong to the formal employment sector, with enhanced income security and benefits such as social security, retirement insurance, and vacations.

Source: See Endnote 480 for this section.

In BRT systems, the frequency of service is carefully calibrated, and therefore bus breakdowns and other operational failures need to be minimized. This in turn implies that buses must be kept in excellent condition. Hence, BRT systems offer a substantial number of maintenance jobs. Maintaining high-quality service also means it is critical to ensure good working conditions for drivers, who need to be well trained and are expected to take responsibility for their performance. Thus, jobs for drivers and mechanics must be decent and well-paying.⁴⁸²

Well-functioning and reliable public transport—whether BRT or others—is critical not only for strictly environmental reasons but also to guarantee equity of access to affordable transport between the rich and poor, and between men and women. Particularly for women, safety is a critical aspect.

Two Strokes and You're Out

Passenger cars are far from the only type of vehicle that poses a significant environmental challenge. In the developing world, many people cannot afford a car. Instead, vehicles with two-stroke engines—motorcycles, motorcycle taxis, and various three-wheelers—are ubiquitous. Large numbers of people and their families depend on income generated with the help of such vehicles in typically informal transport services.

But these vehicles generate huge emissions of air pollutants, with a heavy toll on human health and the environment in many cities. Short of replacing the two-strokes with other transportation modes, retrofits offer substantial improvements in fuel efficiency and considerable promise as a source of green jobs.⁴⁸³ (See Box II.3-3.) Stepped-up financing is essential for retrofits to happen on a sufficiently large scale and for jobs to be created. The economics of retrofits does depend on fuel prices.

Box II.3-3. Engine Retrofits in Southeast Asia

A traditional two-stroke engine can emit as much pollution as 50 modern automobiles. These engines, ubiquitous in many developing countries and used for both personal transport and taxi services, are among the world's largest sources of vehicle emissions. Envirofit, a U.S.-based independent nonprofit company, works to develop and disseminate direct-injection retrofit kits to improve the efficiency of two-stroke engines. Retrofits eliminate the carburetor and inject fuel directly into the engine. Fuel consumption is reduced by 35–50 percent, and emissions of air pollutants are cut by as much as 90 percent. Envirofit's work was recognized in 2007, when it became a winner of the World Clean Energy Awards.

Envirofit runs pilot projects in Vigan and Puerto Princesa, two cities in the Philippines. Apart from the health and environmental benefits, the fuel efficiency offered by retrofits can mean big savings for drivers of two-stroke motorcycle taxis there, and thus a big boost for their livelihoods. The retrofit kits pay for themselves in fuel savings within 10 months. To make the upfront costs affordable, however, the cities provide micro-financing, recognizing that many local taxi drivers have little disposable income.

According to the Asian Development Bank (ADB), there are some 100 million two-stroke vehicles in Southeast Asia alone. Large numbers of such vehicles can also be found elsewhere, especially in South Asia. The challenge is thus enormous, but so is the potential for green jobs. Envirofit works with local partners to develop self-sustaining businesses to install and service the kits, and it plans to expand into Bangladesh, India, Pakistan, and Sri Lanka.

Source: See Endnote 483 for this section.

But changes are also needed when these vehicles are first produced. China and India are among the leading producers of two-wheelers.⁴⁸⁴ India's production of two-wheelers has doubled from 4.3 million in 2001–02 to 8.4 million in 2006–07. Output of three-wheelers has risen from 213,000 to 556,000 over the same period.⁴⁸⁵ Against this rapidly rising wave of production, reducing the environmental and health impact of scooters, mopeds, and motorcycles is both a major challenge and business and green job opportunity. Major challenges need to be overcome, however. As long as fuel prices stay low, there is little incentive and revenue to produce cleaner fuels and engines.

Non-Motorized Transport

Non-motorized transport modes have the unfortunate distinction of being overlooked by most traffic planners and economists. But they fulfill an important function in all societies. For short distances, they are an easy and non-polluting, quintessentially green, mode of transport. In poorer countries, they are often a critical source of income for those providing low-cost pedicab transportation services. More broadly, rural areas require affordable transportation in order to escape poverty. For those in urban areas who lack public transport because it is unaffordable, unreliable, or sidelined by policies favoring private automobiles, there may not be any other mobility option for accessing markets, jobs, and other economic opportunities.

