Does Rail Transit Save Energy or Reduce CO2 Emissions?

By Randal O'Toole

Introduction and Summary

Rail transit uses less energy and emits less greenhouse gases per passenger than buses. This is often used as an argument for building rail transit. But is it valid? This paper looks at the effects of rail transit on total energy consumption and greenhouse gas emissions by transit systems and by a region's total transportation system.*

The paper finds that most rail transit lines use more energy than the average passenger car. While they use less energy than buses, rail transit does not operate in a vacuum: transit agencies supplement it with extensive feeder bus operations. Those feeder buses tend to have low ridership, so they have high energy costs and greenhouse gas emissions per passenger mile. The result is that, when new rail transit lines open, the transit systems as a whole end up consuming more energy, per passenger mile, than they did before.

This paper also notes that the construction of rail transit lines consumes huge amounts of energy and emits large volumes of greenhouse gases. In most cases, even if rail transit does end up saving energy, it would take many decades of energy savings to repay the energy cost of construction.

While highway construction also uses energy, each mile of urban highway typically carries far more passenger miles and freight ton-miles of travel than a mile of typical rail line. This means the energy cost and pollution per passenger mile of highway construction is far lower than for rail transit construction.

This paper concludes that those who are interested in saving energy and reducing greenhouse gas emissions should promote the following policies instead of rail transit:

- Concentrate bus service on heavily used routes; serve lightly used areas with small transit vehicles, perhaps on a demand-responsive basis.

- Relieve highway congestion by building new roads and applying variable tolls to those roads. The Texas Transportation Institute's latest report on urban mobility estimates that highway congestion wastes nearly 3 billion gallons of fuel each year. Congestion relief will both save fuel and reduce emissions.

- Promote the production and development of more fuel-efficient cars. Getting 1 percent of commuters to switch to hybrid-electric cars will do far more to save energy than getting 1 percent to switch to public transit. If fuel prices remain high, this change will happen without any government action, which will make rail transit even less able to save energy.

* *This paper is based on postings to the author's "Antiplanner" blog. Please refer to the blog and search for "Greenhouse Gases" for detailed references.*

Part 1: Methodology

One reason often put forward to build rail transit is that it will save energy. Lately, rail advocates have added the claim that it will reduce greenhouse gas emissions.

Many people accept these statements without question. A recent NPR story argued that "part of the solution (to global warming) is light rail." A Seattle magazine declared Portland the second-greenest city in the world partly on the strength of the reduced greenhouse gases emitted by its light-rail lines.

This paper looks at these claims in detail. Part 1 will set up the problem. Part 2 will look at actual energy consumption and CO2 emissions by various transit systems in 2005, the most recent year for which data are available. Part 3 will compare energy consumption and CO2 emissions before and after light-rail lines are put into operation. Part 4 will look at the construction costs of rail transit. Finally, Part 5 will compare rail transit with alternative policies that might be able to reduce energy consumption and greenhouse gas emissions at a far lower cost.

Our data comes from several reputable sources:

1. The U.S. Department of Transportation's National Transit Database, which includes a table showing energy consumption by mode for almost all public transit agencies in the country.

2. The U.S. Department of Energy's Transportation Energy Data Book, which provides factors for converting gasoline, Diesel, kilowatt hours, and other fuels into BTUs.

3. The Energy Information Administration, which provides coefficients for estimating CO2 emissions by energy source.

4. For comparison, we'll use the EPA's new measure of fuel economy for automobiles. This new measure is more realistic than the old one and in many cases is even slighly conservative.

These data can be used to calculate energy use and emissions for most of the transit systems in the U.S. However, there are a few limits. The National Transit Database only includes fuel numbers for transit lines that are directly operated by transit agencies. Agencies that contract out their operations to private companies such as Laidlaw or First Transit do not report the fuel those companies use. This means there are no results for many of the new commuter rail lines, including those in Dallas, Ft. Lauderdale, Los Angeles, San Diego, San Jose, Seattle, and the Washington DC area.

Yet we end up with data for almost every heavy-rail system, most light-rail systems, and several commuter-rail systems, not to mention hundreds of bus systems and the handful of trolley buses that still operate. For each of these systems we can calculate BTUs and pounds of CO2 emissions per passenger mile.

