Comprehensive Evaluation of Public Transport As An Emission Reduction Strategy

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Aligning Environmental and Transportation Policies to Mitigate Climate Change

NYU School of Law

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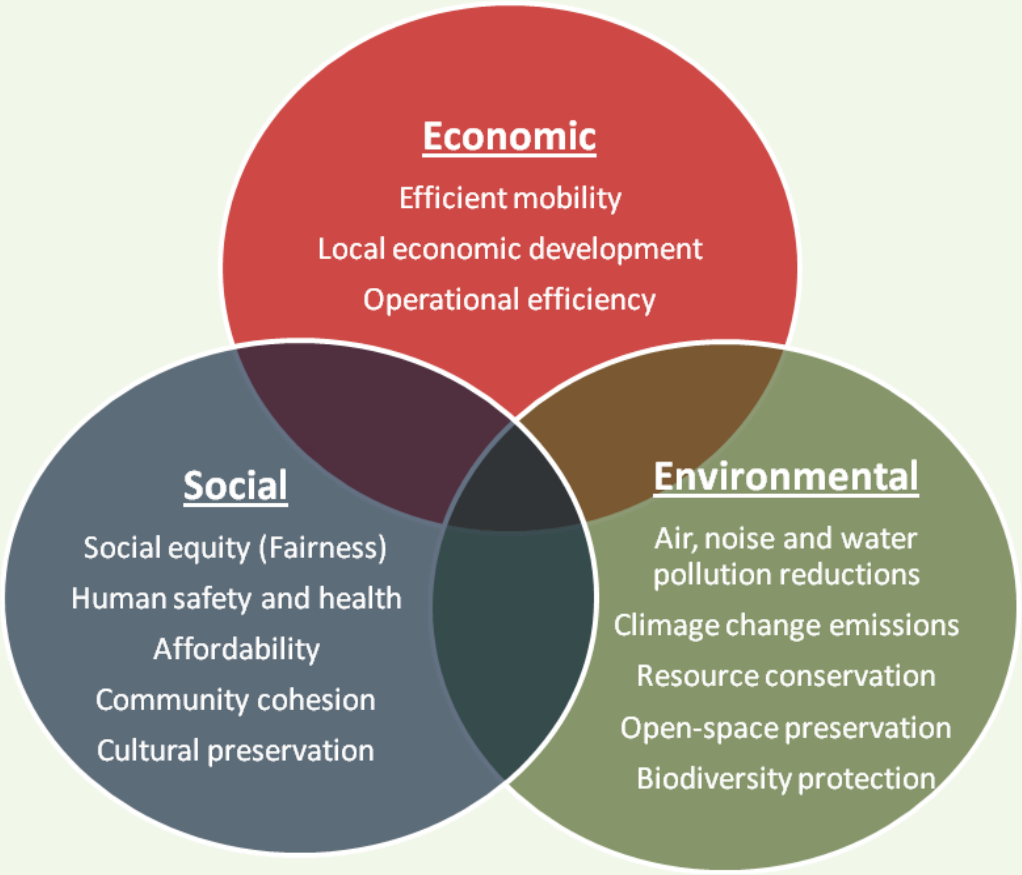
Sustainable Planning

Sustainability emphasizes the integrated nature of human activities and therefore the need to coordinate planning among different sectors, jurisdictions and groups.



Paradigm Shifts

- **Growth -** expanding, doing more.

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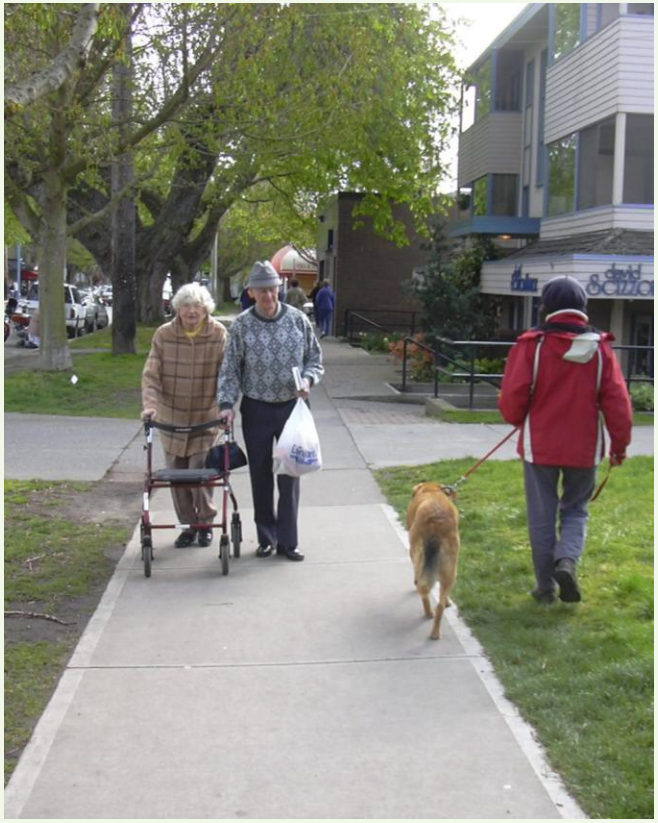
- **Development** - improving, doing better.



- **Mobility** - physical movement.

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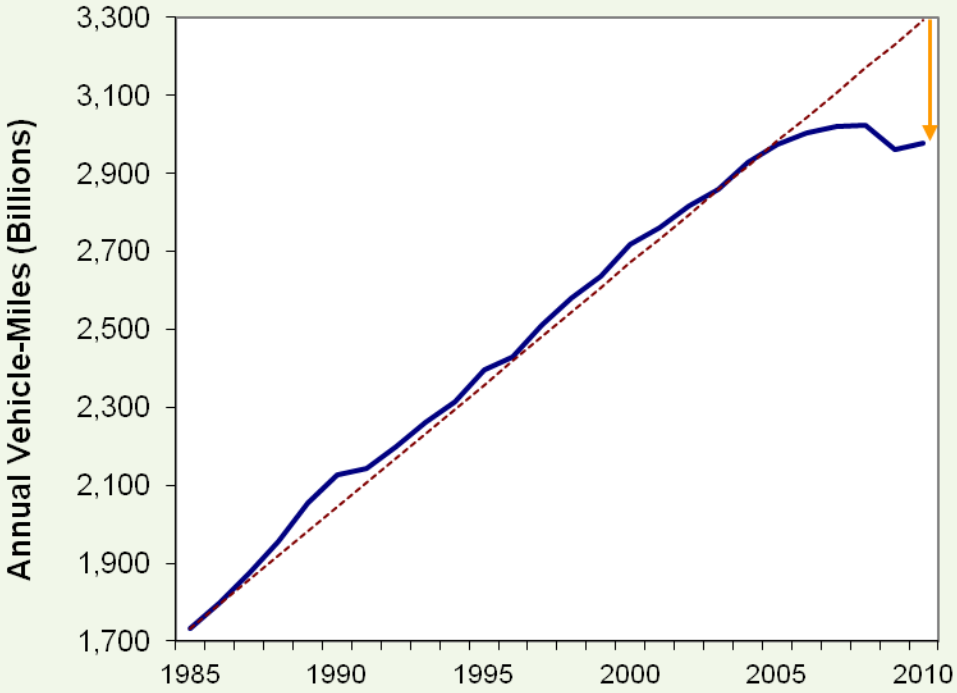
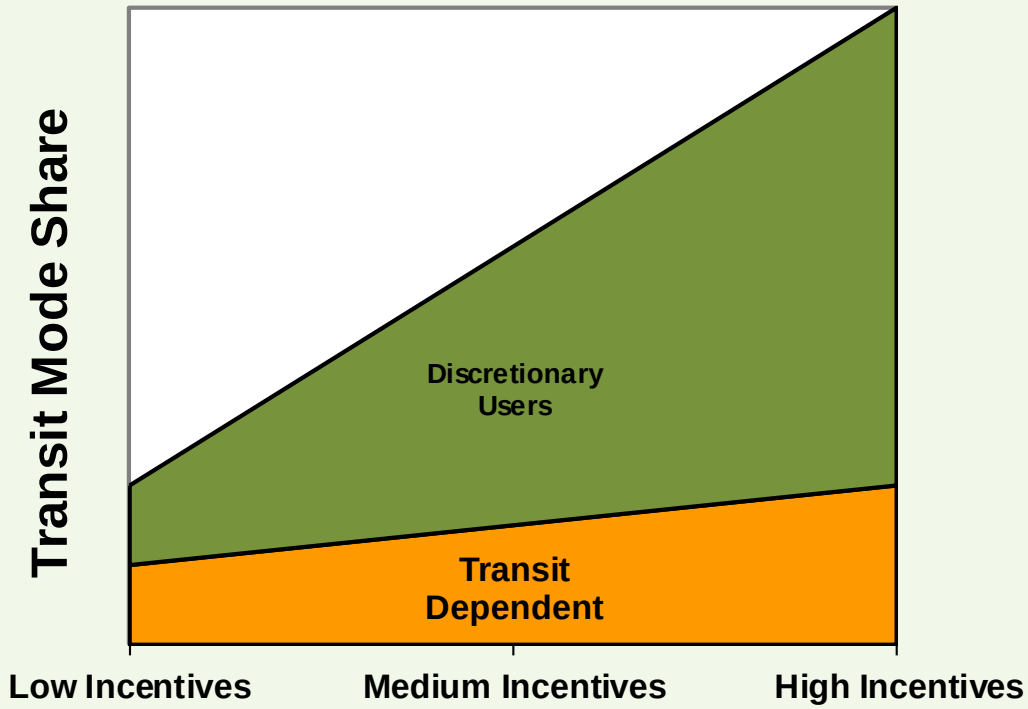
- **Accessibility** - obtaining desired goods, services and activities.

