Transportation Systems

Search this site

- A Better Way to Get Around
- The Team
- Project Definition
  - The Physics
  - How did we get to this point?
- American Freight Movement
  - Freight Trains vs. Freight Trucking
- High Speed Rail
  - The Future of American Transportation: Is HSR the Answer?
- Light Rail
  - The Underlying Science: Efficiency and Emissions
  - A Look at L.A.: Should We Advocate for Light Rail?
- Urban Biking
  - A Challenge to the City of Eugene
- Sitemap

A Better Way to Get Around

Current US transport systems are highly concentrated on roads and highways (i.e. car travel). At the same times, all over the country, cities and states are looking for answers to their transportation problems. These include extreme traffic, increasing costs, expensive infrastructure maintenance (roads). The majority of federal spending has, in the past, gone towards these infrastructure elements. Should we continue this trend, or look more closely at other methods, such as heavy or light rail, buses, and better urban planning? The current US transport system is centered around, and highly reliant of, individuals driving their own car on government constructed roads and highways. This has been the case for the past half century. The current state of the US transportation system is hugely wasteful, in terms of money, time, and energy. Instead of devoting vast amounts of resources to an already wasteful system, some believe we should consider other transport infrastructure whenever possible. By implementing systems such as light rail, heavy rail, buses, and better urban planning, we have the opportunity to reduce waste.

Sections:

The Team: read about the team members and their research area

Project Definition: A description of our overall project and how some thermodynamic concepts relate to it.

American Freight Transport: Brock Tillotson's research into the cost/benefit of replacing more highway trucking with freight trains.

Light Rail: Paige Landsem examines the efficiency of light rail transportation systems, whether investing in their creation and maintenance is justified, and how they compare, efficiency-wise, to automobile transport.

High Speed Rail: Lindsay Wickman's analysis of the current debate over the development of HSR networks throughout the United States.

Urban Biking: Gabe Borlant-Guertler's analysis of the energy costs and benefits of increasing bike-riding infrastructure in large cities.

Subpages (2): Project Definition The Team

Transportation Systems

Search this site

A Better Way to Get Around
The Team
Project Definition
The Physics
How did we get to this point?
American Freight Movement
Freight Trains vs. Freight Trucking
High Speed Rail
The Future of American Transportation: Is HSR the Answer?
Light Rail
The Underlying Science: Efficiency and Emissions
A Look at L.A.: Should We Advocate for Light Rail?
Urban Biking
A Challenge to the City of Eugene
Sitemap

A Better Way to Get Around >

The Team

Gabe Borlant-Guertler
Senior, Political Science
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Graduating in Spring 2012 then plans on working for a couple of years before eventually applying for law school. Will examine the way that urban planning affects the extent of infrastructure built to support biking in large cities such as Portland, OR, and Miami, FL.

Brock Tillotson
Senior, Chemistry
503-803-3676
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I am planning to graduate in the Spring of 2013 and go on to either pursue a Masters in Chemistry or a Ph.D. I will be looking at the benefits, costs, and opportunities in replacing the transportation of freight in the U.S. with more freight trains over the more contemporary use of trucking on our highway infrastructure.

Paige Landsem
Senior, Public Relations
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I'm graduating in the spring of 2012 with a Journalism: Public Relations degree and hope to pursue a public relations career in the sports industry. This term I'll be looking at light rail systems and how their efficiency compares to "status quo" transportation methods like automobile transportation.

Lindsay Wickman
Junior, Accounting & European Studies
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lwickman@uoregon.edu

I will be graduating in the Spring of 2013, and plan to pursue a masters degree in Accounting. I will be researching and analyzing the development of High Speed Rail as a form of energy efficient transportation in the United States.

Transportation Systems

Search this site

A Better Way to Get Around >

Project Definition

Introduction

I. Issue Introduction
Current US transport systems are highly concentrated on roads and highways (i.e. car travel). The majority of federal spending has, in the past, gone towards these infrastructure elements. Should we continue this trend, or look more closely at other methods, such as heavy or light rail, buses, and better urban planning?The current US transport system is centered around, and highly reliant of, individuals driving their own car on government constructed roads and highways. This has been the case for the past half century. We should continue this trend and continue to place investment dollars in new highway and road projects and maintenance of prior projects.The current state of the US transportation system is hugely wasteful, in terms of money, time, and energy. Instead of devoting vast amounts of resources to an already wasteful system, we should consider other transport infrastructure whenever possible. By implementing systems such as light rail, heavy rail, buses, and better urban planning, we have the opportunity to reduce waste.All over the country, cities and states are looking for answers to their transportation problems. These include extreme traffic, increasing costs, expensive infrastructure maintenance (roads). These governments are also facing budget shortfalls and must be selective about where to place their transportation related money.

Subpages (3): How did we get to this point? Issue Introduction The Physics

Transportation Systems

Search this site

American Freight Movement

The Question:

Should Federal and State governments reduce highway infrastructure investment in favor of increasing freight rail ventures?

It is a common belief that the aging US highway system is in need of, and deserves, heavy Federal and State investment to aid in their repair, and to create jobs. This page is a look into whether this is a logical viewpoint or not by contrasting investment in current US freight transport systems (trucks on highways), with the possibility of using the same magnitude of investment in rail systems to carry a larger percentage of US freight. This is done by comparing capacity, cost, infrastructure, pollution, and energy savings.

Click HERE for the results of my study.

Subpages (1): Freight Trains vs. Freight Trucking

Comments

Alexandra Rempel – Nov 17, 2011 1:32 PM

You have a very nice start here; I would suggest continuing straight into your narrative here on this page, incorporating your issue introduction into it. Then, technical details can be reserved for supporting pages.

A Better Way to Get Around
The Team
Project Definition
The Physics
How did we get to this point?
American Freight Movement
Freight Trains vs. Freight Trucking
High Speed Rail
The Future of American Transportation: Is HSR the Answer?
Light Rail
The Underlying Science: Efficiency and Emissions
A Look at L.A.: Should We Advocate for Light Rail?
Urban Biking
A Challenge to the City of Eugene
Sitemap

Light Rail

Should existing light rail transportation systems be expanded?

With a special focus on the Crenshaw/LAX commuter transit corridor in Los Angeles, let's explore the science behind light rail systems and whether they constitute an efficient alternative to conventional transportation.

Sections:

1. The Underlying Science: Efficiency and Emissions

3. A Look at Los Angeles: Should We Advocate for Light Rail?

Image credit: Office of Supervisor Mark Ridley-Thomas (http://ridley-thomas.lacounty.gov/transportation/)

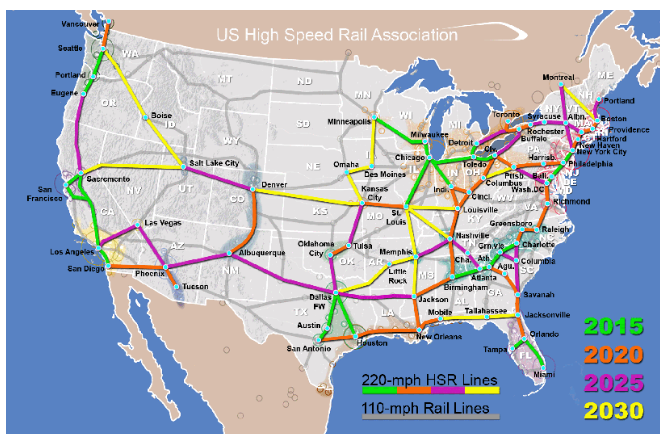
Subpages (2): A Look at L.A.: Should We Advocate for Light Rail? The Underlying Science: Efficiency and Emissions

Transportation Systems

Search this site

- A Better Way to Get Around
- The Team
- Project Definition
  - The Physics
  - How did we get to this point?
- American Freight Movement
  - Freight Trains vs. Freight Trucking
- High Speed Rail
  - The Future of American Transportation: Is HSR the Answer?
- Light Rail
  - The Underlying Science: Efficiency and Emissions
  - A Look at L.A.: Should We Advocate for Light Rail?
- Urban Biking
  - A Challenge to the City of Eugene
- Sitemap

High Speed Rail



What is High-Speed Rail?

High-speed trains are passenger transportation vehicles that are significantly faster than conventional trains. In the United States, HSR is defined as trains traveling at speeds above 125 miles per hour. The fastest train on record reached 361 mph, but most high-speed passenger trains in China and Europe average just under 200 mph. These trains are powered by electricity and can reach maximum speed in under 5 minutes.

What would a High-Speed Rail Network look like in the United States?

President Obama has called for a network that connects the entire country with high-speed rail. Trains reaching speeds of 220 mph would connect densely populated cities with one another, and more scarcely populated regions would still have access to trains traveling at 125 mph. By 2030, 80% of Americans could have access to high speed railways within 25 miles of their home (either directly, or through the use of various forms of public transportation).

What are the benefits to creating a High Speed Rail Network in the United States?

Advocates of President Obama's proposal support making massive capital investments immediately so that the system can be implemented and can begin to facilitate the transition towards a more sustainable way of traveling. Approving federal funds for a this project could pave the way for a more energy efficient, environmentally friendly, economically enhanced nation. In 2008, President Obama said, "Building a new system of high speed rail in America will be faster, cheaper, and easier than building more freeways or adding to an already over-burdened aviation system - and everybody stands to benefit." [1]

How do High-Speed Trains work?

The electricity that powers trains is generated at a plant and is then distributed through wires and transmitted to the train when it connects to a cable. The overhead distribution causes minimal loss of energy and provide a smooth, clean transmission of energy in the form of heat.

How do High-Speed Trains compare to cars?

High-speed trains are not subject to congestion, inclement weather or stop-and-go traffic. They have the potential to be much more energy efficient, and could significantly reduce travel time and costs when compared to automobiles.

What are the drawbacks to developing a High Speed Rail Network?

Depending upon ridership, the hefty economic and environmental costs of improving existing railways and establishing new routes could potentially outweigh the benefits. Although trains are more energy efficient than most other forms of transportation when measured by kilojoules used per passenger mile, it is important to factor in the financial and environmental costs of creating new infrastructure, as well as the possibility that potential passengers will have little incentive to take the train over other forms of transportation. Randal O'Toole of the Cato Institute argues "high-speed rail is slower than flying, less convenient than driving, and five times more expensive to the passenger than either one." [2]

Where have High-Speed Rail systems proven effective?

Many countries in Europe and Asia have sophisticated networks of HSR that connect densely populated cities within the country, as well as lines that facilitate international travel. Spain, France, Germany, Italy, China and Japan are all examples of countries that have successfully implemented HSR networks that make traveling convenient, economical and environmentally friendly! In the United States, the only current HSR line is located in the Northeast Corridor, and connects Boston, New York City and Washington DC.

How much will the entire network cost?

The US Transportation Secretary, Ray LaHood, estimates that the entire project would cost a total of $500 billion over the course of the next 20 years. The funding would be allocated in 3 phases, beginning in 2012, with an estimated completion date of 2030.

What is the current status of the High-Speed Rail Network proposal?

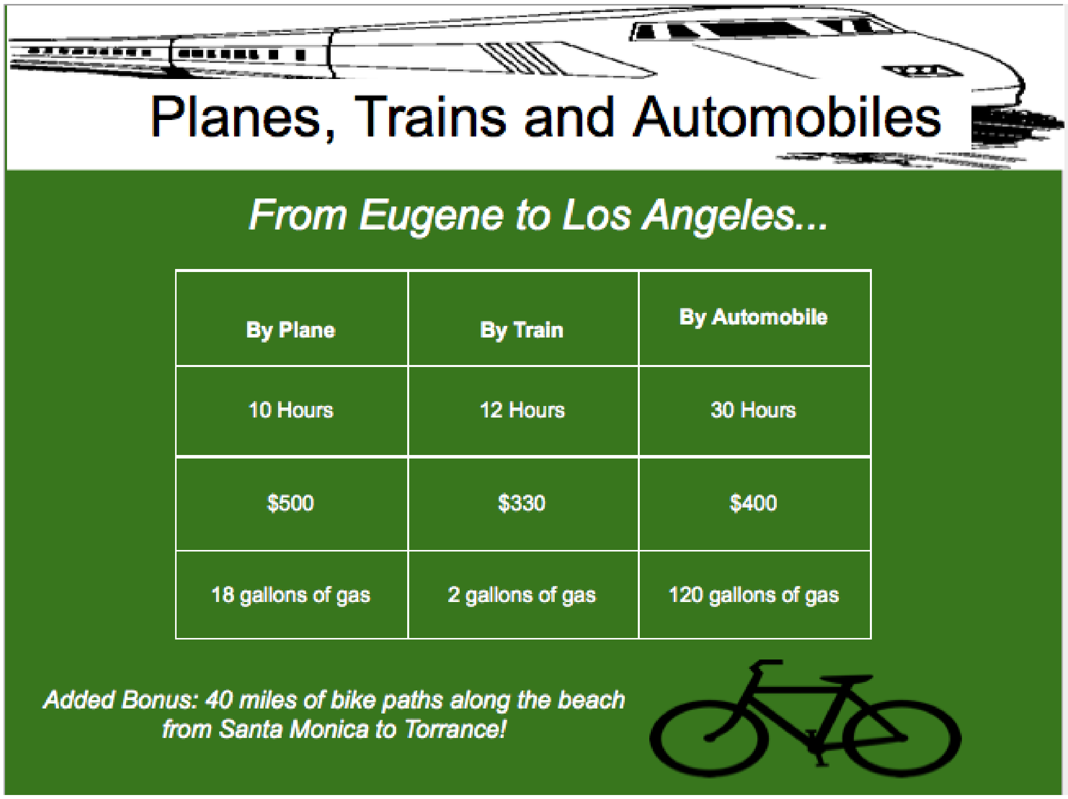
The United States HSR Association claims that 88% of Americans support the development of a nationwide network of high-speed trains, but federal funding has been limited to projects in California, the Northwest and Texas. Currently, advocates are pushing for funding to expedite the process and begin connecting the entire nation.

What can I do to advocate for a High Speed Rail route near me?

Contact your local government representatives or join the United States High Speed Rail Association in their efforts to pass legislation and get funding for the national HSR network!

How would this affect me as a traveler?

The travel costs for high-speed train tickets have not yet been determined, but in order for HSR advocates to attain the projected ridership, ticket prices and travel time would have to be competitive with other forms of transportation. Here is an example of a passenger using HSR to travel from Eugene to Los Angeles, should this line be approved.



[1] Stark, Lisa (2009) **President Obama Lays Out Plan for High-Speed Train Travel**, ABC News, 04.16.09, accessed 10.18.11 (http://abcnews.go.com/Travel/story?id=7351798&page=1#.TuJ-5k8RBFY)

[2] Jones, Charisse (2011) **High-Speed Train System Has a Long Way to Go**, USA Today Travel, 02.15.11, accessed 12.02.11. (http://travel.usatoday.com/news/2011-02-15-businesstravel15_ST_N.htm)

Subpages (1): The Future of American Transportation: Is HSR the Answer?

Comments

Alexandra Rempel - Nov 17, 2011 1:47 PM

This is a great start! Would it be possible to continue your story here, linking out to supporting details? For example, your "individual narrative" starts with historical context. That part could become a page about historical context, called something engaging like "The Roots of High-Speed Rail" (telling your reader what you're up to, without scaring them at the prospect of a dry history lesson).

Transportation Systems

Search this site

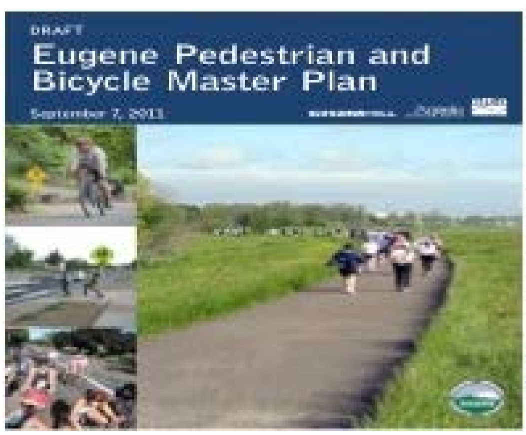
Urban Biking >

A Challenge to the City of Eugene

The Need for a Stronger Bike Infrastructure Policy: An Analysis of the City of Portland's Commitment to Biking and a Challenge to the City of Eugene

Background

In 1973, the Portland Bureau of Transportation developed its first bike plan,1 and in the late 70's the Bicycle and Pedestrian Advisory Committee formed in Eugene2 and began advocating for city investment in bike infrastructure. These organizations began planning and implementing projects that established hundreds of miles of bike accessible routes in their respective cities. In the early 90's, the City of Portland began recording data on bicycle use within city limits and in 1995, Bicycling Magazine rated Portland as the most bike friendly city in the U.S.3 The Portland Bureau of Transportation followed up on this designation by creating an official Bicycle Master Plan, and in 2003, the SmartTrips initiative began in order to create more awareness about the accessibility of biking in Portland and the resulting benefits from increased biking. The City of Eugene created its first Bicycle Master Plan in 1974,4 and it wasn't until 2010 that city planners and bike advocates came together and committed to revising the outdated plan.



