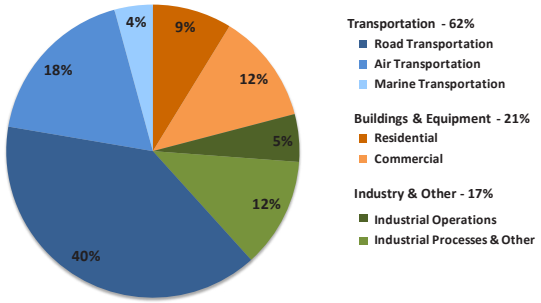
7 BEST PRACTICES

Transit's Role in Meeting Greenhouse Gas Reduction Goals

WHAT IS IT?

Cities and regions across the United States have come to accept that greenhouse gas (GHG) emissions are a chief cause of global warming. Seattle, a city known for environmental activism, has adopted goals of halting and cutting emissions levels across sectors. Reducing greenhouse gas emissions is especially important for the transportation field, which represents the largest source of emissions in Washington State and the City of Seattle. The transportation sector accounts for 62% of GHG emissions in Seattle; over 40% of total Seattle emission are from road transportation alone. For this reason, the city of Seattle has identified reduction of automobile vehicle miles traveled (VMT) as a key goal in achieving its Climate Action Plan targets.

2008 CITYWIDE EMISSIONS BY FACTOR



Road transportation accounts for 40% of total CO_2 emissions in the City of Seattle.

Source: 2008 Seattle Community Greenhouse Gas Inventory (http://www.seattle.gov/archive/climate/docs/2008-community-summary.pdf)

WHY DO IT?

For anyone who has studied the probable impacts of climate change, the answer is clear. On a practical level, climate action plans, or CAPS, often contain ambitious goals but lack implementation strategy or tools for achieving them. Seattle has set a particularly ambitious goal of achieving Carbon Neutrality by 2030. Meeting this goal will require dramatically curbing GHG emissions from transportation. Research shows that new fuel technology alone will not be sufficient; demand management is critical.

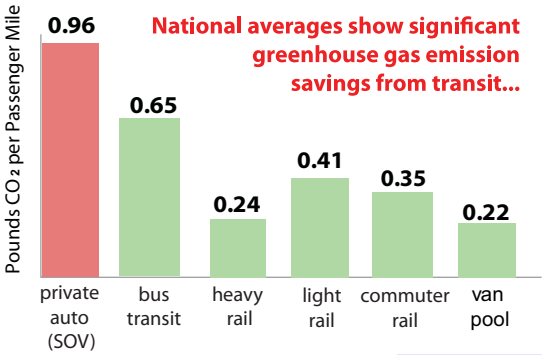
While Seattle has seen progress in reducing GHG emissions on a per capita level in every sector, transportation has seen the smallest reductions and, therefore, has increased as a percentage of total emissions since 1990.

Increasing mass transit use and reducing vehicle miles traveled is a key element of city and regional strategies for reducing transportation sector emissions. Well-utilized public transit emits far fewer emissions than auto travel, as shown in the bar chart below.

GHG Emissions by Sector*	1990	2005	2008	% Change 1990-2008
TRANSPORTATION	**3,947,000**	**4,062,000**	**4,242,000**	**7%**
Road	2,440,000	2,566,000	2,707,000	11%
Marine & Rail	278,000	300,000	291,00	5%
Air	1,229,000	1,196,000	1,244,000	1%
BUILDINGS	**1,609,000**	**1,411,000**	**1,470,000**	**-9%**
Residential	735,000	606,000	613,000	-17%
Commercial	874,000	805,000	857,000	-2%
INDUSTRY & OTHER	**1,720,000**	**1,413,000**	**1,200,000**	**-30%**
Operations	524,000	463,000	366,000	-30%
Processes	1,019,000	853,000	85,000	-26%
Waste	177,000	97,000	85,000	-52%
GHG OFFSETS		**-216,000**	**-143,000**	
City Light Offset Purchases		-216,000	-143,000	
TOTAL EMISSIONS	**7,280,000**	**6,670,000**	**6,770,000**	**-7%**
* *Metric tons of carbon dioxide equivalent (CO2e) rounded to the nearest thousand. Totals rounded to nearest ten-thousand. Sums may not equal due to rounding.*				
2012 Goal - 7% below 1990:	6,770,000			
2050 Goal - 80% below 1990:	1,460			

In Seattle, overall transportation emission have grown since 1990, while building and industrial sectors have reduced total emissions

Source: Seattle Climate Protection Initiative Progress Report 2009; http://www.seattle.gov/archive/climate/docs/CPI-09-Progress-Report.pdf



Estimated CO_2 emissions per passenger mile for transit and private auto

Source: Public Transportation's Role in Responding to Climate Change, Federal Transit Administration, 2010. http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf, page 1

WALK. BIKE. RIDE.

