Victoria Transport Policy Institute
1250 Rudlin Street, Victoria, BC, V8V 3R7, CANADA
www.vtpi.org info@vtpi.org
Phone & Fax 250-360-1560

"Efficiency - Equity - Clarity"

Evaluating Transportation Equity

Guidance For Incorporating Distributional Impacts in Transportation Planning

by
Todd Litman
Victoria Transport Policy Institute

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Abstract

This paper provides guidance on incorporating equity impacts into transportation planning. It defines various types of equity, discusses ways of evaluating equity, and describes practical ways of incorporating equity objectives into decision-making. "Equity" refers to the fairness with which impacts (benefits and costs) are distributed. Transportation decisions often have significant equity impacts. Transport equity analysis can be difficult because there are several types of equity, numerous impacts to consider, various ways to categorize people for analysis, and many ways of measuring impacts. Equity analysis should usually consider a variety of perspectives and impacts.

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Introduction

Equity (also called *justice* and *fairness*) refers to the distribution of impacts (benefits and costs). Transport planning decisions have significant and diverse equity impacts:

- The quality of transportation available affects people's opportunities and quality of life.
- Transport facilities, activities and services impose many indirect and external costs, such as congestion delay and accident risk imposed on other road users, infrastructure costs not funded through user fees, pollution, and undesirable land use impacts.
- Transport expenditures represent a major share of most household, business and government expenditures. Price structures can significantly affect financial burdens.
- Transport planning decisions affect the location and type of development that occurs in an area, and therefore accessibility, land values and developer profits.
- A significant amount of valuable land is devoted to transport facilities. This land is generally exempt from rent and taxes, representing an additional but hidden subsidy of transport activity.
- Transport investments are often used to stimulate economic development and support other strategic objectives. The location and nature of these investments have distributional impacts.

Transportation equity analysis can be difficult because there are several types of equity, various ways to categorize people for equity analysis, numerous impacts to consider, and various ways of measuring these impacts. A particular decision may seem equitable when evaluated one way but inequitable when evaluated another. As a result, transport equity impacts tend to be evaluated inconsistently, or simply dismissed as "intangibles," with the implication that they are unmeasurable and can be ignored. But equity analysis is often important and unavoidable. Transport planning decisions can be stymied by equity concerns, and otherwise justified policies and programs are thwarted by debates about their equity impacts. Most planning professionals sincerely want to address equity concerns and are happy to incorporate equity into their analysis, but few resources exist to provide guidance on how to do this in an objective, comprehensive and effective way.

Planning may claim that their methods are objective, because they rely on quantitative data such as travel surveys and level-of-service rating. But these can reflect biases related to who is surveyed, what is counted and how it is measured, which affects the range of options and impacts considered and how solutions are selected. For example, current planning practices tend to value mobility rather than accessibility, and so favor motorized modes over non-motorized modes, and motorists over non-drivers (Litman, 2003; Martens, 2005). Planners have fewer tools for measuring non-drivers' travel demand or the benefits of mobility management strategies and more accessible land use.

This paper provides an overview of transport equity issues, defines various types of transportation equity, discusses methods of evaluating equity impacts, and describes ways to incorporate equity analysis into transportation decision-making.

Types of Transportation Equity

There are three major categories of transportation equity.

1. Horizontal Equity

Horizontal equity (also called *fairness* and *egalitarianism*[1]) is concerned with the distribution of impacts between individuals and groups considered equal in ability and need. According to this definition, equal individuals and groups should receive equal shares of resources, bear equal costs, and in other ways be treated the same. It means that public policies should avoid favoring one individual or group over others, and that consumers should "get what they pay for and pay for what they get" from fees and taxes unless a subsidy is specifically justified.[2]

2. Vertical Equity With Regard to Income and Social Class

Vertical equity (also called *social justice*, *environmental justice*[3] and *social inclusion*[4]) is concerned with the distribution of impacts between individuals and groups that differ in abilities and needs, in this case, by income or social class. By this definition, transport policies are equitable if they favor economically and socially disadvantaged groups, therefore compensating for overall inequities.[5] Policies favoring disadvantaged groups are called *progressive*, while those that excessively burden disadvantaged people are called *regressive*. This definition is used to support affordable modes, discounts and special services for economically and socially disadvantaged groups, and efforts to insure that disadvantaged groups do not bear an excessive share of external costs (pollution, accident risk, financial costs, etc.).

3. Vertical Equity With Regard to Mobility Need and Ability

This definition is concerned with the distribution of impacts between individuals and groups that differ in *transportation ability and need*, and therefore the degree to which the transportation system meets the needs of travelers with special constraints. This definition is used to support *universal design* (also called *accessible* and *inclusive* design), which means that transport facilities and services accommodate people with disabilities and other special needs ("Universal Design," VTPI, 2005).

These different types of equity often overlap and conflict. For example, horizontal equity requires that users bear the costs of their transport facilities and services, but vertical equity often requires subsidies for disadvantaged people. Therefore, transport planning often involves making tradeoffs between different equity objectives.

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[1] *Egalitarianism* means treating everybody equally, regardless of factors such as race, gender or income.

[2] Neutral public policies and cost-based pricing are also *economic efficiency* principles, as discussed later.

[3] *Environmental justice* is defined as the "equitable distribution of both negative and positive impacts across racial, ethnic, and income groups, with the environment defined to incorporate ecological, economic, and social effects" (Alsnih and Stopher, 2003).

[4] *Social inclusion* means everybody can participate adequately in important activities and opportunities, including access to services, education, employment, and decision-making (Litman, 2003b; Lucas, 2004).

[5] Rawls (1971) provides a theoretical basis for vertical equity. He argued that primary social goods (liberty, opportunity and wealth) should be distributed equally or to favor less advantaged people.

Transportation Equity Evaluation

There is no single way to evaluate transportation equity. Equity evaluation depends on the type of equity, how people are categorized, which impacts are considered and how they are measured, as summarized in Table 1.

Table 1 **Equity Evaluation Variables**

Types of Equity	Categories	Impacts	Measurement Units
• Horizontal • Vertical with-respect-to income and social class. • Vertical with-respect-to need and ability.	• Demographics (age, gender, race, ethnic group, family status, etc.) • Income class. • Geographic location. • Ability (e.g., people with disabilities, licensed drivers, etc.). • Mode (walkers, cyclists, motorists, bus users, etc.). • Vehicle type (cars, trucks, buses, etc.). • Industry (truckers, transit, taxis, vehicle manufactures, etc.). • Trip type and value.	• Price or fare structure. • Tax burdens. • Transportation service quality. • External costs (crash risk, congestion, pollution, etc.). • Economic opportunity and development. • Transport industry employment and business opportunities.	• Per capita. • Per vehicle-mile or kilometer. • Per passenger-mile or kilometer. • Per trip. • Per peak-period trip. • Per dollar paid in fare or tax subsidy.

This table identifies factors that can affect equity analysis, including the type of equity considered, how people are categorized, which impacts are considered, and how they are measured.

For example:

- Highway cost allocation studies are concerned with the horizontal equity of transport facility financial costs with respect to vehicle type, measured per vehicle-mile.
- Environmental justice is generally concerned with vertical equity of various market and non-market costs, with respect to income and class, measured per capita.
- Welfare-to-work programs are concerned with improving commuter services (and therefore economic opportunity) available to economically disadvantaged workers.
- Handicapped access is concerned with the quality of mobility services available to physically disadvantaged people, and therefore their opportunities in life.

These factors significantly affect equity evaluation. Analysis conclusions may change depending on how people are categorized, and which impacts are considered and how they are measured. There is no single correct way to evaluate transportation equity. It is generally best to consider various perspectives, impacts and analysis methods.

Transportation equity analysis is affected by the perspective and scope used in analysis. For example, short-term equity goals to make automobile travel more affordable to lower-income residents often conflicts with the long-term goal of increasing accessibility options for non-drivers by creating more multi-modal transportation systems and more accessible land use patterns.

Equity of Opportunity Versus Equity of Outcome

There is an ongoing debate about how to measure vertical equity. There is general agreement that everybody deserves "equity of opportunity," meaning that disadvantaged people have adequate access to education and employment opportunities. There is less agreement concerning "equity of outcome," meaning that society insures that disadvantaged people actually succeed in these activities. Transportation affects equity of opportunity. Without adequate transport it is difficult to access education and employment. It therefore meets the most "conservative" test of equity.

Equity Compared With Other Planning Objectives

Transportation planning often involves tradeoffs between planning objectives including equity objectives, cost efficiency, mobility and environmental quality. For example, roadway design and management decisions often involve tradeoffs between mobility by automobile, mobility by other modes, land use planning objectives, reducing negative impacts on adjacent residents, financial costs, safety, aesthetics, and economic development. Similarly, transit planners must decide how to allocate resources between special mobility services for people with physical disabilities, standard bus service for lower-income people, and commuter services to reduce traffic problems.

There is no standard way to determine how much weight to give a particular equity objective. Such planning decisions should reflect community needs and values. Some communities may place a higher or lower value on a particular equity objective. For example, one community may dedicate more public resources to facilities and services for people with disabilities than another. Some communities may consider road tolls and parking fees unfair because they are regressive, while others consider them fair because they charge motorists directly for the facilities they use.

Some transportation equity issues can be evaluated based on a performance standard. For example, a community may decide that special mobility services will receive enough funding to allow each registered user at least two trips per week, or monthly transit fares may be set so they represent no more than 7.5% of poor residents' income. Another type of standard establishes the level of public resources that will be devoted to disadvantaged groups. For example, a community may decide that public transit services should receive $50 annually per capita, or achieve at least 30% cost recovery, based on comparisons with peer communities. Such decisions usually require some sort of public involvement process to help incorporate community needs and values into planning and funding decisions (FHWA, 1996; "Planning and Implementation," VTPI, 2005).