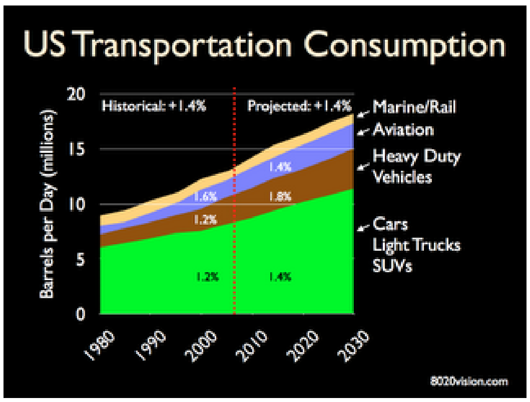
5 6

Issue Introduction

As of 2010, 11% of commuters in Eugene used biking as their primary mode of transportation,7 whereas 6%8 of Portland commuters relied primarily on biking. Although this would seem to suggest a stronger bike culture in Eugene, the greater size of Portland (in area and population) makes the comparison a complicated one. What can be measured more accurately is the percent growth rate in bike ridership after the implementation of bike plans, and the extent of resources committed to enhancing these plans and increasing the growth rate. Since 2010, each city has developed an updated Bicycle Master Plan that extends out twenty years (2030 for Portland and 2031 for Eugene) Although the plans are somewhat similar, the plan created by the City of Portland is more comprehensive, thorough, and ready for action. A comparison of the efforts and investment of each city since the early 90's reveals that Portland is more committed to increasing bike use. The purpose of this essay is to encourage the city planners of Eugene to fully embrace the current Eugene Pedestrian and Bicycle Plan and strive to improve it according to the model set forth by the Portland Bicycle Plan for 2030.

Relevance

Between 1970 and 2009, the number of highway-registered vehicles has more than doubled from 111,242,295 to 254,212,610.9 The number of light duty vehicles with short-wheel bases, or typical 1-5 person passenger vehicles, has jumped even more dramatically, from 89,243,557 to 193,979,654.10 During the same time period, U.S. motor gasoline consumption rose from 88.7 billion gallons to 137.9 billion barrels.11 As more scholars such as David Strahan begin to recognize the threat of peak oil identified by M. King Hubbert in the 1950's, it is becoming increasingly important for government entities in the United States to devise strategies to reduce oil use. U.S. motor gasoline consumption has increased from about 40% of total oil consumption in 1970, to about 48% in 2009,12 so a pivotal aspect of reducing oil use in the future will be reducing the amount of motor gasoline consumed. Cars, light trucks, and SUVs account for more than 50%13 of motor gasoline consumption, so programs aimed at reducing passenger-vehicle use such as the Portland and Eugene Bicycle Master Plans are steps in the right direction toward more sustainable oil and overall energy use.



14

Energy Use Per Transportation Mode

Vehicle Type	Load Factor (persons/vehicle)	Energy Use (BTU/vehicle-mile)	Energy Intensity (BTU/passenger-mile)
Cars	1.6	5489	3496
Personal Trucks	1.7	7447	4329
Taxi & Van (demand response)	1	14952	14301
Vanpool	6.4	8226	1294
Bus - Transit	8.7	38275	4318
Airline	90.4	358000	3959
Rail - Intercity (Amtrak)	17.9	51948	2760
Rail - light & heavy	22.4	70170	2750
Rail - Commuter	32.9	91525	2569
Walking @ 3-4 mph	1	0.32	0.32
Running @ 6-8 mph	1	0.45	0.45
Bicycling @ 10 mph	1	0.1	0.1
Bicycling @ 20 mph	1	0.15	0.15

Vehicle Data: US DOT
Human Data: 252 kcals per BTU

Data compiled by John McGovern
Earth Day Coalition's Clean Transportation Program

15

As seen by the table above depicting energy use per transportation mode, the average BTU, or British thermal unit (approximately 1055 joules),16 intensity per passenger-mile of a car is more than 23,000 times that of a bike going 20 miles per hour.17 This immense energy cost occurs primarily through the combustion of motor gasoline that propels the average 4,000 pound car18 to street legal speeds of up to 60-70 miles per hour, and often faster, although the above calculations are undoubtedly based on an average car speed calculation. Based on the much greater number of cars in the U.S. compared to the other transportation types listed above, the point here is that cars consume the most total oil. Bikes are thousands of times more energy efficient than cars, so increasing the ability of city commuters to use bikes instead of cars will result in massive amounts of local energy conservation. The further drive this point home, the manufacturing of bikes uses considerably less energy than automobile manufacturing.

Life-cycle efficiency of transport modes

Transport Mode	Energy Component	Energy use (MJ / pkm)	
		Low	High

Car	Operating	2.7	3.7
	Manufacture	0.5	1.0
	Total	**3.2**	**4.7**
Bicycle	Operating	0	0
	Manufacture	0.08	0.08
	Total	**0.08**	**0.08**

19 20

According to the table above and to the left, it takes anywhere from about 6 to 12 times as much energy to manufacture a car as it does to manufacture a bicycle. This fact coupled with the immense energy savings from operating a bike versus a car (the energy cost of bike operating is so low that is does register on the table above based on a measurement in megajoules per kilometer) means that commuters who primarily use bikes save a great deal of money that would otherwise be spent on buying a car and filling it with gas. Joe Cortright, a nonresident Senior Fellow with the Brookings Institute, estimates that the extent of bike riding in Portland results in $1.2 billion in savings per year compared to the national average of savings due to bike use (graphic above and to the right).21 Of this $1.2 billion, $800 million stays within the Portland economy, as bike riders spend their gas and vehicle savings on other goods and services.22 Furthermore, every $1 increase in gas price per gallon costs Portlanders $240 million per year, as this revenue is diverted out of the Portland economy to major gas companies.23 Considering gas prices increased $1 in Oregon between October 2009 and September 2011,24 and that prices will likely continue to rise as the global oil supply dwindles, it is imperative that communities reduce their oil consumption in order to promote sustainable economic growth. It is also important to note that the estimated savings are based on the difference between the 6% of current Portlanders who commute primarily by bike, and the approximate 1% of national commuters who do so.25 If this 5% difference results in $1.2 billion saved and $800 million circulated back through the economy, the amount of savings will be immense it the City of Portland achieves its goal of having bicycles account for 25% of intercity commute. Assuming the national average remains at 1% (hopefully it won't), and 25% of Portland commuters use bikes as their primary means of transportation in 2030, Portland citizens will save $5.76 billion compared to the citizens in the average U.S. city and $3.84 billion of this money will remain in the Portland economy.26

In short, efforts to increase bike use result in immense energy savings and monetary savings.

The Issue

Based on the data above, it is clear that projects dedicated toward increasing bicycle use are very beneficial. Although Eugene's percentage of citizens who use bikes as their primary mode of transportation is the highest in the country,27 and the Eugene Bicycle and Pedestrian Plan would seem to suggest a commitment to enhance this percentage, the plan itself is relatively hollow and lacks a clear focus. An article in Eugene Weekly written by Alan Pittman on July 7th, 2011, illustrated the apparent "lack of teeth" in the Eugene plan and revealed the frustrations of those involved in the project. According to Pittman, the "dryly worded plan contains only vague proposed policies that largely correspond to existing city policies without calling for measurable increases in city efforts and results to increase cycling."28 A member of the Technical Advisory Committee named Fred

Tepfer, a University of Oregon employee and long time bicycle advocate, stated bluntly that he was ““very disappointed in the plan”” because the policies were weak and would likely do nothing to change the status quo.29 Pittman described how the plan lacked “specific total mileage of bike infrastructure to build, nor monitoring of progress toward that goal,” and did not have a “calculation or goal for transportation spending saved by the use of far less costly cycling,”30 similar to the statistics from Cortright that appear in the Portland plan. Rob Inerfeld, a Project Manager for the project from the City of Eugene, explained that the lack of concrete details stemmed from the attempt to create a plan that was realistic, and admitted that the big challenge was ““getting the funding.””31 Overall, Pittman determined that “Eugene’s draft plan comes across flat by comparison to Portland’s. That city’s new bike plan touts the social, environmental and economic benefits of quadrupling biking in the city.”32 After reading the current draft of the Eugene plan, published on September 7, 2011, it seems that the Eugene project planners have addressed some of the issues pinpointed in Pittman’s article. However, the Eugene plan is still a long ways from being comparable to the Portland plan, which is about 5 times longer and contains clearer and more tangible goals and strategies to achieve those goals. Although the Eugene plan seems to be headed in the right direction, I strongly recommend that the team working on this plan continues to improve it according to the model represented in the Portland Bicycle Plan for 2030.

The Portland Plan

One of the major aspects of superiority in the Portland Bicycle Plan for 2030 lies in the excellent data collection and statistical representations that city planners used during its development. The City of Portland began bike counts in 1991 and have been tracking all kinds of bicycle related information since then. Since 1990, compared to Portland’s population growth, bicycle use in Portland has increased approximately 400%, while transit use has increased 18% and car use has declined 4%.33 The four major Portland bridges analyzed during the annual bike counts have experienced a 12% increase in traffic due to population growth, but there has been a .2% decrease in car traffic on these bridges.34 These statistics reveal the extent to which the efforts of Portland city planners have paid off regarding their investment in increasing bicycle infrastructure, and promoting programs such as SmartTrips.

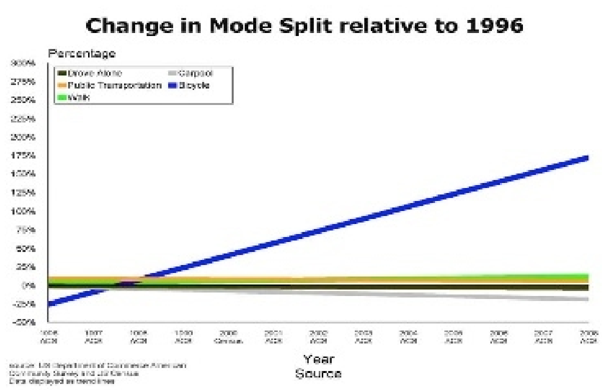


Figure 12. Change in mode split relative to 1996 (Trend Line)

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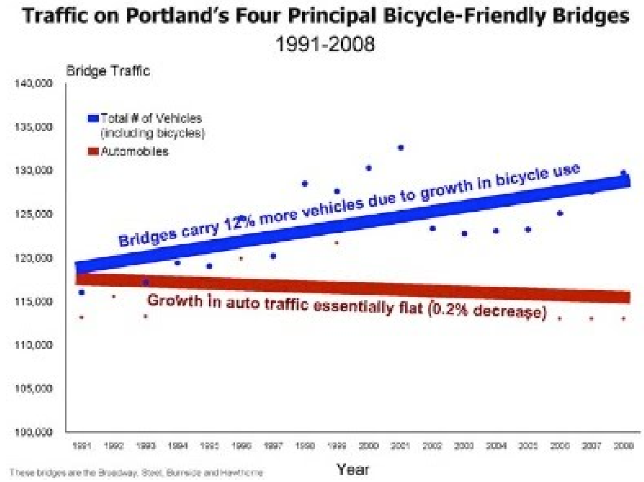
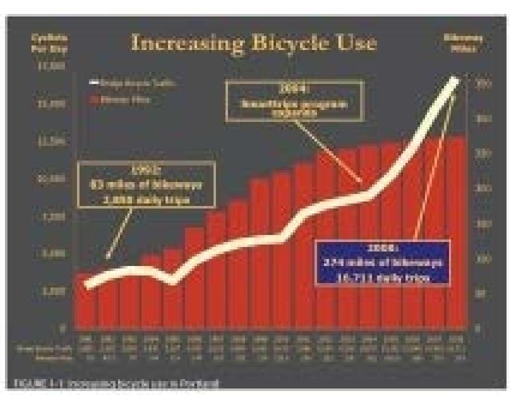


36

Another piece of this data that is worth noting is the cost associated with bike infrastructure versus car infrastructure. Since 1995, the City of Portland has spent about $153 million on active transportation infrastructure, which includes biking and walking, $2.12 billion on transit infrastructure, and $4.23 billion on roadway infrastructure.37 Because active transportation is split into pedestrian and bicycle infrastructure, the amount spent on bicycle infrastructure alone was even less than $153 million. Roger Geller, the Bicycle Coordinator for the Portland Bureau of Transportation, says, "In the 15-year period between 1995-2010 the Portland Metropolitan Region invested into bicycle transportation 1.8% of what it invested into roadway improvements and 3.6% of what it invested into transit. The return on investment has been highest for bicycle transportation."38 If these numbers are compared back to percent increases per mode of transportation since 1990 (although the statistics from 1995 don't correlate perfectly with those from 1990, the comparison remains strong) it is evident that the fraction of investment in bike transportation compared to transit and roadways has resulted in a much greater increase in bike use than transit and car use. In 2008, the Portland Bureau of Transportation estimated that the current 300-mile bikeway network would cost $60 million to replace, which was the equivalent of only 1 mile of urban freeway.39 Overall, bicycle infrastructure is ""by far the most cost-effective way to provide for personal mobility in an urban transportation system.""40



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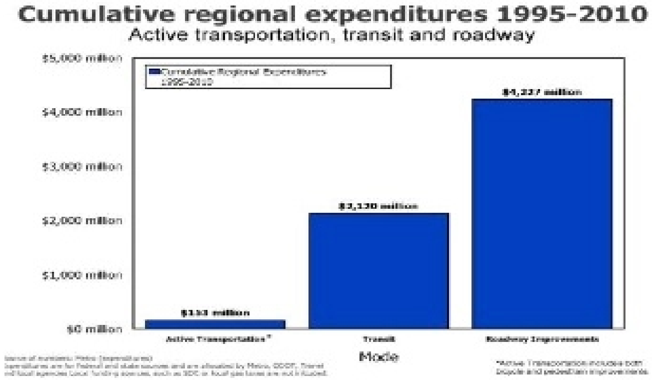

43

Another major aspect of superiority for the Portland Bicycle Plan for 2030 is the actual language used in the plan, and the clarity of its commitments. The Eugene plan vaguely states that its goal by 2031 is to "double the percentage of trips made on foot and by bicycles from 2011 levels."44 There is no reference to the current percentage of either mode of transportation, and the rest of the plan seems to follow this hollow trajectory, even though there have been improvements since Pittman's critical article. The most recent draft includes some cost estimations for proposed projects, but the Eugene plan does not go into nearly as much detail as the Portland plan, and seems less ambitious. On the other hand, the Portland plan states specifically that its goal is to "create conditions that make bicycling more attractive than driving for trips of three miles or less."45 This is coupled with an aim to enforce policies that will lead the city to achieve the goal set out by the joint City of Portland-Multnomah County Climate Action Plan 2009 that "calls for 25% of all trips in the county to be accomplished by bicycle by 2030."46 The Portland plan also aims to allocate a combined $600 million to bicycle programs and bicycle infrastructure projects.47 This funding will allow for the continuation of bike education programs in schools and other programs such as SmartTrips as well as the completion of an intended 962 miles of bike infrastructure, which is 332 miles more than was previously planned for, and 662 miles more than the current total.48 The Portland plan goes into extensive detail about safety measures, environmental improvements, and the health benefits associated with increased bike use and decreased car use, and explains how these issues will become increasingly relevant as Portland experiences an estimated population growth of 1 million by 2030.49

COSTS of citywide bicycle facilities:

FACILITY	FUNDED*		IMMEDIATE / 80 PERCENT		WORLD-CLASS		TOTALS	
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
Trails	2.9	$9,871,000	40.7	$77,311,000	35.0	$35,379,000	78.6	$122,561,000
Separated in-roadway bikeways (bike lanes, buffered bike lanes, cycle tracks)	14.6	$4,921,000	92.7	$105,269,000	278.4	$279,051,000	385.7	$389,241,000
Bicycle boulevards and advisory bike lanes	26.0	$7,975,000	155.3	$38,820,000	74.9	$18,733,000	256.2	$65,528,000
Enhanced shared roadways	0.7	$123,000	38.8	$3,536,000	7.1	$782,000	46.6	$4,441,000
Total	44.2	$22,890,000	327.5	$224,936,000	395.5	$333,945,000	767.1	$581,771,000

*"Funded" project costs are for bicycle elements of projects only (see List of Funded Projects on page A-14 for full project costs). Calculations for miles and costs in "immediate / 80 percent" and "world-class" do not include miles and costs shown as part of funded projects.