SDOT Seattle Department of Transportation

The Federal Transit Administration (FTA)'s statistics are based on average vehicle occupancy of 1.14 for single-occupancy vehicle work trips and 9.2 passengers per bus. Thus, an increase in transit ridership affects emissions reduced: a full bus carrying 40 passengers emits 83% fewer greenhouse gas emissions on a per passenger basis than one carrying the average bus load. Transit vehicles in Seattle consistently carry much higher passenger loads than the FTA estimate.

Most rail systems are powered entirely by electricity; therefore agencies purchasing electricity through clean sources—hydroelectric, wind, nuclear, solar—have a smaller carbon footprint than those using fossil fuel-produced electricity.[1] Seattle City Light uses hydropower and purchased offsets to produce a carbon neutral electric energy source for Seattleites; electrically powered transit in Seattle can claim to be as close to emission free as any service in the nation.

HOW DOES IT WORK?

As regions around the nation seek to address GHG reduction goals, they are looking to public transit providers to lead the way. A review shows that various agencies are addressing this challenge by restructuring operations to serve more passengers, selecting new vehicle technologies or retrofitting existing technologies, and working more closely with land use agencies and housing providers to optimize access to transit. Numerous national and local studies suggest that the most effective strategies fall into three categories:

- Those that focus on making more productive use of existing services and facilities.
- Those that tie any transit expansions to land use changes; together they can have a large impact on CO2.
- Those that consider cost effectiveness; some of the most politically popular means to reduce CO2 emissions are the least cost-effective, but some of the most effective measures actually earn money for the economy and the implementer.

WHO DOES IT?

This section highlights best practice examples from the San Francisco Bay Area and Portland. In the Bay Area, the Metropolitan Transportation Commission (MTC) and Bay Area Rapid Transit District (BART) have adopted methodologies for evaluating proposed investments in terms of their measurable impacts on carbon emissions. In Portland, the regional transit provider, TriMet, has focused on reducing emissions from agency operations as well as playing a role in helping local jurisdictions meet GHG reduction goals. In New York City, the MTA has undertaken similar measures to reduce internal GHG emissions.

These are just a few of the many agencies nationwide that are using transit as a key tool to address regional climate action goals and using their own operations to model low carbon business practices.

Making Better Use of Existing Facilities and Services

MTC is the Bay Area's metropolitan planning organization, or MPO. In developing its most recent Regional Transportation Plan (RTP), MTC developed a methodology for project evaluation in three areas: Economy, Environment, and Equity. Under Environment, it set year 2035 performance targets for reductions in emissions and vehicle miles traveled (VMT). These included a 40% reduction in carbon emissions and a 10% reduction in VMT from 2006 levels.

MTC then evaluated potential projects using these criteria. The "lessons learned," according to the Plan include: "Limits of infrastructure; power of pricing and land use; need for technology and behavioral change." The Plan's authors further explained: "We learned that infrastructure investments produce only modest tangible effects at the regional level, and that aggressive pricing and land-use strategies exert much greater influence than transportation projects alone in moving us toward achievement of the performance objectives."[2]

Even a "massive" investment in transit, the analysis found, would result in minimal reduction in VMT and reduction of carbon emissions: only about 10% of the reductions required to achieve the 2035 objective. Coupled with pricing and land use policies, however, transit could achieve about half of the hoped-for decrease in emissions, and about two-thirds of the necessary reduction in VMT.