This week's analysis will be based on a few assumptions. First, various modes of transport will be compared using BTUs and pounds of CO2 per passenger mile. Some might say that passenger mile is the wrong measure because transit trips tend to be shorter than auto trips. But that shortness reflects a cost, which is that transit dependency limits mobility. While it seems to be an article of faith among smart-growth planners that limiting people's mobility is a good thing, that is not an idea shared by this writer.

Second, most new electricity demands in this country are supplied by coal. While some regions (such as the Northwest) have hydroelectric power plants, hardly any new hydro plants are being built. So this analysis assumes that new electric rail lines will use electricity produced by coal-fired plants.

Third, this review will ignore the question of whether we really need a government policy to reduce energy consumption and greenhouse gases. Is peak oil a problem deserving of government rules and regulation? Is global climate change really a result of humans producing more greenhouse gases? This writer has a strong opinion about the first question and remains agnostic about the second. But we'll skip the debate over those questions for the moment and concentrate on whether, if these are important issues, rail transit does the job.

Fourth, our standard of comparison will be with passenger cars, which consume an average of 3,445 BTUs and emit an average of 0.54 pounds of CO2 per passenger mile. Light trucks (pick ups and SUVs) consume/emit more, but this analysis will ignore them. Why? Because we are evaluating the cost-effectiveness of a public policy. This paper's basic argument will be that, if you accept that we need to reduce energy consumption and greenhouse gas emissions, you need to compare the cost-effectiveness of rail transit with a policy that would encourage more people to drive more fuel-efficient cars.

Based on these assumptions, I've posted a spreadsheet (1.4 MB) that includes energy consumption and CO2 emissions by transit system and mode. This is just an expansion of the National Transit Database summary spreadsheet that I've previously posted, and it includes BTUs (calculated from National Transit Database table 17, "Energy Consumption") and CO2 outputs. It also estimates averages for the transit systems in each urban area, with the caveat that transit services that are contracted out are mostly left out of these averages.

I've also posted a summary spreadsheet that lists BTUs and CO2 by mode for the transit systems in cities that have rail transit. Part 2 of this paper will discuss these results in detail. For now, you can review the results yourself or discuss my assumptions.

Spreadsheet URLs:
NTD summary: http://americandreamcoalition.org/NTDsum05.xls
Rail summary: http://americandreamcoalition.org/RailBTU&CO2.xls

Part 2 - 2005 Results

Does rail transit save energy and reduce greenhouse gas emissions? Based on the results for 2005, the answer seems to be mostly "no." These results are found in two downloadable spreadsheets: the National Transit Database summary (1.4 MB) and a summary spreadsheet for rail cities. You can also download a spreadsheet with the calculations of BTUs and CO2. A brief explanation of the spreadsheets and a guide to abbreviations can be found at the end of this post.

Here is a summary of the results:

Mode	BTU/PM	CO2/PM
Guideway	10,573	2.05
Commuter Rail	2,766	0.50
Light rail	3,458	0.67
Heavy rail	2,692	0.52
Motor Bus	3,733	0.66
Trolley bus	4,004	0.77
All transit	3,276	0.60
Automobile*	3,445	0.54

* As noted in part 1, "automobile" is the average for passenger cars, not including light trucks (pickups and SUVs).

Of course, as always, summaries can be deceptive without more detailed analyses. But I think we can drop much further consideration of the mode known as "automated guideways." Of the three guideways in the database (Detroit, Jacksonville, and Miami), Miami's does best, but it requires more than 6,000 BTUs and emits more than 1.25 pounds of CO2 per passenger mile.

On average, light rail is about par with autos, though of course some lines are better and some are worse. Only commuter rail and heavy rail use, on average, less energy than cars, but they don't save much in the way of greenhouse gases.

Most trolley bus routes are concentrated in urban cores where transit usage is particularly heavy. So it is surprising that they do so poorly. Of the four cities that operated trolley buses in 2005 (Boston, Dayton, San Francisco, and Seattle), only those in San Francisco matched cars for energy efficiency, though not CO2 emissions.

The urban area part of the NTD spreadsheet reveals that transit systems, taken as a whole, use less energy than the auto in only a handful of urban areas: New York, Los Angeles, Chicago (barely), Boston, Atlanta, San Francisco-Oakland, Phoenix, and Honolulu. Only New York, Phoenix, and Honolulu (barely) emit less CO2 per passenger mile than the average auto.

