Elevating Health & Equity into the Sustainable Communities Strategy (SCS) Process

SCS Health & Equity Performance Metrics

Human Impact Partners

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INTRODUCTION

In 2008, the California legislature passed SB375, the intent of which is to decrease emissions of greenhouse gases to target levels in each region of the state. Given the connection between how our environment is built and health behaviors, outcomes, and inequities, this is a unique opportunity to elevate health and equity into transportation and land use planning.

The bodies responsible for implementation are the Metropolitan Planning Organizations (MPOs) in each of the 18 regions of the state, and they are planning for this change through their Regional Transportation Plans (RTPs), an update of transportation policies and guidelines, as well as guidance on the types of projects (and in some cases the actual projects) that will be constructed over the next 25 years. Within the RTPs, all MPOs will be developing a Sustainable Communities Strategy (SCS), which is the document and vision for decreasing greenhouse gas emissions through transportation and land use planning.

Given the high levels of chronic disease, including obesity, diabetes, and asthma, that we are facing as a country, it is imperative that we address the root causes. We spend a higher percent of our GDP on healthcare than any other country and while access to healthcare and genetics are important factors that determine our health status, there is growing recognition that the land use and transportation systems that influence our personal behaviors affect our health status even more. As described below, transportation systems impact health in many ways, through injuries and fatalities, environmental quality (e.g., air quality and noise), physical activity, and income. These impacts are typically not distributed evenly across all populations, with lower income populations and communities of color often facing worse outcomes for a variety of reasons. Understanding the causes of these differences is an important piece of addressing them. For this reason, we believe that equity (defined here to mean the absence of systematic disparities in health or in the major social determinants of health, between groups with different levels of underlying social advantage/disadvantage[1]) must be assessed in addition to health.

A statewide group of public health advocates convened by Human Impact Partners has developed the following set of 13 performance metrics for use in the RTP/SCS processes across the state. In the past, public health and equity have not been fully considered in land use and transportation planning and many health and equity outcomes related to those plans have been poor. We hope to inform the discussion of performance metrics with a health perspective and thereby improve future health outcomes related to these planning efforts. MPOs across the state are including different voices in the Sustainable Communities Strategy discussions as part of their RTPs. Our hope is that MPOs will consider including the following metrics in their SCSs and including public health and equity professionals and advocates in the process of developing their RTP/SCS.

This document lists the 13 health and equity performance metrics prioritized by statewide health experts, agencies, advocates, and transportation planners. This list of 13 was chosen from an original 129 indicators.

There were many agencies, advocates, planners, and individuals involved in choosing the Health & Equity metrics. Inclusion on this list does not imply a "sign-on" to the metrics, only that the agencies and organizations contributed to the prioritization, suggested methodologies and standards.

- Climate Plan
- American Lung Association
- California Department of Public Health
- Los Angeles County Department of Public Health
- Shasta County Department of Public Health
- BARHII
- San Mateo County Health System
- Move LA
- Prevention Institute
- Public Health Law & Policy
- Reconnecting America
- Safe Routes to Schools
- Public Health Institute
- PPIC
- TransForm
- Marin County Department of Public Health
- Public Advocates
- PolicyLink
- Public Law Center
- Raimi & Associates
- Nelson & Nygaard
- Fehr & Peers

The effort was funded by the Resource Legacy Fund.

Metrics chosen needed to be: measurable over time; evidence-based; geographically scale-able (measured at various scales, like local and regional, and at scales useful to those using them); understandable and accessible to policy-makers; stratifiable by race, ethnicity, place, income; relevant to health and equity; and, of course, relevant to the Sustainable Communities Strategy.

The metrics are the result of an intensive 2-month collaboration with the above groups. The metrics will not apply equally to every region, particularly the more rural regions. It is our hope that in each region, local public health agencies and advocates will work with transportation agencies and advocates to adapt the metrics to fit their region. Human Impact Partners and other organizations involved are available to assist those efforts (see "How to Use Health and Equity Metrics" at the end of this document).

This document does not provide recommendations of benchmarks for each metric. While we do provide standards, it is again our hope that agencies and advocates concerned about health and equity will take this document and use it to craft recommendations specific to their region and the politics that exist locally.

Finally, any prioritization process cannot necessarily include all of the metrics. There were metrics that participants felt were important but did not make the final list. Some of the metrics, listed in the appendix below, were recommended for further study by the MPOs.

The structure of the document includes the thirteen metrics and with each metric we provide the evidence that connects that metric to health and equity, a suggested methodology for measuring the metric, resources to help if the methodology is unfamiliar, limitations of the methodology if there are any, and some standards that exist around the metric.

SAFETY

METRICS: SAFETY

1. **Map annual number of pedestrian and bicycle collisions (and severity of injury/fatality): per capita, per geographic area, by daytime population**

2. **Total number of vehicle, bike and pedestrian collisions per capita, broken down by severity: fatalities and injuries**

EVIDENCE BASE

Health Impacts

Number of collisions is directly tied to injuries and fatalities. Motor vehicle crashes are the leading cause of death among those ages 5-34 in the U.S.[2] Areas with high levels of vehicle miles traveled per capita tend to have higher collision and injury rates. More time in a car means higher exposure to the perils of driving, including collisions.[3] There is a statistically significant relationship between traffic volume and the number of vehicle collisions involving a pedestrian.[4] [5] [6] [7] California's pedestrian fatality rates are much higher than the nation's, with pedestrians accounting for more than 17 percent of motor vehicle collision related deaths in California.[8] The lifetime odds of dying as a car driver or passenger are 1 in 261, compared to 1 in 64,596 as a bus occupant or 1 in 115,489 on a train.[9]