BART has performed a similar cost-effectiveness analysis of different strategies for achieving greenhouse gas emission reductions. In support of BART's

1 The calculations in this fact sheet use the carbon dioxide emissions per megawatt hour for the power supplied to the electrical grid in the particular sub-region in which the transit agency operates. The data is from the U.S. Environmental Protection Agency's Emissions & Generation Resource Integrated Database (eGRID) 2006 v2.1, http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html. Sub-region emission factors are used rather than state level emission factors as regional power grids do not correspond with state lines. In addition, using the eGRID sub-region data rather than the state level data is recommended by the Climate Registry General Reporting Protocol, Chapter 14, http://www. theclimateregistry.org/downloads/GRP.pdf

2 Metropolitan Planning Commission, Transportation 2035: Change in Motion. (http://www.mtc.ca.gov/planning/2035_plan/).

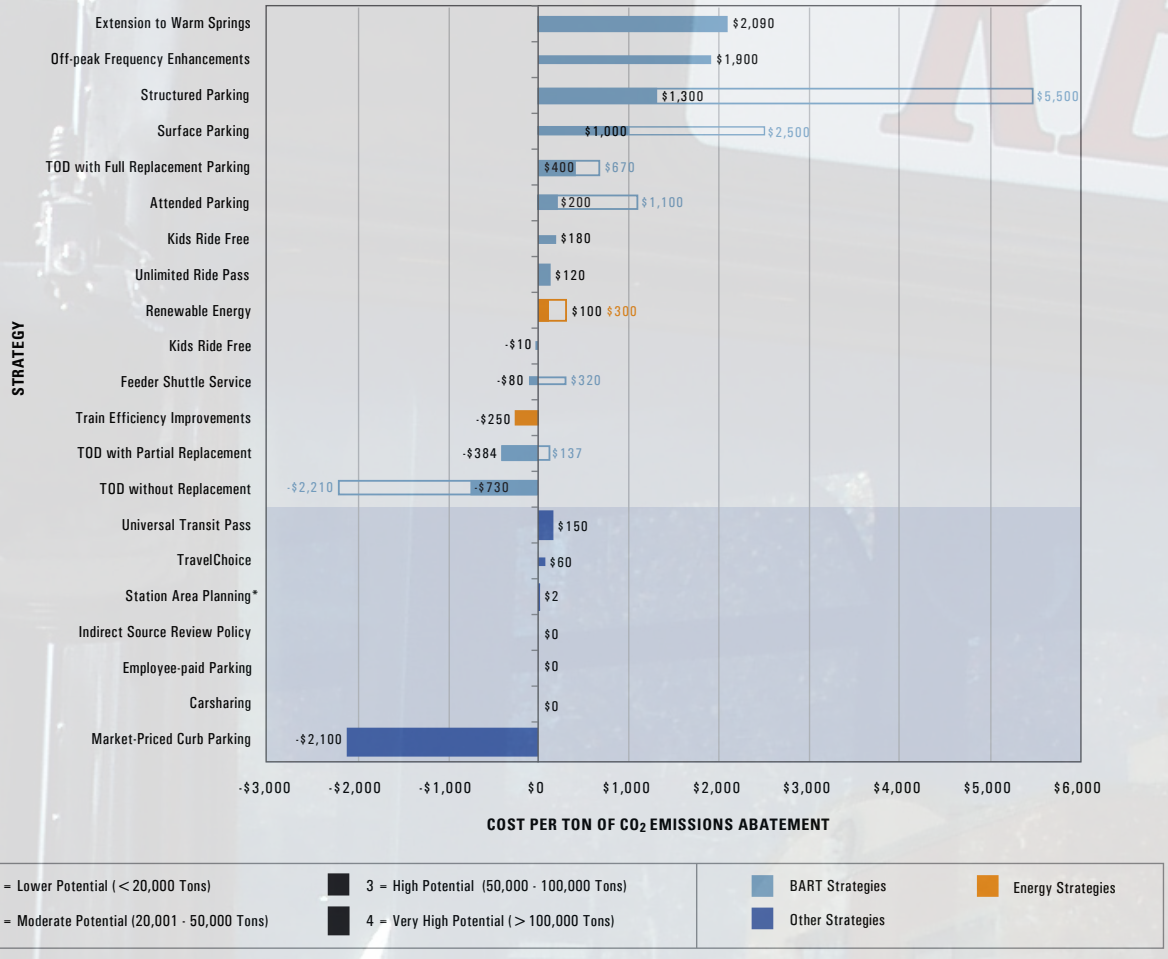
Climate Action Plan, a range of transportation and land use strategies were assessed, some of them strategies that BART itself could enact, and some requiring regional initiatives such as increased transit-oriented (TOD) development or parking management. The range of projects included a number that were capital-intensive, while some were lower cost transportation demand management (TDM) strategies. These included strategies for transit-oriented development and parking pricing at BART stations. While TOD projects were envisioned to be joint development efforts, they were assumed to be "free" to the public, as any subsidy to TOD development was assumed to replace subsidy for greenfield development in the form of utility extensions, roadways, and other costs to taxpayers.