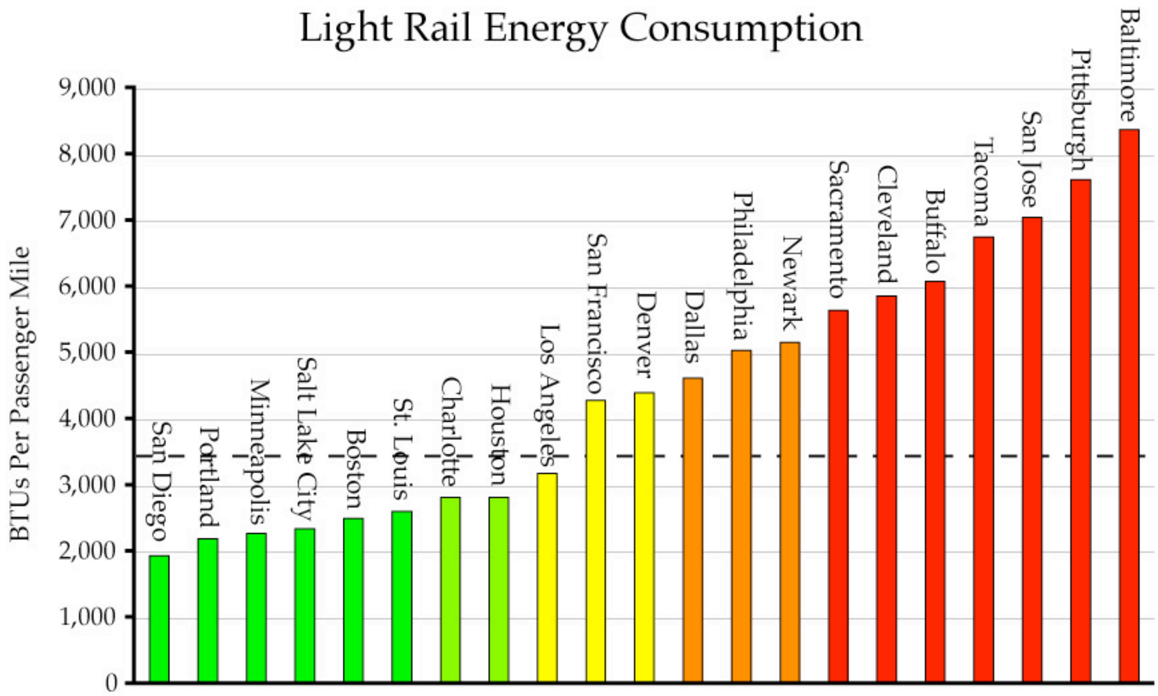
Of course, all of these urban areas except Phoenix and Honolulu have rail transit, so this might be considered a validation of rail transit. But what really makes most of these rail regions exceptional is the concentration of jobs.

It is also worth noting that most of the regions with efficient rail systems also have exceptionally efficient bus systems. In Los Angeles, the buses do far better than autos while the rail lines lag behind. In Atlanta the buses and rail system both do better than autos. The New York MTA bus system does better than most of the region's commuter-rail lines.