The risk of pedestrian injuries may discourage walking as a mode of transport, and negatively impact physical activity levels. The perception of collision risk may also prevent people from cycling. In a survey of adults in the Vancouver metropolitan area, the top deterrents to cycling were the risk of injury from car-bike collisions; the risk from motorists who don't know how to drive safely near bicycles; motorized vehicles driving faster than 50 km/hr; and streets with a lot of car, bus, and truck traffic.[10] Additionally, beyond the immediate physical consequences of a collision, an individual's well-being can also be impacted from resulting levels of disability, high medical costs and lost productivity.[11]

Equity Impacts

Pedestrian collisions are more common in low-income areas, potentially reflecting greater residential density, greater traffic volume, and lower automobile ownership among residents of these neighborhoods.[12] In Alameda County, for example, the combined rate of pedestrian injury or death in high poverty areas is six times that in low poverty areas (12 cases per 1,000 people in high poverty areas vs. 2 cases per 1,000 people in low poverty areas).[13]

There are also racial disparities in risks associated with pedestrian crashes.[14] A greater incidence of crashes involving pedestrians exists among minorities; African American and Hispanic race/ethnicity as well as uninsured status are linked to increased risk of mortality from collisions.[15]

METHODOLOGY

In California, the Statewide Integrated Traffic Records System (SWITRS) records data for all vehicle, bicycle and pedestrian collusions that are reported. This data is available at the intersection level and therefore able to be geocoded and aggregated by census tract, neighborhood, city or region-wide. When calculating collisions per capita, the daytime population (when available) may be a more reliable denominator, however collisions before 5 AM and after 7 pm should be excluded when using the daytime population. Alternatively, residential population overall can be used as the denominator. Race/ethnicity data is largely missing from SWITRS, so stratification by race is not possible using this data.

TIMS (Transportation Injury Mapping System) will map SWITRS data by census track, traffic zones, schools, etc. http://www.tims.berkeley.edu/ MPOs need to be careful with TIMS data as it doesn't include all collisions (only those that are severe or fatal). For complete data use the SWITRS site.

RESOURCES

Serious and fatal injuries are geocoded and available at no cost from UC Berkeley SafeTREC (http://www.tims.berkeley.edu/)

Monitoring: San Francisco Department of Public Health- Healthy Development Measurement Tool: Indicator ST.3.c Number of bicycle collisions- http://www.thehdmt.org/indicators/view/59
Forecasting: An example of the development and use of a multivariate, area-level regression model of vehicle-pedestrian injury collisions that has been applied to predict area-level change in vehicle-pedestrian injury collisions associated with land use development and transportation planning decisions:
Wier M, Weintraub J, Humphreys EH, Seto E, Bhatia R. (2009). An area-level model of vehicle-pedestrian injury collisions with implications for land use and transportation planning. *Accident Analysis & Prevention*, 41(1):137- 45.
http://www.sfphes.org/transportation/Pedestrian_Injuries_and_Fatalities_SF.pdf

LIMITATIONS

As mentioned above, SWITRS data relies on collisions that have been reported. However, collisions that do not result in a serious injury and collisions resulting from poor road maintenance tend to go unreported. A joint study by the San Francisco Department of Public Health and the San Francisco Bicycle Coalition found that only 5 percent of dooring incidents (i.e., when a bicyclist is hit by a car door) were reported to the police.[16] In addition, neighborhoods in San Francisco with higher immigrant population densities may have lower reporting rates because of fear of law enforcement, whereas neighborhoods with a strong community police presence may be more likely to report collisions.[17]

STANDARDS

Statewide, in California in 2009:
The motor vehicle collision fatality rate was 7.3 per 100,000 people;
The motor vehicle collision injury rate was 425 per 100,000 people.[18]

The pedestrian fatality rate from collisions with motor vehicles was 1.5 per 100,000 people
The pedestrian injury rate from collisions with motor vehicles was 34 per 100,000 people.[19]

The bicyclist fatality rate from collisions with motor vehicles was 0.3 per 100,000 people;
The bicyclist injury rate from collisions with motor vehicles was 31 per 100,000 people.[20]

Healthy People 2020[21]
The U.S. Department of Health and Human Services (USDHHS) Healthy People 2020 provides science-based, 10-year national objectives for improving the health of all Americans. By 2020, the following should be achieved:

Unintentional injury prevention

- Reduce nonfatal motor vehicle crash-related injuries to 1.2 deaths per 100 million vehicle miles traveled;
- Reduce pedestrian deaths on public roads to 1.3 deaths per 100,000 population;
- Reduce nonfatal pedestrian injuries on public roads to 20.3 injuries per 100,000 population;
- Reduce cyclist deaths on public roads to 0.22 deaths per 100,000 population.

ACCESS TO GOODS, JOBS & SERVICES

METRIC: ACCESS TO GOODS, JOBS & SERVICES

3. Proportion of households that can walk or bike (10 minutes) to meet at least 50 percent of their daily needs. Public daily needs defined as: schools, parks, healthcare institutions and transit. Private daily needs defined as: restaurants, grocery stores, food markets and childcare.