Measuring Transportation Quality

Equity analysis is affected by how transportation is evaluated (Litman, 2003a; Caubel, 2004; TSG, 2005). It can be evaluated in terms of *mobility* (physical travel) or in terms of *accessibility* (people's ability to reach desired activities and destinations). Accessibility is a broader definition that takes into account land use patterns (the distribution of destinations), and mobility substitutes (electronic communication and delivery services).

Mobility is easier to measure than accessibility, so conventional transport performance indicators, such as traffic speed and roadway level-of-service, tend to measure motor vehicle mobility, while other forms of access tend to be undercounted and undervalued.[6] This skews planning and investment decisions to favor motor vehicle travel at the expense of other modes, and so tends to favor people who drive more than average at the

[6] Conventional transportation surveys tend to undercount nonmotorized trips because they ignore short trips, leisure trips, travel by children, and walking links of motorized trips. More comprehensive surveys, such as the most recent NPTS, indicate that walking is about twice as common as previous travel surveys indicate. For discussion see Litman, 2003a.

expense of those who drive less than average. For example, prioritizing transport projects based on their ability to improve roadway level-of-service, and therefore their ability to increase vehicle traffic volumes and speeds, tends to create roadway environments less suitable for walking, cycling and public transit access. Only by measuring transport based on accessibility can such tradeoffs, and their equity impacts, be evaluated.

Put more positively, evaluating transport quality based on accessibility rather than mobility expands the range of potential solutions to transport problems. It places more value on alternative modes (walking, cycling, transit, telework and delivery services) and the connections between modes, and recognizes that transport service quality can be improved by increasing land use accessibility in addition to increasing mobility.

Basic Access and Basic Mobility

Equity analysis may involve prioritizing transport activity, recognizing that some travel, called *basic*, *essential* or *lifeline* transport, is particularly important to society. This usually includes access to essential services, education and employment opportunities, plus service vehicles and fright transport. *Basic access* means that people are able to reach activities considered important to society. *Basic mobility* refers to physical travel that provides basic access.

Basic Access Goods, Services and Destinations:

- Emergency services (police, fire, ambulances, etc.).
- Public services and utilities (garbage collection, utility maintenance, etc.).
- Health care (medical clinics, rehabilitation services, pharmacies, etc).
- Basic food and clothing.
- Education and employment (commuting).
- Some social and recreational activities.
- Mail and package distribution.
- Freight delivery.

Basic access can be considered a “merit good” and even a right (Goodwin, 1990; Hamburg, Blair and Albright, 1995). This is why, for example, emergency, service and high occupant vehicles are often given priority in traffic and parking, why public transit services are often subsidized, and why there are standards to insure that transport systems accommodate people with disabilities. The concept of basic access is important for transport equity analysis. It means that transport activities and services can be evaluated and prioritized according to the degree to which they provide basic access. As a result, equity analysis often requires determining what types of trips considered basic and the transport service quality considered adequate to satisfy basic access needs.

Categorizing People

Equity evaluation requires that people be categorized by demographic and geographic factors to identify people who are transport disadvantaged. Such categories can vary depending on how they are defined. For example, although it is common to categorize people as “motorists,” “transit users,” and “pedestrians,” most people use a variety of modes, particularly over the long-term. Although only a small portion of households rely

entirely on public transit at a particular time, many have members who use public transit, and many people who do not currently use public transit may sometime their life and so value having it available. Similarly, most people can expect to experience a disability that limits their mobility sometime during their lives, and so can benefit from transport system features that accommodate such constraints. For this reason, it is often most appropriate to use a household or lifecycle analysis for equity analysis. Sustainability is concerned with *intergenerational equity*, that is, insuring that impacts on future generations are considered in decision-making ("Sustainability," VTPI, 2005). This represents an additional perspective for categorizing people.

Factors That Can Contribute to Transportation Disadvantaged Status:

• Low Income. • Non-driver/car-less. • Disability • Language barriers. • Isolation (in an inaccessible location).	• Caregiver (responsible for dependent child or disabled adult). • Obligations (requires frequent medical treatments, attends school or is employed).

Disadvantaged status is multi-dimensional. Disadvantaged status evaluation should take into account the degree and number of these factors that apply to an individual. The greater their degree and the more factors that apply, the more disadvantaged an individual or group can be considered. For example, a person who has a low income but is physically able, has no caregiving responsibilities, and lives in an accessible community is not significantly transportation disadvantaged, but if that person develops a disability, must care for a young child, or moves to an automobile-dependent location, their degree of disadvantage increases.

Impact Categories

Transport equity can involve various impacts (costs and benefits), such as those listed below.

Public Facilities and Services

- Amount and distribution of public funds for transport facilities and services.
- Parking requirements imposed on developers, businesses and residents.
- Government subsidies and tax exemptions for transportation industries.
- Use of tax-exempt public land for transportation facilities.
- Planning and design of transportation facilities.
- Degree of public involvement in transport planning.

User Costs and Benefits

- Overall level of mobility and accessibility (passenger-miles, trips, ability to reach activities).
- Vehicle ownership and operating expenses.
- Vehicle taxes and government fees, and fuel taxes.
- Road tolls and parking fees (including exemptions and discounts).
- Public transportation fares (including exemptions and discounts).
- Fitness (use of physically active modes, such as walking and cycling).
- Cost recovery and subsidies (portion of costs borne by a particular activity or group).

Service Quality

- Number of travel modes available in an area (walking, cycling, private automobile, vehicle rentals, public transportation, taxi, rail, air travel, delivery services, etc.).
- Roadway quality (traffic speeds, delay, safety, physical condition, etc.).
- Parking facility supply, location, regulation, price and design.
- Public transportation service quality (frequency, speed, reliability, safety, comfort, etc.).
- Land use accessibility (density, mix, connectivity, location of activities, etc.).
- Universal design (accommodation of people with disabilities and other special needs).

External Impacts

- Traffic congestion and risk an individual or vehicle class imposes on other road users.
- Air, noise and water pollution emissions.
- Barrier effect (delay that roads and railroads cause to nonmotorized travel).
- Transport of hazardous material and disposal of hazardous waste.
- Aesthetic impacts of transportation facilities and traffic activity.
- Impacts on community livability.

Economic Impacts

- Access to education and employment, and therefore economic opportunities.
- Impacts on business activity, property values, and economic development in an area.
- Distribution of expenditures and employment (who gets contracts and jobs).

Regulation and Enforcement

- Regulation of transport industries (public transportation, trucking, taxis, etc.)
- Traffic and parking regulation and enforcement.
- Regulation of special risks (railroad crossings, airport security, hazardous material, etc.).

Reference Units

Transportation activities and impacts can be measured in various ways that give different conclusions about what is equitable. Analysis often uses *reference units* to compare impacts, such as per-capita, per-trip, per-passenger-mile, or per-dollar. Cost values can include capital, operating or total expenditures; for a single year or several years; expenditures by a particular agency, a particular level of government, all levels of government, or by society overall (for example, including parking subsidies by businesses). Geographic areas and demographic groups can be defined in various ways. These factors can be selected and manipulated to support a particular conclusion.

Reference units reflect various assumptions and perspectives, which may be biased in favor of certain activities or users (Litman, 2003b). For example, *per capita* analysis assumes that every person should receive an equal share of resources. *Per-mile* or *per-trip* analysis assumes that people who travel more should receive more resources. *Cost recovery* analysis assumes that people should receive public resources in proportion to how much they pay in fees and taxes. Table 2 summarizes the equity implications of different reference units used for transport analysis.

Table 2 **Equity Implications of Different Reference Units**

Unit	Description	Equity Implications
Cost Recovery	Transport expenditures are evaluated according to whether users pay their costs.	Favors wealthier travelers because they tend to spend more and deserve the least equity-justified subsidies.
Congestion (V/C Ratio, roadway LOS)	Transport investments are evaluated according to most cost-effective roadway capacity expansion.	Favors people who most often drive on congested roads over people who seldom or never use such facilities.
Vehicle Miles Traveled (VMT)	Transport investments are evaluated according to which route or mode can increase vehicle travel at the least cost.	Favors people who drive their automobile more mileage than average.
Passenger Miles Traveled (PMT)	Transport investments are evaluated according to the most cost-effective way of increasing personal mobility.	Favors people who travel more than average. Tends to favor motor vehicle travel.
Passenger Trips	Transport investments are evaluated according to the costs of each trip.	Provides more support for transit and nonmotorized travel.
Access	Transport investments are evaluated according to where improved access can be accommodated at the lowest cost.	Depends on how access is measured.
Mobility Need	Transport investments are evaluated according to which provides the greatest benefits to disadvantaged people.	Favors disadvantaged people.
Affordability	Transport user fees are evaluated with respect to users' ability to pay.	Favors lower-income people.

Equity analysis is affected by the units used for comparison. Some units only reflect motor vehicle travel and so undervalue alternative modes and the people who rely on such modes.

Cost recovery (the ratio between costs imposed by a user and what they pay in user fees and special taxes) reflects the principles of economic efficiency and horizontal equity, both of which require that people should "get what they pay for and pay for what they get," unless a subsidy is specifically justified. There are various ways to calculate user fees when evaluating roadway cost recovery. They should generally only include special fees and taxes which only people who use the facility or service pay. Only taxes above the general sales tax rate should be considered user fees. For example, many jurisdictions charge special fuel taxes, but exempt fuel from general sales tax. Only the portion of fuel taxes above the general sales tax level in that jurisdiction should be considered a user fee.