Trends Supporting Multi-Modalism



- Motor vehicle saturation.
- Aging population.
- Rising fuel prices.
- Increased urbanization.
- Increased traffic and parking congestion.
- Rising roadway construction costs and declining economic return from increased roadway capacity.
- Environmental concerns.
- Health Concerns

Increasing Transit Mode Share



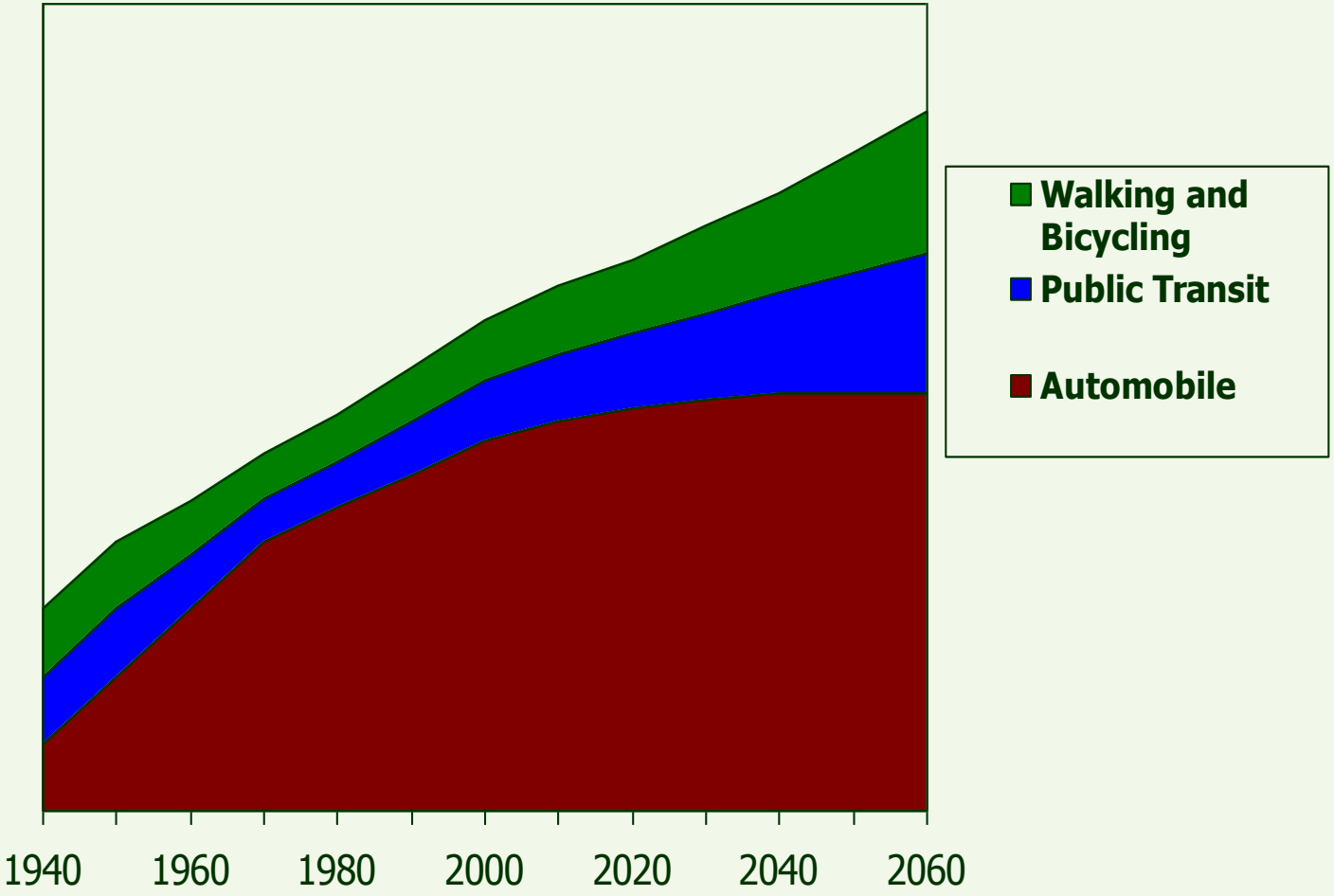
A small portion of the population is *transit dependent* and will use transit services even if quality is poor and driving is cheap.

As public service quality improves and motorists have more incentive to use alternative modes, transit passengers consist of more *discretionary travelers* (people who can use automobile travel).

Since transit services experience scale economies (more ridership reduces unit costs and increases the justification for more and better service), incentives for discretionary travelers to use transit tend to improve service.

Total Travel Trends

During the last century automobile travel grew significantly while travel by alternative modes stayed stagnant. During the next century automobile travel growth will decline while use of other modes will increase.



Leverage Effects

Study	Cities	Vehicle-Mile Reduction Per Transit Passenger-Mile	
		Older Systems	Newer Systems
Pushkarev-Zupan	NY, Chicago, Phil, SF, Boston, Cleveland	4	
Newman-Kenworthy	Boston, Chicago, NY, SF, DC	2.9	
Newman-Kenworthy	23 US, Canadian, Australian and European cities	3.6	
Holtzclaw 1991	San Francisco and Walnut Creek	8	4
Holtzclaw 1994	San Francisco and Walnut Creek	9	1.4
Litman 2004	50 largest U.S. cities.	4.4	
ICF 2008	U.S. cities	3-4	

Various studies indicate that high quality public transit (such as rail or Bus Rapid Transit services) tend to leverage additional reductions in vehicle travel by affecting land use. When this occurs, each transit passenger-mile typically reduces 2-9 automobile vehicle-miles.

Public Transit Benefit Categories

Improved Public Transit Services	Increased Public Transit Travel	Reduced Automobile Travel	Transit-Oriented Development
• Improved user convenience and comfort • Improved travel options, particularly for non-drivers • Improved local property values	• Direct user benefits • Economic development benefits from increased access to education and employment. • Increased public fitness and health, since most transit trips include walking and cycling links.	• Reduced traffic congestion • Road and parking cost savings • Consumer cost savings • Reduced crash risk to others • Air and noise pollution reductions • Energy conservation • Economic development benefits	• More livable communities. • Reduced sprawl (more compact, mixed development) reduces land consumption, reduces costs of providing public services, preserves openspace. • Improved accessibility, particularly for non-drivers • Reduced vehicle ownership

Public Transit Benefit Categories

Basic Mobility	Efficient Urban Transport
Broadly distributed services, including times and locations with low demand, and special mobility services such as demand response buses.	Service concentrated on busy routes, intended as an efficient substitute for driving in order to reduce traffic problems (traffic and parking congestion, energy consumption and pollution emissions)
Basic convenience and comfort. Users are transit dependent and so will use the service regardless.	Service must be competitive in convenience and comfort in order to attract travelers away from driving.
Mostly buses in mixed traffic.	Includes grade separated bus and rail services.
Serves lower-density development.	Intended to support and encourage transit-oriented development.
Tends to be energy inefficient (low fuel efficiency per passenger-mile).	Tends to be energy efficient (high fuel efficiency per passenger-mile), and by supporting transit-oriented development it can leverage large additional per capita energy savings.

Comparing Benefits – No Induced Travel

Planning Objectives	Expand Roadways	Efficient and Alt. Fuel Vehicles	Shifts from Autos to Alternative Modes
Vehicle Travel Impacts	*Increased VMT*	*Increased VMT*	*Reduced VMT*
Reduce traffic congestion	✓		✓
Roadway cost savings			✓
Parking cost savings			✓
Consumer cost savings			✓
Improve mobility options			✓
Improve traffic safety			✓
Energy conservation		✓	✓
Pollution reduction		✓	✓
Land use objectives			✓
Public fitness & health			✓