EVIDENCE BASE

Health Impacts

Neighborhood conditions can have a powerful effect on health.[22] A neighborhood's physical characteristics may promote health by providing safe places for children to play and for adults to exercise that are free from crime, violence and pollution.[23] Being within walking or biking distance of neighborhood goods and services promotes physical activity, reduces vehicle trips and miles traveled, and increases neighborhood cohesion and safety.[24] Reducing vehicle trips and miles traveled can also reduce air and noise pollution, which subsequently impacts respiratory disease, cardiovascular disease, and other health conditions. Living in dense, mixed-use communities can also improve cardiovascular and respiratory health as well as reduce the risk of obesity.[25]

PUBLIC GOODS & SERVICES (health care, schools, parks & transit):

Access to Health Care Services and Health

The timely use of primary care has a role in preventing morbidity and hospitalizations for a number of chronic diseases, including asthma and diabetes. Research has found that Federally Qualified Health Centers in medically underserved areas can lower preventable hospitalization rates.[26] Travel distance to a health care provider and lack of transportation are well established barriers to receiving adequate health care.[26] [27] [28] Additionally, people with a usual source of health care are more likely than those without a usual source of care to receive a variety of preventive health care services.[29] [30] Fifteen percent of adults in the U.S. lack a usual source of health care. This equates to more than 40 million people that have no particular doctor's office, clinic, health center, or other place where they regularly go for health care advice.[31]

School Location, Education and Health

Research findings indicate that the physical location of schools, in particular the distance that students travel to school, significantly impact health outcomes. Long travel distances to school are a primary barrier and have the strongest influence on the students' decision to walk or bike there.[32] [33] Living within a half-mile of a school greatly increases the likelihood of walking or biking to that school across all racial groups.[34] Active commuting to school can provide a substantial portion of children's physical activity and has been associated with increasing levels of independence, social interaction and communication.[35] [36] [37] [38] [39] However, the level of violence in the surrounding area where a school is located can make it difficult for students to travel to and from school safely, discouraging them from walking or bicycling to school regardless of the distance or the walkability of the neighborhood.[40]

Access to and duration in school are incredibly important, as there are well-documented associations between education and health.[41] In 1999, the age-adjusted mortality rate of high school dropouts between the ages of 18-64 was more than twice as large as the mortality rate of those with some college education.[42] Better educated individuals have healthier behaviors; are less like to be hypertensive and suffer from diabetes; and are more likely to exercise and obtain preventative care. In addition, maternal education is strongly associated with infant and child health; four more years of schooling lowers the probability of reporting in fair or poor health by 6 percentage points; and estimates suggest that a year of education increases earnings by about 10 percent.[43]

Access to Parks and Health

People who live closer to parks are more likely to use them for physical activity.[44] Having park space available increases the amount of exercise that residents get.[45] For example, a 1 percent increase in park space can increase physical activity in youth by 1.4 percent.[46] Nationally, about 30 percent of physically active people report exercising in public parks.[47] Access to parks and open space is also associated with higher levels of social interaction, which has positive impacts on mental health through higher social support and better social networks.

Access to Public Transportation and Health

Public transportation that is both convenient and fast, and transit oriented development (meaning walkable, mixed-use communities located around transit stations) can affect travel activity and provide large health benefits, including reduced traffic crashes and pollution emissions, [48] increased physical fitness,[49] improved mental health,[50] improved basic access to medical care and healthy food and increased affordability which reduces financial stress to lower-income households.[51] In fact, Americans who use public transit spend a median of 19 minutes daily walking to and from transit; twenty-nine percent achieve at least 30 minutes of physical activity a day solely by walking to and from transit.[49]

PRIVATE GOODS & SERVICES (food retail & childcare centers)

Access to healthy food retail and health

Lack of access to healthy food is one of the barriers, particularly for low-income communities, to healthy eating. Diet-related disease is one of the top sources of preventable deaths among Americans, with the burden of overweight and obesity falling disproportionately on populations with the highest poverty rates.[52] [53] It is well known that nutritious eating and regular physical activity aid in the prevention of chronic medical conditions, especially diabetes, cardiovascular diseases and cancers, and can alleviate the effects of conditions such as obesity.[54]

The choices that people make about what they consume on a day-to-day basis are influenced by the food options available at different retail locations.[55] For many low-income populations in urban areas, accessible and affordable nutritious food remains a significant unmet need. Such households often buy less expensive but more accessible food at fast food restaurants or highly processed food at corner stores. These types of foods are usually higher in calories but lower in nutritional value.[56] Eating at fast-food restaurants is associated with higher caloric intake, lower vegetable consumption, greater consumption of sweetened beverages and higher rates of obesity.[57] Research has shown that where there are high numbers of fast-food restaurants compared to grocery stores, there are also higher rates of diabetes, cardiovascular disease, and cancer.[57]

Childcare centers and health

Today, the majority of U.S. children live in families in which all parents work.[58] Access to childcare is essential for working parents to maintain employment and/or education. Accessible high-quality childcare provides children with valuable opportunities for cognitive, behavioral and educational development, and results in positive physical health outcomes.[59] [60] [61] [62]

From an extensive study done about land use in Seattle, they saw that the land uses that were most strongly linked to the percentage of household walking trips in the Seattle area were educational facilities, commercial office buildings, restaurants and taverns, parks, neighborhood scale retail establishments, civic uses, grocery stores. They also found that the number of retail establishments (rather than total retail square footage) was found to be important in the decision to walk for non-work purposes. For each quartile increase in the number of retail locations, walking for non-work trips increased 19 percent.[63]