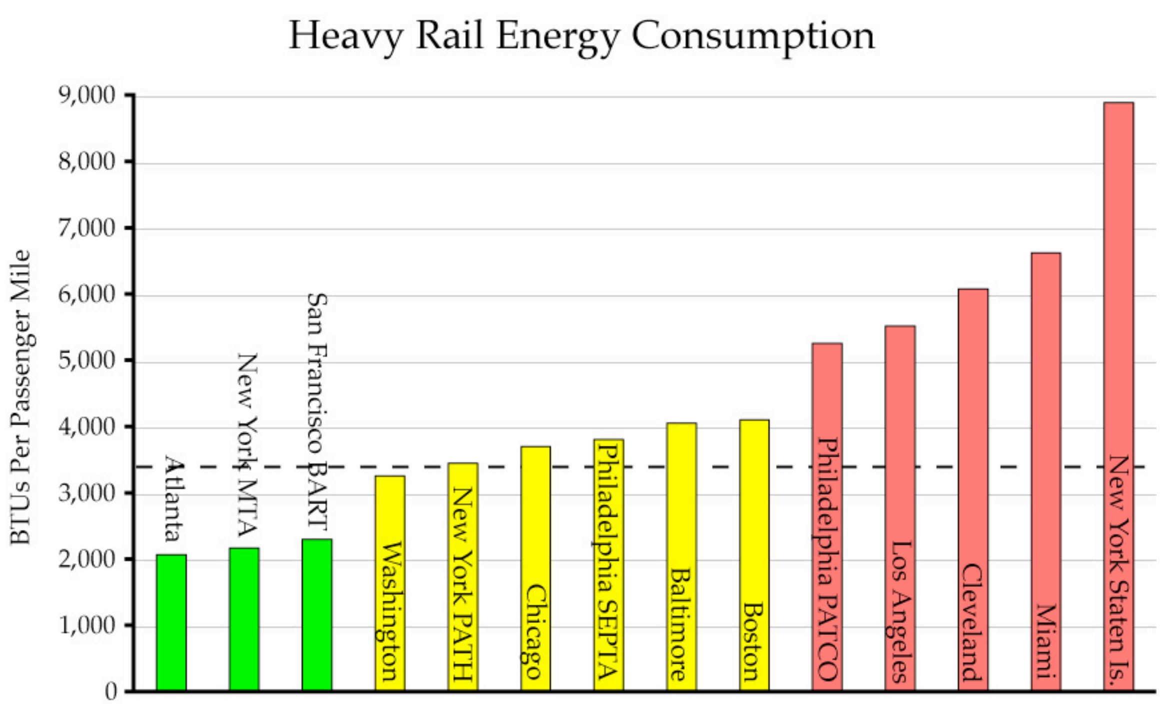
Los Angeles buses do well because they carry an average of 16 people, compared with the national average of 10. Atlanta buses may do well because most of them use compressed natural gas rather than Diesel fuel.

Take a look at the rail summary spreadsheet to get a better idea of how well transit works in each urban area. This spreadsheet is just a summary of the NTD spreadsheet, and it leaves out many of the smaller bus agencies in regions like New York, Los Angeles, and San Francisco-Oakland. But it is a lot easier to review than the giant NTD file.

The charts below further summarize the results for each of the three main types of rail transit.



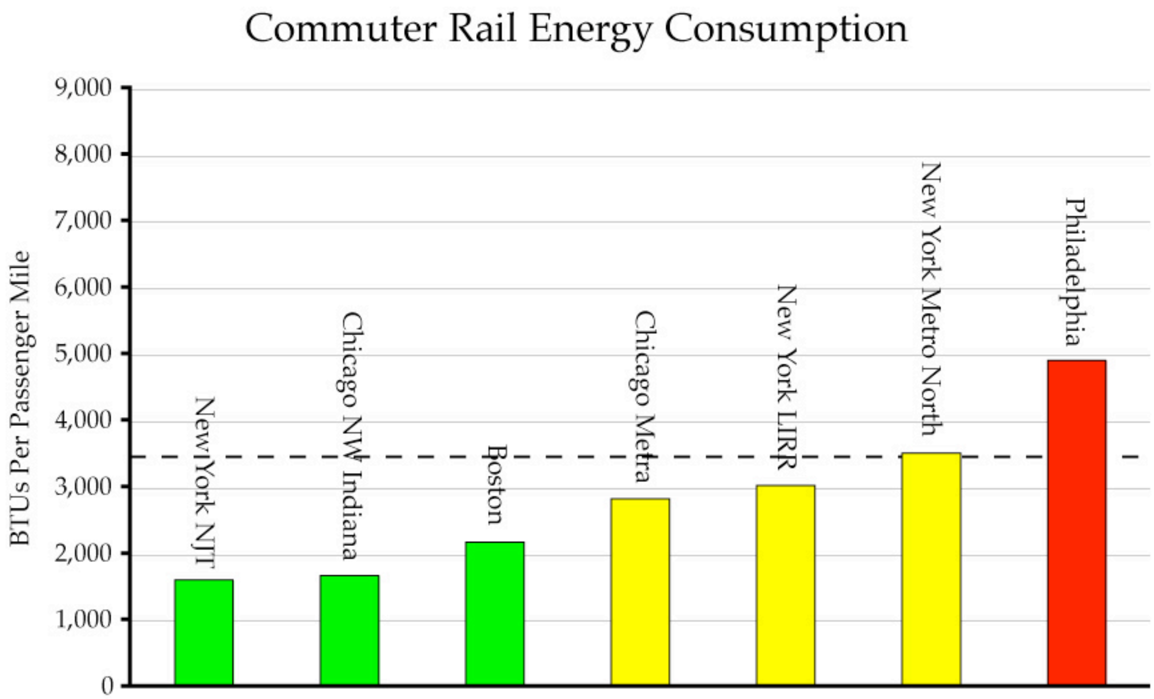
A majority of light-rail systems consume more energy per passenger mile than the average passenger car, represented by the dotted line.