Worldwide, some 105 million bicycles were produced in 2004. But this level of output was reached as early as 1988 and production has since fluctuated, going as low as 86 million in 2001. The industry offers employment in dozens of countries, but just five producers—China, India, the European

Union, Taiwan, and Japan—account for 87 percent of global production. China alone produced 58 percent of all bicycles in 2004. Production of electric bicycles—with a small electric motor that assists pedaling uphill or allows riders to cover longer distances more easily—is booming, reaching about 12 million units in 2005. Almost all of them were manufactured in China.⁴⁸⁶

No good global employment statistics appear to exist for this industry, or for associated businesses such as rental services.⁴⁸⁷ Bicycles can be simply a personal means of transport or, when they are used as a cycle rickshaw, support a livelihood in many of the world's poorer cities.⁴⁸⁸ (See Box II.3-4.) Greater availability of financing is a key aspect of replicating and scaling up such initiatives in many parts of the world.

In Uganda, for example, “boda bodas” (bicycle taxis) provide convenient short-distance transport. Uganda had about 200,000 boda bodas in 2000, compared with 70,000 motorcycle taxis. In both Uganda and Kenya, they provide employment for large numbers of previously unemployed youth.⁴⁸⁹ Starting in 1990, the Ngware Bicycle Transport Group pioneered the business of organized bicycle taxi services in Kisumu, Kenya, successfully creating jobs and offering affordable, non-polluting access to education and health services for residents.⁴⁹⁰

Box II.3-4. Rickshaws and Livelihoods in India

The Institute for Transportation and Development Policy (ITDP) has helped introduce modern bicycle rickshaws in India. Their numbers have grown from 20,000 in 2003 to more than 300,000 today. The new design weighs 30 percent less and a multi-gear system makes pedaling considerably easier. According to a survey, these changes have led to increased incomes of 20–50 percent because rickshaw operators were physically able to work longer, and improved comfort and safety attracted new passengers, including some who previously rode highly polluting motorized rickshaws. Not only do the livelihoods of operators improve, but manufacturing the modernized rickshaw in India may open new green job opportunities. ITDP is now similarly helping to modernize the becak (a three-wheeled rickshaw) used in Indonesia.

Source: See Endnote 488 for this section.



© 2006 TopFoto / Dinodia
A physically handicapped rickshaw driver in an auto rickshaw in Bangalore city, Karnataka, India.

Rail transport is more fuel-efficient and more labor-intensive than road transport.⁴⁹¹ German studies suggest this is true for track construction relative to road construction as well. Indeed, highway construction generates the fewest jobs of any public infrastructure investment.⁴⁹² Yet, in many countries, trends in inter-urban transport have been strongly in favor of road vehicles, moving away from rail transport for both passengers and freight.

In the European Union (EU-25), for instance, at roughly 4.9 million kilometers the road and motorway network accounts for 95 percent of all transport routes. Road length grew by 22 percent between 1990 and 2003, whereas the railway network shrunk by 8 percent to under 200,000 kilometers.⁴⁹³ A total of 8.2 million people were employed in all transport services combined in 2004. Railway transport—far less fuel-intensive and polluting than trucking and other road transport—accounted for just 11 percent, or 900,000 jobs. Rail employment has fallen in the last few decades; in just the short span of time between 2000 and 2004, the number of jobs was cut by 14 percent even as value-added grew 3 percent.⁴⁹⁴ Road passenger and freight transport, by contrast, keeps growing, representing just over half the total, or 4.3 million jobs. (Air transport, the most fuel-intensive mode, contributed 5 percent, or 400,000 jobs.)⁴⁹⁵

China's rail network grew by 24 percent in 1992–2002, but due to boosted labor productivity, employment was cut almost in half, from 3.4 million to 1.8 million. India's network grew only 1 percent, but due to radically different policies, employment stayed almost the same, falling from 1.7 million to 1.5 million over the same period of time. China's rail system is primarily focused on freight transport, whereas India's is oriented more toward passenger services.⁴⁹⁶

In African countries, a World Bank report notes that, "the changed role of rail...over the last thirty years has seen it move from a situation where many of the systems were carrying a high share of their country's traffic to one in which their market share has declined, their assets have steadily deteriorated, their quality of service has reduced, and they are in many instances only a minor contributor to solving the transport problems of the continent." Railway privatization—between 1993 and 2005, 13 rail concessions were granted, with another seven in progress—has been offered as a solution to badly run-down systems. Investment has risen, but given that it has been financed through gifts and concessional loans, may not be sustainable. Increased labor productivity has led to reduced railway employment.⁴⁹⁷