Equity Impacts

Inequities exist not only in access to goods and services within certain neighborhoods, but also in the ability to live in neighborhoods with health-promoting conditions – an ability which varies with household economic and social resources.[23] Nearly one fifth of all Americans (approximately 52 million people) live in poor neighborhoods (i.e., neighborhoods in which at least 20 percent of residents are poor).[23] Between 1970 and 2000, poor families became more likely to live in neighborhoods with concentrated poverty and rich families became more likely to live in neighborhoods with concentrated wealth.[64] This concentrated poverty impacts inequity – according to a recent study, the median wealth of white households is 20 times that of black households and 18 times that of Hispanic households, a finding most recently impacted by plummeting home values.[65] Individuals in minority racial or ethnic groups are more likely to live in poor neighborhoods – nearly half of all blacks live in poor neighborhoods, compared with only one in ten whites.[66]

Historic trends of reduced public spending affect poor neighborhoods more than wealthy communities.[67] The influence of socioeconomic segregation as well as racial or ethnic segregation influences neighborhood conditions in a variety of ways, from funding and quality of public schools to employment opportunities, housing quality, municipal services, and hazards such as pollution, noise and crime.[23] A recent study in New York revealed that low-income non-white populations are at a disadvantage when trying to access daily goods and services. There was a stronger relationship for black populations than Latino populations but both populations have less access.[68] For low-income families, the costs of childcare can consume a major portion of income, leaving less money for food, housing and other necessities. Finally, children with low neighborhood amenities or those lacking neighborhood access to sidewalks or walking paths, parks or playgrounds, or recreation or community centers had 20 to 45 percent higher odds of obesity and overweight, compared with children who had access to these amenities.[69]

METHODOLOGY

Use GIS to map the distribution of daily goods and services in a particular region and households that can access them by biking or walking. Display the proportion of parcels that can access a minimum of four out of the eight public and private goods/services (50 percent) by noting the geographic areas with access below 50 percent access and those areas above 50 percent access. This analysis should produce two different maps, one showing bike access and one pedestrian access, as well as a display of the geographic equity of distribution.

RESOURCES

The San Diego Association of Governments (SANDAG) has begun to develop methodology for mapping and quantifying neighborhood access to healthful resources. For more information, contact Vikrant Sood at vso@sandag.org.

Richmond General Plan: Neighborhood Completeness Index[24] – Moore Iacofano Gostsman, Inc. (2007). Richmond general plan update- Issues & opportunities paper #8: Community health and wellness(Draft). p23 http://www.cityofrichmondgeneralplan.org/docManager/1000000640/Existing%20Condictions%20Report%20August%202007.pdf

LIMITATIONS

While geographic distance is just one dimension of accessibility, proximity to services does not necessarily promote increased walking and biking, reduced daily vehicle trips and miles traveled, increased, and increased interactions among neighbors and others on the street. While this metric demonstrates the geographic

distribution of key public services within a neighborhood, two residents within the same neighborhood may have very different abilities to access goods and services, due to the size and topography of the neighborhood, available transportation options, affordability of goods and services, hours of operation, and language and cultural accessibility.[70] It is also important to note that accessibility is not a measure of the quality of goods/services available.

STANDARDS

Richmond General Plan[24]: If a given parcel in the city is within 1⁄4 mile of at least 9 of the 18 services listed, that parcel is considered to have good physical proximity to daily goods and services (service index of 0.5). A service index of 0.5 or higher relates to completeness of neighborhoods.
Available at:
http://www.cityofrichmondgeneralplan.org/docManager/1000000640/Existing%20Condictions%20Report%20August%202007.pdf

SFDPH: Proportion with access to 8 out of 11 public goods and services and 9 out of 12 key retail services.
Available at: http://www.thehdmt.org/objectives/view/62

Ahwahnee Principles for Resource Efficient Communities[71]

- Community Principle 1. All planning should be in the form of complete and integrated communities containing housing, shops, workplaces, schools, parks and civic facilities essential to the daily life of the residents.
- Community Principle 2. Community size should be designed so that housing, jobs, daily needs, and other activities are within easy walking distance of each other.
- Community Principle 7. The community should have a center focus that combines commercial, civic, cultural and recreational uses.
- Community Principle 8. The community should contain an ample supply of specialized open space in the form of squares, greens and parks who frequent use is encouraged through placement and design.

Available at: http://www.lgc.org/ahwahnee/principles.html

California TOD Housing Program Guidelines[72]. Transit-supportive land use
This law establishes the priorities for distributing funding for TOD communities, and it gives points for housing that will be built near a transit stop and has access to 10 of the following uses:

> Bank, child care facility, community center, convenience store, hair care, hardware store, pocket park or playground, health club or outdoor recreation facility, laundry or dry cleaner, library, medical/dental office, pharmacy, place of worship, policy/fire station, restaurant, coffee shop, deli/bakery, school, senior care facility, shoe repair, grocery store, social service facility, theater.

METRIC: ACCESS TO GOODS, JOBS & SERVICES

4. Proportion of households and proportion of jobs within 1/4 mile of local public transit (including both bus and rail) or 1/2 mile of a regional public transit, that has less than 15 minute frequencies

EVIDENCE BASE

Health Impacts

The greatest pedestrian "capture rate" is when transit stops are within a 10 minute walk from home or office, have frequent headways, and are close to a dedicated transit right-of-way.[73]

Accessibility of transit to both homes and workplaces provides the opportunity for a number of different health benefits. High per capita traffic fatality rates as well as the increase of diseases related to sedentary lifestyles both contribute to the poor health outcomes and high costs of care in the U.S..[51] Recent analysis by Todd Litman of the Victoria Transportation Policy Center[51] of the health benefits of public transportation in the U.S. found that:

- Current demographic and economic trends (aging population, rising fuel prices, increasing health and environmental concerns, and rising medical care costs) are increasing the value of public transportation health benefits;
- Inadequate physical activity contributes to numerous health problems, causing an estimated 200,000 annual deaths in the U.S., and significantly increasing medical costs. Among physically able adults, average annual medical expenditures are 32 percent lower for those who achieve physical activity targets ($1,019 per year) than for those who are sedentary ($1,349 per year);
- Public transit reduces pollution emissions per passenger-mile, and transit-oriented development provides additional emission reductions by reducing per capita vehicle travel;
- Traffic casualty rates tend to decline as public transit travel increases in an area. Residents of transit-oriented communities have only about a quarter the per capita traffic fatality rate as residents of sprawled, automobile-dependent communities;
- Neighborhood design features that support transit, such as walkability and mixed land use, also support public health. Of people with safe places to walk within ten minutes of home, 43 percent achieve physical activity targets, compared with just 27 percent of less walkable area residents.

Alternatively, the more time a person spends in a car, the less time that person has to engage in leisure time physical activity.[74] Each additional hour spent in a car per day is associated with a 6 percent increase in the likelihood of obesity. Each additional hour walked per day is associated with a 4.8 percent reduction in the likelihood of obesity.[75]

Frequency of public transit service is an important predictor of whether people use and rely on transit as an alternative to driving alone for daily trips. Shifts from driving to transit use can decrease vehicle miles traveled at a regional level - with potential health benefits including reductions in air pollution and greenhouse gas emissions as well as injuries and deaths in motor vehicle collisions. At the local level, increases in transit use and decreases in personal vehicle trips can reduce local traffic volumes and benefit local air quality, reduce traffic related noise levels, and decrease traffic hazards to pedestrians and bicyclists. Shifts to transit from driving also support increases in physical activity through walking and biking trips to get to transit, and its related benefits to physical and mental health. Safe, quality public transportation systems also support social interaction and community cohesion.[76]

Access to public transportation is currently low. Nearly 60 percent of the U.S. population lives in major metropolitan areas of over 1 million, but only 8.3 percent of households have access to major subway service,

and over 50 percent of Americans do not live within one-quarter mile of a transit stop.[77] A study in Seattle showed that for every quarter mile increase in distance from a transit stop to home, the odds of taking a transit trip decreased by 16 percent. A quarter mile increase in distance from transit to work reduced the likelihood of taking transit to work by 32 percent.[78]

* For research regarding the health impacts of access to work and thus income see **Metric #9**- Percent of household income consumed by housing and transportation combined.

Equity Impacts

While public transit use has benefits such as increased physical activity, public transit infrastructure in most US cities is not as convenient as vehicle transport, and those who do not have the option to buy a car may have a disadvantage, particularly elderly people and families with young children. Residents in low-income communities are less likely to own a car and more likely to rely on public transportation,[79] [80] and therefore often have longer commutes. People of color are also more likely to use transit and carpooling to get work, increasing the likelihood of longer commute times.[81] Costs and inaccessibility to public transit are barriers to accessing one's workplace and other resources. Other barriers include poor sidewalk quality, no sidewalks, lack of proper signage, and absence of bus shelters or benches. As transportation expenditures continue to rise, the amount households have to spend on housing, food, health care, insurance, education, and other needs decreases. Prohibitive transportation costs can interfere with employment prospects, economic self-sufficiency, and access to needed goods and services including health care and food. Providing affordable public transportation, particularly to transit dependent and low-income communities, is one way to address these inequities in access that negatively impact health.[82]

Of special concern also are rural communities. Two-thirds of rural Americans – 60 million people – are almost wholly not served by public transportation.[83]

It is therefore critical to ensure that communities not only have access to transit in order to reach jobs and needed services, but also that this transit is affordable. When modeling accessibility, different modes of public transportation, such as local buses, commuter buses, light rail and commuter rail, need to be disaggregated. When aggregated, the resulting analysis may suggest communities have access to transit that is, in actuality, high-fare and unaffordable, and rail service expansion may come at the cost of affordable local bus service.

METHODOLOGY

Enumerate both bus and rail public transit stops with less than 15 minute frequencies from local transit authorities; Estimate distance between stops and each household/job or intersection location. Using GIS network analysis so that true distance to transit is captured rather than "as the crow flies" will avoid underestimates of travel distance.

MPOs should use their region-specific Travel Demand Models that include data on residents, jobs and transit for this performance metric and use the local transit authorities to gather information on transit frequency.

RESOURCES

Transit access and transit frequency methodologies:

- *Example of transit access methodology:* SFDPH-HDMT Indicator ST.2.b Proportion of households with 1/4 mile access to local bus or rail link http://www.thehdmt.org/indicators/view/52
- *Examples of transit frequency methodologies:*
  MTC Appendix C: Regional Snapshot Analysis Detailed Methodology.
  http://www.mtc.ca.gov/planning/snapshot/Appx%20C-Detailed%20Methodology.pdf

SFDPH-HDMT: Indicator ST.2.c Local transit service frequency, morning peak commute
http://www.thehdmt.org/indicators/view/223

OnTheMap is a tool by the U.S. Census's LEHD project that maps a number of different layers, including education, transportation and workforce categories: http://lehdmap.did.census.gov/

The National TOD Database is a GIS platform that includes every fixed-guideway transit system in the U.S. and demographic and land-use data for the half-mile radius around all stations: http://toddata.cnt.org/

LIMITATIONS

Proximity does not necessarily equal accessibility. Lower income communities tend to rely more heavily on public transportation and modes of transportation used to access work are dependent upon numerous variables. Among many others, these may include cost, perceived and actual safety, lack of pedestrian facilities and signage, weather, pedestrian access and safety, traffic patterns, availability of bicycle lanes and racks, hours of operation, availability of parking, and availability of travel stipends/incentives provided by work or to low-income families.[84]

An additional concern is the aggregation of transit modes in some Travel Demand Models. Aggregating bus and train transit together assumes that low-income residents can afford to commute to jobs on high-cost transit like BART in San Francisco. As a result, when rail service increases, it is likely to show increased transit accessibility for low-income communities, and affordable bus services may be cut.