Only three heavy-rail systems are exceptionally energy efficient.

A few cities — Houston, Minneapolis, Portland, Salt Lake City, San Diego, St. Louis — have installed new light-rail systems that seem fairly energy efficient. But light rail is a loser in Baltimore, Buffalo, Dallas, Denver, Newark, Sacramento, and San Jose, not to mention the older lines in Cleveland and Philadelphia.

New heavy rail systems in Atlanta, San Francisco, and Washington seem to be efficient, but not those in Baltimore or Miami (see figure on previous page). Atlanta's is not much more efficient than its buses and Washington's is only slightly more efficient than autos, so the only real winner among new heavy-rail systems is BART.



Most commuter-rail systems for which data are available are energy efficient, but no data are available for the newer commuter-rail lines.

We have no commuter rail data for any city with new commuter lines (Dallas, Ft. Lauderdale, L.A., San Diego, San Jose, Seattle, Washington). I suspect if we did we would find the same thing as for light and heavy rail: not much gain in most cases.

Regions with older rail systems — Boston, Chicago, Cleveland, New York, Philadelphia, Pittsburgh — are a mixed bag. Rail does okay in Boston and New York, but it is marginal in Chicago and does poorly in the other cities. Since buses are fairly efficient in Boston and New York, it seems likely that a transit-friendly urban form — meaning a high-density job center, not high population densities — is what makes transit efficient in these cases.

These results suggest that, if your bus system is not very energy efficient — think Baltimore, Cleveland, Dallas, Denver, Miami, Sacramento, and San Jose — then rail is not likely to do much better and will probably be much worse. Transit agencies in these regions should focus on improving their bus ridership before even dreaming about rail.

Most of the cities where new rail lines appear to be successful had highly successful bus systems when they began building rail. As I've noted previously, rail must be supported by feeder buses, and so the energy efficiency of transit systems must be considered as a whole. We'll find out later this week what this means for these cities.

Spreadsheet Interpretation

The NTD summary sheet is divided into three parts. Rows 1 through 1368 are mode-by-mode, agency-by-agency listings of costs, trips, passenger miles, energy consumption, and CO2 emissions. Rows 1371 through 1379 summarize the results by mode. Rows 1381 through 1752 summarize the results (where available) by urban area.

The Rail summary spreadsheet takes the passenger miles, BTUs, and CO2 data from the NTD spreadsheet for all commuter-, heavy-, and light-rail systems for which those data are available. It also includes the major bus systems in those cities. It does not include many minor bus systems, so the totals for some urban areas may differ slightly from the totals in the NTD summary sheet.

Here are a few of the less obvious abbreviations used in the spreadsheets:
AG - Automated Guideway
BTU - British Thermal Unit
CO2 - Carbon Dioxide
CR - Commuter Rail
DR - Demand Response
FB - Ferry Boat
HR - Heavy Rail
IP - Inclined Plane
LR - Light Rail
MB - Motor Bus
PM - Passenger Miles
TB - Trolley Bus
UZA - Urbanized Area
VP - Van Pool
VRH - Vehicle Revenue Hours
VRM - Vehicle Revenue Miles
VT - Vintage Trolley

Here are the factors I used to calculate BTUs and CO2 emissions. The factors are all per gallon except for electricity which is per kilowatt hour.

	BTUs/unit	CO2/unit
Diesel	138,700	22.384
Gas	125,000	19.564
LPG	95,500	12.805
LNG	90,800	13.360
Methanol	64,600	19.608
Ethanol	84,600	11.324
Bunker	150,000	26.033
CNG	35,500	23.598
Kerosene	135,000	21.537
BioDiesel	126,206	7.319
Electricity	10,339	2.000

Part 3 — Before and After

Part 2 found that light-rail systems in Houston, Minneapolis, Portland, Salt Lake City, San Diego, and St. Louis seemed to be energy efficient compared with automobiles. But are they really?

When transit agencies open light-rail lines, they don't usually make significant reductions in bus service. Instead, they convert corridor bus lines to feeder buses for the light rail. Since many people end up driving to light-rail stations, these feeder buses end up carrying far fewer riders than the corridor buses that the light-rail replaced.