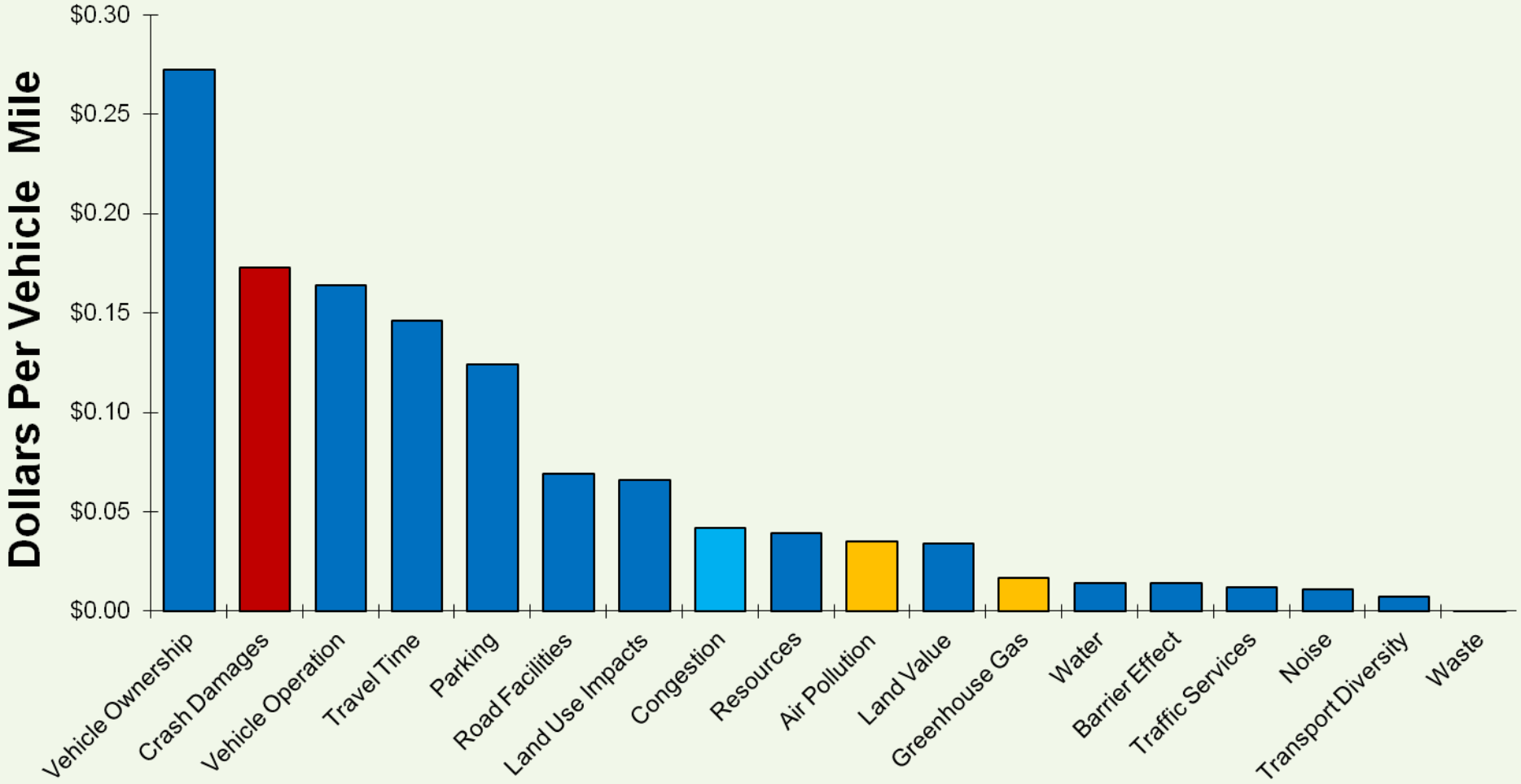
✓ = Supports objective

Comparing Benefits – Induced Travel

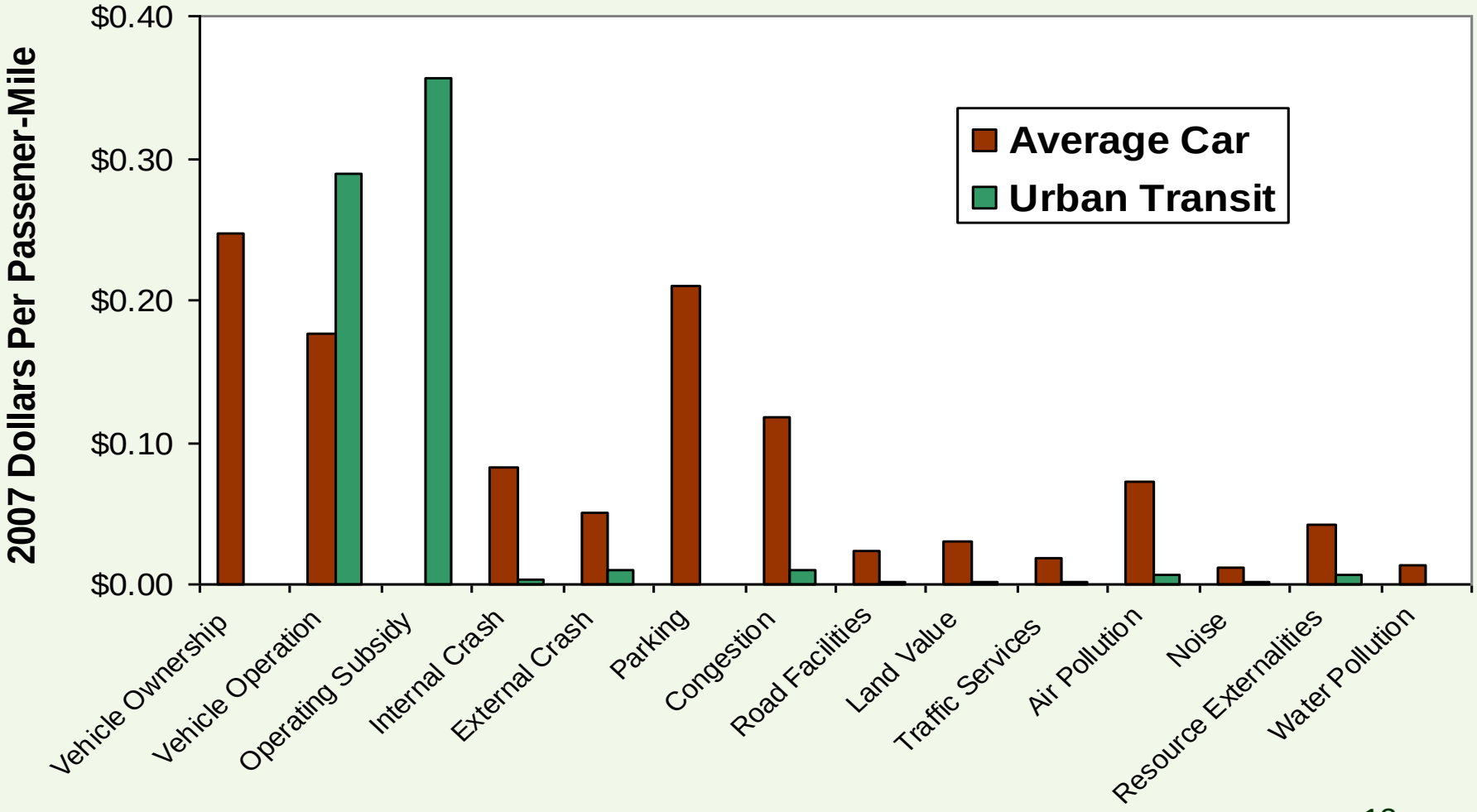
Planning Objectives	Expand Roadways	Efficient and Alt. Fuel Vehicles	Shifts from Autos to Alternative Modes
Vehicle Travel Impacts	*Increased VMT*	*Increased VMT*	*Reduced VMT*
Reduce traffic congestion	✓	×	✓
Roadway cost savings	×	×	✓
Parking cost savings	×	×	✓
Consumer cost savings	✓/×	✓/×	✓
Improve mobility options	×	×	✓
Improve traffic safety	×	×	✓
Energy conservation	×	✓	✓
Pollution reduction	×	✓	✓
Land use objectives	×	×	✓
Public fitness & health	?	?	✓