STANDARDS

We can look to transit-oriented design guidelines for some standards. While they do not directly address the metric of proportion of housing and jobs near transit, they can supply guidance.

The Metropolitan Transportation Commission (MTC) in the Bay Area established corridor thresholds for amount of housing that would support different types of public transit in the MTC Resolution 3434 TOD policy for regional transit expansion projects.[85]

BART	3,850 units
Light Rail	3,300 units
BRT	2,750 units
Commuter Rail	2,200 units

TOD Design Guidelines Matrix[86]
Average Jobs/Housing Mix
- Urban Core – 10 jobs per 1 dwelling unit
- Urban general - 5 jobs per 1 dwelling unit

Mix of Uses (% residential, % non-residential)
- Urban Core - 20% residential and 80% non-residential
- Urban General – 50% residential and 50% non-residential

Jobs/Acre
- Urban Core – 500 jobs/acre
- Urban General – 75-150 jobs/acre

California TOD Housing Program Guidelines.[87] Net density for housing:

Large city downtown:	60 units per acre
Urban center	40 units per acre
All other areas	25 units per acre

METRIC: ACCESS TO GOODS, JOBS & SERVICES

5. Proportion of daily trips less than 3 miles and less than 1 mile by mode (walking/biking/bus and rail transit/driving)

EVIDENCE BASE

Analysis of national data regarding daily travel found that half of all trips in metropolitan areas are three miles or less and 28 percent are one mile or less; in rural areas 30 percent of all trips are two miles or less.[88] Yet a majority (65 percent) of one-mile trips in metropolitan areas are still made by automobile.[89] Research also demonstrates that proximity to public transit helps to determine travel choice.[48]

While neighborhoods characteristics shape travel mode choice,[90] the "5-D factors"[91] also promote transit ridership when they occur near rail transit stations. The "5 Ds" include:

1) Net-Residential Density – "denser developments generate fewer vehicle-trips per dwelling unit than less dense developments";
2) Job-Housing Diversity – "having residences and jobs in close proximity will reduce the vehicle-trips generated by each by allowing some trips to be made on foot or by bicycle";
3) Walkable Design – "improving the walking/biking environment will result in more non-auto trips and a reduction in auto travel" (with synergistic effects with density and diversity);
4) Destinations – "households situated near the regional center of activity generate fewer auto trips and vehicle-miles of travel";
5) Distance to Rail Mass Transit Station – "transit ridership rates among station-area residents increase exponentially as the distance to a rail station declines. Land use and transportation planning that does not incorporate the above factors contributes to increases in miles driven in motor vehicles, along with the associated hazards from air and water pollutants, noise, and vehicle collisions. Heavy volumes of local vehicle traffic also create traffic "hotspots" and contribute to unfair burdens of air pollution, noise, and stress for those living adjacent to busy streets and highways, and degrade the environment for walking, biking, and public transit."

* Further discussion of the health and equity aspects of access to public transit and different mode share can be found in **Metrics #4, 6 & 7**.

Equity Impacts

African Americans widely report low levels of leisure time physical activity.[92] [93] While the benefits of physical activity have been discussed elsewhere in this document (see Metric #6) one outcome of low levels of physical activity is an increased rate of obesity. Racial differences in risk factors are established early; evidence from one study found that by age 4, 13 percent of Asians and 16 percent of whites were obese, compared to 21 percent of blacks, 22 percent of Hispanics and 31 percent of American Indians.[94] In women in the U.S., body weight is inversely related to socioeconomic status.[95] Multiple studies have found that the lack of recreational facilities and concerns about personal safety can discourage exercise.[96] [97]

Although the prevalence of obesity is higher for black than for white women, obesity is more strongly related to mortality for white than for black women.[98] [99] One study focused on assessing the challenges to maintaining a healthy weight found that transportation difficulties, physical settings offering little opportunity for physical activity, food insecurity and rural isolation were all factors contributing to obesity among rural, economically disadvantaged women.[100]

Another population suffering from high rates of obesity is adolescents. Approximately 50% of U.S. youth do not currently meet the public health recommendations for frequency and vigorousness of physical activity.[101] [102] [103]

METHODOLOGY

MPOs should use their region-specific Travel Demand Models to measure this metric.

RESOURCES

Metropolitan Transportation Commission. Planning Section. Transportation 2035 Plan For the San Francisco Bay Area Travel Forecasts. Data Summary, Table E22. Oakland, CA: MTC, December 2008. p. 121-125.

STANDARDS

Every decade, Caltrans conducts a statewide travel survey.[104] The update is in process now, but from the last survey, we can provide some benchmarks. In California, the proportion of total trips made to and from different sources is included in the following table. While not included here, the tables also report out the proportion of trips that drivers make to and from different sources, and the proportion of "person trips" taken to and from difference sources. This source also includes the breakdown by MPO region for all regions in the state.