This, rail transit's energy and CO2 cost per passenger mile savings are potentially offset by increased energy and CO2 costs per bus passenger mile. I first noticed this for Salt Lake City. Salt Lake City brags about the great success of its light rail, and it did lead to a modest increase in total transit ridership.

When it opened the light-rail line, Utah Transit actually increased miles of bus service. Yet the average load of Utah Transit's buses fell by almost half, from 8.9 to 4.5 riders. As a result, the BTUs per bus passenger mile more than doubled. While light rail consumes only about 2,700 BTUs per passenger mile, the average for the transit system as a whole increased from under 4,300 in 1992 to nearly 5,600 in 2005.

Let's take a look at these other cities. In most cases, I will compare the year before a light-rail line opened with the year after. In a few cases, I compare the year after with two or three years before the line opened because rail construction often leads to disruptions in bus service and reductions in ridership that would not have taken place without the rail project.

Houston: In 2001, Houston's bus system required 3,680 BTUs and emitted 0.59 pounds of CO2 per passenger mile. Houston opened its light-rail line in 2004, and in 2005 the region's transit system consumed almost 4,000 BTUs and released 0.65 pounds of CO2 per passenger mile.

Minneapolis: Before opening the Hiawatha light-rail line in 2004, the Twin Cities' transit system was using about 4,000 BTUs and emitted about 0.65 pounds of CO2 per passenger mile. The light rail improved the system-wide average to 3,875 BTUs and 0.55 pounds of CO2 per passenger mile. Note, however, that this is still not quite as good as an automobile (3,445 BTUs and 0.54 pounds of CO2 per passenger mile).

Portland: Portland's transit system has two major lines with a few minor branches. Before the first line to Gresham opened in 1986, the region's bus system was using 3,700 BTUs and releasing 0.60 pounds of CO2 per passenger mile. After the line opened, energy consumption increased to 3,900 BTUs and CO2 emissions increased to 0.68 pounds per passenger mile.

Between 1988 and 1998, Portland's transit ridership grew by 54 percent, which sounds impressive unless you know that during the 1970s bus ridership grew by 150 percent. So the system was much more efficient when the second light-rail line opened in 1998, consuming just 3,260 BTUs and emitting just 0.54 pounds of CO2 per passenger mile — about the same as an automobile. This wasn't solely because of light rail: at 3,500 BTUs per passenger mile, Portland buses alone were doing much better in 1998 than they were in 1983 or 1988.

Portland lost ground again when it opened a new light-rail line to Hillsboro. In 2000, the first full year of operation of that line, energy requirements increased to 3,500 BTUs and CO2 emissions grew to 0.60 pounds per passenger mile.

Portland also opened a 5.5-mile branch in 2001 and a 5.8-mile branch line in 2004. The overall transit system's energy consumption improved after each opening, but the biggest improvements were due to increased bus ridership, which boosted bus efficiencies from 4,100 BTUs to 3,600 BTUs between 2000 and 2002 and from 3,640 to 3,360 BTUs per passenger mile between 2003 and 2005. Light-rail energy costs declined from 2,500 to 2,200 BTUs per passenger mile between 2000 and 2002, but increased from 2,040 to 2,200 BTUs per passenger mile between 2003 and 2005. These two branch lines are so short that the changes in energy use may have nothing to do with them.

San Diego opened the first modern light-rail line in the nation in 1981, but my data don't go back that far. So let's look before and after 1999, when San Diego added a new line that doubled the total number of miles of light-rail service.

Before the line opened, San Diego transit was using about 3,300 BTUs and releasing about 0.62 pounds of CO2 per passenger mile. The new light-rail line improved things slightly, reducing energy use to 3,000 BTUs and CO2 emissions to 0.59 pounds per passenger mile.

St. Louis's light-rail line has been heralded as a great success, and it did for a time seem to turn around a transit system that had been steadily losing ridership. Before the first line opened in 1994, the region's bus system had been using about 4,600 BTUs and emitting 0.75 pounds of CO2 per passenger mile.

In 1995, the first full year of light-rail operation, total ridership dramatically increased. But bus ridership significantly dropped even though the agency increased the vehicle miles of bus service. The result was that energy consumption increased to more than 5,200 BTUs while CO2 emissions grew to 0.88 pounds per passenger mile.