FIGURE 5-2: Costs of citywide bicycle facilities

50

51 52

Conclusion

Overall, the Portland Bicycle Plan for 2030 is more complete and more comprehensive than the Eugene Pedestrian and Bicycle Master Plan. The point of this essay is not to condemn the work of the Eugene project staff, in fact, the effort put forth by the Eugene project staff is a significant step in the right direction, and one that city planners across the U.S. should undertake immediately. Instead, this essay should be seen as an encouragement for the City of Eugene to continue on with the development of its plan, and put as much emphasis on increasing bicycle infrastructure as possible. The fact that Eugene already has the highest percentage of commuters who use bicycles as their primary means of transportation shows the immense potential of any project, especially a project similar to the one already adopted in Portland. In short, the City of Eugene should fully support the efforts of the Eugene Pedestrian and Bicycle Master Plan staff, and the City of Eugene should do everything in its power to obtain and allocate the funds needed to complete the project. Increasing bicycle use is a vital aspect of creating sustainable communities that will prosper as the 21st century progresses.

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1 **Portland Transportation History Timeline.** *Portland Bureau of Transportation.* accessed 12.8.2011. http://www.portlandonline.com/transportation/index.cfm?c=36416&a=65562

2 Seager, Mike. **Eugene Bicycle History Online at City of Eugene Website**. *Webikeeugene.org.* accessed 12.8.2011. http://www.webikeeugene.org/2010/08/31/eugene-bicycle-history-online-at-city-of-eugene-website/

3 **Portland Transportation History Timeline.** *Portland Bureau of Transportation.* accessed 12.8.2011. http://www.portlandonline.com/transportation/index.cfm?c=36416&a=65562

4 Seager, Mike. **Eugene Bicycle History Online at City of Eugene Website**. *Webikeeugene.org.* accessed 12.8.2011. http://www.webikeeugene.org/2010/08/31/eugene-bicycle-history-online-at-city-of-eugene-website/

5 Cover page of Eugene Pedestrian and Bicycle Master Plan, downloaded 12.8.2011 http://www.centrallanertsp.org/EugeneTSP/PedBikePlan/Home

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7 Pittman, Alan. **Eugene Bike Plan Wobbles Along: Bicycle Advocates say plan needs pumping up**. *Eugene Weekly.* published 7.21.11.

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25

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28 Ibid.

29 Ibid.

30 Ibid.

31 Ibid.

32 Ibid.

33 Geller, Roger. Build it and they will come: **Portland Oregon's experience with modest investments in bicycle transportation. Portland Bureau of Transportation.** published 4.2011. downloaded 12.8.2011, 1.

34 Based on graph from: Geller, Roger. **How Portland Benefits from Bicycle Transportation.** *Portland Bureau of Transportation*. no publish date given. downloaded 12.8.2011, 2.

35 Graph from: Geller, Roger. Build it and they will come: **Portland Oregon's experience with modest investments in bicycle transportation. Portland Bureau of Transportation.** published 4.2011. downloaded 12.8.2011, 12.

36 Graph from: Geller, Roger. **How Portland Benefits from Bicycle Transportation.** *Portland Bureau of Transportation*. no publish date given. downloaded 12.8.2011, 2.

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38 Geller, Roger. **Build it and they will come: Portland Oregon's experience with modest investments in bicycle transportation. Portland Bureau of Transportation.** published 4.2011. downloaded 12.8.2011, 12.

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52 Ibid, 150.

Transportation Systems

Search this site

A Better Way to Get Around
The Team
Project Definition
The Physics
How did we get to this point?
American Freight Movement
Freight Trains vs. Freight Trucking
High Speed Rail
The Future of American Transportation: Is HSR the Answer?
Light Rail
The Underlying Science: Efficiency and Emissions
A Look at L.A.: Should We Advocate for Light Rail?
Urban Biking
A Challenge to the City of Eugene
Sitemap

A Better Way to Get Around > Project Definition >

The Physics

- Work: Work is key metric to measure when talking about transportation. None of the infrastructures mentioned (highway, rail, bus lines) requires that a specific type of energy source be used. The only requirement is that this fuel be converted into mechanical work to drive the vehicle towards its destination. The work required to maintain current systems is typically less than the work that would be exerted to construct new systems. This is an important factor when considering the overall efficiency of developing new transportation systems.
- Heat: Car engines use heat to run, but they are not always effective in maximizing the thermal energy. Once a car is started, the fuels reach a high temperature and pressure, which can be translated into work by the engine. Larger vehicles require more heat, as they need more power to move.
- Entropy: The entropy involved in transportation is directly related to the energy and heat of a system. In fuel-based cars, the heat is generated by igniting fuels, and is used up between the time a car is started and reaches its destination. The required joules are proportionate to the size of a transporter, the weight of the cargo and the efficiency of the engine.
- Efficiency: The efficiency of any given transportation is probably the most important metric to consider when doing any comparison. The efficiency of any form of transportation can be measured by the joules required per passenger, per kilometer (or mile). Although buses, trains and other forms of mass transit use more joules per kilometer, it is important to factor in the number of passengers. A compact car may use 1 MJ to transport the driver 30 miles. However, a bus that uses 20 MJ to travel that same distance may carry 100 passengers.
- Energy: The energy required to actually make any of these systems work in the first place is another key measurement to take into account. Even if the system represents a greater efficiency over time, if it takes dramatically more energy and materials to implement in the first place, there is little incentive to switch from the status quo. Embodied energy would include the work it takes to do all of the construction, obtain all of the materials, and anything else that would need to be done to get the system up and running. Since very little data was available for embodied energy of existing transportation projects, the metric of dollars spent on the project is used to get a rough idea of the energy used in a project. A highway is an example of a very high material requirement, with the amount of cement used to just repair highways in 2005 reaching 40% of cement used in the US that year 1. Energy costs are higher in areas with high energy concentration.

A Better Way to Get Around > Project Definition >

How did we get to this point?

Primitive Transportation Methods

Initially, humans relied solely on human muscle output for transportation, as ancient hunter-gatherer societies navigated the simple hunting trails they had carved out while tracking their food. Over time, humans domesticated animals, and a significant amount of transportation work was transferred over to animal muscle output. Sedentary and agriculturally dependent populations continued to rely increasingly on the energy they extracted from plants either directly, or indirectly as they consumed meat from animals who either ate plants or herbivores. As these early agricultural societies expanded and realized the benefits of trade and conquest, a need for more efficient transportation arose. Beginning in 500 B.C.,[1] the Roman Empire built an organized system of roads that eventually spanned across the empire in order to connect major population centers, facilitate trade, and increase the speed of military transportation. The Romans were unique because they had the resources and centralized planning needed to develop and maintain the extensive roadway infrastructure, and when their empire crumbled, these roads largely fell into disrepair as the volume of goods and people moving on them decreased. Roadway projects similar to that of the Romans were not revisited until the 17th century in Western Europe.

Roman Roadway Network[2]

Roman Road[3]

Water Transportation

However, land transportation was quickly supplemented by the use of waterways in other ancient societies. The Egyptians and Phoenicians constructed the first river boats between 4000-3500 B.C.,[4] marking a shift from transportation based on muscle energy alone, to transportation that incorporated water currents and wind power. Boating technology became increasingly refined as large cargo boats began transporting goods along established trading networks, as their sails utilized not only the flow of water but the wind. Before long, boats became military vessels, and entire populations, such as the Nordic Vikings, began migrating to new lands using boats and establishing new population centers. In terms of infrastructure, building to facilitate water transportation typically entails creating a canal. The ancient Mesopotamians initially built irrigation canals dating back to approximately 4000 B.C., and the Egyptians created canals to bypass cataracts in the Nile as far as 2300 B.C.[5] More modern projects such as the Panama canal have opened vital trade routes, but today, a significant percentage of human transportation efforts have shifted from water to roads, highways, and air travel. Transportation by water allowed a much greater level of mobility than land in these societies because it utilized the Earth's natural energy flows, currents and winds, to do work and move the boats. On the other hand, land travel requires a much higher concentration of energy in the form of fuels that had to either be grown or foraged for. The shift back towards land transportation and the building of land transportation infrastructure didn't occur until the industrial revolution.

Ancient Water Trade Routes[6]

Egyptian Suez Canal on the Nile[7]

Limits

Generally, roads develop in societies as the need for moving people and commodities between areas increase. These needs generally stem from an increase in population and an increase in available energy. This occurred in the Roman Empire because of the amount of energy it had control of, and the vast population and trade network that developed within it. However, upon the fall of the Roman Empire, these roads largely fell into disrepair as the volume of goods and people moving on them decreased, and the energy available to repair them disappeared. In pre-industrialized England, transportation was limited in scale and in variety. The majority of people lived outside of the urbanized centers, with only 17.5% in towns with populations above 10,000 by 1750.[8] As energy production was land based, these population centers required massive amounts farm land surrounding them to support the population. The roads going through these areas had very low traffic due both to the low number of people using them and the scarcity of goods that were worth transporting a great distance, and thus were not well maintained.[9] This caused the transportation cost of materials to be very high, as primitive methods were frequently required, such as pack horses.[10] Another important phenomenon in pre-industrial England was the limited availability of land for production. Any increase in the production of any good necessitated increased land use, and as production grew, so did the amount of required land. At this point in time, the land was largely dedicated to food and fuel production. Because of this, population growth and the demand and production of goods were slow to increase. These circumstances resulted in a lack of large scale transportation networks existing in pre-industrial England, as well as a lack of demand for them.

The Industrial Revolution and Coal

The Industrial Revolution did not transform systems of transportation simply because it could. Changes were a byproduct of increased agricultural output and the growing use of coal. Coal allowed more energy to be extracted from the land than ever before, and allowed humans to overcome the previous limitations on production and growth, i.e. more growth necessitates the use of more land. This had several effects. As labor became more divided, distance grew between the producer of a good and its final consumer.[11] The exchange of goods and services was no longer contained to a single farm or small community; what began on a farm could make its way to a city to be used as part of a secondary industry. Since producer, intermediary, and consumer were spread apart, goods had to travel further to their final destination. As crop output rose with new technologies (such as fertilizers and new methods of farming), there were more oats for horses to eat, which resulted in more power for the horses, allowing them to travel farther. Additionally, “There was a massive rise in the scale of road transport in the later seventeenth and eighteenth centuries, facilitated by the rapid increase in the mileage of turnpike roads, and therefore a parallel rise in the need to employ more horses.”[12] Between 1681 and 1840, the annual rate growth of goods traffic by road between London and the provinces exceeded 1%. This was a cumulative growth of roughly sixfold over the span of only 160 years.


With such rapid growth in England during this time period, the systems of transportation evolved and expanded. An increase in the production of and reliance upon coal sparked the development of the canal system, and eventually, the railroad system. Not only did the rising use of coal facilitate the necessity for transporting it, but it simultaneously fueled the development of methods used to transport it. A rise in urban growth required "inter-town linkages" and the development of single roads in order to transport people and goods more directly, and without expending excessive energy.[13] Thus, there were systems to transport rapidly by water and by land.

Single roads and canal transport were fast and efficient, but the development of railways made it inexpensive to transport coal by land. The widespread use of coal and the increased societal and economic dependence upon it helped compensate for the diminished availability of other natural energy sources while the population steadily increased during the Industrial Revolution.[14] As the availability and use of coal increased, a rising number of secondary jobs were created, and as masses of people migrated towards industrialized urban centers for work, the need for more transportation rose. Trains were an efficient method for transporting the masses into the city centers. The railway system in England was so much more effective in transporting people, material goods and coal than previous methods that an increasing amount of energy and resources were directed towards continual development of infrastructure, which in turn fueled the dependence of the English people on railway transportation.

The Industrial Revolution also made huge changes in how Americans were able to travel. The increased use of coal caused the cost of creating the large transportation networks needed to move goods across the large country possible and economically viable. No form of transport was more important in this time than locomotives, with track mileage in the U.S. increasing ten fold from 1840 to 1860.[15] In 1869, the transcontinental railroad linked the eastern and western coasts of the United States, cementing coal's role as the fuel that trade and travel relied on. This not only made expedient travel an expectation, it also made the use of fossil fuels for transportation a necessity.

The 20th Century

Moving into the 20th century, the invention and popularization of the car as well as the discovery of other types of fossil fuels caused the US government to invest more and more in roads and highways. Over this period, the car replaced rail for the chosen method of passenger transportation, especially after President Eisenhower's *Federal Aid-Highway Act of 1956* which fueled the construction of 40,000 miles of highway in the US till 1980.[16] During this time period, use of passenger rail plummeted as personal energy use increased due to car usage.


INTERCHANGE BETWEEN THE 5 AND 110 FREEWAYS,Los Angeles, United States (N 34°02' - W 118°16')


Currently, the vast amount of travel, whether it is people or cargo, is done with cars and trucks on the US highway system. Currently, 88.7% of passenger movements (measured in passenger-miles) is done on the highway, with 10.61% through airways, 0.56% railways, and 0.04% waterways.[17] Cargo (measured in ton-miles) currently lies at 34.4% highway, 31.1% railway,11.0% waterway, and 0.03% air.[18]

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[1] Rodrigue, J. & Brian Slack. (2011) **The Geography of Transport Systems: Road Transportation,** *Department of Global Studies and Geography, Hofstra University*, 2011, accessed 10.30.11. (http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/ch3c2en.html).

[2] Rodrigue, J. (2011) **The Geography of Transport Systems: Roman Road Network.** *Department of Global Studies and Geography, Hofstra University*. 2011, accessed 10.30.11. (http://people.hofstra.edu/geotrans/eng/ch2en/conc2en/romannet.html).

[3] Taylor, T. (No date given) **History of England: Roman Roads.** *Historic-UK.com* 2011, accessed 10.30.11 (http://www.historic-uk.com/HistoryUK/England-History/RomanRoads.htm).

[4] Nickolsen, J. (2011) **Sailboat History Timeline 1.** *Timeline Help.* 2011, accessed 10.30.11. (http://www.timeline-help.com/sailboat-history-timeline.html).

[5] No author given. (2011) **Canal.** *Wikipedia*. Last updated 11.04.11, accessed 10.30.11 (http://en.wikipedia.org/wiki/Canal).

[6] No author given. (2011). **Phoenicia.** *Wikipedia.* Last updated 11.01.11, accessed 10.30.11 (http://en.wikipedia.org/wiki/Phoenicia).

[7] http://www.multimedia-publishing.com/egypt.htm

[8] Wrigley, E.A., **Energy and the English Industrial Revolution**. Cambridge: Cambridge University Press, 2010. Page 59.

[9] Ibid, Page 102.

[10] Ibid, Page 102.

[11] Ibid, Pages 30-31.

[12] Ibid, Page 31.

[13] Ibid, Pages 42-43.

[14] Ibid, Page 243.

[15] No author or date given. **America on the Move: Transportation Infrastructure**. *National Museum of American History*. Accessed 10.30.11 (http://americanhistory.si.edu/onthemove/themes/story_47_1.html).

[16] Cox, W. & Love, J. (1996) **40 Years of the US Interstate Highway System: An Analysis The Best Investment A Nation Ever Made.** *The Public Purpose,* accessed 10.30.11 (http://www.publicpurpose.com/freeway1.htm#intro).

[17] No author or date given. **Passenger-Miles, 1993-2005.** *Research and Innovative Technology Administration.* accessed 10.30.11 (http://www.bts.gov/publications/pocket_guide_to_transportation/2008/html/table_04_03.html).