Cost recovery justifies devoting more resources and providing better public services to wealthier individuals and groups because tend to pay more income, property and sales taxes. However, this contradicts vertical equity criteria, which require that public resources be allocated to favor disadvantaged people. A reasonable compromise between these conflicting objectives is to strive for cost recovery with non-essential goods and services, such as luxury air travel and general road use, but apply vertical equity criteria to *basic access* transport services and activities, such as facilities to accommodate people with disabilities, and other facilities and services that provide basic transportation to people who are economically, physically or socially disadvantaged. This does not means that such services need be free, but their price should reflect users ability to pay, so fees relative to wages can be a useful indicator of basic transport affordability.

Equity analysis often involves comparing per capita expenditures by geographic region or by mode. But it may be wrong to assume that expenditures in an area only benefit residents, or that expenditures on a particular mode only benefit its users. Residents may benefit little from a highway project through their neighborhood; it may primarily benefit through travelers and make them worse off due to traffic impacts. Public transit improvements may benefit motorists as well as transit riders by reducing roadway congestion and their need to chauffeur non-driving family members and friends.

In summary, reference units are useful for equity analysis, but it is important to understand their assumptions and perspectives. Horizontal equity analysis should be usually be based on *per capita* rather than *per-mile* comparison, with adjustments to reflect differences in user need and ability to for vertical equity objectives. For example, when comparing two geographic areas or demographic groups with comparable incomes and abilities, it would be most fair if they each receive equal annual per capita allocations of public resources, but if one area or group is economically, socially or physically disadvantaged, it should receive a greater allocation. Similarly, if one group or travel activity imposes greater costs, it should be charged higher user fees or taxes until per capita subsidies are about equal, unless one group deserves extra subsidy on vertical equity grounds.

Incorporating Equity Analysis Into Transportation Planning

Transport equity analysis is usually performed as part of other planning activities. This chapter describes techniques for incorporating equity analysis into transport planning.

Data Sources

Various tools and resources are available to help evaluate the distribution of transport impacts and their equity impacts (FHWA, 1997; ICLEI, 1997). These provide information on the distribution of impacts between different groups of people. New data sources are available to help evaluate people by income and ability (FHWA and FTA, 2002), and new GIS (Geographic Information System) tools facilitate geographic analysis of impacts.

It is often possible to collect information for transportation equity analysis in surveys performed for other purposes, by including questions concerning income and mobility constraints in regular travel surveys, and by including transportation questions in surveys related to other issues. For example, a survey of social service clients can include questions concerning how they normally travel, their ability to use an automobile, and whether inadequate transportation is a significant problem.

Below are examples of potential data sources useful for equity analysis.

1. Government agency budgets and reports that indicate public expenditures by jurisdiction and mode, and on facilities and programs targeted to serve particular groups.

2. Census and surveys can provide the following data, disaggregated by geographic, demographic, and income category:

    - People's level of mobility (e.g. person-trips and person-miles of travel during an average day, week or year).
    - The portion of the population with disadvantaged status (low income, physical disability, elderly, single parents, etc.).
    - The portion of their time and financial budgets devoted to travel.
    - The problems people face using transportation facilities and services.
    - The degree to which people lack basic access.

3. Traffic accident injury and assault rates for various groups.

4. Audits of the ability of transport facilities and services to accommodate people with disabilities and other special needs.

5. Analysis of the degree to which disadvantaged people are considered and involved in transport planning.

6. Reports on the frequency of special problems by disadvantaged travelers (faulty equipment, inaccurate information, inconsiderate treatment by staff, etc.), the frequency of complaints by disadvantaged travelers, and the responsiveness of service providers to such complaints.

Horizontal Equity

Horizontal equity requires that public resources be allocated equally to each individual or group unless a subsidy is specifically justified. However, exactly what constitutes an equal share depends on which resources are considered and how they are measured. For example, comparisons can be made per household, per resident, per adult or per vehicle. This requirement applies to allocations of *general taxes* but not to *user fees*, so equity analysis may depend on how certain revenue sources are categorized.

Adjustments may be required to account for geographic differences (such as greater dependence on walking and transit in cities, and greater dependency on highways in suburbs and rural areas), differences in costs (such as higher costs of facilities and services in dense urban areas), and the extra costs of serving people with disabilities and other special needs. In most jurisdictions, transportation facilities and services are financed by several levels of government (local, regional, state/provincial, national), the total of which should be considered in analysis. Many transportation projects involve large budget expenditures certain years for major investments, so expenditures may vary significantly from year to year. Some public resource allocations are not reflected in transportation budgets, including tax discounts and exemptions for particular groups, land allocations (for example, public land devoted to transportation facilities), or are incorporated into other budgets, such as traffic services provided by police and parking facility costs borne in building budgets. Comprehensive analysis is therefore required to accurately determine the distribution of public resources for transportation facilities and services (ICLEI, 1997).

Various *roadway cost allocation* (also called *cost responsibility*) studies have calculated the share of roadway costs imposed by different types of vehicles (motorcycles, automobiles, buses, light trucks, heavy trucks, etc.), and how these costs compare with roadway user payments by that vehicle class (Jones and Nix, 1995; FHWA, 1997). This reflects the principle of horizontal equity, assuming that users should bear the costs they impose unless a subsidy is specifically justified. *User payments* refers to special fees and taxes charged to road users, including tolls, fuel taxes, registration fees and weight-distance fees, but does not include general taxes applied to vehicles and fuel.[7]

[7] Although highway cost allocation principles specify that only *special* roadway taxes beyond *general* taxes should be considered user fees, some advocacy groups argue that all taxes on vehicles and fuel should be considered user fees and allocated based on payments. For discussion see Morris and DeCicco 1997; "Evaluating Criticism of Transportation Cost Analysis" in Litman, 2005a.

Vertical Equity

Vertical equity requires that disadvantaged people be identified and given special consideration in planning, to insure that they are not made worse off, and that their needs are accommodated. Ng (2005) describes the following steps for doing this.

1. Identify disadvantaged groups (minority, low income, car-less, disabled, single parents).
2. Identify disadvantaged geographic areas using census data ("Environmental Justice Areas").
3. Identify degrees of disadvantage in each geographic area, with five levels of severity.
4. Identify location of important public services and destinations (transit, highways, employment centers, hospitals, daycare centers, etc.).
5. Evaluate specific transportation plans according to how they affect accessibility between disadvantaged communities and important destinations.

The study *Measuring Accessibility as Experienced by Different Socially Disadvantaged Groups* (TSG, 2005) examines the quality of transportation services provided to various groups, and recommends standards for their services.

The degree to which non-drivers are disadvantaged relative to drivers can be measured using *mobility gap* analysis (LSC, 2001). A mobility gap is the different in motorized travel (automobile, public transit, taxi, etc.) between households with and without automobiles (called "zero-vehicle households"). This can be determined using travel survey data to compare the average daily trips generated by different types of households, taking into account factors such as the smaller average size and lower employment rates of zero-vehicle households. After taking these factors into account, zero-vehicle households are generally found to generate 30-50% fewer personal trips. This methodology may understate real transportation needs by assuming that automobile-owning households have no unmet mobility needs, which ignores the mobility problems facing non-drivers in vehicle-owing households. For example, a household that owns one vehicle shared by two or three adults, or households with adults who cannot drive due to disabilities or other problems, may face mobility gaps similar to zero-vehicle households.

Specific techniques can be used to quantify vertical inequity with respect to income (Marshall and Olkin, 1979). One approach is called the Dalton Principle: resource transfers from high- to lower-income people that maintain their overall income ranking is considered to improve equity. The *Gini-index*, the *Theil Coefficient* and the *Coefficient of Variation* are used to quantify inequity. Since these only consider income they may need adjustment to reflect other factors, such as people's mobility needs and physical ability.

Transportation Equity Indicators

Indicators are measurable variables selected to reflect progress toward planning objectives. It is useful to identify a practical set of indicators for transport equity analysis. Indicators should be selected to reflect various equity issues and perspectives, to have reasonable data and analysis requirements, and to be transferable between various situations.

Five equity objectives and possible indicators for each are described below. These can be expanded, elaborated and disaggregated to meet specific planning requirements.

Horizontal Equity

1. *Treats everybody equally, unless special treatment is justified for specific reasons.*

    - Policies and regulations are understood by the public and applied without bias.
    - Per capita public expenditures and cost burdens are equal for different groups.
    - Service quality is comparable for different groups and locations.
    - Different modes receive public support approximately in proportion to their level of use.
    - All groups have opportunities to participate in transportation decision-making.

2. *Individuals bear the costs they impose.*

    - Transport user fees and tax payments reflect the full costs imposed by each person or trip, unless a subsidy is justified on equity grounds.
    - Subsidies provided for equity or economic objectives are efficiently targeted.

Vertical Equity

3. *Progressive with respect to income.*

    - Lower-income households pay a smaller share of their income, or gain a larger share of benefits, than higher income households.
    - Affordable modes (walking, cycling, ridesharing, transit, carsharing, etc.) receive adequate support and are well planned to create an integrated system.
    - Special discounts are provided for transport services based on income and economic need.
    - Transport investments and service improvements favor lower-income areas and groups.

4. *Benefits transportation disadvantaged people (non-drivers, disabled, children, etc.).*

    - Investments and policies help create a more diverse, less automobile-dependent transport system that effectively serves non-drivers.
    - Land use policies improve non-motorized accessibility.
    - Transportation services and facilities (transit, carsharing, pedestrian facilities) reflect *universal design* (they accommodate people with disabilities and other special needs, such as using strollers and handcarts).
    - Special mobility services are provided for people with special mobility needs.

5. *Improves basic access: favors trips considered necessities rather than luxuries.*

    - Transportation services provide adequate access to medical services, schools, employment opportunities, and other “basic” activities.
    - Travel is prioritized to favor higher value travel, such as emergency and HOV trips.