Different performance measures and evaluation tools were then applied. These included costs per ton of emissions abatement, total emissions abatement, and co-benefits, other than emissions reduction.

BART's analysis arrived at similar conclusions to the work done by MTC. The most cost-effective strategies on a per-ton basis were found to be joint development and parking pricing, while major infrastructural investments were found to be cost-effective only to the extent that they might have long-term impacts on land use patterns. The relationship between system capacity and latent demand was also found to be an important factor; the most effective way to reduce driving over time is to manage road supply through pricing, and ultimately reduce supply.

Simple strategies such as fare incentives that fill seats at off-peak times, station area planning and station access improvements can reduce GHG emissions at relatively low costs (compared with programs in other sectors) and help meet other regional land use and transportation goals.

COST PER METRIC TON OF CO_2 EMISSIONS ABATEMENT (BY STRATEGY)



*Includes planning for land use change: does not include public or private infrastructure investment

Some strategies evaluated by BART had little to no cost per ton of CO2 reduced; some made a profit.

Source: BART Climate Action Plan. Actions to Reduce CO2: A Cost Effectiveness Analysis. Nelson\Nygaard

Fares

One main factor that people consider when making transportation decisions is cost. During times when the system has excess capacity, such as on weekends or off-peak, fare incentives may be needed to shift drivers to transit, since roadways are less congested. Fare programs must be given careful thought, however, as they may result in reduced revenue for the agency. For example, when New York City Transit introduced unlimited ride weekly and monthly passes, ridership increased but revenue fell nearly 4% because the average fare per trip went down. Agencies must make sure that growing ridership in the short term (a good GHG reduction strategy) does not threaten longer-term ability to maintain service levels.

Feeder Service for Transit

A common barrier to shifting people away from long regional trips by private vehicle is the "last mile" connections to trunk line transit service like light rail or commuter rail. Shuttle services are often the most viable option in suburban environments where pedestrian and bicycle options are limited. In the Bay Area, a number of South San Francisco employers pool resources to provide coordinated shuttle service connections to BART and Caltrain throughout the day. The ALLIANCE program allows employers to provide a high-quality service that no individual company could afford. Run by San Mateo County's Demand Management Agency, the ALLIANCE program also provides marketing and recruitment support to employers.

Better Access to Transit/Walkable Communities

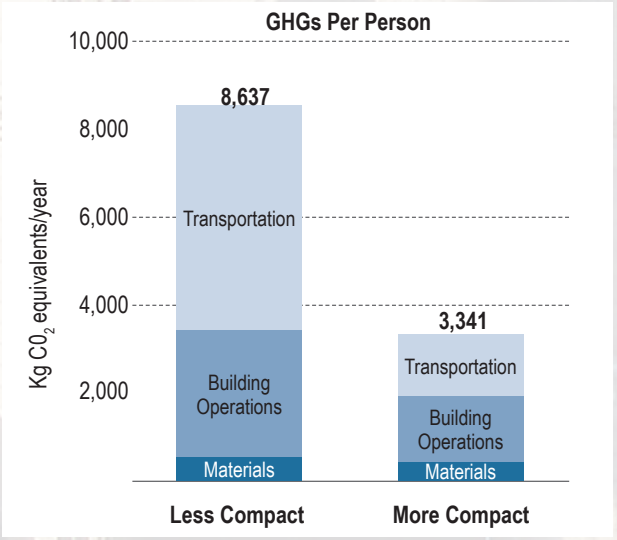
The most effective way to decrease vehicle miles traveled is building communities that are more transit oriented. As shown in the graphic at right, people living in compact developments emit far fewer kilograms of CO2.