[18] No author or date given. **U.S. Ton Miles of Freight (BTS Special Tabulation).** *Research and Innovative Technology Administration.* accessed 10.30.11 (http://www.bts.gov/publications/national_transportation_statistics/html/table_01_46b.html).

Freight Trains vs. Freight Trucking

Though it may be hard to tell now, at one point in American history, the train was the most vital part of the country's transportation network. The rising use of coal in industry in America led to production of goods at previously unheard of rates. This coupled with centralization of production and the expansiveness of the country led to a high demand for transportation networks. America's first railroad, the 13-mile Baltimore-Ohio railroad was built in 1930. From this point forward, railway construction ramped up quickly, as is shown on Figure 1.

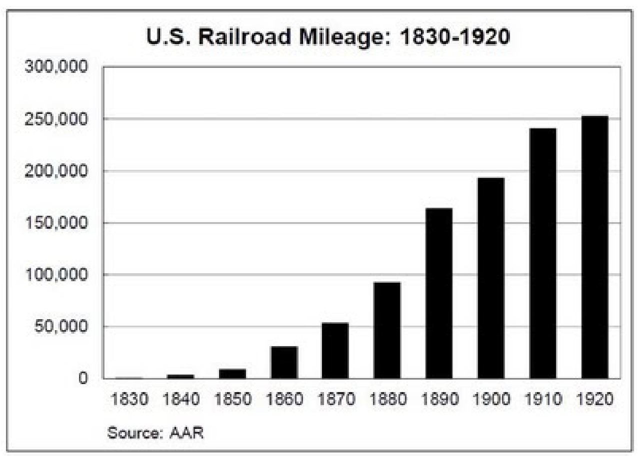

Figure 1: US railroad mileage from 1830-1920 [1]

By 1900, railroads had an effective monopoly on the transportation of goods, as only waterways and canals could compete. However, rail peaked in the 1920's and the Great Depression saw the industry ton-miles fall by

50% and 30% of all rail miles fell into disrepair[2] (http://www.aar.org/~/media/aar/Background-Papers/A-Short-History-of-US-Freight.ashx). WWII saw a brief influx of business, but regulation and other obligations saw railroad freight shares to continue to drop through the 1970's. This can be seen in Figure 2.

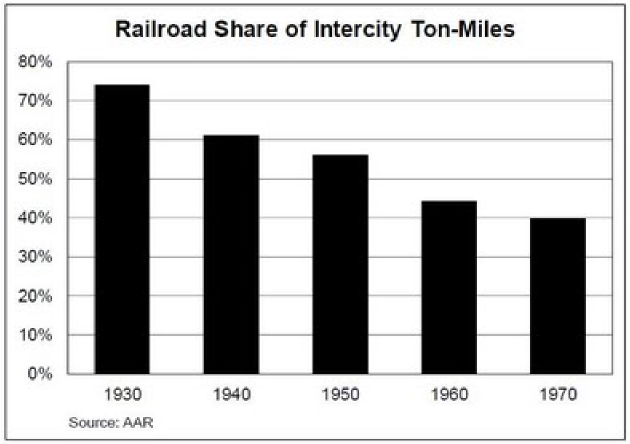

Figure 2: Railroad share of intercity ton-miles 1930-1970[3]

Around this time of rail infrastructure loss, another type of transportation was maturing. The Federal Aid Highways Act of 1956 was passed with support of President Eisenhower. This plan saw the construction of 65,000 km of initially planned highways and connected every city with a population of over 100,000. This had a huge effect on what mode of transportation was used for freight. By 1958, trucking had increased to 20% of intercity ton-miles, and rail was down to 46% [4]

Although deregulation and other factors led to freight train use to slowly recover throughout the 1980's and 1990's, a large percentage of freight shipping in America is still done with trucks. Figure 3 shows that the vast majority of tonnage was moved by trucks in 2002. Figure 4 summarizes the share of intercity ton-miles in 1990 and 2001 for various shipping modes.

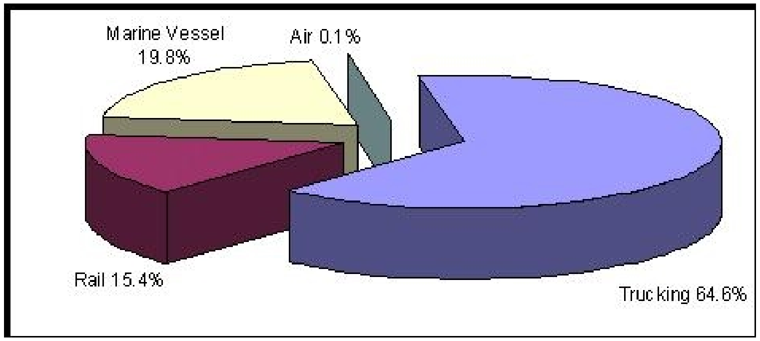

Figure 3: Freight shipping by mode. Units of tons moved.[5]

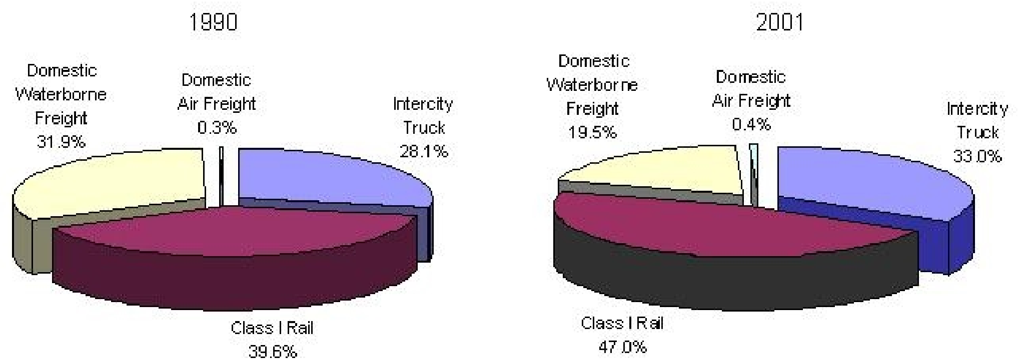

Figure 4: Percent of ton-miles moved by modes in 1990 and 2001.[6]

So what exactly is the problem with freight trucking? It is widely known that trucking is a fuel and material intensive process. An 18-wheel truck can weigh 40 tons, and is made primarily with metals. The average fuel efficiency for this type of vehicle is around 5 mpg, and the trucking industry alone uses 13% of the fuel sold in the US. These statistics would not be so concerning if the world had an unlimited supply of resources, but it doesn't. A peak in world oil production, originally predicted by the geologist M. K. Hubbert whose graph is show in Figure 5, will come in the next 100 years, and probably sooner.

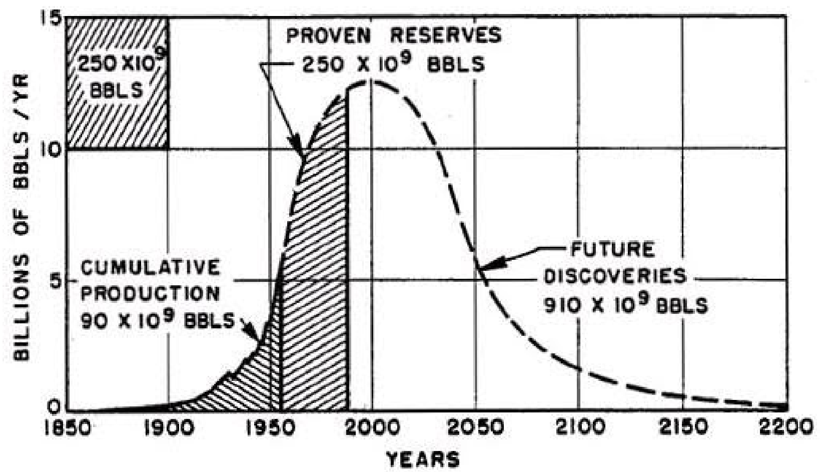

Figure 5: Graph from Hubbert's paper on peak oil.[7]

Our use of resources is increasing exponentially at all times. For example, from 1995 to 2005, the world consumed ¼ of all oil ever produced in human history.[8] Already, price increases are showing the effects of our society's incredible use of resources, Figure 6.

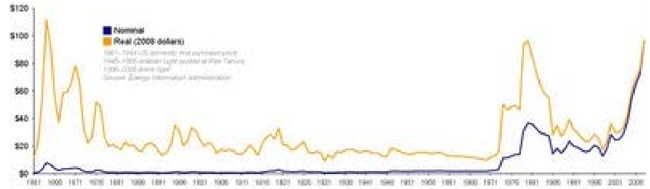

Figure 6: Oil prices 1861-2006 adjusted for inflation.[9] For better view click here

Other resources, especially rare elements, are also approaching dangerous levels of use. As can be seen in Figure 7, we are using up several common materials at an exponential rate that will see resource exhaustion within one to two centuries.

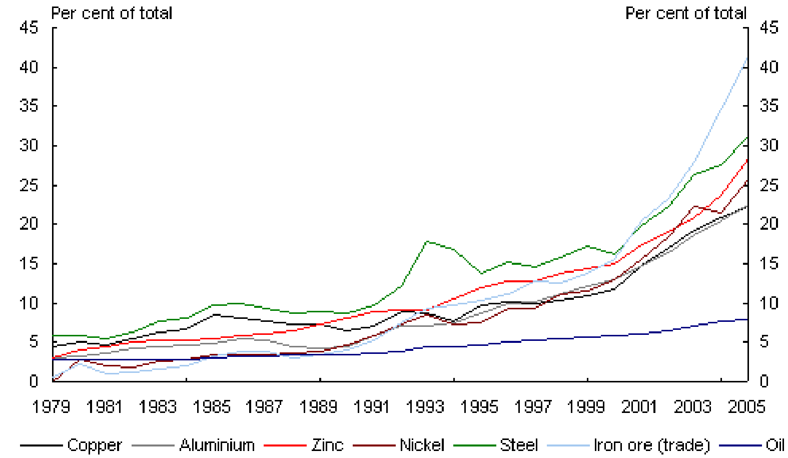

Figure 7: Cumulative use of resources in terms of percent of total reserves. [10]

In light of this fast approaching energy problem, it would be prudent for our society to look for ways to increase the efficiency of its transportation sector. Additionally, federal and state governments are experiencing budget shortfalls and the way transport dollars are spent deserves more scrutiny than ever. In response to this, many proponents of rail systems frequently bring up the fact that trains are much more efficient that trucks for freight movement. In terms of freight transportation, Figure 4 above shows that the modes that represent the most ton-miles traveled in the U.S. are freight trains and trucks by a large margin. This means that these two technologies warrant an efficiency and cost comparison to properly evaluate if either technology is a feasible long term strategy and/or a replacement for the other.

Any plan to replace freight trucking with rail rests on the assumption that freight rail represents this more efficient choice. But is it true that the use of freight trains instead trucks represents significant energy savings? To answer this question the operating efficiency of both modes were compared, as well as the embodied energy their infrastructure represents.

In term of infrastructure, trucking and freight rail have dramatically different footprints. To assess the energy an infrastructure required for its construction, a metric called embodied energy is used. Embodied energy gives an idea of the entirety of the energy required to produce the product, from resource extraction to construction. In short, it gives an idea of the resource intensiveness of the infrastructure element. An embodied energy study is usually conducted by accessing the materials in use in the system, among other analyses. Every type of material has an embodied energy associated with it which depends on its production process. For example, aluminum has a specific energy of 220 MJ/kg, while asphalt concrete is 2.4 MJ/kg. So an infrastructure with relatively low embodied energy will either use less materials, use less energy intensive materials, or both. A freight rail system usually constitutes one or two lanes of tracks, each usually less than 5 feet wide. A cut away of a typical rail road section is shown in Figure 8.

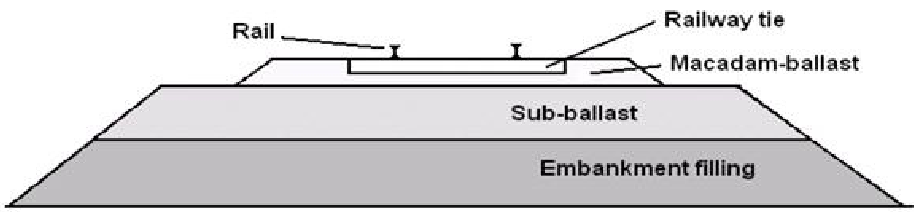

Figure 8: Cross-section of a typical railroad.[11]

The ballast and embankment usually consists of gravel and asphalt, and the tracks themselves are made mostly of steel. In contrast, truck infrastructure (interstate highways), usually consist of 2-4 highway lanes running in either direction, each about 13 feet wide. A schematic of a typical highway is shown on Figure 9.

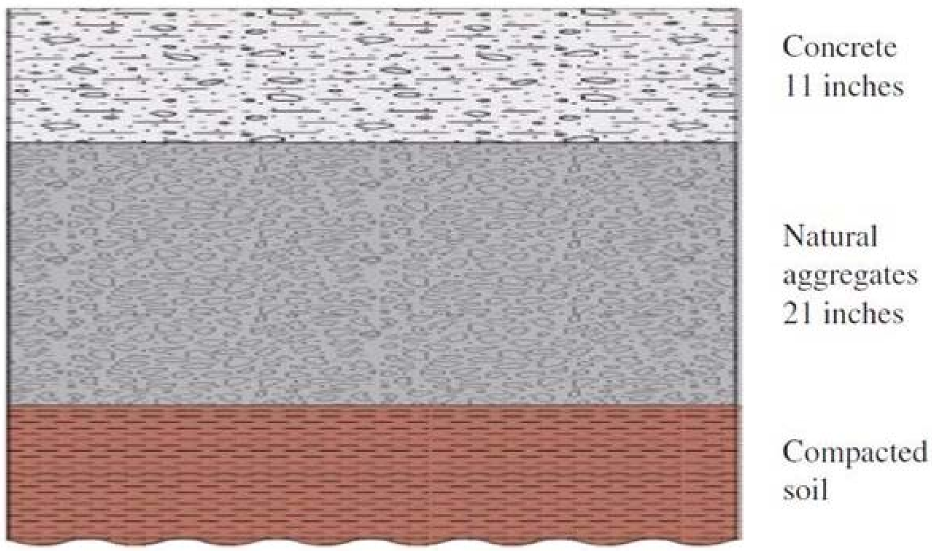

Figure 9: Cross section of a typical highway. [12]

For the calculation of embodied energy two studies were used, one on freight rail and the other on highway. In Environmental Performance of the Rail Transport System in a Life-Cycle Perspective, Karin Sward analyzes the embodied energy of railroads, taking into account materials used, recycleability, and material lifetimes. Her findings are summarized in Figure 10.

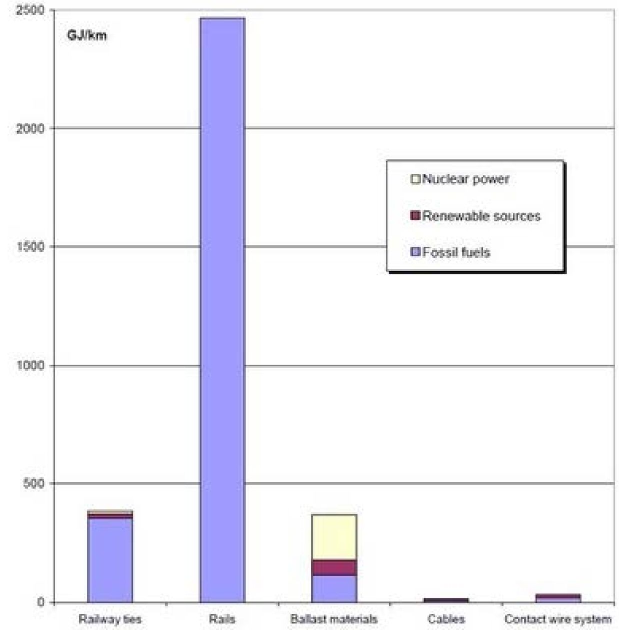

Figure 10: Embodied energy and what part of the rail system constitutes it. [13]

Additionally, Sward estimates the embodied energy of the maintenance each km of rail would require a yield. This is shown on figure F. A similarly themed study, A Life Cycle Perspective On Concrete And Asphalt Roadways: Embodied Primary Energy And Global Warming Potential conducted by The Athena Institute in Ottawa, ON, was used to find the corresponding statistics for highways. Their results can be found in Figure 11.