✓ = Supports objective × = Contradicts objective

Comparing Costs



Automobile Versus Transit Costs



Conventional Evaluation

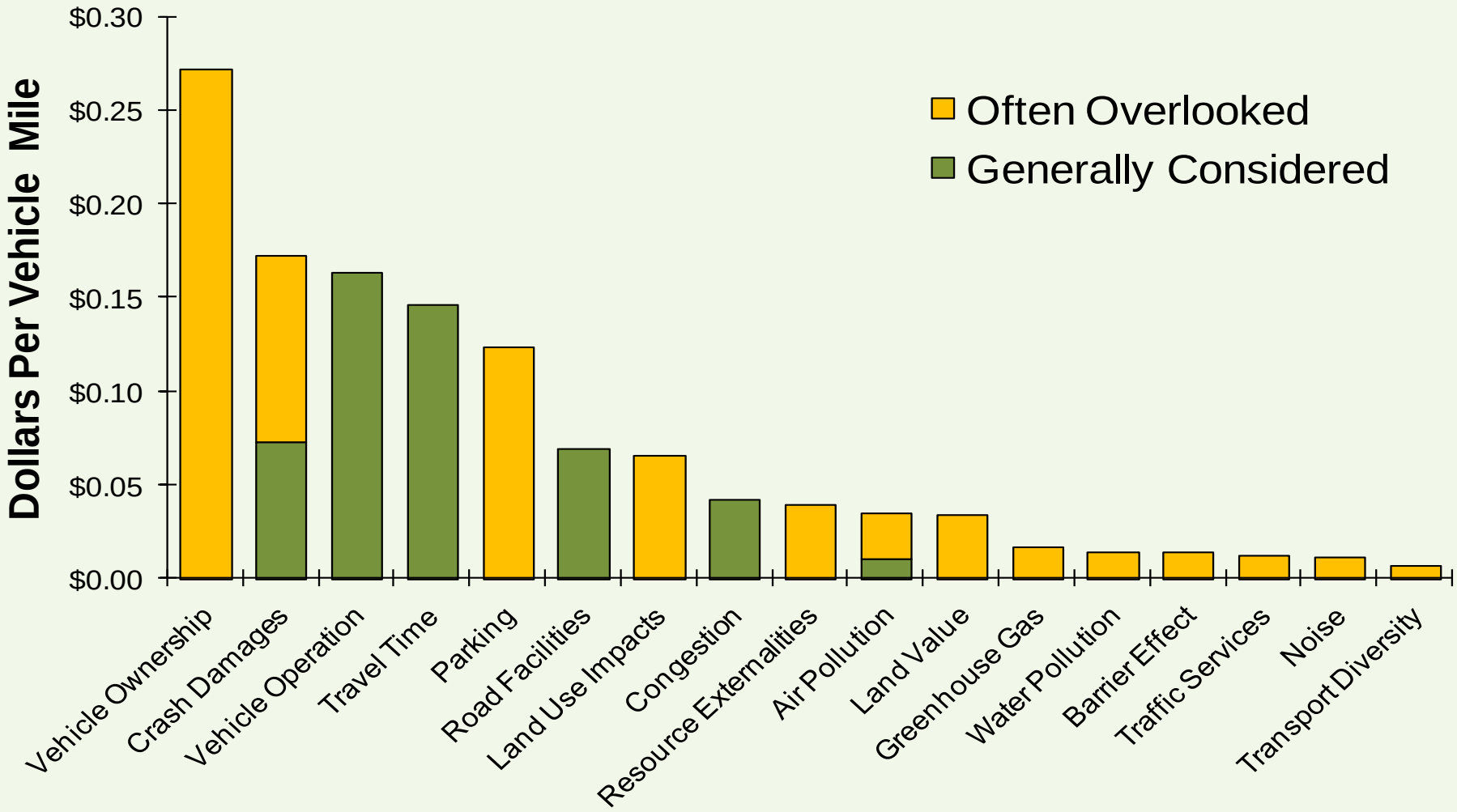
Generally Considered

- Congestion impacts
- Vehicle operating costs
- Per-mile crash impacts
- Per-mile pollution emissions.

Often Overlooked

- Parking costs
- Total consumer costs
- Downstream congestion
- Crash, energy & pollution impacts of changes in mileage
- Land use impacts
- Impacts on mobility options for non-drivers/equity impacts
- Changes in active transport and related health impacts

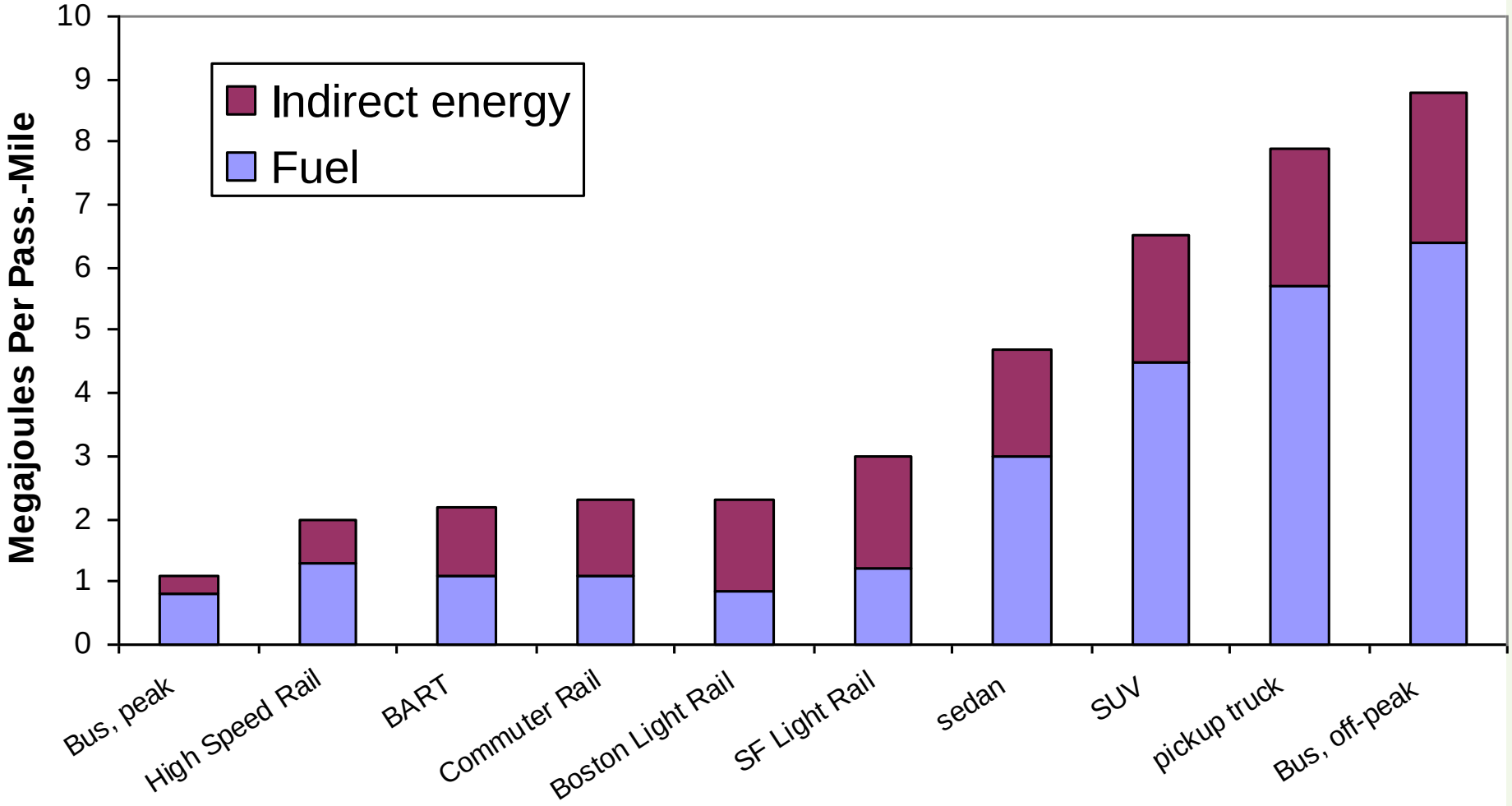
Comparing Costs



Energy and Emission Reductions

- Transit has relatively low *average* fuel efficiency because most service is designed primarily to provide basic mobility.
- Marginal energy costs of additional ridership is often very low.
- Some transit improvements, such as grade separation and faster loading systems, increase transit energy efficiency by reducing delays and stop-and-go operating conditions.
- High quality transit tends to stimulate transit-oriented development which provides significant additional energy savings and emission reductions.
- High quality public transit provides additional benefits besides energy savings and emission reductions. These co-benefits should be considered when evaluating public transit cost efficiency.
- High quality public transit supports other energy conservation and emission reduction strategies, including transport pricing reforms and smart growth land use policies.