From	To	Percent
Home	Other	41%
Other	Other	15%
Home	Work	23%
Home	Shop	11%
Work	Other	10%

GENERAL TRANSPORTATION

METRIC: GENERAL TRANSPORTATION

6. Daily amount (in minutes) of work-trip and non-work trip related physical activity

EVIDENCE BASE

Health impacts

Walking to work helps people meet minimum requirements for physical activity. Americans using public transit spend a median of 19 minutes daily walking to and from transit; twenty-nine percent achieve at least 30 minutes of physical activity a day by walking to and from transit.[49] However, commuting to work makes up only 15 percent of the daily travel trips people take; forty-five percent of daily trips are for shopping/errands and 27 percent are social and recreational.[105] Numerous health benefits could result if individuals walk or bike during all or a portion of these trips. The benefits of physical activity include a reduced risk of premature mortality and reduced risks of coronary heart disease, hypertension, selected cancers, obesity and diabetes.[106] [107] [108] [109] [110] [111] Regular participation in physical activity also reduces stress, depression and anxiety, improves mood, and enhances ability to perform daily tasks throughout the life span.[112] [113] Additionally, walking and biking as forms of transportation do not contribute to noise or air pollution emissions.

Even with all the known benefits of regular physical activity, in 2003 only 53 percent of Americans achieved 30 minutes of moderately vigorous activity at least 5 days a week and approximately 23 percent of Americans had no leisure-time physical activity within the past month.[114] Physically inactive people are twice as likely to develop coronary heart disease as regularly active people and heart disease is the leading cause of death among men and women in the United States.[115] Sedentary lifestyles and inactivity can also lead to overweight/obesity.[116] Persons who are overweight or obese are at increased risk for high blood pressure, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems and some types of cancer.

Equity impacts

Residents in low-income communities are less likely to own a car and rely on public transportation to a greater extent.[117] [118] Nationally, people of color tend to have longer commutes than the white population, with a lower share of African-Americans, Asians and Hispanics enjoying commutes under 20 minutes and a higher share of people of color having "extreme commutes" over 60 minutes.[119] People of color are also more likely to use transit and carpooling to get work, increasing the likelihood of longer commute times.[120] VMT and commute times correlate with obesity and have an inverse relationship to amount of physical activity.[121] [122] A study of adults in Chicago found that "people of lower socioeconomic status tend to walk more frequently, but also tend to live in neighborhoods that discourage walking."[123] Costs and inaccessibility to public transit are barriers to accessing one's workplace and other resources.

METHODOLOGY

Because traveling between the home and work and running errands are daily events for most people, and because many adults in this country do not meet the minimum requirement for daily exercise, we support a performance metric related to the amount of physical activity people obtain during their daily travel trips.

MPOs could consider using an activity-based model to calculate the amount of physical activity from daily work and non-work trips. The Metropolitan Transportation Commission in the Bay Area is developing such a process, although it is not complete yet. More information about the MTC's Activity-based model development is available at: http://www.mtc.ca.gov/maps_and_data/datamart/abm/.

We suggest MPOs using either the American Community Survey (ACS) or the National Household Transit Survey (NHTS) (in conjunction with regional transportation surveys, if available) to calculate this metric.

- Using the time distribution by mode, the ACS gives the number of persons spending a threshold number of minutes it takes to get to work. Using a standard threshold (e.g., 15 minute or more), calculate the amount of physical activity for walking and bicycling, when available. The ACS is collected every 3 years on the city level.
- If using the NHTS, disaggregate work and non-work trips. Calculate daily duration of walking and cycling trips per capita by dividing the daily minute totals by mode by the number of persons, yielding average trip times. Both the 2001 and 2009 NHTS data contain information regarding bike and pedestrian travel modes by work and non-work trips. The NHTS is available at the state- and Metropolitan Statistical Area (MSA)-level and conducted every 5-7 years. Additional add-on samples, along with random national samples collected in the add-on area, are available for purchase and compiled into a cleaned geocoded database for ready application to local planning and forecasting.

LIMITATIONS

Few MPOs currently have created the capability to capture this indicator using an activity-based model.

ACS Limitations: The ACS only captures trips taken to work (and not all daily travel trips). If commute trips involve more than one mode, respondents are asked to report the mode used for most of the trip distance. Also, bicycling is included with motorcycling as a mode, so the ACS cannot give an accurate estimate of physical activity from biking.

NHTS Limitations: Because the NHTS is a national probability sample, the data is not very reliable at the city level. It is possible to purchase add-on data for specific metropolitan regions, which would add statistical reliability to the sample.

RESOURCES

- Journal articles using the NHTS for transportation decision-making: http://nhts.ornl.gov/2009/pub/Compendium.pdf
- Example calculation of bike/pedestrian physical activity using NHTS: Pucher J, Buehler R, Merom D & Bauman A (2011). Walking and Cycling in the United States, 2001-2009: Evidence From the National Household Travel Surveys. *American Journal of Public Health*, 101, in press [Epub ahead of print].
- Example calculation of transit-associated walking times using the NHTS: Besser LM & Dannenberg AL. (2005). Walking to public transit: Steps to help meet physical activity recommendations. *American Journal of Preventative Medicine*, 29(4): 273–280.
- For more information regarding CDPH methodology (replicating the London Woodcock Active Transportation modeling), contact Neil Maizlish, PhD, MPH. California Department of Public Health at Neil.Maizlish@cdph.ca.gov

STANDARDS

The Surgeon General recommends that adults engage in moderate-intensity physical activity five times per week for at least 30 minutes each time, or in vigorous-intensity physical activity three times per week for at least 20 minutes each time, in order to achieve adequate levels of physical activity.[124]

Healthy People 2020[125]

The U.S. Department of Health and Human Services (USDHHS) Healthy People 2020 provides science-based, 10-year national objectives for improving the health of all Americans. By 2020, the following should be achieved:

Physical Activity

- Objective PA-2: Increase the proportion of adults who meet current Federal physical activity guidelines
  for aerobic physical activity of moderate intensity;
- Objective PA-13: Increase the proportion of trips made by walking;
- Objective PA-14: Increase the proportion of trips made by bicycling.