Table 3 illustrates how these five indicators are applied to a particular strategy (in this case, Commute Trip Reduction Programs) in the *Online TDM Encyclopedia* (VTPI, 2005). Of course, such indicators can be modified to reflect the needs of a particular planning application.

Table 3 **Commute Trip Reduction Programs - Equity Summary** (VTPI, 2005)

Criteria	Rating	Comments
Treats everybody equally.	2	Gives non-drivers benefits comparable to drivers.
Individuals bear the costs they impose.	1	Involves subsidy, but usually equal or less than existing parking subsidies.
Progressive with respect to income.	3	Lower-income employees tend to use alternative modes.
Benefits transportation disadvantaged.	3	Benefits non-drivers.
Improves basic mobility.	2	Improves access to employment by non-drivers.

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts.

It can be useful to incorporate equity indicators into a comprehensive evaluation matrix with other planning objectives, as illustrated in Table 4. This type of matrix can be expanded to include more impact categories and perspectives. In this case, a simple numeric rating system is used to evaluate each option with regard to various planning objectives, but other systems can be used (Litman, 2001). For example, some evaluation systems weigh each objective (for example, placing more value on Congestion Reduction than Consumer Savings, or weighing road safety more than Environmental Protection) or monetizes (measures in monetary units) all impacts. These values can be summed and compared using graphs (visual comparisons tend to be easier to understand). It may be useful to add notes for each cell discussing why that rating was chosen.

Table 4 **Impact Evaluation – Example** (VTPI, 2005)

Impact	Weight	Option 1	Option 2	Option 3
Treats everybody equally.		-2	-2	1
Individuals bear the costs they impose.		0	-2	3
Progressive with respect to income.		-2	3	-3
Benefits transportation disadvantaged.		0	3	1
Improves basic mobility.		2	3	3
Congestion Reduction		3	2	3
Road & Parking Savings		-3	2	3
Consumer Savings		0	3	-3
Road Safety		1	2	2
Environmental Protection		-2	3	3
Efficient Land Use		-3	3	2
Community Livability		-3	3	3

Rating from 3 (very beneficial) to –3 (very harmful). A 0 indicates no impact or mixed impacts.
This table illustrates a matrix for comparing the impacts of three transportation improvement options. For example, Option 1 may involve a road widening project, Option 2 a transit improvement, and Option 3 congestion pricing.

Transportation Equity Analysis Examples

This section describers various examples of transportation equity analysis. For more examples see FHWA and FTA, 2002.

Quality of Services for Disadvantaged Groups

The report *Measuring Accessibility as Experienced by Different Socially Disadvantaged Groups* (TSG, 2005) describes a major study to develop and apply better measures of accessibility that are sensitive to the varying perceptions and needs of different social groups. The study sought to capture the ways in which different social groups perceive and use their local environment, covering both strategic-level accessibility (e.g. access to employment opportunities) and micro-level accessibility (e.g. access to local bus stops). It focused on seven socially disadvantaged groups: young people (16-24), older people (60+), Black and Minority Ethnic (BME) people, disabled people (physically disabled and people with mental health illness), people traveling with young children (aged 11 or under), unemployed people and shift workers.

The results indicate that very similar concerns were shared across the different groups, despite differences in level of independence, income levels, eligibility for travel concessions and degree of personal mobility. The participants' travel horizons were fairly limited and many tended not to travel outside their local area very often. The boundaries of the area that these individuals are willing to travel within is determined by a combination of their existing experiences, their perceptions, their knowledge, their confidence and the ease with which the journey can be made.

A new, free-standing tool was developed by TSG researchers to reflect perceived walk access conditions, called *WALC* (Weighted Access for Local Catchments). Barriers associated with walk access were found to include: (i) the local terrain (e.g. steep hills); (ii) the lack of provision of seating and a shelter at bus stops; (iii) difficulties in crossing busy roads, due to speeding traffic, heavy traffic volumes, lack of safe crossing points, and barriers (e.g. guard railing) preventing crossing at convenient points; and (iv) low levels of street lighting. Further user surveys were carried out to identify the weights different groups attach to each of these features, and to collect complementary data on physical conditions through street audits in the case study areas.

To validate the tool analysis, focus groups comprising representatives of selected social groups were asked about their comprehension of the resulting maps and to compare the tool outputs with their own perceptions. Participants across all groups showed a clear understanding of the purpose and content of the accessibility maps, and found them to be comprehendible, relevant and useful. The groups supported the WALC tool's assumption of an unweighted 5 minutes walk time to a bus stop, 8 minutes to a DLR station, or 10 minutes to an underground station, and the approach used for calculating weighted accessibility. Focus groups emphasized the importance of accurate estimates of walk speeds, and the need to take account of service reliability (including the ability to board the first vehicle).

Public Funding Allocation

Horizontal equity requires that public policies and investments treat people equally unless a subsidy is specifically justified. If two jurisdictions are comparable in terms of residents' income and travel needs it is equitable that they should receive comparable per capita transport funding. But funding practices often violate this principle, resulting in more per capita funding in some jurisdictions than others. There are many reasons for this. Some jurisdictions have more political power than others, and so receive a greater share of public funds for a particular time period. Others have special needs that may justify special funding. One pattern that emerges is that rural areas tend to receive more transportation funding per capita than urban areas.

For example, Georgia state law requires that state highway funds be allocated equally among the state's 13 Congressional Districts, resulting in higher per capita funding in rural districts. A study found that the British Columbia Ministry of Transportation and Highway spent about a third as much per capita in the Vancouver region as in other regions.[8] Chen (1996) also found that cities receive far less per capita transportation funding due to planning practices that favor automobile-oriented investments over investments in other modes.

There are three possible justifications for these cross-subsidies. First, if highways are considered to be funded by user fees (vehicle fees, fuel taxes and tolls), funding could be allocated based on where these fees are paid rather than per capita. However, urban regions contain about half of all registered vehicles and generate about half of all fuel tax revenues, so the funding discrepancy is not justified from this perspective. In other words, rural roads receive more funding per vehicle-mile than urban roads.

Second, it could be argued that urban residents often drive on rural highways, and rely on interregional fright services, and so benefit from rural highway expenditures. However, rural residents also travel in urban areas and rely on urban services.

Third, it could be argued that rural residents are economically disadvantaged and have fewer travel options compared with urban residents, and so deserve a subsidy to meet their travel needs. Such subsidies are only justified for those rural motorists who really are disadvantaged, it does not justify subsidizing all rural highway travel.

This suggests that highway funding is inequitable. Only by providing significant urban transit funding can transportation budgets be considered fair.

[8] This analysis helped convince provincial officials to provide substantial additional funding for the Vancouver region's transit system for the sake of urban/rural funding equity.

Parking Requirement Equity Impacts

Parking requirements are an example of how transportation decisions can have significant, unintended, and often overlooked equity impacts. Most jurisdictions have regulations that specify the minimum number of parking spaces that must be supplied at each destination. These requirements tend to be generous, designed to insure that motorists can almost always find convenient at any destination (Litman, 2000). They are even justified on equity grounds, to insure that each development bears the costs of the parking demand it generates, to avoid spillover parking problems at nearby sites.

But these parking requirements represent a subsidy of vehicle ownership and use worth hundreds of dollars annually per motorist (Shoup, 2005; "Parking Costs," Litman, 2005a). They encourage parking to be unpriced (abundant supply makes collecting fees unprofitable), causing parking costs to be borne indirectly through mortgages and rents, retail prices, and taxes. People bear these costs regardless of how many vehicles they own and how much they drive. As a result, households that own fewer than average vehicles or drive less than average tend to pay more than the parking costs they impose, while those who own more than average vehicles or drive more than average tend to underpay. Since vehicle ownership and use tend to increase with income, these regulations and subsidies tend to be regressive, that is, they place a relatively large burden on lower-income people.

By increasing automobile ownership and use these policies reduce demand for alternative modes such as walking and public transit, and therefore transportation system diversity. Because parking requires paving large amounts of land, they tend to encourage sprawl and create less walkable communities. These changes reduce mobility and accessibility for non-drivers, and increase total transportation costs, which tends to be particularly harmful to economically, socially and physically disadvantaged people.

These equity impacts are often overlooked when parking requirements are established. This is not because the people involved are immoral or uncaring, rather they generally have not considered all the equity impacts resulting from such decisions, particularly indirect and long-term impacts on other groups.[9] Decision-makers lack tools to quantify many of these equity impacts. They may be unfamiliar with alternative solutions to parking problems that better support equity objectives.[10] They may consider equity a specialized issue of concern to social agencies, outside of their responsibility.

Parking planning is not unique. Most transport planning decision have diverse and significant equity impacts that are often unrecognized in the planning process. Decision-makers therefore have a responsibility to improve their understanding of equity impacts.

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[9] Since decision-makers tend to be busy, middle-class professionals who drive automobiles, they are likely to perceive the benefits of generous parking requirements and are less sensitive to the unfair costs such requirements impose on non-drivers.

[10] "Parking Management" and "Parking Solutions" chapters of the *Online TDM Encyclopedia* (VTPI, 2005).

Transportation Cost Analysis

Both horizontal equity and economic efficiency require that users bear the costs they impose on society, unless a subsidy is specifically justified ("Market Principles," VTPI, 2005).[11] *Highway cost allocation* (also called *highway cost responsibility*) refers to analysis of the costs imposed by various types of vehicles and the degree to which they are recovered by user fees (Jones and Nix, 1995; FHWA, 1997). Most cost allocation studies only consider direct roadway expenditures, and categorize users according to vehicle size and type (automobiles, buses, light and heavy trucks). The table below summarizes the results of a major U.S. highway cost allocation study. It indicates that about a third of roadway costs are subsidies (costs not borne directly by user fees).