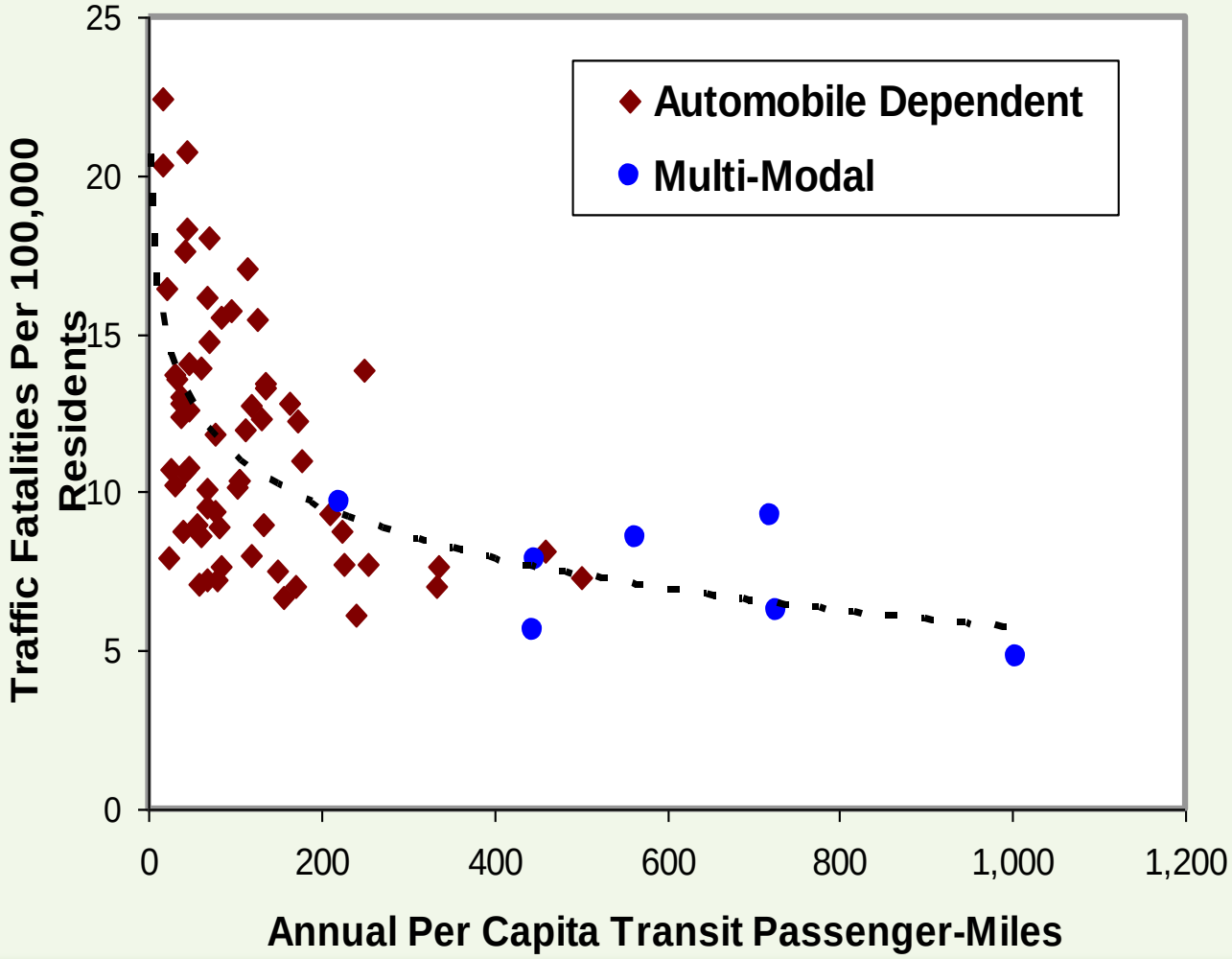
Lifecycle Energy Consumption



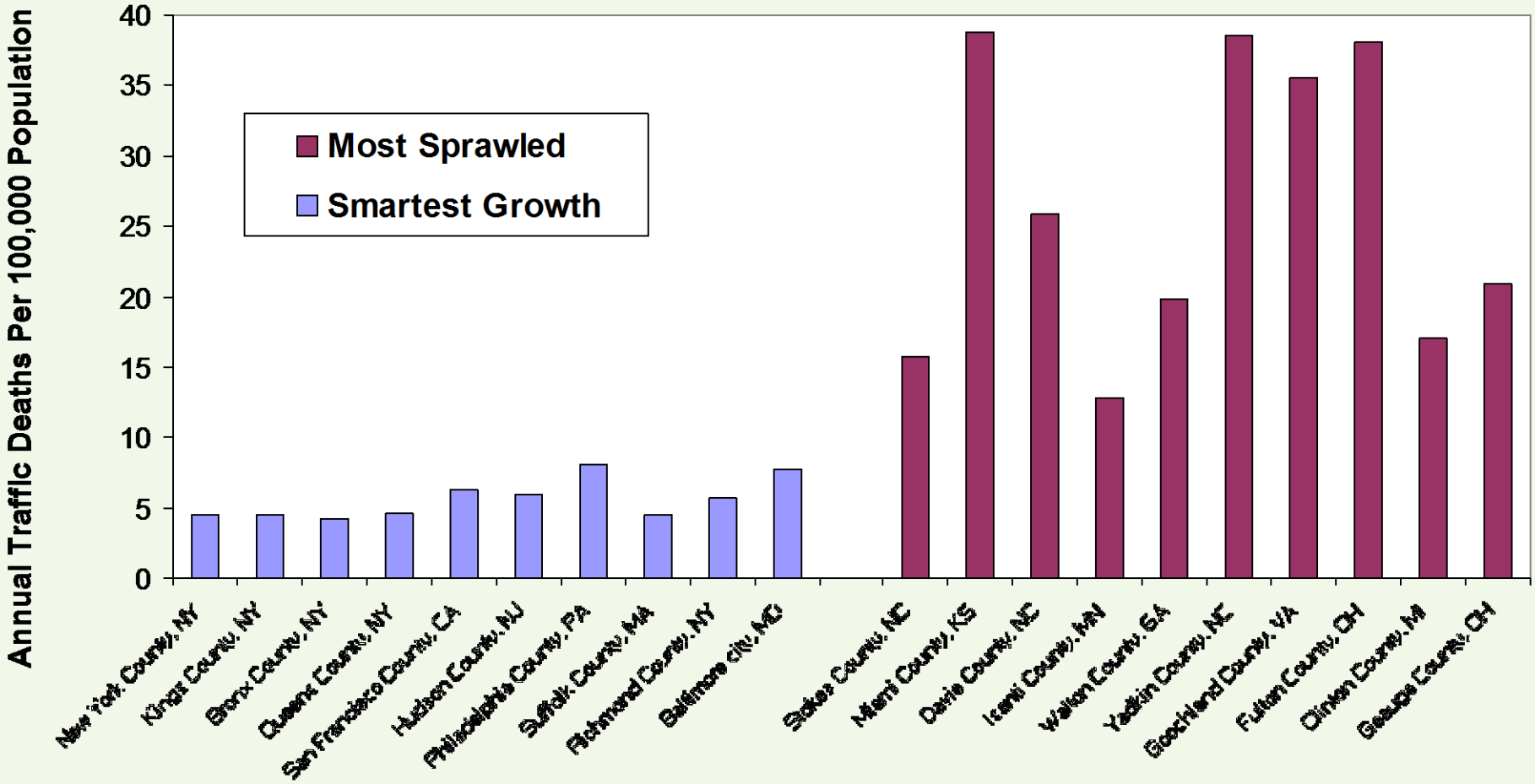
High Quality Transit Reduces Congestion

- Urban road congestion maintains equilibrium. It gets bad enough to discourage further vehicle trips.
- The quality of travel options affects this point of equilibrium: If alternatives are inferior, few motorists will shift mode and congestion will be severe. If alternatives are attractive, motorists are more likely to shift modes, reducing congestion equilibrium.
- The faster the transit service, the faster the traffic speeds on parallel highways. Door-to-door travel times for motorists tend to converge with those of grade-separated transit.