	Flexible Asphalt Concrete
Pavement Structure	typical
Initial Construction	
Embodied primary energy (GJ)	31,664
- feedstock portion (GJ)	21,543
GWP (tonnes)	738
Rehabilitation	
Embodied primary energy (GJ)	20,566
- feedstock portion (GJ)	15,108
GWP (tonnes)	384
Totals (50-year life cycle)	
Embodied primary energy (GJ)	52,231
- feedstock portion (GJ)	36,650
GWP (tonnes)	1,122

Figure 11: Embodied energy of a 3-lane highway [14]

For comparison, the results of the two studies are displayed on Figure 12.

User not signed in
Sign in

Figure 12: Embodied energy comparison between highway and rail summary

Looking at this table it is easy to see that rail infrastructure is dramatically less material intensive than highway, with eight times less energy used in the initial build, and almost 20 times less spent in maintenance. Additionally, only four years of maintenance on one kilometer of highway uses as much energy as constructing an entire kilometer of rail line from scratch.

It is clear that switching from highway to rail would represent a large saving in terms of the embodied energy of the infrastructure, but what about the operation? The US Department of Transportation had a study titled Comparative Evaluation of Rail and Truck Fuel Efficiency on Competitive Corridors carried out in 2009 in order to find this out. This study compares the fuel efficiencies of trains and trucks which are in direct competition with one another. The study defines this by stating that each truck and train route, or “movement”, being compared have similar starting points and ending destinations, as well as transport the same commodity. Figure 13 displays the ranges of fuel efficiencies for the different types of train cars in use. Figure 14 shows the same statistic but for the varying types of truck trailers in use. For a reference on what the majority of rail cars and truck trailers used are, view Figure 15.

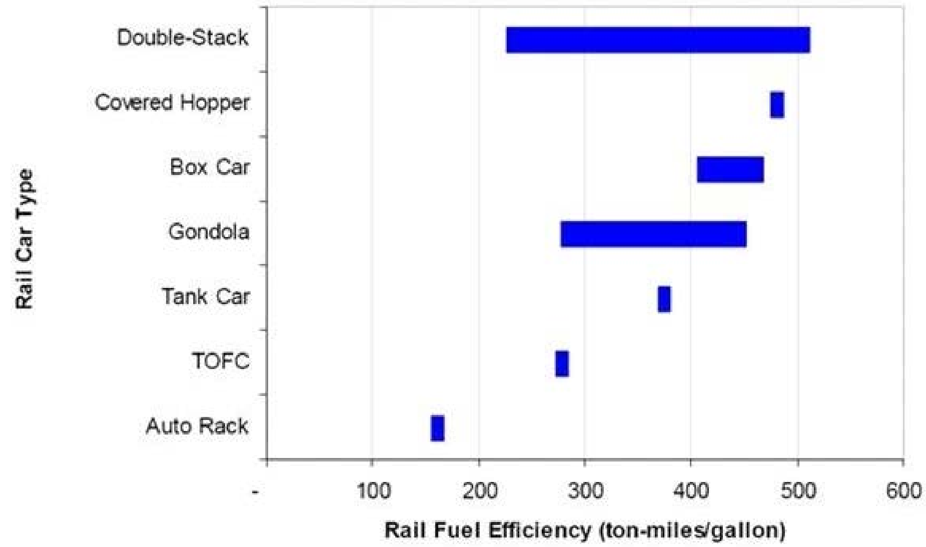

Figure 13: Fuel efficiencies for types of rail cars. [15]

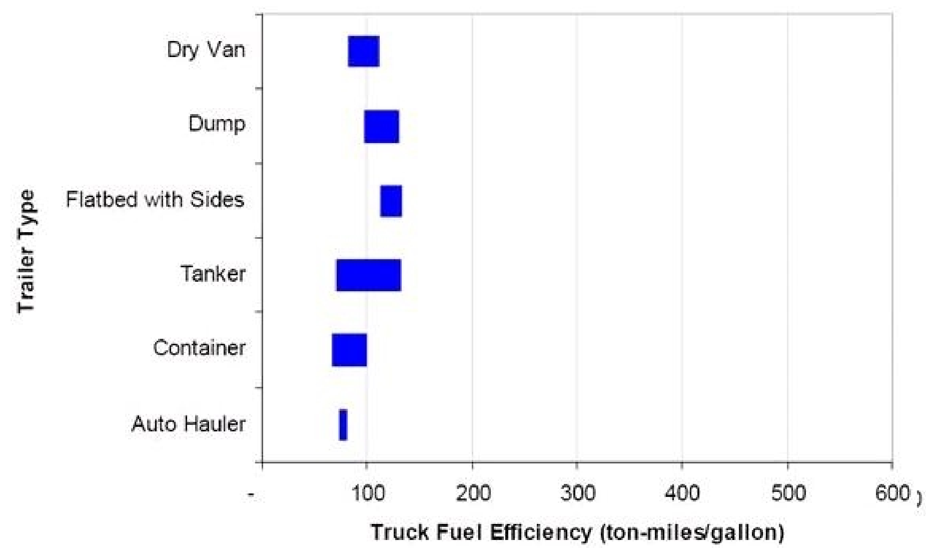

Figure 14: Fuel efficiencies for types of truck trailers. [16]

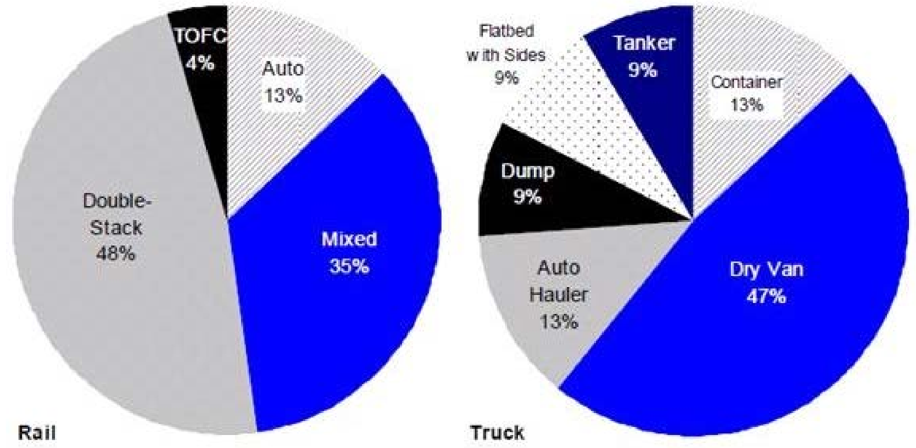

Figure 15: Types of rail cars and truck trailers in use. [17]

By comparing Figures 13 and 14, it is easy to see that virtually all train car types provide a higher fuel economy than even the most efficient truck trailer. The study's main finding was that in all of the comparable movements, trains were always more efficient than trucks, on a scale of 1.5 to 6 times more. This result is shown on Figure 16.

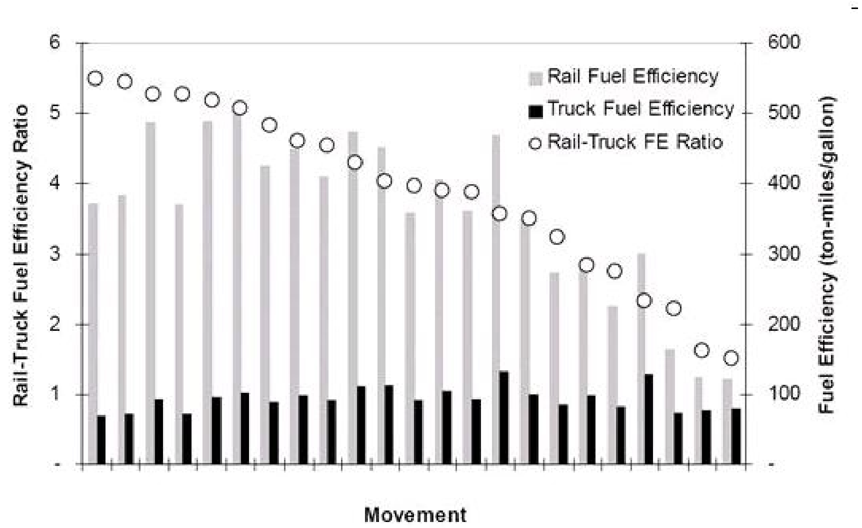

Figure 16: Efficiencies of rail and truck compared across movements. Ratios also graphed. [18]

From both its dramatic advantages in terms of embodied energy in the infrastructure and in operation, it is clear that freight rail represents a dramatic energy saving over its lifetime when compared to highway trucking.

Of course, to compete with trucks, freight trains need to demonstrate that they not only have an advantage in terms of fuel efficiency and materials usage, but also in costs to consumers and society. David J. Forkenbrock of the University of Iowa conducted a study titled Comparison of external costs of rail and truck freight transportation. In it, he takes a look at what the operating costs of rail and trucking are, i.e. those paid by the companies themselves, as well as the external costs, paid by society. External costs include accidents, greenhouse gas emissions, pollution, and noise. His findings are displayed on Figures 17 and 18.

.

Summary of external costs of truck and rail freight (1994 cents per ton-mile)[a]

	Accidents	Air pollution	Greenhouse gases	Noise	Total
General freight truck	0.59	0.08	0.15	0.04	0.86
Heavy unit train	0.17	0.01	0.02	0.04	0.24
Mixed freight train	0.17	0.01	0.02	0.04	0.24
Intermodal train	0.17	0.02	0.02	0.04	0.25
Double-stack train	0.17	0.01	0.02	0.04	0.24

[a] *Source*: Truck costs are from Forkenbrock (1999).

Figure 17: Summary of external costs of truck and rail freight. [19]

Private and external costs of truck and rail freight (1994 cents per ton-mile)[a]

	Private cost (1)	External cost (2)	User charge underpayment (3)
General freight truck	8.42	0.86	0.25
Heavy unit train	1.19	0.24	
Mixed freight train	1.20	0.24	
Intermodal train	2.68	0.25	
Double-stack train	1.06	0.24	

[a] *Source*: Truck costs are from Forkenbrock (1999).

Figure 18: Private and external costs of truck and rail freight. [20]

He concludes that "On a per-ton-mile basis, trucking generates over three times the external costs of any of the four types of freight trains considered in the analysis".[21]

Not only is rail more fuel and cost efficient, but it also holds several other advantages over trucks. First of all, investing in rail technologies is a sound investment in the future of transportation. Rail transport lends itself to running on electricity produced with green methods, like wind and hydro, better than trucks or other highway modes because it can directly be powered from the grid. Trucks and cars require expensive, heavy batteries to do this, and it is not yet clear if this method would be feasible. Also, replacing trucking on the highway would dramatically reduce wear on the highways which, as is demonstrated above, is a highly material and fuel intensive process. Figure 19 shows a calculation done in a study conducted in 1994 titled Excessive Truck Weight: An Expensive Burden We Can No Longer Afford.

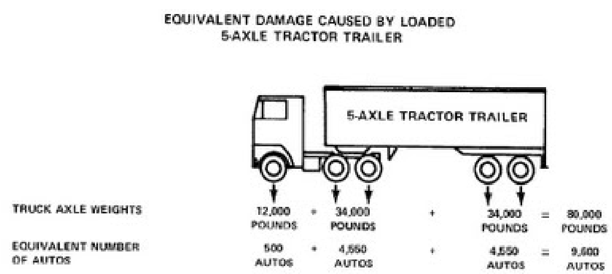

Figure 19: Truck wear on the road surface. [22]

This shows that the wear caused by just one freight truck is equivalent to 9,600 regular cars. If this is true, then although trucks only accounted for 7.49% of vehicle miles driven in 2000 [23], they accounted for over 99% of wear on highway surfaces! By removing trucks from the road, we can dramatically reduce the need for expensive highway expansion and repair.

But if rail is not only more efficient but also less costly, why isn't rail used even more than trucks? First of all, freight trains usually run much slower than a truck on a highway (disregarding traffic). Many time-sensitive goods must be shipped by truck because of this fact. However, the largest reasons a greater percentage of freight is not shipped via rail are simply capacity and access. Railroads are nowhere as pervasive as roads. While roads constitute 3.9 million miles of our transportation network[24], freight railroads only totaled about a quarter million miles as of 2007 [25] . Many shippers simply do not have the option to ship via rail because the infrastructure does not exist, or it once existed and requires repairs. The current US freight rail system is shown in Figure 20.

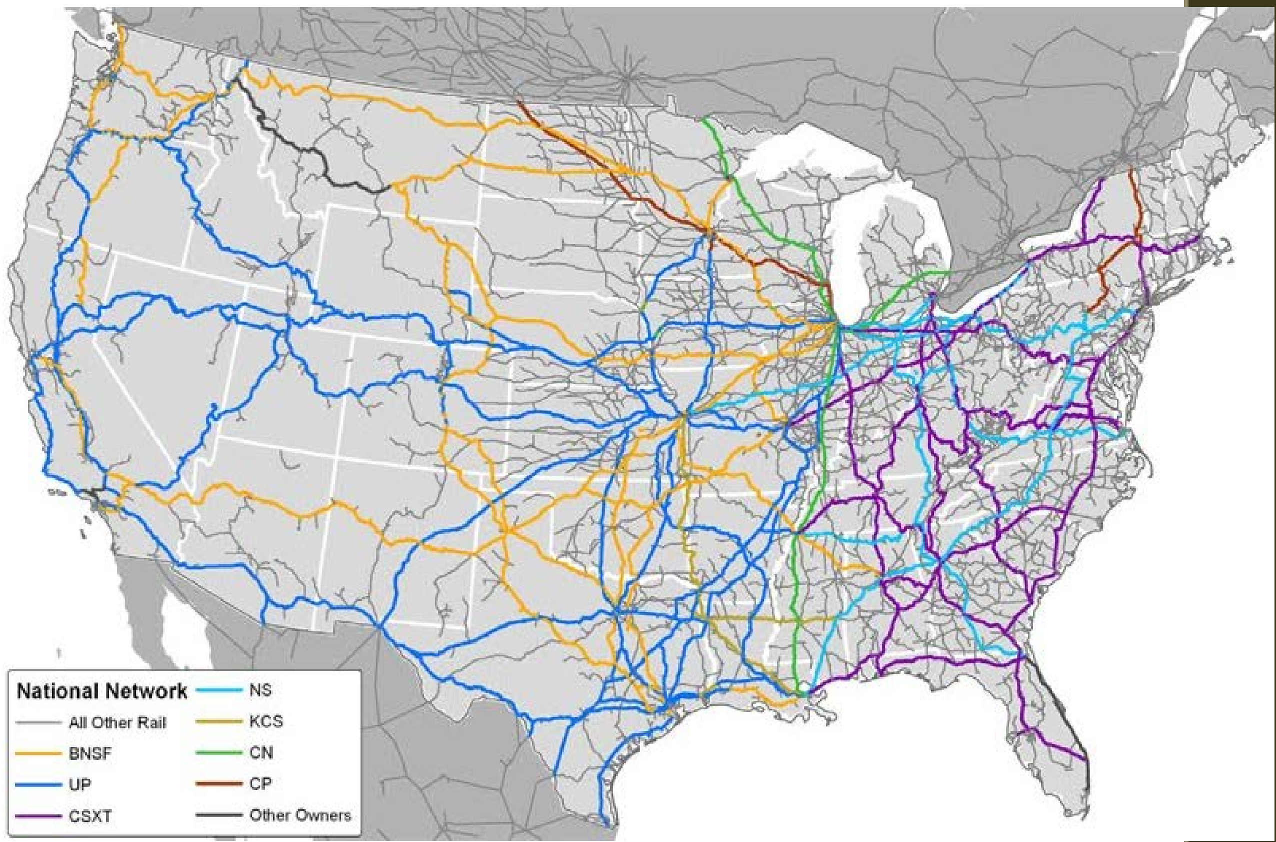

Figure 20: Primary rail networks by carrier. [26]

In terms of capacity, a looming problem exists. While freight traffic has steadily increased since the 80's, the amount of rail has not. This is demonstrated in Figure 21, from a study conducted by Cambridge Systematics in 2007, National Rail Freight Infrastructure Capacity and Investment Study .This study also rates current rail traffic on primary corridors in terms of the service they can provide. (The lower the traffic the higher the service and vice-versa). Figure 22 displays these grades. As can be seen, there are several at capacity or over capacity primary rail sections as of 2007. However, this congestion will skyrocket in the future if projects of rail traffic increases are accurate, seen on Figure 23. The projected change in congestion grades by 2035 are shown on Figure 24. The study cites the need for a massive investment in rail infrastructure in the next two decades, but they may not come due to the fact that, traditionally, freight rail is required to finance their own infrastructure without public assistance.