A thriving economy led to increases in both bus and rail ridership over the next five years. In 2001 St. Louis opened a second light-rail line. Again, bus ridership plummeted, while rail passenger miles grew. BTUs per passenger mile increased for both bus and rail, but paradoxically, the system as a whole reduced energy consumption by about 2 percent per passenger mile. This happened because many former bus riders started using the new rail line. CO2 production per passenger mile remained constant.

Heavy rail: Part 2 noted that new heavy-rail lines in Atlanta, San Francisco-Oakland, and Washington seemed to save energy while lines in Baltimore, Los Angeles, and Miami did not. Existing heavy-rail lines in Boston, Chicago, Cleveland, and Philadelphia also do poorly compared with autos; of existing heavy-rail systems, only New York's (and not all of the ones in New York) compares favorably with cars.

The Atlanta, San Francisco-Oakland, and Washington lines also started before the earliest data I have available (1982). BART, which seems to be the most efficient of the three, opened a large addition to Dublin in 1997. This branch serves Contra Costa and Alameda counties, so we can compare just the Contra Costa and Alameda bus systems with BART. In 1996, before the Dublin line opened, these three systems used 2,935 BTUs per passenger mile. After the line opened, energy consumption increased to just over 3,100 BTUs per passenger mile. Total passenger miles increased by less than one percent, so the benefits of getting a few people out of their cars were more than made up for by the loss of efficiency for the 99 percent who were already riding transit.

In sum, Houston, Portland, Salt Lake, and St. Louis's first light-rail line all led to significant increases in energy usage. Minneapolis saved some energy, while San Diego and St. Louis's second line both saved slight amounts of energy. Except in places like inner New York City, heavy rail is not a great energy saver either.

Considering the high energy costs of building rail lines — a subject for part 4 — it does not seem worth building rail transit to obtain a small energy savings, and certainly not worth it if energy requirements go up.

Part 4 — Construction

Let's say you want to build a rail line and you are convinced, despite all the evidence in my previous posts, that operating it will use less energy per passenger mile than buses or cars. Before you start construction, first ask: How much energy will it take to build the rail line?

Sound Transit, which is building one of the most expensive light-rail lines in the country and is asking voters for money to build another 50 miles that will cost even more, estimates that one of these lines will save 14,000 tons of CO2 emissions per year. But, based on the environmental impact statement for the line, a group called the Coalition for Effective Transit estimates that constructing the line will use enough energy to emit 640,000 tons of CO2. That's about 45 years' worth of savings.

That estimate is based on the "generous assumption" that half the energy needed for construction will come from hydroelectric power. I am not that generous. All hydroelectric power in the Northwest is fully committed to existing energy uses. Besides, electricity is not a significant power source for major construction projects. New energy demands, such as that needed to build a rail line, must come from other sources — sources that will emit thousands of tons of CO2.

Either way, rail lines must be virtually rebuilt from the ground up every 30 years or so. If the energy used to build the line costs more than 30 years worth of your savings, you aren't saving energy at all.

The environmental impact statement for Portland's North Interstate light rail estimated that the line would save about 23 billion BTUs per year, but that construction would cost 3.9 trillion BTUs. Thus, it would take 172 years for the savings to repay the construction cost. Since we know from Portland's other light-rail lines that they are not really saving anything at all, I somehow doubt that we will ever see any net savings.

In Denver, the environmental impact statement for the West light-rail line admitted (on page 5-76) that light-rail operations would use more energy than either the no action alternative or the enhanced bus alternative. Planners thoughtfully amortized the estimated energy cost of construction so readers could simply add it to the operational cost.

Unfortunately, lots of transit planners have neglected to include the energy costs of construction in their supposedly comprehensive environmental impact statements. I can't find any mention of energy in the table of contents for a light-rail project in Dallas (and I am not going to waste my time downloading a 43-megabyte file on the off chance that it is in the document but not the table of contents).

In any case, any claims that rail transit will reduce energy consumption must be met with skepticism unless they are accompanied by evidence that the operational savings will quickly repay the construction cost.

Part 5 — Policy Alternatives

The previous analyses have shown that rail transit often, but not always, uses less energy than buses. But it often uses more energy than automobiles. Moreover, any energy savings from rail is almost always more than made up for by the energy costs of running nearly empty feeder buses to serve the rail network.

Meanwhile the energy cost of building rail transit can be huge, especially if tunneling is required. Even if rail operations save energy, it can take decades for that savings to make up for the energy cost of construction. Since rail lines have to be largely rebuilt every 30 years or so, any energy savings that does not repay the construction cost within 30 years is likely to be a net loss.