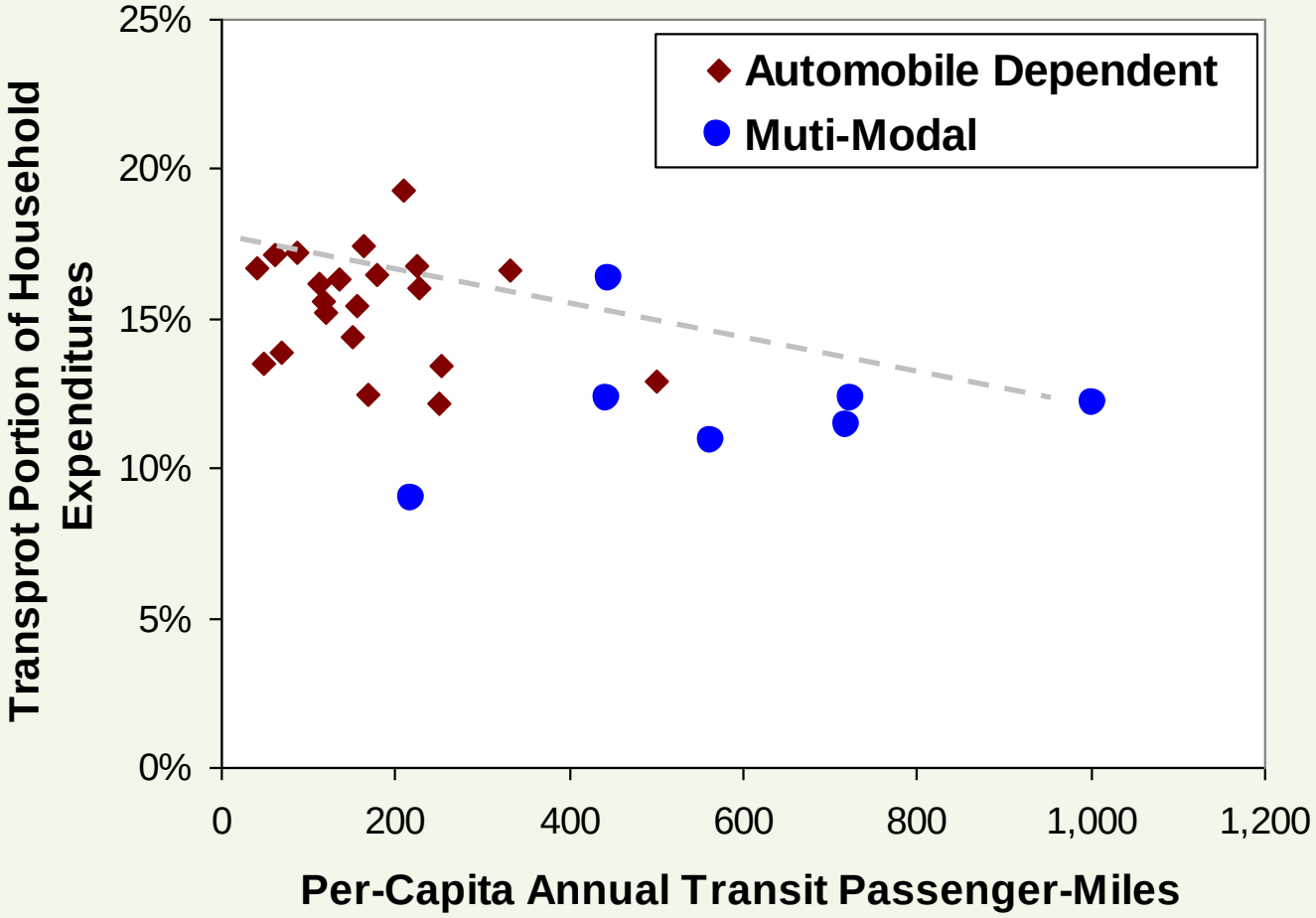
Traffic Fatalities



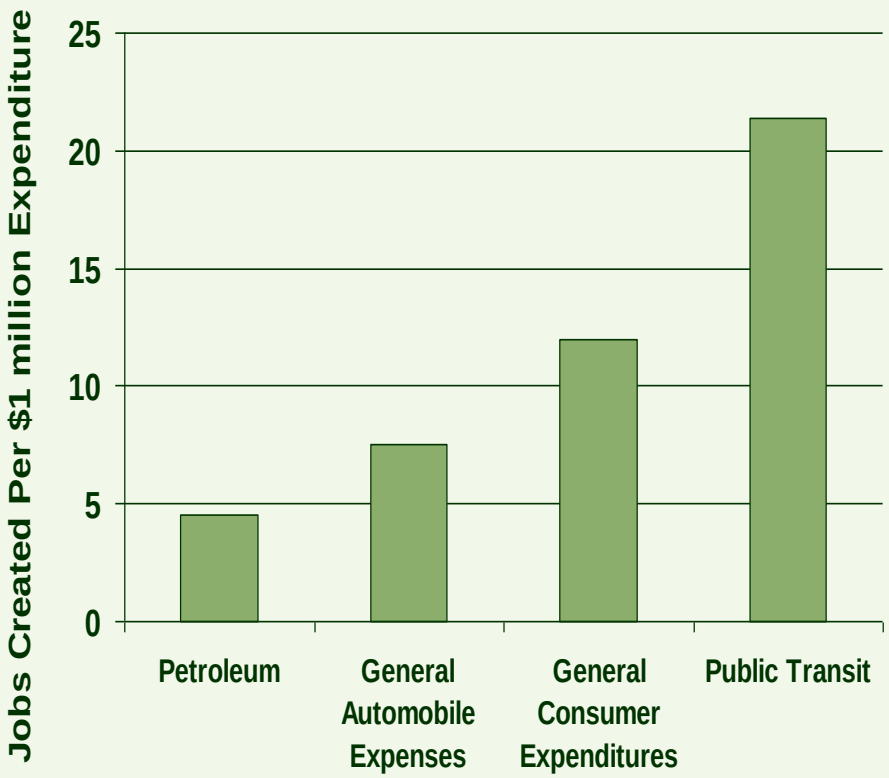
Smart Growth Safety Impacts



Transportation Affordability



Community Economic Impacts



- Transport savings and efficiencies (congestion, parking, taxes) increases productivity and competitiveness.
- Reducing vehicle expenditures and expanding transit service increases regional employment and business activity.
- Agglomeration efficiencies.
- Supports strategic land use development objectives.
- Increases affordability, allowing businesses to attract employees in areas with high living costs.
- Changes in household expenditures on vehicles and fuel.

Property Value Impacts

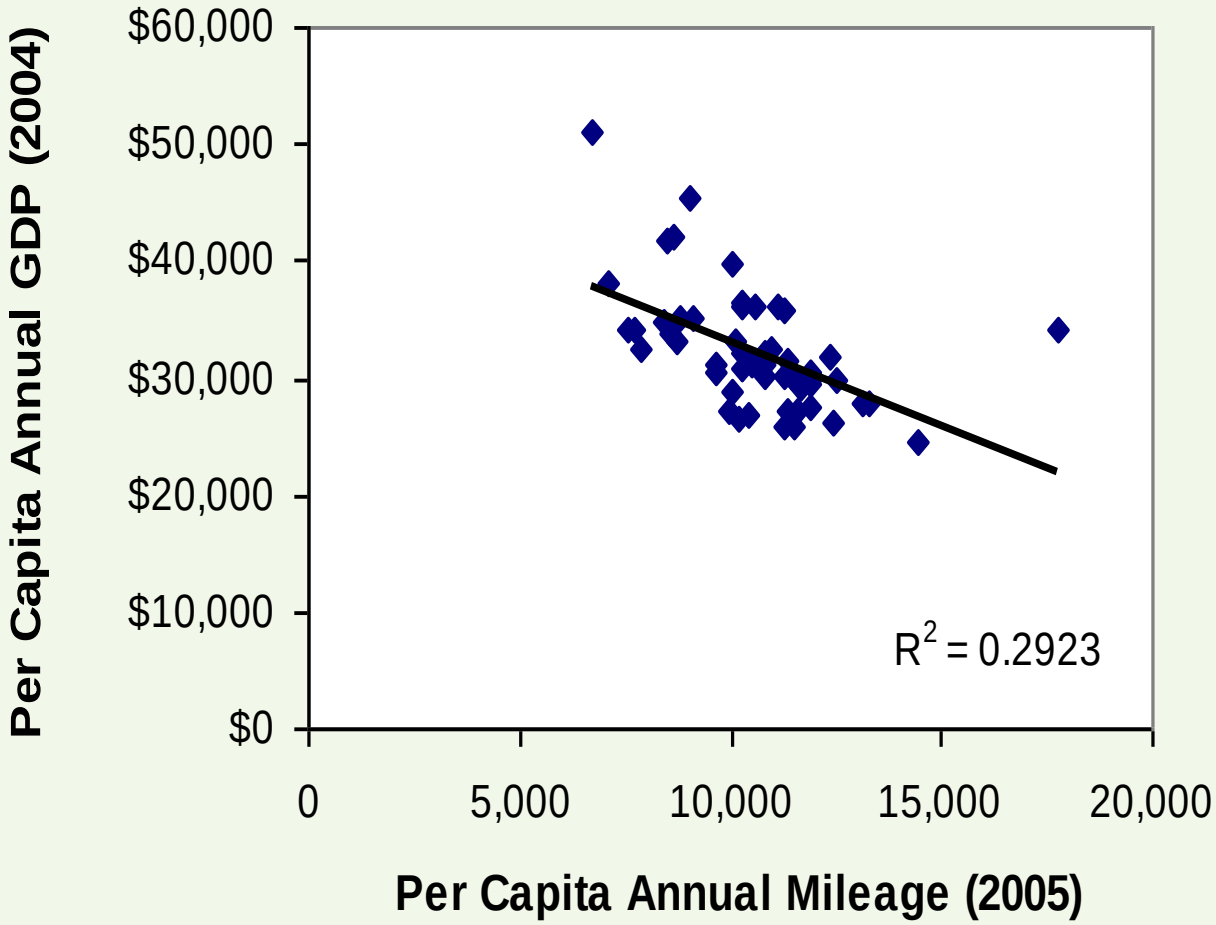
Property values tend to be 5-15% higher (and sometimes much more) in transit-oriented developments. This reflects the capitalized value of the transport cost savings.

Property Development

Per Capita GDP and VMT

Productivity tends to decline with increased mobility. (Each dot is a U.S. urban region.)