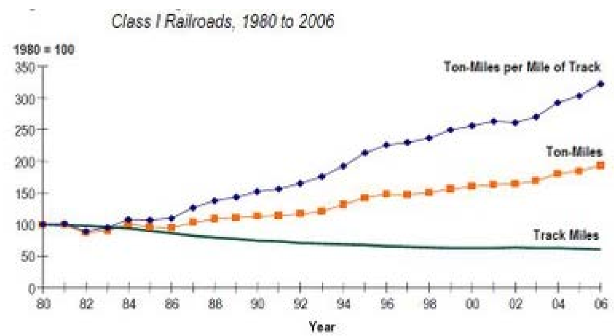

Figure 21: Growth of traffic and track-miles for Class 1 Railroads 1980 to 2006. [27]

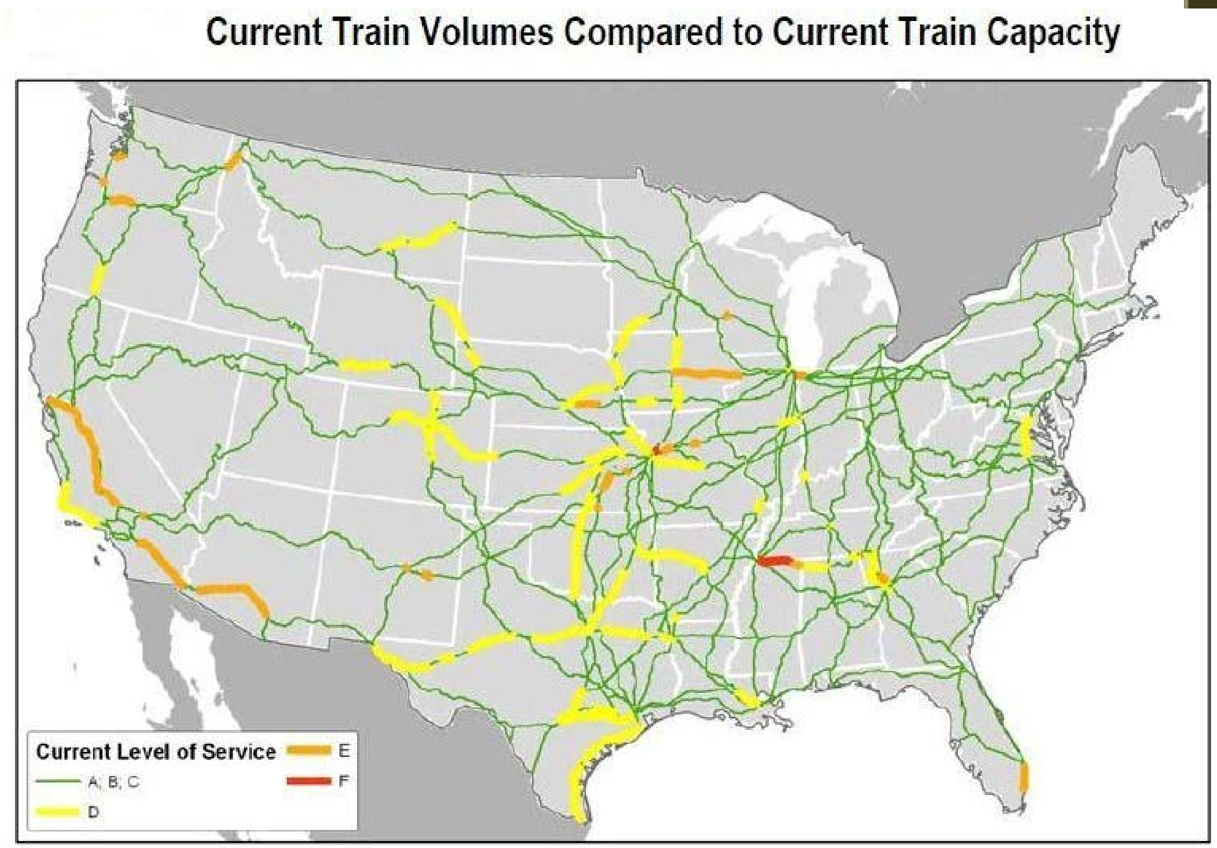

Figure 22: Levels of service for primary rail 2007. A,B,C are below capacity, D is at capacity, E is over capacity,

and F is far above capacity. [28]

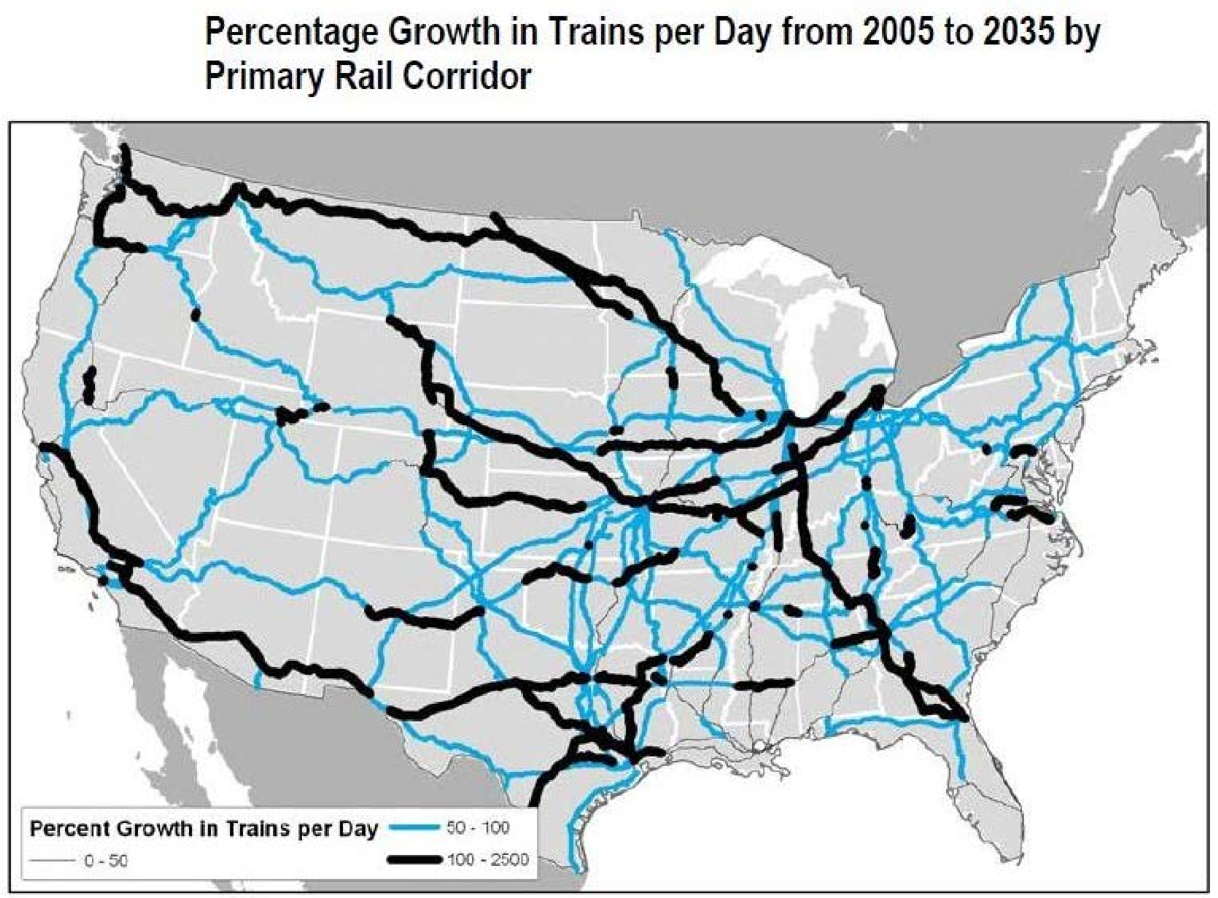

Figure 23: Percent growth in trains per day, projected 2035. [29]

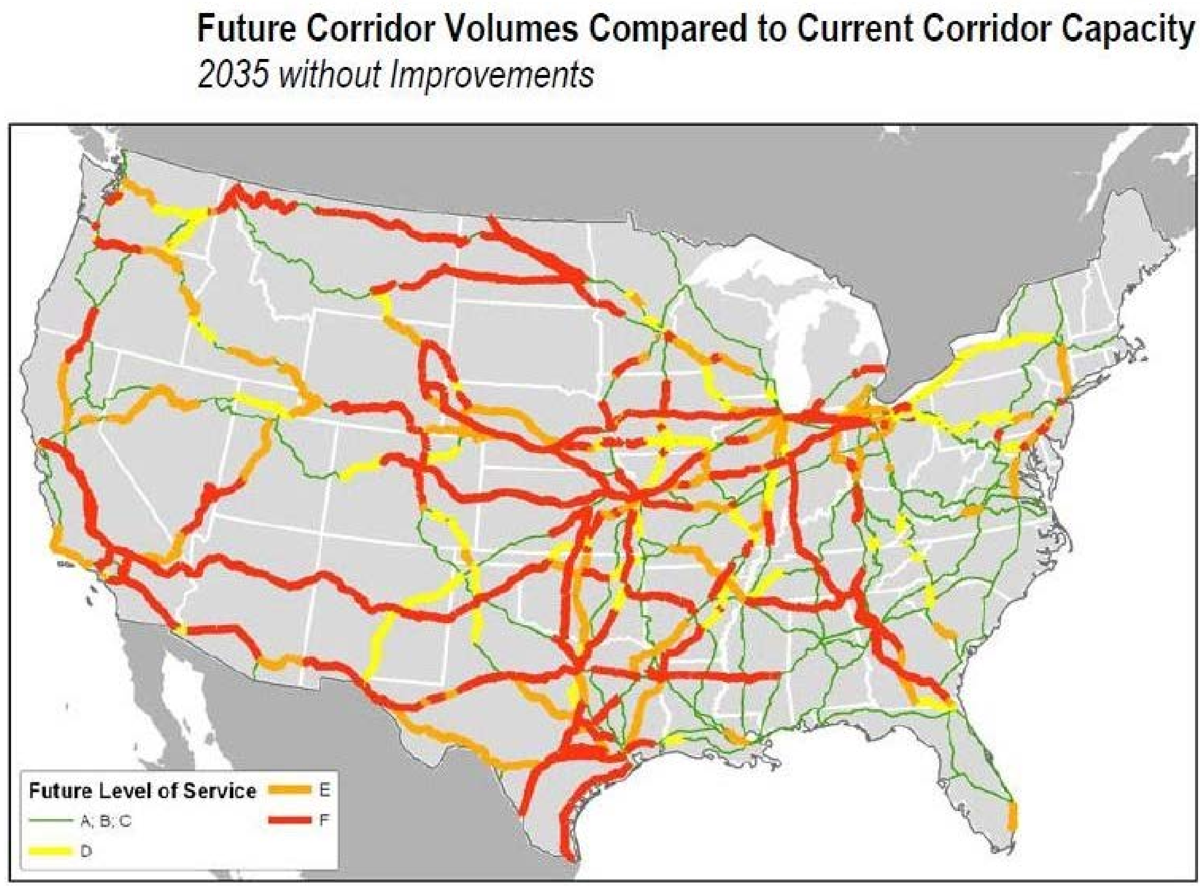

Figure 24: Levels of service for primary rail projected 2035. A,B,C are below capacity, D is at capacity, E is over capacity, and F is far above capacity. [30]

So what should be done about this? With the massive necessary expansions of rail service that will be required over the coming decades, it is important that action be taken sooner rather than later. If this is left entirely to private industry, as has been the case in the railroad industry for the past 30 years, then there is a dramatic risk of public interests not being taken into account. By continuing to pour the vast majority of our transportation dollars into highway infrastructure, we are not only supporting an inefficient use of materials and fuel, but we also lose time and money that could be spend developing a public infrastructure that can eventually replace the massive US highway system.

Some more concrete ways that federal and especially state governments can positively influence the situation are listed here:

1. Finance, either through loans or grants, short line rail projects where appropriate. These short lines give access to more products to the national rail system, and allow for people to makes choices in what types of transportation they support. A good example of a project like this is the Coos Bay Rail Link, which connects the Port of Coos Bay with Eugene where freight can be transported to primary providers. This was made possible by a $12.5 million loan from the economic development arm of the state government.

The rail also secured a $7.8 million ConnectOregon III grant and a $13.5 million Transportation Infrastructure Generating Economic Recovery (TIGER) II grant to carry out the necessary infrastructure repairs. A map of the line is shown in Figure 25.

2. Work with primary rail companies more closely when planning long term financial commitments and planning for regional transportation infrastructures. The fact that rail provides so much of our freight transportation already coupled with its already projected growth means that we will rely on our rail infrastructure more than ever moving into the future. The government will need to be involved to make sure the opportunity for a successful freight transportation centered on trains is not wasted.
3. Tax incentives and disincentives to encourage consumers to choose freight rail over freight trucking.

By accomplishing these, and other strategies, it is possible to be on our way towards a more efficient future, led by freight rail.

Figure 25: Coos Bay Rail Link. [31]

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The Future of American Transportation: Is HSR the Answer?

The Roots of High Speed Rail

During the Industrial Revolution, the English built systems of transportation to connect towns and industrialized centers and to facilitate the movement of people as well as goods. While the United States has developed these systems through the creation of highways, air travel and public intercity transportation, President Obama has called for a new method of connecting communities and economic centers. The development of High Speed Rail (HSR) networks would give passengers and companies an alternative, potentially more economical and efficient method for transportation.

Although the United States has been developing railways since the 1820s, there was competition between trains and transportation by canals and steamboats. The United States government funded the purchase of land and initial development so that numerous short lines could be established, especially in the South. The first transcontinental railway was constructed in the 1860s and was backed by the Pacific Railway Act of 1862. It was a product of a decades-long movement to facilitate transporting freight and passengers longer distances. Once established, the transcontinental railway shifted focus specifically to moving freight over long distances, leaving suburban traffic to other means of transportation. Most suburban communities were left with little public local transportation. This paved the way for the development of highways and an increased dependence on automobiles for travel. As airline travel grew in popularity during the 1950s, the use of trains for long distance passenger travel decreased. The Rail Passenger Service Act of 1970 helped subsidize train travel for passengers, and eventually grew into what is currently known as Amtrak. Despite criticisms and declining numbers in passengers, the trains continue to run across the nation. Amtrak rails cover 22,000 miles throughout the country, but travel at relatively slow speeds in comparison to HSR trains and those in Europe and Asia.

The passenger cars of the original trains in the 19th century were ornate and heavy, while those of the 1920s and 1930s were constructed using lighter materials. The stainless steel used for the cars were much lighter than the wooden cars of the previous century, and allowed for higher speeds and greater efficiency. Over the last 50 years, the construction of train cars has remained similar, but new technologies have afforded greater efficiency and an increase in capacity. Additionally, new technologies paved the way for trains to move at higher speeds, using electricity as a main source of power. However, decreasing ridership has limited the funding available to implement these new technologies. Throughout the United States, few investments have been dedicated to improving rail systems, with the exception of the Northeast Corridor. Because rail travel is competitive with air travel in terms of travel time and price, more passengers in New York, Boston and Washington D.C. are willing to travel by train. However, an increase in congestion at airports and on highways has prompted interest in rail travel within the last decade.

The national HSR network proposed by President Obama would offer Americans an alternative form of transportation to travel long distances, and has the potential to shift away from air travel and lighten the load on highways. But it takes time to build new tracks and trains, and to acquire passengers. As it took 50 years to develop the highway systems in the United States, so it will take decades to fully develop an intercity passenger rail system that compliments the use of highways, air travel and public transportation. At this point in time, Americans must choose whether or not to begin transitioning into a new method of traveling. This shift begins with funding to start building infrastructure, and so we must decide…

Should the United States Congress approve federal funding to invest in a national high-speed rail network?