In rare cases, new rail lines do seem to save a small amount of energy. But the high dollar cost of rail transit, combined with the high risk that there will be no real savings, eliminates any notion that rail can be a cost-effective way of reducing energy consumption or greenhouse gas emissions.

If saving energy and reducing CO2 emissions are worthy public goals, then there are many transportation policies that can achieve these goals with greater assurance and at a far lower public cost. Here are three ideas.

1. **A Transit Strategy** — From an energy standpoint, the bus systems in many cities perform at a mediocre level. But some systems use less than half as much energy per passenger mile as automobiles. The big difference is average bus loads: by carrying an average of 15 to 30 passengers at a time, instead of the national average of just 10, bus systems in Los Angeles, New York-New Jersey, Providence, and elsewhere manage to save lots of energy.

The best way to increase bus loads is to provide the best service to areas where transit customers live. The transit industry has a goal of providing service within a quarter mile of every suburbanite in every urban area, which guarantees lots of empty buses. Focus instead on the urban core, where transit-dependent people tend to locate, and provide corridor and limited services in the suburbs.

When they must serve routes that won’t attract as many riders, transit agencies should reduce the size of their buses. Because the federal government pays much if not all of the cost of new buses, transit agencies tend to buy buses that are larger than they really need. Smaller buses would use less fuel and could be used on routes where average loads were less than 15 people at a time.

Larger loads and smaller buses could do far more to reduce the amount of energy used by public transit than building rail lines. If the goal is to reduce greenhouse gases, using alternative fuels makes a lot more sense than relying on electric power, which usually means coal. Biodiesel, for example, is estimated to have net CO2 emissions that are only a third of regular Diesel.

2. **A Highway Strategy** — The Texas Transportation Institute estimates that congestion costs more than 2.3 billion gallons of wasted fuel each year. Relieving this congestion by fixing bottlenecks, using congestion tolls, and adding new capacity will do far more to reduce energy than rail transit. Moreover, new highways can largely pay for themselves, especially if tolls are used, while rail transit requires huge subsidies.

Some people fear that new roads will simply induce more travel, and the energy costs of that travel will cancel out the savings from congestion relief. As previously discussed here, the induced-demand story is as much a myth as the claim that General Motors shut down streetcar systems in order to force people to buy cars. Besides, increased mobility leads to increased wealth, and increased wealth will help us cope with any global climate problems that arise in the future.

3. **A Transportation Strategy** — This analysis compared transit systems with the average passenger car, which consumes about 3,445 BTUs per passenger mile. But many cars are well above (or below in this case) average.

Vehicles that get 30 miles per gallon or better, such as the Ford Escape Hybrid, Honda Fit, Toyota Corolla, or Camry Hybrid, use less than 2,800 BTUs and emit only 0.43 pounds of CO2 per passenger mile (assuming an average of 1.5 people per car). The Toyota Prius and Honda Civic Hybrid consume less than 2,000 BTUs and emit only about 0.30 pounds of CO2 per passenger mile. Only two commuter-rail lines in the New York region and one light-rail system (San Diego) do this well.

History indicates that spending billions on rail transit is unlikely to coax more than 1 or at most 2 percent of travelers to switch from autos to transit. What kind of incentives would be needed to persuade 1 or 2 percent of Americans to change from the car they have to a Prius or another car that gets 30 to 40 miles per gallon or better? It is likely that the cost of any such incentives will be far lower than building rail transit.

In fact, no government incentives may be needed at all. During the 1970s and 1980s, high fuel prices led Americans to buy cars that were more fuel efficient, with the result that the average car on the road in 1990 consumed about a third less energy per mile than in 1973. After 1990, average miles per gallon flattened out, but cars got bigger, so ton-miles per gallon continued to increase.

If gas prices stay high, we can expect fuel economy to increase again. In fact, since 2002, it has grown at an average of 1.1 percent per year. If your goal is to provide a transit system that uses less energy than 3,445 BTUs per passenger mile — the average for cars on the road in 2005 — and it takes 10 years to plan and build a rail line, by the time your line is open for business the average car will be using little more than 3,000 BTUs per passenger mile, and your rail line will probably still be a waste.

There may be places in the world where rail transit works. There may be reasons to build it somewhere in the United States. But saving energy and reducing greenhouse gas emissions are not among those reasons. Regions and states that want to be green should explore other alternatives such as the ones described here.