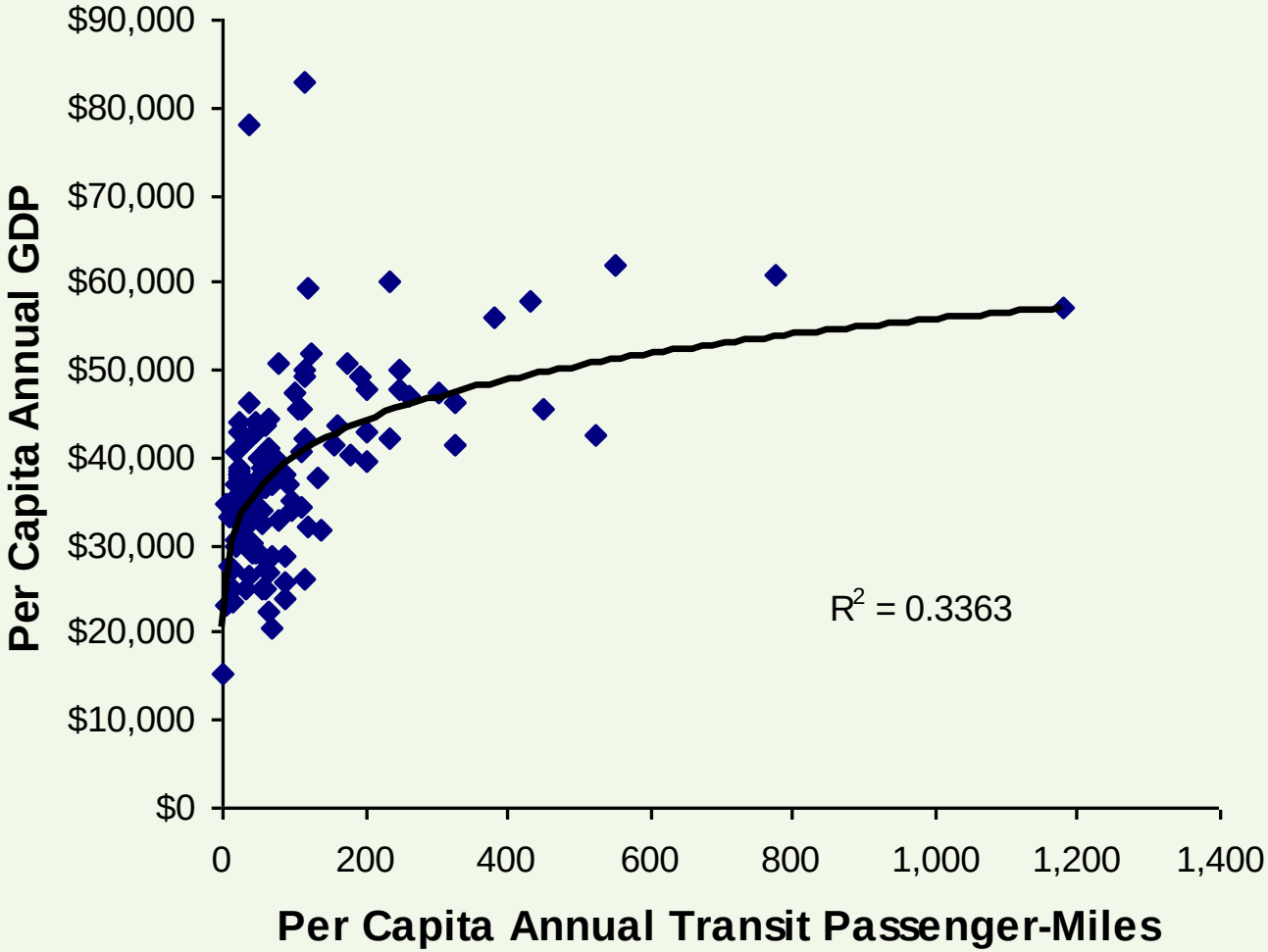
Bureau of Economic Analysis and FHWA data



Per Capita GDP and Transit Ridership

Productivity tends to increase with transit ridership. (Each dot is a U.S. urban region.)

Bureau of Economic Analysis and FHWA data



Win-Win Transportation Solutions

Market reforms justified on economic principles that help provide various economic, social and environmental benefits.

- Improved travel options.
- Incentives to use travel alternatives.
- Accessible land use.
- Policy and market reforms.

Sustainable Transport Hierarchy

1. Walking
2. Cycling
3. Public Transit
4. Service & Freight
5. Taxi
6. HOV
7. Private Automobile

Mode Shifts

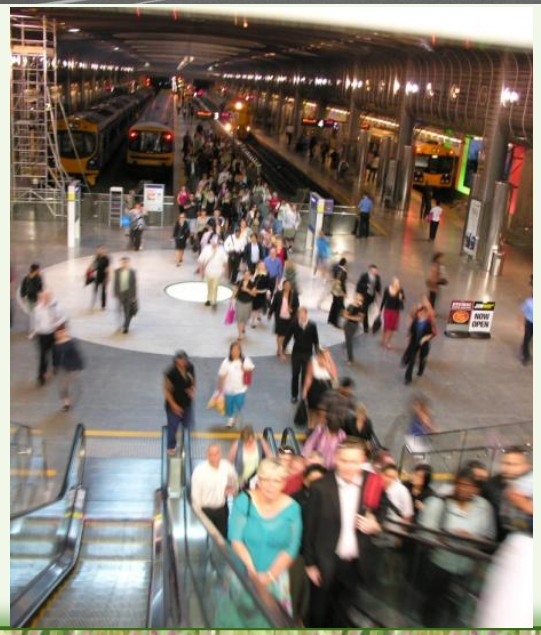
How do we convince people who drive luxury cars to shift mode?

Attracting Discretionary Riders

- Quality service (convenient, fast, comfortable).
- Low fares.
- Support (walkable communities, park & ride facilities, commute trip reduction programs).
- Convenient information.
- Parking pricing or “cash out”.
- Integrated with special events.
- Positive Image.

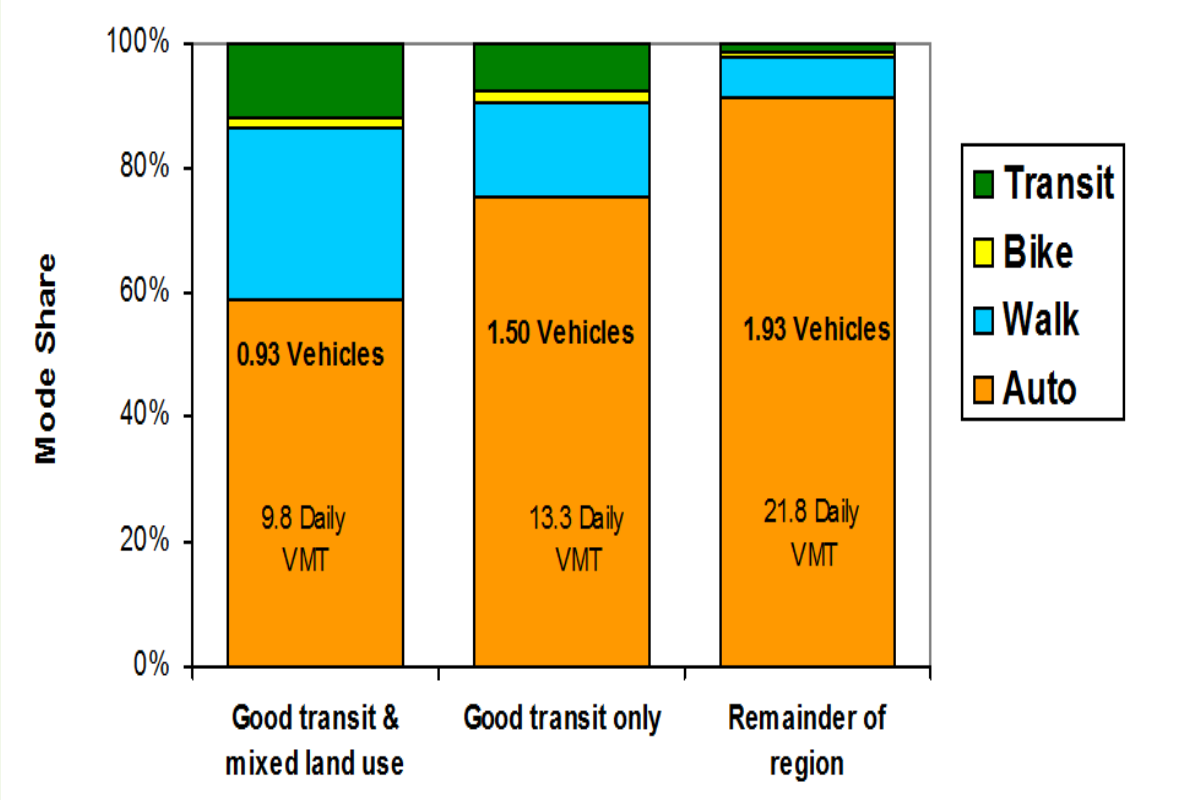
Transit Station Level-Of-Service

- Clean
- Comfort (seating, temperature, quiet)
- Convenience (real-time user information, easy fare payment)
- Accessible (walkability, bike parking, nearby housing, employment, nearby shops)
- Services (refreshments, periodicals, etc.)
- Security



Transit-Oriented Development

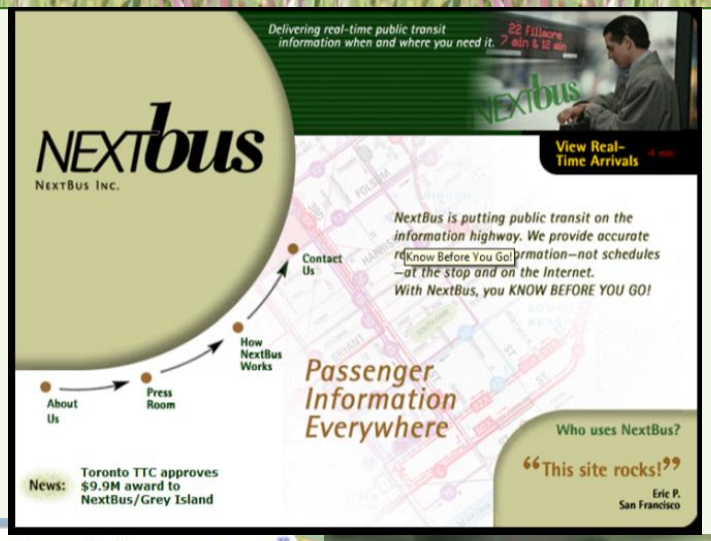
Transit-oriented development (TOD) tends to significantly reduce vehicle ownership and use, and increase travel by walking, cycling and public transit. TOD residents drive about half as much as residents of automobile-oriented communities.



Improve User Information

Provide information when and were users need it:

- Transit route, schedule and fares
- Discounts and incentives.
- Real-time arrival.
- Navigation to bus stops, train stations and destinations.
- Travel times for various modes (e.g., transit vs. driving).
- Special problems (warnings of delays).
- On-board wifi services.
- Parking availability and price.