BART's analysis concluded that transit-oriented development has the most potential to produce revenue and reduce emissions. When taking a typical BART station and implementing transit-oriented development in place of parking lots, BART could reduce emissions by 650 to 2,300 tons per project and achieve revenue gains of $600 to $1,400 per ton.[3]

3 BART Actions to Reduce Greenhouse Gas Emissions: A Cost-Effectiveness Analysis. Nelson\Nygaard. Page 16.

An ALLIANCE Shuttle.

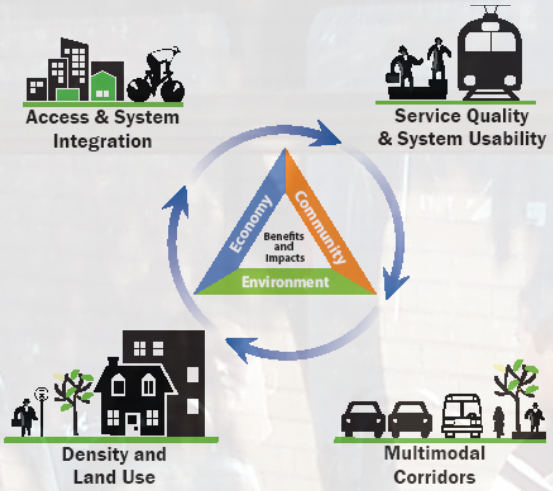
Source: Nelson\Nygaard



Source: Journal of Urban Planning and Development, Norman, March 2006

Enhancements to Existing Service

Transit service strategies that shift travelers from auto travel to transit are the primary focus of efforts to reduce GHG emissions. Simply adding service (headways) to existing high demand lines is an effective strategy, but can be expensive since much of the cost of operating services comes from operator salaries and benefits. Speeding up existing service is often a more cost-effective strategy, since it allows transit operators to get more service for the same amount of operating cost and increases transit's competitiveness with driving. There is also an important role for local agencies that operate the streets and signal systems, since they can provide the priority needed for transit to bypass traffic and speed operations such as through traffic signal priority systems, which holds a green signal to allow a train or bus to



To capture the full social and economic benefit of transit, a total system approach is needed.

Source: Nelson\Nygaard

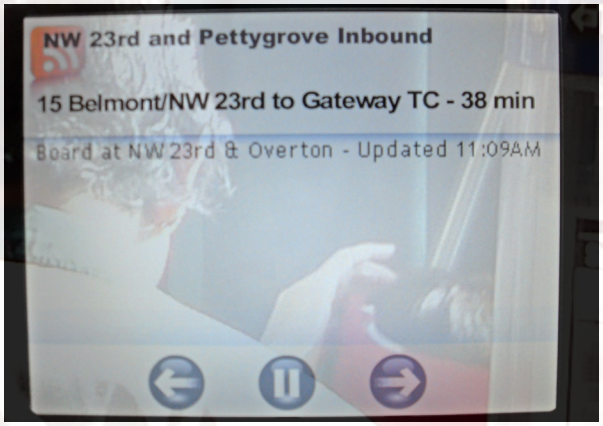
pass. TriMet is doing its part by focusing on creating a "total transit system" to attract every choice rider possible. To do this, the agency is focusing on service reliability, adequate capacity, and complete travel information for customers.

Better Passenger Information

Measures like real-time arrival information and cell phone service updates that improve customer service have a role in attracting and retaining passengers. TriMet is now providing open source data on vehicle location, allowing private individuals or companies to create better information technology for passengers (e.g., real-time cell phone applications). A local transit advocate recently released a new "transit appliance" that will, for less than $200, will allow any business or office to provide real-time transit vehicle arrival information on a digital screen using a wifi connection.

Marketing

This is a measure that costs little in relation to many other strategies, but can reap large rewards in increased ridership and ultimately greenhouse gas reduction. Measuring the effects of marketing campaigns can be difficult, but in general making sure the public is aware and knowledgeable about available transit service is a critical step in attracting riders. Marketing has the biggest effect in instances where transit is most competitive with driving in terms of price, convenience, and travel time. The BART study concluded that targeted marketing of existing transit services might be one of the most cost-effective means for reducing transportation related greenhouse gas emissions.



Screen shot from the "transit appliance" which provides real time transit vehicle arrival information using open source data from TriMet.