In 2004, transport equipment manufacturing employed about 3 million persons in the EU-25, accounting for 9 percent of the EU-25's manufacturing workforce. The manufacture of motor vehicles, trailers, and semi-trailers represented more than two-thirds of these jobs.⁴⁹⁸ The manufacture of railway and tramway locomotives and rolling stock in the EU-25 employed just 140,000 people in 2003, or half a percent of all industrial employment.⁴⁹⁹

The shift away from rail has been a matter of policy choice, and a turnaround is possible. New priorities would entail substantial job opportunities. Employment potential in different countries depends on a range of factors, including labor productivities, availability of capital, the ability

to furnish the needed construction and equipment through domestic companies, and others. Even though the United States, for instance, has long neglected passenger rail systems, a 2004 report argued that a 10-year federal investment program in new high-speed rail as well as rail maintenance could create close to a quarter million jobs.⁵⁰⁰



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*The Krasnoyarsk Electric Train
Maintenance Depot.*

Implications of a Modal Shift

We have assessed the potential for greening auto industry jobs through fuel efficiency and surveyed employment in public transport. But what would happen if a substantial modal shift occurred away from heavy reliance on cars? Would it lead to a net gain or net loss of jobs? Unfortunately, there are few comprehensive studies in this regard.

Assessments of alternative passenger transport policies conducted in Germany and Britain, though dated now, offer useful insights. They suggest that an alternative transport policy offers not only savings in fuel consumption but also important job opportunities. A 1998 study by the Öko-Institut in Freiburg, Germany, compared a “business-as-usual” scenario with an alternative scenario for the 1995–2010 period designed to cut German CO₂ emissions by a quarter. Although it allowed for an increase of 21 percent in passenger kilometers traveled by all modes, it posited a substantial change in the “modal split,” with railroad and urban public transit travel volume more than doubling and bicycle use growing by 72 percent, while distances traveled by car would decrease by 8 percent. (Also, automobiles were projected to become far more fuel-efficient.)⁵⁰¹

The study found that a loss of 130,000 jobs in automobile manufacturing and related sectors would be more than offset by 338,000 new jobs, for a net addition of 208,000 jobs. These results were based on cautious assumptions, so that actual net employment benefits may well be higher. Still, some of the lost jobs would be well-paid ones, and in major car-producing areas the local employment impacts could be significant. The study assumed that higher gasoline taxes would help bring about the shift toward public transport. Close to half the additional tax revenues of about \$13 billion would finance new infrastructure and financial support for public transport, and thus jobs in mass transit. The remainder, returned to taxpayers, was assumed to be re-spent on

typical consumer purchases, and to be responsible for three-quarters of the total net job gain. However, if the surplus tax revenues were used to cut wage costs instead (by reducing employers' social security contributions), the net employment effects were thought to range as high as 400,000 new jobs.⁵⁰²

A study conducted by ECOTEC for Friends of the Earth Great Britain in 1997 assessed the impact of promoting far greater use of railways and buses (70–80 percent higher in 2010 than in 1990), as well as bicycling and walking, while reducing reliance on car use. The study assumed that the total number of passenger kilometers traveled would decline by 11 percent from 1990 levels. It concluded that at least 130,000 new direct jobs could be created by 2010, more than offsetting the loss of an estimated 43,000 jobs in automobile maintenance and repair. In addition, measures to encourage the use of less polluting, more efficient automobiles (natural gas, electric, and hybrid vehicles) and to promote leasing rather than car ownership, were found to possibly create another 35,000 jobs (because of greater attention to upkeep, leased cars lead to more maintenance jobs).⁵⁰³

A 2007 study jointly financed by the European Commission and several European governments—Climate Change and Employment—notes that the ECOTEC study “is to this day the most complete in measuring the employment effects linked to the implementation of sustainable-development transport policies.”⁵⁰⁴ Most attention in the intervening years has rather narrowly gone to alternative fuels, rather than broader transportation issues. And the real-world trends have of course continued to favor cars and trucks over rail and other alternatives. As Climate Change and Employment notes, business-as-usual scenarios essentially foresee more of the same in coming years, with predictable outcomes in terms of employment—favoring jobs related to trucking and other private road uses, and disfavoring rail and other public transport options.⁵⁰⁵

For a scenario more in line with a future of green jobs, a major turnaround in transportation priorities and land use policies will be required—not just in Europe, but in other regions of the world as well. This implies a re-balancing of rail-versus-road choices, a shift in subsidies and other forms of financing, and a shortening of travel distances for passengers and freight. With such a shift, there is enormous scope for sustainable mobility and sustainable employment worldwide.