Table 5 **Roadway Cost Responsibility, 1997 US Dollars Per Mile** (FHWA, 1997)

Vehicle Class	**VMT** (millions)	Federal Costs	State Costs	Local Costs	**Total Costs**	**Total User Payments**	**External Costs**
Automobiles	1,818,461	$0.007	$0.020	$0.009	$0.035	$0.026	$0.009
Pickups and Vans	669,198	$0.007	$0.020	$0.009	$0.037	$0.034	$0.003
Single Unit Trucks	83,100	$0.038	$0.067	$0.041	$0.146	$0.112	$0.034
Combination Trucks	115,688	$0.071	$0.095	$0.035	$0.202	$0.157	$0.044
Buses	7,397	$0.030	$0.052	$0.036	$0.118	$0.046	$0.072
All Vehicles	*2,693,844*	*$0.011*	*$0.025*	*$0.011*	*$0.047*	*$ 0.036*	*$0.010*

This table summarizes the results of a major cost allocation study which found that user fees fund only about two-thirds of roadway facilities.

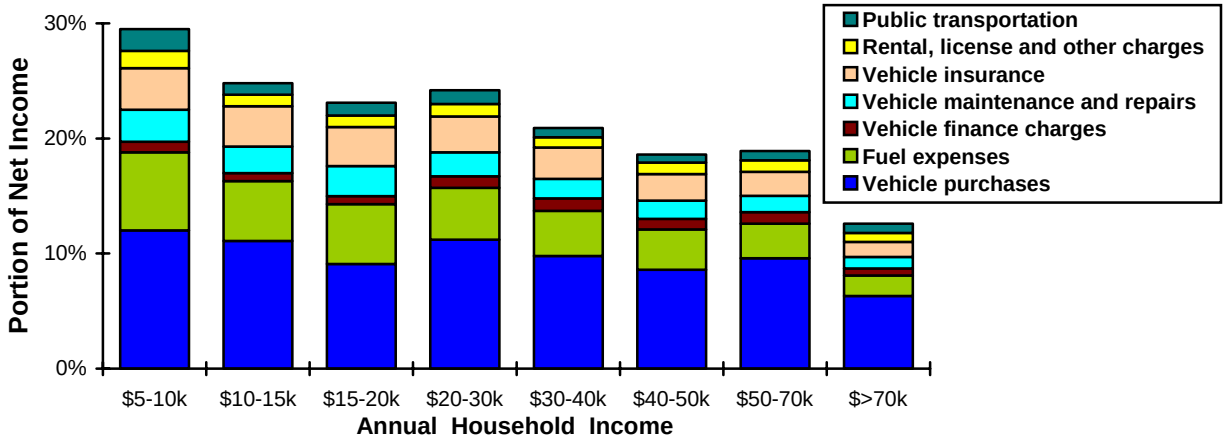
More comprehensive transportation cost studies include additional costs such as parking subsidies, traffic services, congestion delay, accident risk and pollution damages (INFRAS and IWW, 2004; Litman, 2005a). Considering more costs tends to indicate greater inequity. For example, considering just roadway costs not borne by user fees, automobile travel is subsidized about 1¢ per mile, but much greater subsidies are found if traffic services, parking subsidies, accident externalities and environmental impacts are also considered. These external costs mean that people who drive more than average receive greater public subsidies than people who drive less than average. Since driving tends to increase with income, this is both horizontally and vertically inequitable. Considering just financial costs, this inequity is partly offset by the additional taxes paid by higher-income people, but this offset is smaller when non-market costs such as accident risk and pollution damages are also considered.

[11] Equity and efficiency definitions of optimal pricing differ somewhat. Horizontal equity focuses on *average* costs, often measured at the group level, while economic efficiency focuses on *marginal* costs per trip, which ignores sunk costs such as past construction investments. However, average and marginal costs tend to converse over the long run since over time most costs become variable.

Transportation Cost Burdens

Transportation is a major financial burden to many consumers, particularly for lower-income households. Figure 1 illustrates transport expenditures relative to total household income by income class. Lower-income households spend a far higher portion of income on transport than wealthier households, indicating that these costs are regressive.[12]

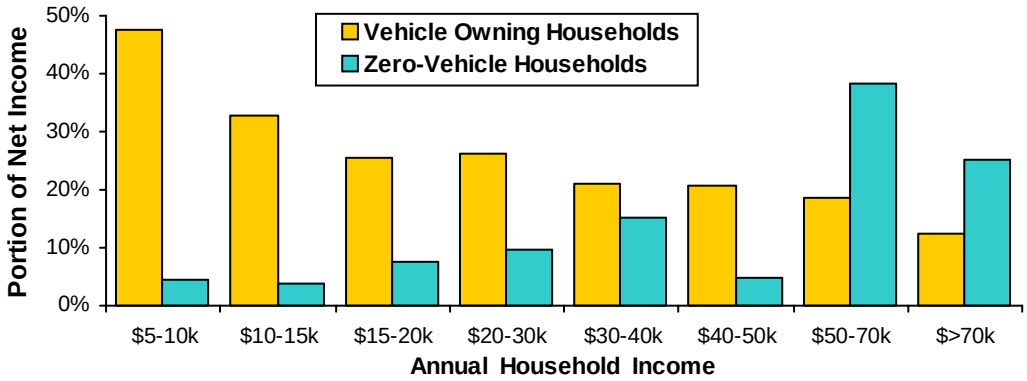
Figure 1 **Portion of Household Income Spent on Transport** (BLS, 2000)



Transportation expenditures are highest as a portion of net (after tax) income for lower-income households, indicating that transportation costs are regressive.

Households that own a motor vehicle tend to spend far more of their income on transportation then zero-vehicle households, as illustrated in Figure 2.

Figure 2 **Portion of Household Income Devoted to Transport** (BLS, 2003)[13]



Transport costs tend to be regressive for vehicle-owning households, but not zero-vehicle households.

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[12] Equity impacts can also be evaluated with respect to *expenditures* rather than *income*. Expenditures are less volatile and include other types of wealth such as savings and benefits such as foodstamps.

[13] This figure assumes that all vehicle costs are borne by vehicle-owing households and all public transport costs are borne by zero-vehicle households. This is not exactly accurate since vehicle-owning households do use public transport and zero-vehicle households pay some vehicle expenses, but is consistent with other research showing much lower transport expenditures in vehicle-owning than zero-vehicle households.

This financial burden is significantly affected by the type of transport system in an area. Low-income residents of automobile-dependent communities tend to spend much more of their income on transport than residents of communities with more diverse, multi-modal transport systems.[14] This suggests that automobile dependency is regressive, and that policies and programs that improve travel options tend to be progressive (Frumkin, Frank and Jackson, 2004).

The consumer costs and regressivity of automobile transport are even greater than these figures indicate when indirect costs are also considered, particularly residential parking, which represents about 10% of housing costs on average, and more for lower-priced, urban housing (Jia and Wach, 1998). High parking costs reduce housing affordability, imposing additional burdens on lower-income households, which are often forced to choose between suburban housing with lower rents but higher transportation costs, and more costly urban housing with lower transportation costs.

Although automobiles are expensive and their costs are regressive, studies indicate that vehicle ownership can be an important contribution to helping disadvantaged people obtain and maintain employment (Sawicki, and Moody, 2001). This has several equity implications. It suggests that strategies that help poor people obtain access to automobiles may provide equity benefits, for example, as part of welfare-to-work programs. Carsharing and other vehicle rental services, special vehicle and insurance purchase loan programs, and Pay-As-You-Drive insurance can help some disadvantaged people increase their mobility and economic opportunities (VTPI, 2005).

Because driving is costly, regressive and difficult (particularly for some disadvantaged people, such as people with disabilities and immigrants who do not speak English), automobile-oriented solutions create additional equity problems. Cheap automobiles affordable to poor people tend to be unreliable, and are sometimes unsafe. Lower-income drivers often share vehicles with other household members. Even poor people who own an automobile often rely somewhat on other modes. As a result, disadvantaged people tend to benefit from a more diverse transport system. In other words, disadvantaged people may benefit from policies that help them drive, but they can benefit even more overall from policies and programs that increase total travel options.

Similarly, land use strategies that improve community accessibility, such as locating affordable housing, public services and jobs in more accessible, multi-modal locations provides equity benefits by reducing cost burdens on disadvantaged households ("Location Efficient Development," VTPI, 2005).

[14] For example, households in communities with high quality transit systems spend a smaller portion of their income on transport than residents of more automobile dependent communities (Litman, 2004).

Traffic Impacts

The physical impacts of vehicle traffic can have significant equity impacts. For example, the congestion impacts that motor vehicles impose on other road users is horizontally inequitable to the degree that High-Occupant Vehicle (carpools, vanpools and buses) passengers are delayed by congestion, although they use less road space and so impose less delay on others per passenger-mile. Similarly, motor vehicle use imposed delay and accident risk on pedestrians and cyclists, and noise and air pollution on nearby residents.

Some traffic impacts, such as congestion delay and accident risk, are monetized (measured in monetary units) for economic evaluation (Litman, 2005a). However, adjustments may be needed for comprehensive equity evaluation. For example, most monetized congestion cost estimates only consider impacts on motor vehicles. Impacts on nonmotorized travel, including delay and travel foregone, are usually ignored, although they are often significant compared with costs that are considered, particularly in urban areas ("Barrier Effects," Litman, 2005a). They represent a horizontal inequity (motorists impose far more delay and risk on nonmotorized travelers than nonmotorized travelers impose on motorists), and to the degree that people who are transportation disadvantaged drive less and rely more on nonmotorized modes, this represents a vertical inequity.