Source: Portland Transport Blog (http://portlandtransport.com/archives/2010/09/169_transit_inf.html)

GHG benefits of transit oriented development come not just from increased transit use, but even greater overall reduction in driving resulting from walkable urban form

Source: Nelson\Nygaard

Tie Transit Improvements to Land Use

Most detailed analyses conducted to identify cost-effective strategies to reduce transportation-related greenhouse gas emissions point to the need to increase efforts to build dense, walkable, transportation-efficient communities and neighborhoods and to transfer the real cost of parking construction and operations to users.

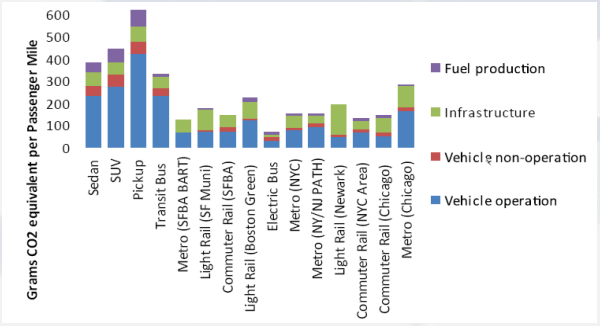
Developing new high capacity lines or extending existing lines is a capital-intensive endeavor, but one that can drastically reduce greenhouse gas emissions if carefully executed to serve or leverage transit-supportive development. A study completed for the American Public Transit Association suggests that transit service has a primary benefit from the act of substituting a mile of travel by car with a mile of travel on transit, but also causes a secondary benefit. Since transit fosters more compact and walkable communities, even those living near transit who don't

use it will still reduce vehicle miles traveled as a result of being able to accomplish errands through shorter walking and cycling trips. This secondary benefit may be as much as 1.9 times as large as transit's direct impact.[4] In Portland, planners have come to refer to these benefits as "the trip not taken."

Power Sources and Full Lifecycle Emissions

Most rail transit and some bus transit services, such as Metro's trolleybus fleet, rely on electricity for power. Those relying on electricity from low emissions sources, such as hydroelectric, have lower emission that those using electricity from coal burning power plants. Since Seattle has among the cleanest electricity in the United States, electric powered transit is an attractive option if reducing CO2 emissions is a goal.

4 ICF International for the American Public Transit Association. "The Broader Connection between Public Transportation, Energy Conservation and Greenhouse Gas Reduction." February 2008.



Lifecycle CO2 emissions per passenger mile based on average occupancy for range of vehicles and systems.

Source: Mikhail Chester and Arpad Horvath. *Life-cycle Energy and Emissions Inventories for Motorcycles, Diesel Automobiles, School Buses, Electric Buses, Chicago Rail, and New York City Rail*, 2009. http://escholarship.org/uc/item/6z37f2jr

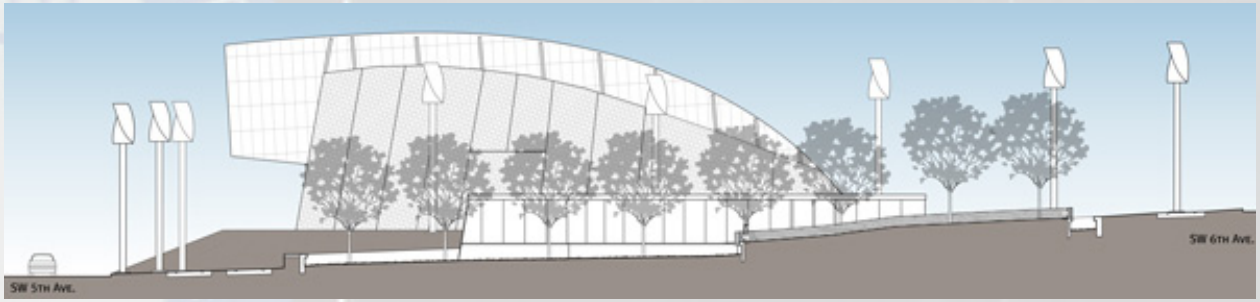


Illustration of the TriMet's South Terminus Energy Project.