In 2009, President Obama proposed building high-speed rail (HSR) lines in populated corridors throughout the nation as part of the American Jobs Act. His vision was that the US would have a network that resembles those already established in many other countries around the world and could

reduce long-distance travel by car or by plane. For trips between densely populated regions, trains would travel at speeds of 220 miles per hour, and the entire nation would be connected by trains traveling at speeds of at least 110 miles per hour. Although the $53 billion in requested funds was partially rejected, funding for HSR is still under review. Currently, advocates are using the approved funding for research and to begin establishing a foundation of routes in the Northeast, California, Texas and the Northwest. During this first phase of construction and experimentation, the federal government must decide whether or not to approve additional funding that would be allocated in phases to establish a comprehensive network of local and long-distance public transportation. President Obama's ultimate goal regarding high-speed trains is to provide access to the system to 80% of all Americans within the next 25 years.[1]

Those In Favor

Those who support funding a high-speed rail network in America argue that the substantial capital investment would have economic, environmental and social benefits that would far outweigh the costs. As the population and transportation demands of Americans continues to grow, so must the travel capacity. As long as people are dependent upon cars and airplanes, there will be costs to maintain and expand the systems that support them. Advocates of the HSR system propose that America redirect the funds from highways and airports towards railways.

The United States High Speed Rail Association claims that $87.2 billion dollars are lost every year in automotive gridlock, including $2.8 gallons of wasted gasoline and 4.2 billion hours of wasted time. Additionally, $41 billion dollars are lost in domestic air traffic delays. Shifting away from car and airway travel could reduce these number dramatically. Trains are the only form of transportation not subject to congestion or weather conditions. They offer increased productivity to passengers, as well as the freedom to walk on board without spending time in lines, going through security, waiting for baggage or stopped in traffic. High-speed trains can go from 0 to 200 mph in under 5 minutes, saving travelers trips up to 70% the time used by conventional rail. For trips under 5 hours, trains are comparable to planes in terms of overall travel time.

Not only are trains efficient time-wise, but they also have the potential to be one of the most energy efficient forms of transportation. High-speed trains run electrically, thanks to advancements in technology over the past century. The electricity is created at a generation plant, and then transmitted to overhead lines and distributed from the wires to the trains in the form of electrical currents. Devices such as pantographs press against the undersides of the contact wire, allowing for the smooth transition of energy. This propels the train as it moves rapidly along the tracks. The transmission and distribution of electricity between generation sites and the end-use sites has proven to be an efficient process. While some the energy supplied by the generator is lost due to the resistance of wires and equipment, overall losses are usually somewhere between 6% and 8% in the United States, depending on the distance between the generator and end-use site. This means that over 90% of generated electricity can be converted into heat and used by mechanisms such as high-speed trains [2]. Because trains are not subject to traffic and delays along the route, they are efficient in their use of this heat. This is not the case for other forms of transportation that must continually stop and restart. While 55% of the electricity in the United States is currently generated at power plants that use fossil fuels for production, there is potential to shift towards electrical generation using renewable resources. Hydro, solar and nuclear energy are all potential sources for electricity and the facilitation of high-speed rail networks.

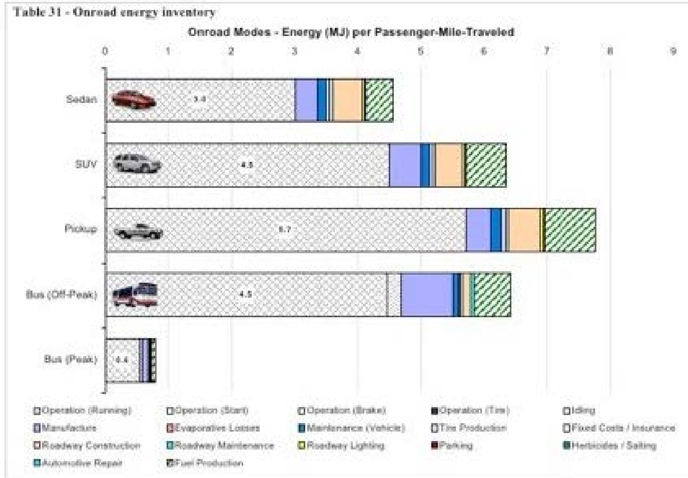

Table 31 - Onroad energy inventory

Of the 20 billion barrels of oil used by Americans each year, 70% is used for transportation purposes. Research has shown that these habits of consumption are not sustainable long-term, as we are reaching peak oil production. The time has come to pursue a comprehensive solution that significantly reduces American dependence upon fossil fuels. The US High Speed Rail Association believes that, "Building an electrically powered national high speed rail network across America is the single most powerful thing we can do to get the nation of oil." Once started, a nationwide network will take at least 20 years to develop, so HSR advocates are pushing for a quick start. Given the growth of the population in America, a new system is inevitable. Transitioning into a system that could be powered by alternative forms of energy would reduce dependence on foreign oil by 12.7 million barrels a year and would assist in creating an "Energy Secure America". [3]

In addition to being energy efficient mechanisms, trains have the potential to transfer the largest number of travelers with the least amount of energy per passenger. The E4 Series Shinkasen train has the capacity to seat 1634 people- double the capacity of the world's largest plane. While the average car with 1 or 2 occupants uses 2.3 MJ/km, and a 747 jet at 80% capacity uses 2.1 MJ/km per passenger, trains use only 1.8 MJ/km per passenger. This means that trains maximize the available heat and work more effectively in transportation, consume fewer units of energy while traveling the same distances. For trains, the Association of American Railroads claimed that in 2009, trains averaged 480-ton-miles per gallon. According to British Airways, a 747 jet gets 52.2 mpg per passenger, while a 1-ton car such as the 2011 Ford F-350 averages less than 20 mpg.[4]

Yet another benefit of high-speed trains as an alternative form of transportation is the potential reduction in carbon emissions. Trains have the potential to emit 90% less pollutants than planes and cars. A 2009 report said by 2030, the HSR would remove 12 billion pounds of CO2 in California alone. A UC Berkley study concluded that transitioning towards clean transportation such as trains can solve problems of mobility, energy, environment, economy, health and social problems simultaneously.

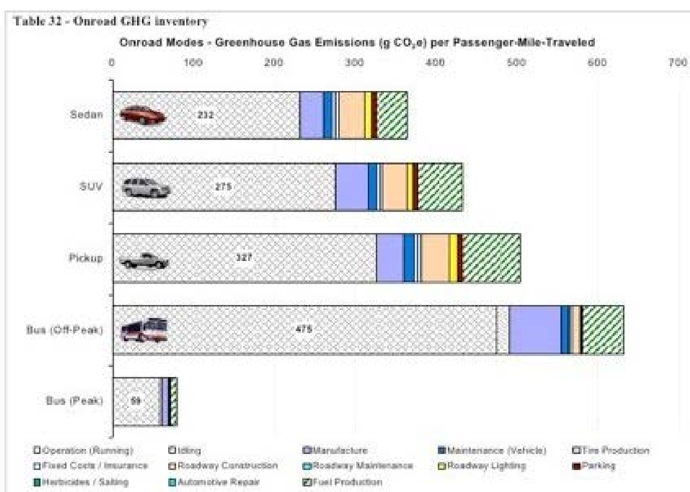

Table 32 - Onroad GHG inventory

The construction and implementation of a HSR system would have high costs, but would have substantial economic value for American workers. Building an entirely new infrastructure would create jobs for researchers, architects and construction workers, and positions would be created once the systems are implemented. Millions of Americans would have job opportunities, should funding for this project be approved. The capital costs for developing entirely new infrastructure would be higher than the costs of maintaining highways and airports, but the operational costs would be reduced. It would cost

$100 billion to build 3000 miles of new freeways, 5 airport runways and 90 departure gates, whereas $53 billion would help create a foundation for a new system of transportation in America. And although creating the infrastructure for a nationwide high-speed rail network would have substantial economic and environmental capital costs, the returns on these investments have the potential to be tremendous. If ridership is at 75%, the energy return on investment in recouped in 8 years and the greenhouse gas emissions are recouped in 6 years. At mid-level occupancy, the payback period would be 28 years for the energy and 71 years for greenhouse emissions. These estimates factor in every conceivable cost; from running lighting for construction and train stations, to emissions from bulldozers and transportation of materials.

Those Who Oppose

Operationally, trains have the potential to be infinitely more efficient than automobiles and airplanes. However, opponents of President Obama's transportation initiative contend that the building and maintenance costs are astronomical when considering building an entirely new infrastructure across the country, and may not ever pay off economically or environmentally.

The costs of planning, building and operating a HSR network include funding thousands of miles of new high grade track, signaling, electrification, hundreds of brides, miles of tunnels, hundreds of train stations and support facilities along the routes. These capital investments are especially overwhelming in a time of economic uncertainty, and are not easily justified when the financial return on investment is questionable. The total cost of developing the network could exceed $500 billion, but the amount of income that the system will ultimately generate is anyone's guess. If the trains operate anywhere under 25% occupancy, the return on investment is infinite- both in terms of economic and environmental costs. [5] Unless the new HSR trains are accessible and competitive with other forms of transportation with regard to travel time and cost, ridership may very well fall below this benchmark. With such uncertainty, opponents of HSR argue that it will cost more to make HSR competitive than it would to maintain the systems already in place.

Another concern about the HSR network is that of the environmental costs incurred to build the necessary infrastructure. President Obama's plan calls for the development of the new system in phases. While the environmental impacts would be spread out over the next 20 years, the trains would likely be operating with few passengers until the projected completion in 2030. This means that the trains will running at low occupancy level, which could bring their energy efficiency level below that of a one-passenger car. Electrical trains release less CO_2 than fossil fueled cars, however the generation and transmission of electricity releases more SO_2. Although shifting towards dependence on trains for transportation could potentially reduce global warming, the emission of this respiratory irritant could have widespread health effects. Opponents of the HSR network reason that the investment of energy required for steel production, construction of stations and the operation of the trains, along with the CO_2 emissions may never be recouped over the lifetime of the network.

Even if the trains were at capacity, opponents contend that the electricity required to fuel a HSR network may still be generated using fossil fuels. While some regions have systems in place to generate alternative forms of energy, more than 60% of the electricity in the United States is produced in plants using fossil fuels. The construction of the trains in Phase 1 would require 310,000 Gwh, and the infrastructure would add on an additional 31,000 GWh, in addition to the 1% increase in electricity consumption per year to operate the trains. Therefore, opponents contend that HSR is not necessarily the answer to easing American dependence upon fossil fuels.[6]

California is Paving the Way... But Will Others Follow?

With funding from the federal government and other public and private investments, the state of California has begun to construct a high-speed train line from San Francisco to Anaheim. Upon completion, it will reduce the travel time from 6 hours in a car to 2 hours and 38 minutes by train and has the potential to transport hundreds of millions of passengers each year. Although there has been controversy about the economic and environmental impacts of such a project, California is implementing a comprehensive network of public transportation that strives to reduce traffic, lessen dependence upon highway systems, clean up the air and create a more convenient method of transport for travelers within the state.

HSR advocates in California have addressed many of the concerns about ridership and return on investment for the financial and environmental costs of high-speed rail. Economically, HSR development in California will create 150,000 construction jobs, as well as 400,000 jobs once the project is complete. In addition, the millions of dollars that are continually invested in improving highways and airports can be significantly reduced throughout the next 20 years. Although the project has tripled in cost and may not be completed until after 2030, research has shown an increase in the projected ridership, as the plan is more thoroughly developed. Not only will trains travel at 220 miles throughout California, but the funding will also be used for local transportation to and within densely populated regions. A network of intercity passenger rail and improved public bus systems are projected to substantially increase the occupancy of the trains, further increasing the energy efficiency. Third party research has confirmed that ridership will reach 30 million by 2020 and 95 million by 2030. In addition to a foreseeable economic return on investment, California projects that developing an HSR network within the state will reduce carbon emissions by 12.5 billion pounds per year, nearly a 90% reduction in comparison to current emissions. [7]

Perhaps one of the most ambitious goals of California HSR is that of using 100% renewable energy to generate electricity for this form of transportation. Although 55% of the state's electricity comes from fossil fuels, HSR developers have proposed alternatives such as 100% solar electricity, a 20%/80% wind/solar mix, or a 100% wind plan. This would address the environmental concerns and dependence on fossil fuels for transmission, and research has shown that the added cost of running trains with wind-generated electricity would add a surcharge of only $0.86 per passenger. The capacity for renewable energy sources has proven to be substantial. Already, California has generated 30 billion kWh from renewable sources, at a premium of only 3.5 cents per kWh above standard electricity. Advocates believe that it is not a matter of cost or resources in the long run, but a matter of gaining political and economic support to get HSR projects started. [8]

California is in the early stages of setting an example for HSR lines throughout the nation. With funding and political support in place, advocates believe that California will lead the way and other states will se the potential to provide alternative forms of transportation that are economical, convenient and sustainable.

Where Do We Go From Here?

Americans have to decide whether to maintain and expand a transportation system that is dependent upon fossil fuels, or invest in entirely new infrastructure that can be powered by alternative sources. HSR has proven to be an energy efficient way to travel, and can have immediate returns. The state of California has been provided with federal funds for the completion of a HSR line, but the advocates within the state have done research and utilized local resources to create a system that they hope will be economically and environmentally effective in the years to come. If President Obama's transportation initiative receives funding, individual states can begin to facilitate the transition away from fossil fuels, using the most effective methods for generating electricity and encouraging ridership in each region. Should the funds be granted, the phases of HSR can be implemented and the benefits will be evident. Although Congress allocated $10 billion for various railway projects around the country, the Senate recently approved legislation that would halt funding beginning in 2012. In late September, the Senate Appropriations Transportation subcommittee approved a spending bill to continue funding highway development, but approved no money for high-speed rail.These habits of spending will only further increase American dependence on oil, as well as the waste of heat, energy, time and money that come along with highway and air travel. If the state and federal governments are persuaded that Americans are interested in HSR travel and are confident in high levels of occupancy, the financial and environmental capital costs can be justified. The United States High Speed Rail Association offers an opportunity for students and other HSR advocates to let their voices be heard and come together to push for legislation and funding that support transitioning into a future of convenient, sustainable, economical forms of transportation.

[1] US Department of Transportation (http://www.fra.dot.gov/rpd/passenger/31.shtml)
[2] ABB Inc., **Energy Efficiency in the Power Grid**, 2007, accessed 12.05.11. (www04.abb.com/nsf/energyefficiencyinthepowergrid.pdf)
[3] Chu, Steven (20111) **Journey to Energy Independence**, accessed 12.05.11. (http://www.americanenergyindependence.com/)
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[5] Crossgrove, Christine (2011), **Tracking High-Speed Rail's Energy Use and Emissions**, accessed 11.13.11. (http://its.berkeley.edu/btl/2010/spring/HRS-life-cycle)
[6] IBID.
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Sitemap

Light Rail >

The Underlying Science: Efficiency and Emissions

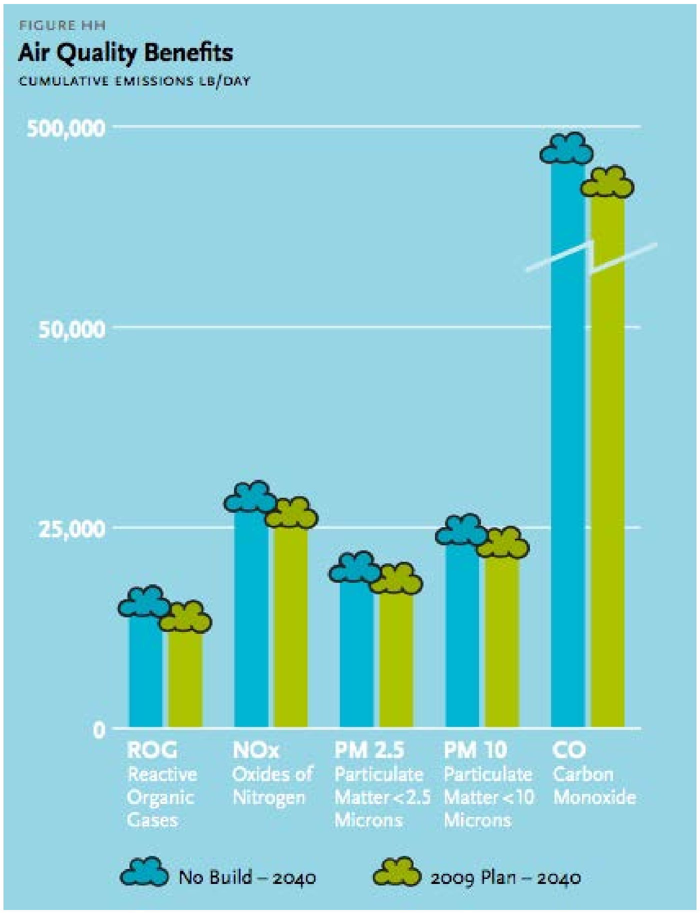
What Los Angeles looks like now, thanks to carbon emissions from hundreds of thousands of cars:

What MTA thinks Los Angeles could look like with expanded light rail infrastructures:

(Image credit: Crenshaw/LAX Transit Corridor Project Overview Fact Sheet, July 2011)

...but is this possible?