Described in a more positive way, current evaluation practices tend to underestimate the full benefits and equity impacts of strategies that reduce vehicle traffic and improve nonmotorized travel conditions because they ignore benefits from improved nonmotorized travel, which are particularly important to many disadvantaged people.

Road space reallocation and traffic management programs have various distributional impacts, including benefits to motorists, although these are sometime overlooked. For example, traffic calming tends to reduce automobile traffic speeds while improving safety for motorist and nonmotorists, and neighborhood livability ("Traffic Calming," VTPI, 2005). HOV priority strategies benefit rideshare and transit passengers, and motorists if they reduce traffic congestion ("HOV Priority," VTPI, 2005). Bicycle lanes benefit cyclists and motorists to the degree that they reduce conflicts. Parking regulations, such as parking duration limits, benefit some users, trips and businesses at the expense of others.

Special analysis may be justified to determine whether transportation planning decisions violate environmental justice principles. For example, geographic analysis can help determine whether lower-income and minority communities contain an excessive portion of hazardous waste sites, or undesirable transportation facilities such as major highways and freight terminals (Bullard and Johnson, 1997). Special programs may be justified to clean up brownfields, insure that regional transportation facilities meet local community needs, mitigate traffic impacts, and compensate for external costs imposed on disadvantaged populations.

Planning Biases and Distortions

Current planning practices contain biases and distortions that tend to be both horizontally inequitable (they favor one mode or user over others), and vertically inequitable (they tend to harm disadvantaged people). Examples are described below (Beimborn and Puentes, 2003; Litman, 2003b; "Comprehensive Transport Planning," VTPI, 2005).

- Emphasis on mobility rather than accessibility. Conventional planning measures mobility rather than accessibility, which favors motorized modes, and undervalues alternative modes and land use policies to increase accessibility.
- Undervaluation of nonmotorized travel. Conventional travel surveys tend to undercount short trips, non-commute trips, travel by children and walking links of motorized trips, which undervalues nonmotorized travel. This skews planning and funding toward motorized modes, reducing transport quality for nondrivers.
- Incomplete evaluation. Conventional economic evaluation tends to overlook many indirect costs of roadway capacity expansion and the full benefits of alternative modes and mobility management solutions (Litman, 2005a).
- Fragmented and incremental planning, that allows individual decisions that contradict strategic planning objectives. For example, it is common for planning agencies to impose generous parking requirements on development, even in areas that want to encourage infill development, more compact development, and use of alternative modes.
- More funding and lower local matching requirements for roadway and parking facilities than for other modes. This encourages decision-makers to define transportation problems as highway problems and underinvest in alternative modes and management solutions.
- Automobile underpricing, including free parking, fixed insurance and registration fees, general taxes funding roadways, and lack of congestion pricing. These market distortions increase vehicle ownership and use, and therefore reduce development of other modes.
- Environmental injustice. There is evidence that lower income and minority neighborhoods bear more than their share of undesirable transport facilities, and receive less than a fair share of transport investments and services (Bullard and Johnson, 1997).
- Land use policies that favor sprawl, such as generous parking and setback requirements, density restrictions, and single-use zoning. This leads to more automobile-dependent communities that provide poor access for non-drivers.

Although individually these biases and distortions may seem modest and justified, their impacts are cumulative, resulting in large total subsidies for automobile travel and significant harm to society. For example, parking subsidies total hundreds of dollars annually per vehicle (Shoup, 2005), far higher than public subsidies per transit rider. Automobile travel also imposes costs for local road and traffic services, congestion, accident costs and environmental damages worth hundreds of dollars annually per vehicle ("Transportation Costs," VTPI, 2005). These impacts are widely dispersed through the economy, incorporated into taxes, rents and retail prices, and so are generally ignored in individual planning decisions. By reducing transport system diversity and land use accessibility, these distortions harm disadvantaged people, which is vertically inequitable.

Transportation Pricing Reforms

Horizontal equity requires that as much as possible, consumers pay the costs imposed by their activities. Reforms such as higher fuel tax, road and parking pricing, and distance-based fees, can increase equity by making prices more accurately reflect costs, taking into account factors such as vehicle type, time and location ("Pricing Evaluation," VTPI, 2005).

Transportation price increases are often criticized as being regressive, since a particular fee represents a greater portion of income for lower-income people than for higher-income people. Overall equity impacts depend on how prices are structured, the quality of transport alternatives available, how revenues are used, and whether driving is considered a necessity or a luxury (Litman, 1996; Rajé, 2003). If there are good alternatives, revenues are used to benefit the poor, and disadvantaged people are given discounts, price increases can be progressive overall.

There is a long history of incorporating vertical equity objectives into transport pricing with targeted discounts that benefit lower-income people. Adam Smith (1976), the founder of modern economics, wrote that, "*When the toll upon carriages of luxury coaches, post chaises, etc. is made somewhat higher in proportion to their weight than upon carriages of necessary use, such as carts, wagons, and the indolence and vanity of the rich is made to contribute in a very easy manner to the relief of the poor, by rendering cheaper the transportation of heavy goods to all the different parts of the country.*"

There is often debate over the equity of road and parking pricing, particularly when fees are introduced on previously unpriced facilities. Pricing is criticized on horizontal equity grounds, since most roads and parking facilities are currently unpriced. Motorists ask, "Why should I pay while other motorists do not?" But this argument can be reversed: unpriced roads and parking can be considered unfair if motorists must pay elsewhere. Critics argue that road pricing represents "double taxation" since they already pay fuel taxes that fund roads. However, road and parking pricing is usually applied in areas where the costs of providing facilities is particularly high, such as in city centers and new highways. Such fees can be considered a surcharge for these higher-than-average costs.

Pricing proponents emphasize that motorists receive benefits, such as reduced traffic congestion, and that pricing is optional. For example, motorists may have a choice between free but congested highway lanes, and uncongested but priced lanes. Similarly, they may be able to choose between convenient but priced parking, and less convenient but free parking. This is called *value pricing*. Whether motorists have adequate alternatives is often an important issue in pricing equity analysis.

Pricing reforms can benefit disadvantaged people if they reduce negative impacts on disadvantaged neighborhoods or improve travel options for non-drivers. For example, Kain (1994) predicts that congestion pricing can benefit lower income commuters and non-drivers overall by improving transit and rideshare services. Cameron (1994) concludes that a 5¢ per mile road user fee in Southern California is not regressive because all residents benefit from reduced congestion and pollution.

Comparing Modes

Different modes serve different types of users and uses, and so have different equity implications. Some modes are particularly useful to people who are physically, socially or economically disadvantaged, and so may deserve extra public support. Table 6 compares the uses of common travel modes. Each is suitable for certain applications. Walking and bicycling inexpensive, but are slow and limited by physical ability. Taxies are relatively expensive. Ridesharing requires cooperation from drivers. Transit provides mobility for non-drivers who are not very wealthy or fit.

Table 6 **Suitability of Travel Modes** (Litman, 2005)

Mode	Non-Drivers	Poor	Handi-capped	Limitations	Most Appropriate Uses
Walking	Yes	Yes	Varies	Requires physical ability. Limited distance and carrying capacity. Difficult or unsafe in some areas.	Short trips by physically able people.
Wheelchair	Yes	Yes	Yes	Requires sidewalk or path. Limited distance and carrying capacity.	Short urban trips by people with physical disabilities.
Bicycle	Yes	Yes	Varies	Requires bicycle and physical ability. Limited distance and carrying capacity.	Short to medium length trips by physically able people on suitable routes.
Taxi	Yes	Limited	Yes	Relatively high cost per mile.	Infrequent trips, short and medium distance trips.
Fixed Route Transit	Yes	Yes	Yes	Destinations and times limited.	Short to medium distance trips along busy corridors.
Paratransit	Yes	Yes	Yes	High cost and limited service.	Travel for disabled people.
Auto driver	No	Limited	Varies	Requires driving ability and automobile. High fixed costs.	Travel by people who can drive and afford an automobile.
Ridesharing (auto passenger)	Yes	Yes	Yes	Requires cooperative automobile driver. Consumes driver's time if a special trip (chauffeuring).	Trips that the driver would take anyway (ridesharing). Occasional special trips (chauffeuring).
Carsharing (Vehicle Rentals)	No	Limited	Varies	Requires convenient and affordable vehicle rentals services.	Occasional use by drivers who don't own an automobile.
Motorcycle	No	Limited	No	Requires riding ability and motorcycle. High fixed costs.	Travel by people who can ride and afford a motorcycle.
Telecommute	Yes	Varies	Varies	Requires equipment and skill.	Alternative to some types of trips.

Each mode is suitable for certain types of travel. None is a perfect substitute for driving.

It is sometimes appropriate to compare funding and traffic management of various modes. For example, critics sometimes argue that public transit users receive excessive subsidies compared with motorists, based on comparison of costs and subsidies per passenger-mile, but their arguments often overlook important factors (Hodge, 1995; Litman, 2004).

- Critics usually only consider a small portion of total costs, usually just direct roadway expenditures, but ignore other subsidies of automobile travel, such as parking, congestion externalities and environmental impacts.
- A significant portion of transit funding (about half) is justified to provide basic mobility for non-drivers, including costs for special equipment and services to accommodate people with disabilities. These special services often requires significant subsidy per trip.
- Most transit service is provided on dense urban corridors where automobile costs (road capacity, parking, pollution impacts, etc.) are also costly when measured per vehicle-mile. Transit service costs and subsidies should therefore be compared with the costs of accommodating additional automobile travel under the same circumstances.
- People who depend on transit tend to travel fewer miles per year, so, although their cost per passenger-mile may seem high, their per capita costs are relatively smaller.