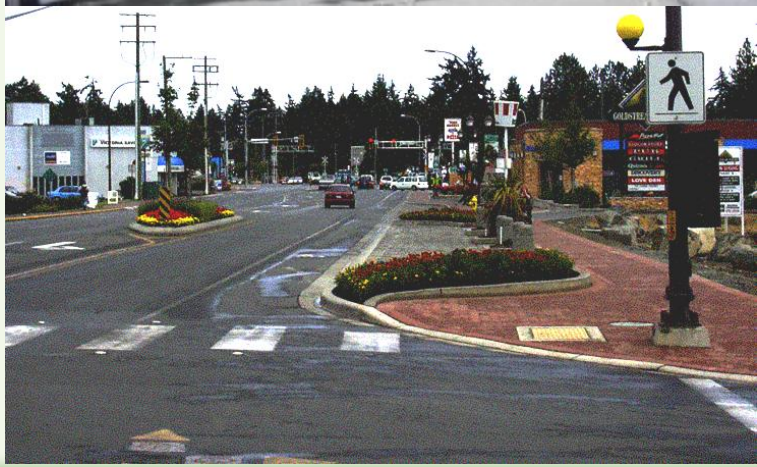


Employee Trip Reduction Programs

Employers encourage employees to walk, bicycle, carpool, ride transit and telework rather than drive to work.

Walking and Cycling Improvements

- More investment in sidewalks, crosswalks, paths and bike lanes around transit stops and stations.
- Improved roadway shoulders.
- More traffic calming.
- Bicycle parking and changing facilities.
- Encouragement, education and enforcement programs.



School & Campus Transport Management

Programs that encourage parents and students to use alternative modes to travel to schools, colleges and universities.

Smart Growth (Density, Design, Diversity)

- More **compact**, infill development.
- **Mixed** land use.
- Increased **connectivity**.
- Improved **walkability**.
- **Urban villages.**
- Increased transportation **diversity**.
- Better parking **management**.
- Improved **public realm**.
- More **traffic calming** and speed control.

Smart Growth Benefits

Economic

- Increased resource efficiency
- Lower development costs
- Lower public service costs
- Road and parking cost savings
- Economies of agglomeration
- More efficient transportation

Social

- Improved transport options, particularly for nondrivers
- Improved housing options
- Community cohesion
- Preserves unique cultural resources
- More opportunities to exercise

Environmental

- Greenspace & habitat preservation
- Reduced air pollution
- Increased energy efficiency
- Reduced water pollution
- Reduced "heat island" effect

Location-Efficient Development

- Locate affordable housing in accessible areas (near services and jobs, walkable, public transit).
- Diverse, affordable housing options (secondary suites, rooms over shops, loft apartments).
- Reduced parking requirements.
- Reduces property taxes and utility fees for clustered and infill housing.

"Raise My Prices, Please!"

Of course, motorists do not like to pay more for roads and parking, but unpriced facilities are not really free, consumers ultimately pay through higher taxes and retail prices. The choice is actually between paying directly or indirectly.

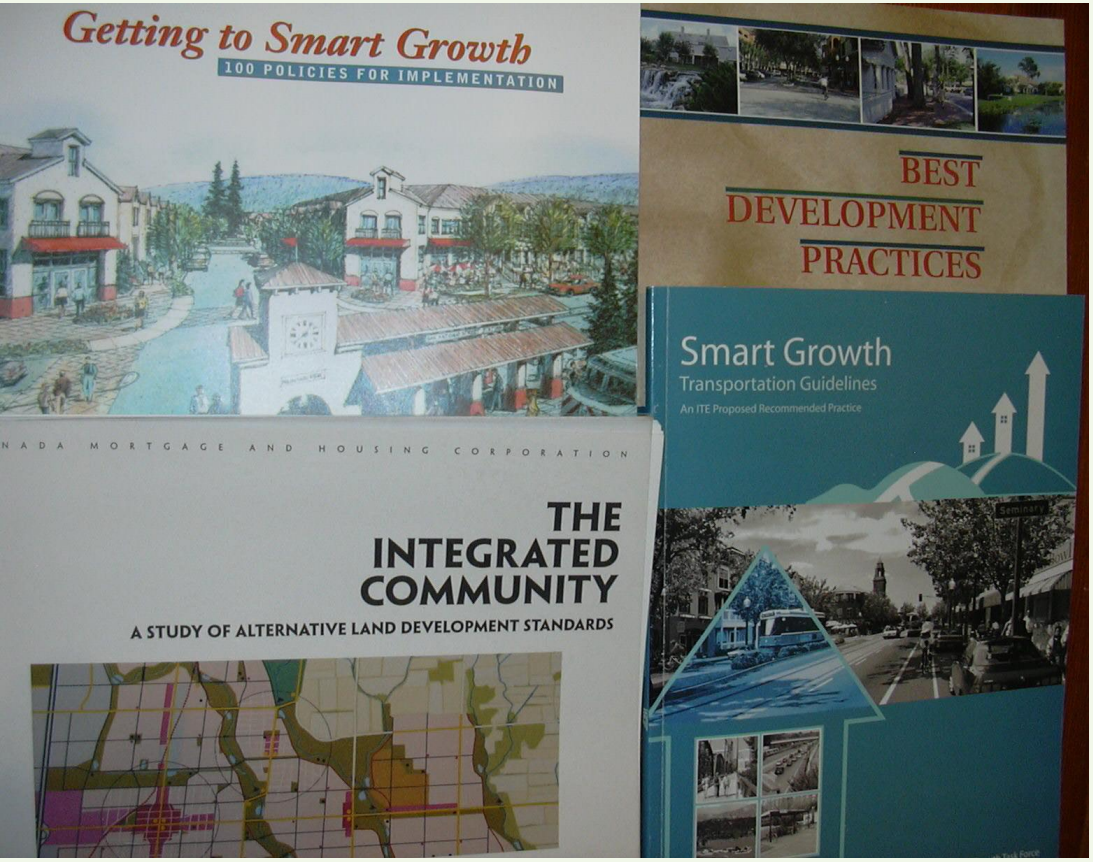
Distance-Based Pricing

Motorists pay by the vehicle-kilometre, so a $600 annual premium becomes 3¢/km and a $2,000 annual premium becomes 10¢/km. This gives motorists a significant financial incentive to drive less, but is not a new fee at all, simply a different way to pay existing fees.

Parking Management

- More flexible parking requirements.
- Share parking spaces rather than having assigned spaces.
- Charge users directly for parking, rather than indirectly through taxes and rents.
- Parking Cash Out (Employees who current receive free parking are able to choose a cash benefit or transit subsidy instead.)

Supported by Professional Organizations



- Institute of Transportation Engineers.
- American Planning Association.
- American Farmland Trust.
- Federal, state, regional and local planning and transportation agencies.
- International City/County Management Association
- National Governor’s Association
- Health organizations.
- And much more...

Motorists Benefit Too

More balanced transport policy is no more “anti-car” than a healthy diet is anti-food. Motorists have every reason to support these reforms:

- Reduced traffic and parking congestion.
- Improved safety.
- Improved travel options.
- Reduced chauffeuring burden.
- Often the quickest and most cost effective way to improve driving conditions.

Responding To Criticisms

Criticism	Response
Public transit carries too small a portion of travel in North America significantly reduce automobile travel.	High quality public transit and transit oriented development can have a large leverage effect: each transit passenger-mile can reduce 2-10 automobile vehicle-miles.
On average, U.S. public transit is not very energy efficient, only slightly more efficient than car travel and less than a hybrid car.	The marginal energy costs of additional transit travel can be small, and with its leverage effects, high quality public transit can provide large energy savings.
Public transit, especially urban rail, has high costs per passenger-mile.	Although it severs a small portion of total travel, it operates on major urban corridors where accommodating additional automobile travel is also very costly.
Public transit travel has increased little in recent years despite "massive" investments.	Transit spending is actually small compared with total road and parking expenditures, and about half is intended to provide basic mobility for non-drivers rather than attract travelers out of cars. Where high quality public transit is provided, ridership often increases substantially.
Public transit is costly, requiring large subsidies.	High quality public transit provides many co-benefits, and its subsidies are often smaller than total road and parking subsidies required for urban-peak driving.

Key Messages

- Public transport can provide many different types of benefits to users and society, particularly if it substitutes for automobile travel.
- High quality (convenient, comfortable, integrated, and affordable) transit service and transit-oriented development are most effective at reducing automobile travel.
- Public transit projects can be a catalyst for more accessible, compact land use development, which provides additional benefits.
- Conventional planning tends to overlook and undervalue many of these benefits.
- Current demographic and economic trends are increasing user demands and social benefits of alternative modes, particularly high quality transit.
- Public transit improvements and transit-oriented development can benefit physically, economically and socially disadvantaged people and so help achieve equity objectives.

“Evaluating Public Transit Benefits and Costs”

“Smart Transportation Emission Reductions”

“Transportation Cost and Benefit Analysis”

“Win-Win Emission Reduction Strategies”

“Online TDM Encyclopedia”

and more...

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