This graph from the Los Angeles County Metropolitan Transportation Authority (LACMTA)'s 2009 Plan outlines how the improved transportation plan will reduce several types of harmful emissions (assuming a best-case scenario outcome for the plan; from p. 53) compared to the "no build" option which would assume current transportation practices:[1]



Let’s consider the energy used to operate a light rail system and to operate an automobile:

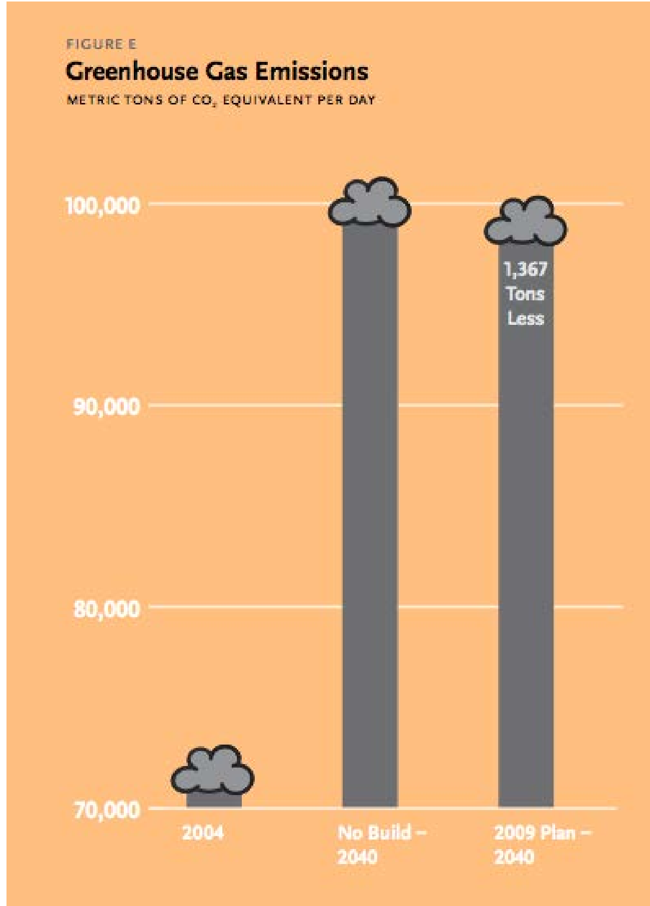
Mode	Btu per passenger mile
Automobile	3,538
Light rail system	2,812

(These statistics are from U.S. Department of Energy’s Energy in Transportation Data Book: Edition 28, from 2009. Full citation below, #6.)

It's easy to look at a chart like that and assume that a lower number means lower emissions, but how does that look in a real-world setting?

In 2009, Los Angeles had the nation's worst air quality, but the 2009 Plan for transportation improvements (see the "Should We Advocate for Light Rail" page for more information) aims to reduce air pollution six metric tons per day through encouragement of carpooling, development of new light rail networks and the institution of more fuel-efficient buses.

LACMTA serves 1.6 million passengers daily across all its transportation forms (according to p.28 of the plan), and provides this visual representation of how the 2009 Plan will reduce greenhouse gas emissions in transportation (as compared to the same time frame with no provisions for transit improvement; graph from p. 15):



The plan clearly lays out how it will affect miles traveled and vehicle emissions (p. 15):

```
Los Angeles County's 10 million residents generated approximately 29 million daily trips in 2004,
resulting in almost 160 million daily vehicle miles traveled (VMT). By 2040 this would grow to
almost 230 million daily VMT. This 2009 Plan will help reduce the growth in daily VMT by three
million which is substantial considering the 33 percent growth in population and employment.

Based on the average vehicle, one VMT emits approximately one (1) pound of CO2; therefore, this
2009 Plan reduces GHGe by nearly 1,370 metric tons of CO2 equivalent (fig. e). Increases in
vehicle e;ciency and implementation of congestion pricing may further reduce GHGe.
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While all of those statistics sound great, it's important to look deeper than just a colorful packet distributed by the transit authority. Infrastructure development costs must also be considered. Let's look at these efficiency issues from a thermodynamic perspective:

Light rail differs from heavy rail in several ways, which are essential to understanding how heat is involved in the system's energy-using process:

· The term "light" comes not from the physical weight of the system, but from the number of passengers each system can carry: light rail typically carries fewer than heavy rail like subway systems.[2]

· Heavy rail involves multiple-car trains, whereas light rail systems are single-car. There is also more space between heavy-rail stations than light rail.[3]

· Light rail systems receive their power electrically, from an overhead electric line; the overhead rail is not present in heavy rail.[4]

· Light rail systems usually run on the same ground level as automobile traffic, but in a separate lane, unlike heavy rail which requires a unique system (for example, underground like the systems in New York, Washington D.C., and others).[6]

The presence of this electrified third rail – the overhead electric line – is the "jumping off point" for understanding how heat is involved in light rail's energy-using process.

While constructing light rail infrastructures is expensive. $1.715 billion in funding is set aside for the Crenshaw line, mostly coming from Measure R (see citation below, #6), also discussed in the next page. However, these costs (monetary and energy costs) are recovered through improved transportation efficiency, in the increased efficiency of light rail systems and the subsequent alleviation of highway traffic as new riders are attracted to light rail.

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[1] Los Angeles County Metropolitan Transportation Authority. **"LA Metro 2009 Plan."**

Accessed 12.8.11. (http://www.metro.net/projects/reports/)

[2] Cole, D. (2010) **Transit 101: Light Rail and Heavy Rail**. *Metro Cincinnati Blog*. 8.26.2010, accessed 10.25.11 http://metro-cincinnati.org/?p=1566

[3] Ibid.

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[5] Davis, Stacy C.; Susan W. Diegel, Robert G. Boundy (2009). *Transportation Energy Data Book: Edition 28*. US Department of Energy.

Automobile statistic: Chapter 2, p. 14.

Light rail statistic: Chapter 2, p. 16.

[6] Los Angeles County Metropolitan Transportation Authority. **Crenshaw/LAX Transit Corridor: Project Overview Fact Sheet.** 7.11, accessed 11.29.11. (PDF accessible from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCIQFjAA&url=http%3A%2F%2Fwww.metro.net%2Fprojects_studies%2Fcrenshaw%2Fimages%2FOverview-Fact-Sheet.pdf&ei=qKXiTtP-MuOoiAKNq7DNBg&usg=AFQjCNE6-nnVypaXftT3F7XZQUl69b0RtA&sig2=biUfB_gt9e0vEAPwWEOGuw)

Light Rail >

A Look at L.A.: Should We Advocate for Light Rail?

When the general public thinks of innovative transportation, they think of cities with robust light rail networks like Portland, Oregon. Rarely does a city like Los Angeles spring to mind: LA is filled with smog and gridlock.

However, the city noticed that gridlock and smog weren't going away. LACMTA CEO Arthur Leahy understood the sentiment of area residents, saying that Angelenos were "fed up with traffic and want relief, sooner rather than later." With lengthening commute times and rising environmental pressures, the Metropolitan Transportation Authority realized that an extension of its existing public transit options was necessary.

Two years ago, MTA released its "2009 Plan," a 30-year forecast for public transportation improvement and growth in the metropolitan area. Emphasis was placed on expanding light rail networks, improving the environmental quality of buses and encouraging more passengers per vehicle.

While the 2009 plan was a broad look at what needed to change in LA transportation, I'm focusing here on the plan's implications for light rail.

Light rail in Los Angeles is nothing new. The Los Angeles Railway streetcar, a predecessor of today's system, ran from 1895-1924. Eventually, the system moved from streetcars to buses, with the final streetcar eliminated in 1968. Light rail returned to Los Angeles in 1990 with the introduction of the Metro Blue Line in 1990.[1] The Blue Line, which runs between Long Beach and downtown Los Angeles, was the first line constructed and operated by the Los Angeles County Transportation Commission (LACTC), now the Los Angeles County Metropolitan Transportation Commission (LACMTA).[2]

Since a light rail network is already in place in Los Angeles, the question is not *should* such systems be built in the first place; rather, the question is "should these networks be expanded?" I want to examine whether light rail systems should be expanded, or whether that funding should be devoted to highway improvement projects (or project supporting the development or improvement of other public transit systems). As more and more cities plan to build light rail or expand their existing systems, it is imperative to consider whether the expansion is an efficient, environmentally friendly decision.

In Los Angeles specifically, the question is *should the MTA expand its existing systems to include the Crenshaw/LAX line?*

The Crenshaw/LAX corridor is a proposed light rail line, slated for completion in 2017 or 2018. It would run through Los Angeles' historically African-American Crenshaw neighborhood, to the Los Angeles International airport (LAX).

While Crenshaw/LAX was named a priority in the 2009 Plan, and development seemed to be progressing smoothly, it has recently come under fire from certain activist groups. Thus, I will examine whether the Crenshaw/LAX line should be built and, if not, whether any of the alternatives suggested by detractors would be a more feasible option.

LA Metro's Crenshaw Line: Just the Facts

2006: The *Los Angeles Times* publishes an editorial suggesting the Crenshaw/LAX corridor should be a transit priority.

2008: Los Angeles county voters pass Measure R, which funds nearly $40 billion for transportation improvements through a half-cent sales tax increase.

2009: MTA releases its 2009 Plan, outlining the importance of light rail in expanding and improving the city's public transportation through 2030
December 10: Metro Board officially adopts the Crenshaw/LAX light rail line as the locally preferred alternative project for the area.

2011:
October 10: President Obama names the line one of 14 infrastructure projects nationwide to be expedited through a quickened environmental review process.
October 21: Activist group Crenshaw Subway Coalition filed a lawsuit against MTA, objecting to its plans for the line.

What social and political issues are in play?

Support for the Crenshaw line began as early as 2006, when the Los Angeles Times editorial board voiced its support for the line. “If it helps people or things move more quickly and efficiently, L.A. needs more of it,” they wrote. Pre-Measure R and pre-2009 Plan, support was building for an expansion of the light rail system.

The Crenshaw/LAX line has its roots in political issues. In November 2008, Los Angeles county voters approved Measure R, a one-half-cent sales tax increase over thirty years to fund transportation improvement and development projects. The measure passed with 67.22% of the vote. While there were concerns about the measure's stipulations – namely that the sales tax increase would raise the county’s rate to equal the highest in the state – it received high-profile support, including a supportive editorial from the *Los Angeles Times*.[3]

The *Times*’ editorial board also endorsed the development of the Crenshaw/LAX metro line when it was first proposed in November 2006, calling it a priority project that should receive funding from Proposition 1B, another piece of legislation supporting infrastructure improvements and development.[4]

The line rode strong support from major outlets like the *Times*, and was selected as the Locally Preferred Alternative for a transit option from the Crenshaw District to LAX on November 18, 2009.[5]

Opposition to the Crenshaw/LAX line has mostly centered around the way the line is being developed, rather than on whether the line should be constructed in the first place. In October 2011, a neighborhood group called the Crenshaw Subway Coalition filed a lawsuit against LA’s MTA, alleging that the organization violated environmental and civil rights when the MTA board approved the Crenshaw/LAX project on September 22, 2011.

The group's two central complaints with the project were 1) that there were no plans for a station at Leimert Park, a prominent African-American cultural area, and 2) that the above-ground structure would have a detrimental economic impact on African-American-owned businesses in the area during construction. The activists proposed an underground subway that would contain a Leimert Park stop and would not impose on businesses during construction. (You can read the coalition’s release regarding the lawsuit here: http://crenshawsubway.org/2011/11/breaking-news-lawsuit-filed/)

The coalition retained Los Angeles firm Johnson & Sedlak to represent them in the lawsuit. The firm previously represented groups such as the Sierra Club and Audubon Society in environmental law cases. According to the release, attorneys found a dozen major environmental law violations in the Crenshaw/LAX project’s environmental document.

While the Metro board had expected the lawsuit, board member and LA county Second District Supervisor Mark Ridley-Thomas said the suit had the potential to slow the line’s development, especially “if it is in any way deemed meritorious.”[6]

Ridley-Thomas has been a key advocate for the line, but criticism has fallen on Los Angeles Mayor Antonio Villaraigosa for his opposition to the desired improvements. The two come at the issue from different perspectives: Ridley-Thomas wants his constituents to have easier public transit access, while Villaraigosa sees the line as a vehicle for job creation.[7]

During a May 2011 MTA board meeting, he voted to modify the Crenshaw line to both include an underground component and include a Leimert Park stop. Villaraigosa voted “no” on the separated-grade (subway-style) section of the line – ultimately, the vote failed and the line will remain entirely above ground – but voted in favor of the motion to build a Leimert Park stop, which passed. (Full details of the meeting can be found in an archived live blog from LA Streets Blog.

So, where does this leave us? Should the Crenshaw/LAX line be built? Should we advocate for the expansion of light rail systems?

Yes. The Crenshaw/LAX line should be built. As part of a comprehensive transportation improvement plan for the area that includes more fuel-efficient buses and more passengers per automobile, the Crenshaw/LAX fits perfectly into Los Angeles' vision for fewer transportation emissions and faster commute times.

The same goes for other light rail expansion efforts. They should move forward, but education is important.

Light rail is an important issue, and there are passionate people arguing on either side. It’s difficult to find information from a traditionally “unbiased” source (i.e., a newspaper article). Most news comes from advocacy blogs, news releases from political offices and editorial boards.

Dig in. Weigh both sides of the argument. And don’t forget that, like LA’s 2009 Plan, an efficient transportation plan can include a highway system. In an area like Los Angeles, that is probably “in too deep” with regards to highway transportation, the plan can include a campaign to encourage more riders per vehicle (i.e., carpool lanes) alongside light rail and bus systems.

As long as community concerns are considered, I support the expansion of existing light rail systems since their creation will alleviate automobile traffic and reduce carbon emissions. If a car-dependent city like Los Angeles can prove to be a successful model for light rail expansion, surely there is hope that other cities can follow suit and transition to a cleaner, more sustainable way of transportation.

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[3] *Los Angeles Times* editorial board. **"Yes on Measure R."** 10.9.2008, accessed 12.4.11. (http://www.latimes.com/news/opinion/editorials/la-ed-measurer9-2008oct09,0,2413553.story)

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Comments

Alexandra Rempel - Nov 17, 2011 1:42 PM

This guy Cox seems to be a biased source! Be sure to give your assertions plenty of support, especially if people with public agendas are among them.

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Urban Biking

The Question:

Should urban planners dedicate resources toward increasing infrastructure that enables and encourages bicycle use and promote that use through marketing programs, community initiatives, and legislation?

In 2002, the Portland Office of Transportation started the TravelSmart and SmartTrips marketing programs in order to encourage local bicycle use and reduce single passenger car use.[1] Initiatives such as these, and the extent of Portland's bike trails and bike accessible roads have made Portland the second most bike friendly city in the United States.[2] Across the country, the city of Miami is committed to becoming a "Bicycle Friendly City" by 2012, and is in the process of planning and developing the necessary programs and infrastructure to do so.[3]

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[1] *walkinginfo.org.* Pedestrian and Bicycle Information Center. Web. 10/11/11.

[2] *America's Top 50 Bicycling Cities.* Bicycling.com. Web. 10/11/11.

[3] *City of Miami Bicycle Initiatives.* City of Miami Office of Transportation. Web. 10/11/11.

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