Similarly, many people assume that pedestrians and cyclists pay less than their fair share of roadway costs since they are not generally charges road user fees, as are motorists. They therefore object to cyclists using public road, and to the use of roadway funding for walking and cycling facilities and programs. However, they also tend to overlook important factors (Litman, 2002a).

- The local roads that pedestrians and cyclists used most are funded primarily by local general taxes (at least in the U.S.), which residents pay regardless of how much they drive.
- Walking and cycling imposed much smaller roadway costs per mile of travel, including road construction and maintenance requirements, and congestion, accident risk and pollution impacts imposed on others.
- People who rely primarily on non-motorized travel for transportation tend to travel fewer miles per year than motorists.

When these factors are considered, per-capita transportation funding often turns out to be lower for zero-vehicle households than for automobile-owning households. People who rely primarily on non-motorized transportation tend to subsidize the local road and parking facility costs of motorists.

Sustainability Planning Equity Indicators

Sustainability planning takes into account various impacts and objectives, including those related to equity. Nicolas, Pochet and Poimboeuf (2003) describe how local travel survey data and other available information is used to evaluate transport system sustainability in Lyons, France. Their equity analysis compared the relative mobility and transportation cost burdens for various groups, disaggregated by mode (automobile, public transit, walking), geographic location (central, middle and outer urban areas) and household demographics. Table 7 summarizes these indicators

Table 7 **Lyons Indicators** (Nicolas, Pochet and Poimboeuf, 2003)

Dimension	Indicator	Level of Analysis
Mobility		
Service provided	Daily number of trips Trip purposes Average daily travel time	Overall and by geographic location
Organization of urban mobility	Mode split Daily average distance traveled Average travel speed	Overall and by travel mode
Economic		
Cost for the community	Annual transportation costs (total, per resident and per passenger-km) Households Businesses Local government	Overall and per mode
Social		
Relative benefits and costs by different groups.	Household vehicle ownership Personal travel distance Household transportation expenditures (total and as a portion of income)	Overall, by income and geographic location
Environmental		
Air pollution - global	Annual energy consumption and CO2 emissions (total and per resident)	Overall, by mode, by location of emission, and location of resident.
Air pollution – local	CO, NOx, hydrocarbons and particulates (total and per resident)	Overall, by mode, by location of emission, and location of resident.
Space consumption	Daily individual consumption of public space for transport and parking. Space required for transport infrastructure.	Overall, by mode and place of residence.
Other	Noise Accident risk	Overall, by mode and place of residence.

This table summarizes sustainable transportation indicators used in Lyons.

Strategies To Achieve Transportation Equity Objectives

This section identifies various ways of achieving transportation equity objectives.

Horizontal Equity – Planning and Investment Reforms

Horizontal equity requires that public resources be allocated equally to each individual or group unless a subsidy is specifically justified, although exactly what constitutes an equal share depends on which resources are considered and how they are measured. In general, resource allocations should be measured per capita, with adjustments made to account for special needs, such as extra costs to accommodate people with disabilities and to provide fare discounts for people with low incomes.

Reforms are needed to correct current planning biases that favor certain groups and modes. For example, funding allocation rules that favor certain areas in terms of per capita funding, or certain modes in terms of funding per trip, should be corrected to allow resources to be allocated in the most equitable and cost effective way ("Least Cost Planning," VTPI, 2004). It is particularly appropriate to insure that alternative modes frequently used by economically, physically and socially disadvantaged people receive a fair share of public resources. Better survey techniques are needed to better count walking and cycling travel, so these modes receive a fair share of transportation funding.

Horizontal Equity – Pricing Reforms

Horizontal equity requires that prices (what it costs to purchase a good or service) reflect the full costs of providing that good or service unless a subsidy is specifically justified. Automobile use is currently underpriced: a significant portion of costs are external (not charged to motorists) or fixed (not related to how much a vehicle is used), and fees seldom reflect factors that affect costs, such as time, location or vehicle type. Various pricing reforms can achieve horizontal equity objectives by making transport prices more accurately reflect costs (Litman, 2005b; VTPI, 2005). They can also achieve vertical equity objectives by supporting alternative modes, improving affordability, and by prioritizing travel to favor basic mobility and HOV modes. These include:

- *Fuller cost recovery* – User fees such as fuel taxes and tolls increase to reflect costs imposed. For example, fuel taxes could be increased to fund a greater portion of roadway costs, and more parking facilities should be priced.
- *Weight-distance fees* – Fees that reflect the roadway costs imposed by a vehicle class.
- *Road Pricing* – Charge directly for road use, with rates vary to reflect how roadway and congestion costs vary by location, time and vehicle type.
- *Parking cash out* – Allow commuters to choose cash instead of subsidized parking.
- *Parking pricing* – Vary rates to reflect how costs vary by location, time and vehicle type.
- *Pay-As-You-Drive vehicle insurance and registration fees*, which converts fixed costs into variable costs with respect to annual vehicle travel.
- *Environmental taxes and emission fees*. Some economists recommend special fees based on the environmental imposed by an activity, such as vehicle air pollution emissions.

Vertical Equity – Progressive With Respect To Income

There are many ways to increase transport system affordability and insure that transport policies and program are progressive with respect to income ("Affordability," VTPI, 2005)

- As much as possible, prices should be structured to favor economically, socially and physically disadvantaged people. For example, transit services, road tolls and other services can have discounts for people who qualify for low-income benefits. Each household can receive a limited number of free road toll or parking vouchers.
- Implement mobility management programs, such as commute trip reduction and school transport management, which support and reward users of alternative modes.
- Support carsharing (vehicle rental services located in residential areas, designed to provide an affordable alternative to private vehicle ownership), pay-as-you-drive insurance (insurance and registration fees based directly on how much a vehicle is driven), and other programs and pricing options that make occasional automobile use more affordable.
- Offer parking cash out (employers who provide free parking also offer employees the cash equivalent when they commute by alternative modes) and unbundled parking (parking is rented separately from building space, rather than automatically included, so renters who reduce their parking needs save money).
- Favor more affordable modes in planning and investment decisions, including walking and cycling, ridesharing, public transit and intercity bus, carsharing, and Internet service.
- Implement smart growth policies that create more access and multi-modal land use. Locate public services (schools, hospitals, shops, etc.) where they are easily accessible without an automobile. Insure that affordable housing is in accessible locations.

Vertical Equity – Benefiting Transportation Disadvantaged People

Because disadvantaged people tend to drive less than average and often rely on non-automobile modes, anything that increases transportation system diversity and land use accessibility tends to increase vertical equity ("Transportation Diversity," VTPI, 2005). Conversely, anything that increases automobile dependency tends to contradict vertical equity objectives by reducing travel options for non-drivers and increasing transportation costs ("Automobile Dependency," VTPI, 2005). As a result, planning and market distortions that favor automobile travel, described earlier in this paper, tend to reduce vertical equity, while mobility management and smart growth strategies tend to increase vertical equity by creating more diverse and accessible transport systems.

Certain modes and services are particularly important to transport disadvantaged people, including walking, cycling, ridesharing, public transit, intercity bus and rail services, taxi, lower-priced aviation services, special mobility services, carsharing, public Internet services, and delivery services. In addition to the individual modes, it is important to provide good connections between these modes and destinations, for example, insuring that there are good walking and cycling conditions around transit stops, that transportation terminals accommodate people with disabilities, and that public transit serves airports.

Martens (2005) argues that current transport modeling and economic evaluation practices tend to exaggerate the benefits of automobile-oriented improvements and undervalue improvements to alternative modes or improved land use accessibility, which tends to be regressive because it skews planning and investment decisions to favor people who are economically, socially and physically advantaged (those who currently drive high mileage) and at the expense of those who are disadvantaged (who currently drive low mileage and rely on alternative modes). As he explains:

> "Both transport modeling and cost-benefit analysis are driven by distributive principles that serve the highly mobile groups, most notably car users, at the expense of the weaker groups in society. Transport modeling is implicitly based on the distributive principle of demand. By basing forecasts of future travel demand on current travel patterns, transport models are reproducing the current imbalances in transport provision between population groups. The result is that transport models tend to generate suggestions for transport improvements that benefit highly mobile population groups at the expense of the mobility-poor. Given the importance of mobility and accessibility in contemporary society for all population groups, the paper suggests to base transport modeling on the distributive principle of need rather than demand. This would turn transport modeling into a tool to secure a minimal level of transport service for all population groups." (Martens, 2005)

To correct these biases he recommends the following changes to transportation modeling and economic evaluation techniques to reflect equity objectives:

First, transportation improvements should be evaluated primarily in terms of *accessibility* rather than *mobility*. For example, transportation improvements should be rated based on the number of public services and jobs that residents can feasibility reach within their ability (i.e., ability to walk and drive), travel time and financial budgets, not simply travel time savings to vehicle travelers. This recognizes the value of non-automobile modes (walking, cycling, public transit and telecommuting) and land use improvements (such as more compact and transit-oriented development) to improve accessibility and achieve transport planning objectives.

Second, the monetary value attached to a specific accessibility gain should differ between individuals or population groups in *reverse relation* to their current levels of accessibility, to reflect the principle of diminishing marginal benefits. In other words, accessibility gains for the mobility-poor (people who currently travel relatively few annual miles) should receive higher monetary value in the evaluation of transport improvements than the accessibility gains for the mobility-rich (people who currently travel relatively high annual miles), simply because people with limited current mobility will value an extra destination higher than a person with greater current mobility, ceteris paribus. Translated to cost-benefit analysis, it means that travel time savings for the mobility-poor should be valued higher than travel time savings for the mobility-rich. This reflects consumer welfare theory, not just social justice objectives. For example, it reflects society's objective to help disadvantaged people access education and employment opportunities that allow them to participate more effectively in the economy.