Source: Used with permission from TriMet. (http://trimet.org/news/southterminus_energy.htm)

The amount of CO2 emitted per passenger mile traveled in any particular mode can be measured based on tailpipe emissions, but is probably more accurately accounted for based on a full lifecycle accounting. This includes all emissions generated over the full life of a transportation system, including those from construction and materials, infrastructure maintenance, production and use of fuels, and eventual disposal of vehicles and infrastructure. Researchers at University of California at Berkeley developed methods for analyzing full lifecycle costs of transit and private auto modes. The results of a variety of transit and non-transit modes are illustrated in the graphic below.

The chart shows that electric buses have among the lowest non-operational emissions over a lifespan, far lower than a diesel powered transit bus. For a range of rail systems, transit greenhouse gas emissions are substantially lower than those for private automobile modes when emissions from construction, manufacturing and maintenance are considered.

Reducing Emissions from Transit Agency Operations

Transit providers can change internal practices to further reduce greenhouse gas emissions, such as by making green practices part of procurement, fostering an environmental workplace, constructing green buildings and facilities, and conducting research into and implementing new technologies that can reduce emissions and energy consumption.

TriMet is currently conducting a detailed assessment of its carbon footprint according to American Public Transportation Association's recommended practice for quantifying greenhouse gas emissions. The analysis is not complete yet, but data in the 2007 National Transit Database shows that TriMet's total operational footprint was 76,000 metric tons of CO2.[5] The more detailed APTA footprint analysis will tell TriMet both its debits—the amount of greenhouse gases emitted by source—as well as its credits, or how much greenhouse gases are not emitted because of TriMet's ability to shift mode choice and foster compact development. The footprint analysis will allow TriMet to identify its biggest sources of emissions and create targets for reductions.

5 Eric Hesse, TriMet Strategic Planning Analyst. E-mail message 15 May 2009.

MAX light rail and historic trolley at the south terminus of Portland's downtown transit mall, a planned hub for alternative energy.

Source: Nelson\Nygaard

One main source of GHG emissions for transit agencies comes from traction power. TriMet trains currently have wayside regenerative braking capability, which allows power released from braking to be briefly stored in the third rail and used by another train. This measure has reduced traction power needs by 20%; however, only 50-75% of potential power released from braking is being retained. TriMet is researching on-board regenerative braking, which allows the braking train to store the energy on-board. This technology has the potential to capture 75-100% of the energy released from braking.[6] Other initiatives TriMet has undertaken include: using biodiesel blends containing vegetable oil and fats, and installing railroad ties made of recycled plastic taking from car gas tanks; and developing the South Downtown Transit Mall light rail terminus alternative energy project. This pilot project, which recently received funding from the Federal stimulus package, will include solar and wind power generators, including 22 wind turbines at the South Mall light rail terminus.

The Metropolitan Transportation Association (MTA), the state authority running transit systems in New York City, has identified several innovative measures to cut greenhouse gas emissions, including:

- Building administrative and maintenance facilities to LEED standards or higher.
- Using aluminum, which has a lower resistance than steel, for the third rail, resulting in less energy use from braking.
- For new track construction, creating humped tracks at platforms so trains can take advantage of gravity and use less power for braking and accelerating.
- Retrofitting train cars with aluminum where possible to lower the train weight and thus reduce energy needs.[7]

CONCLUSIONS

The city of Seattle will need to partner with Metro, Sound Transit, PSRC and other regional agencies to ensure transit is fully leveraged in efforts to meet GHG reduction goals. While renewable energy sources, cleaner fuels, and green technology will help to reduce GHG emissions, significant changes in neighborhood design and transportation funding priorities are needed to meet greenhouse gas reduction goals. In Seattle, the Walk, Bike, Ride initiative can serve as a blueprint for more detailed strategies; research shows that dense, mixed-use communities that allow people to travel by foot, bike, and transit are critical to climate protection.

Achieving emissions reductions requires involvement and leadership at the national, state and regional level. Many greenhouse gas emissions reduction strategies can all be undertaken by transit providers; however, some of the most important policies for reducing greenhouse gas emissions require wider, more systemic change than a transit agency can achieve on its own. New partnerships and mechanisms for prioritizing land use and transportation projects will be needed to meet state and national goals.

6 Eric Hesse. Phone interview. 15 May 2009.

7 http://www.lirr.org/sustainability/index.html?c=EnergyCarbon