Increase Transportation System Diversity

Because non-drivers (people who for any reason cannot use an automobile) have fewer travel options and inferior transport services compared with motorists, and because disadvantaged people tend to be non-drivers, increased transportation system diversity tends to increase equity. For example, disadvantaged tend to benefit from improved walking and cycling conditions, improved public transit and intercity travel options, improved vehicle rental and carsharing services, improved ridesharing, improved taxi services, discounted air travel services, delivery services, and internet access. These can have synergistic effects, since, for example, improved walking conditions also improves transit access and helps create more accessible land use patterns.

Support Smart Growth Development

Automobile dependency and sprawl tend to be inequitable because they make non-drivers (people who for any reason cannot rely on automobile transportation) relatively worse of compared with drivers, and tend to increase total per capita transportation costs by reducing the effectiveness of more affordable travel options (walking, cycling and public transit), and by increasing the total amount of travel required to maintain a given level of accessibility, imposing a financial burden on lower-income residents (Schneider and McClelland, 2005). McCann (2000) found that households in sprawled regions devote more than 20% of their expenditures to surface transportation (more than $8,500 annually), while those in communities with more efficient land use spend less than 17% (less than $5,500 annually), representing savings of hundreds of dollars a year. Similarly, lower-income households that rely on automobile transportation tend to spend a relatively large portion of their income on basic transportation, while those that use other travel modes spend much less (STPP, 2003; Bernstein, Makarewicz and McCarty, 2005).

Described more positively, transportation and land use policies that help create more multi-modal transportation systems and more accessible land use development help achieve equity objectives by improving accessibility for non-drivers and by making transportation more affordable to lower-income households (“Smart Growth,” VTPI, 2005). Reforming current planning and investment practices that favor sprawl tends to support equity objectives (“Smart Growth Reforms,” VTPI, 2005). Smart growth is sometimes criticized for being inequitable, on the grounds that it reduces housing affordability, but it can incorporate features to improve overall transportation and housing affordability (“Location Efficient Development,” VTPI, 2005).

There is sometimes a conflict between a short-term perspective, which focuses on current cost burdens, and a long-term perspective that considers how current policies affect future transportation and land use patterns. For example, increased vehicle taxes and fees intended to discourage automobile travel and encourage use of alternative modes may seem inequitable from a short-term perspective, because they increase the unit costs of vehicle travel, but may increase equity overall if they help create a more diverse transportation system and more accessible land use patterns, which reduce total consumer transportation costs.

Universal Design

Universal design (also called *accessible design* and *handicapped access*) refers to transport systems that accommodate the broadest possible range of users, including people with disabilities, people using handcarts, and other special needs ("Universal Design," VTPI, 2005).[15] Walking facilities, public buildings, transportation terminals and public transportation vehicles should all reflect universal design principles. Every community should have taxis and special mobility services that accommodate people with significant physical disabilities. It is important that some residential neighborhoods and all commercial centers meet a high standard of universal design.

Give Diverse Stakeholders More Influence On Transport Planning

Vertical equity often requires better planning that involves people who are often excluded ("Transportation Planning," VTPI, 2004). This may require more outreach to disadvantaged groups (minorities, lower-income people, single mothers, etc.), consideration of an expanded range of impacts, and more integration between different jurisdictions and agencies. In some cases it may be appropriate to assign an advocate to represent disadvantaged groups that have difficulty participating in planning processes, such as children, people with severe disabilities and homeless people.

Collect Information Needed For Transport Equity Evaluation

Vertical equity objectives require better transport data collection, to help quantify impacts on different groups. This may include information on the mobility needs and activities of various disadvantaged groups, information on impacts that have are often overlooked (such as the distribution of parking costs, the delay that wider roads and increased vehicle traffic have on nonmotorized modes, the quality of transportation services for non-drivers, and the impacts of land use decisions on accessibility and transportation costs.

Table 8 identifies various transportation improvement strategies that help achieve specific equity objectives. This type of analysis can be modified to reflect the needs and values of a particular community. For example, different types of pricing reforms can have different equity impacts, depending on how they are structured and how revenues are used, so with thoughtful design, pricing reforms can achieve a maximum range of equity objectives.

[15] A useful exercise for transport decision-makers is to spend a couple weeks without driving an automobile, and a day or two traveling around public facilities in a wheelchair.

Table 8 **Strategies for Achieving Equity Objectives**

Strategy	Treats Everybody Equally	People Bear the Costs They Impose	Progressive With Respect To Income	Benefits Transport Disadvantaged	Improves Basic Access
Pricing reforms (higher fuel taxes, road and parking pricing, distance-based fees).	X	X			X
Increased transport system diversity (improvements to modes used by disadvantaged people).			X	X	X
More accessible land use, and location-efficient development.			X	X	X
More affordable automobile options (PAYD insurance, carsharing, need-based discounts, etc.)			X		X
Correct policies that favor automobile travel over other modes (planning and investment reforms).	X	X	X	X	
Improve public involvement in transport planning.	X			X	
Improve data collection (more information on disadvantaged people and alternative modes).	X		X	X	

This table indicates the equity objectives achieved by various transportation planning and management strategies. Many strategies support multiple equity objectives.

Conclusions

Equity refers to the distribution of impacts, and whether they are considered fair and appropriate. Transport planning decisions often have significant equity impacts, but these can be difficult to evaluate because there are various types of equity, categories people, impacts, and ways to measure impacts, as summarized in Table 9. A particular decision may seem equitable evaluated one way, but inequitable evaluated another.

These factors must be carefully defined. Many people fall into multiple categories and change status over time. Some impacts must be explained to help stakeholders understand their transportation equity impacts. New equity issues emerge over time, reflecting changing needs, values, and understanding of impacts. The large number of categories may be intimidating. It is not generally possible to evaluate all possible permutations of perspectives, impacts and groups. However, it is useful to recognize the full universe of possible issues and select those most important in a particular situation.

New analysis tools and information resources are available to better evaluate equity and incorporate equity objectives into transport planning. There is no single correct methodology. It is generally best to consider a variety of issues and perspectives. A planning process should reflect each community's equity concerns and priorities. Public involvement is therefore important for transport equity planning.

Transportation equity analysis is usually performed as part of other evaluation activities, rather than as a stand-alone project. Equity considerations can be incorporated in analysis of transportation planning and funding, land use planning, road and facility design, transportation pricing and subsidies, the provision of transportation services, and just about any other transportation decision-making. Below are some general guidelines for applying equity analysis in transport planning.

- Consider a variety of perspectives and impacts when evaluating equity.
- Allocate transportation resources approximately equally per capita, based on user payments, or some combination of the two; unless a subsidy is specifically justified.
- Insure that basic mobility and access needs are met. If necessary, prioritize facilities and services to favor basic transport.
- Take into account the needs of disadvantaged people to insure that they have an adequate level of service. Special discounts and exemptions can be provided to disadvantaged groups. Consider disadvantaged people's needs when planning all facilities and services.
- Involve stakeholders in planning to help identify equity concerns and priorities.

More comprehensive equity analysis allows planners to better anticipate problems, incorporate equity objectives in planning (for example, it can help identify congestion reduction strategies that also improve mobility for non-drivers and help lower-income people), and it can help optimize planning decisions to maximize equity objectives. Improved equity analysis in transport planning can reduce conflicts and delays, and better reflect a community's needs and values.

Table 9 **Transportation Equity Indicators and Categories**

Types of Equity	Categories of People	Impacts	Measurement
Horizontal Equal treatment. Equal allocation of funds and other resources. Equal use of public facilities. Cost recovery. **Vertical With-Respect-To Income And Social Class** Transport affordability. Housing affordability. Discounts for low-income travelers. Impacts on low-income communities. Employment opportunities. Quality of services for lower-income travelers. **Vertical With-Respect-To Need And Ability** Universal design. Special mobility services. Disabled parking policies. Quality of services for non-drivers.	**Demographics** Age Gender Race Ethnic group Family status Lifecycle stage **Income class** Quintiles. Below poverty line. Lower-income community residents. **Geographic location** Jurisdictions Residents of impacted neighborhoods/streets. Urban/suburban/rural. **Ability** People with disabilities. Licensed drivers. **Mode** Walkers Cyclists Motorists Public transit users. **Vehicle Type** Cars/SUVs/motorcycles Trucks (light and heavy) Bus Rail **Industry** Freight (trucks, rail, etc.). Personal transport. Vehicle manufactures. **Trip Type and Value** Emergency Commute Commercial/freight Recreational/tourist	**Public Facilities and Services** Funding for facilities and services. Parking requirements. Subsidies and tax exemptions. Planning and design of facilities. Public involvement. **User Costs and Benefits** Mobility and accessibility. Vehicle expenses. Taxes and government fees. Road tolls and parking fees. Public transportation fares. Fitness (use of active modes) **Service Quality** Number of modes available. Road and parking facility quality. Public transport service quality. Land use accessibility. Universal design. **External Impacts** Traffic congestion and crash risk. Pollution emissions. Barrier effect. Hazardous material and waste. Aesthetic impacts. Land use impacts. Community cohesion. **Economic Impacts** Access to economic opportunities. Impacts on economic development. Expenditures and employment. **Regulation and Enforcement** Regulation of transport industries. Traffic and parking regulation. Regulation of special risks	**Per capita** Per adult. Per commuter. Per student. Per disabled person. Per low-income household. **Per vehicle-mile or kilometer** **Per passenger-mile or kilometer** **Per trip** Per commute trip. Per "basic mobility" trip. Per peak-period trip. **Per dollar** Per dollar of user fees paid. Per dollar of total taxes paid. Per dollar of subsidy.

This table lists various types of equity, categories of people, impacts and measurement units. Major categories are bold, and many have subcategories. These can be selected to reflect the issues considered most important in a particular transportation equity evaluation.

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