METRIC: GENERAL TRANSPORTATION

7. Work and non-work trip mode share (including biking, walking, transit (bus and train), carpooling and SOV) – Both at peak times and all day

EVIDENCE BASE

Health Impacts

Commute travel between the home and the workplace, as well as non-work related trips, is a good indicator of environmental impacts, physical activity, obesity, social cohesion, and mental health. The extent of these impacts depends on transit mode. Vehicle miles traveled are directly proportional to air pollution and greenhouse gas emissions.[48] Air pollutants, including ozone and particulate matter, are causal factors for cardiovascular mortality and respiratory disease and other illness.[126] Greenhouse gases contribute to climate change, which may increase the following: heat-related illness and death, health effects related to extreme weather events, health effects related to air pollution, water-borne and food-borne diseases, and vector-borne and rodent-borne disease.[127] The more time a person spends in a car, the less time a person has to engage in leisure time physical activity.[128] Transportation choices impact obesity. Each additional hour spent in a car per day is associated with a 6 percent increase in the likelihood of obesity. Each additional hour walked per day is associated with a 4.8 percent reduction in the likelihood of obesity.[129]

Driving to work is a significant cause of stress for many people, so reduced commuting time could lead to decreased stress levels.[130] Highway congestion has been associated with elevated blood pressure among car or bus drivers.[131] Some studies have looked specifically at "commute impedance," such as traffic jams, and road construction. Researchers have concluded that traffic impedance is associated with higher blood pressure, more self-reported "tense" and "nervous" feelings, more self-reported colds and flu, and more days at the hospital.[132]

Long commutes can distance an individual from his/her community and decrease social connectivity. Amount of time spent commuting impacts time for family and social activity.[133] Social connectivity helps manage stress, and is connected with longer lifespan and access to emotional and physical resources.[134] [135] Drivers in the Southern California region have especially long work trip travel times. For example, Los Angeles and Riverside were ranked by the U.S. Census as having the fourth and fifth highest percentages of people with "extreme" commutes of longer than 90 minutes per day (5 percent and 3 percent, respectively),[136] and 20 percent of those living in the larger Los Angeles region commute more than 45 minutes each way to work.[137]

It is important to note that building or expanding freeways, thereby adding lane miles, has not proven to be a long-term solution to congestion. It can, in fact, exacerbate the problem by inducing travel.[138] [139] [140] [141] [142]

The health impacts of biking and walking as modes of transportation are discussed above in **Metric #6**.

Equity impacts

The different modes of transportation used to access work, as well as other goods and services, are influenced by a number of factors including cost, distance, accessibility, perceived and actual safety, weather, pedestrian safety, traffic patterns, availability of bicycle lanes, hours of operation, availability of parking, and availability of travel reimbursement or incentives provided by work or to low-income families.[143] Lower income, transit-dependent households who work in industries that do not have regular 9 to 5 working hours are much more vulnerable to reductions in off-peak transit service. Jobs in the health care, retail, food and personal service, and hospitality industries, for example, have fewer educational requirements but also require odd hour commutes. These industries also tend to have less flexible working hours, making transit-dependent lower

income households are more vulnerable to travel delays.

Residents in low-income communities are less likely to own a car and rely on public transportation to a greater extent.[79] People of color are more likely to use transit and carpooling to get work, increasing the likelihood of longer commute times.[144] Costs and inaccessibility to public transit are barriers to accessing one's workplace and other resources. Commute distance can be an indicator of travel costs: longer commutes are generally associated with higher costs of gas, vehicle wear and tear, and/or public transit fares. Low-income populations spend a higher proportion of their income on travel costs associated with commuting, and thus bear this cost burden to a greater degree.

METHODOLOGY

MPOs should use regional transportation surveys or region-specific travel demand models to analyze mode share. If MPOs do not have modeling capabilities, the National Household Travel Survey (NHTS) collects data on daily trips by mode.

RESOURCES

Monitoring & Forecasting: Forecasting pedestrian and bicycle travel demands using travel demand model and mode share/trip length data: http://www.bicyclinginfo.org/library/details.cfm?id=4461
Forecasting: An M & Chen M. (2007). Estimating Nonmotorized Travel Demand. Transportation Research Record, 2002: 18-25.

LIMITATIONS

As mentioned above, because the NHTS is a national probability sample and the data is not very reliable at the city level. It is possible to purchase add-on data for specific metropolitan regions, which would add statistical reliability to the sample.

STANDARDS

Caltrans conducts a statewide travel survey once a decade. They are in the process of conducting the survey now, but using data from the 2000-2001 CA Statewide Travel Survey, we can see the weekday mode share split for the entire state.[145]

	All weekday trips	Commuter trips 24 hour	Commuter trips 7-9 am
SOV trips	69%	83%	85%
Driving with passengers	19%	10%	8%
Public transportation	2%	3.4%	3.8%
School bus	2%	N/A	N/A
Bike	0.7%	0.7%	0.6%
Walk	7%	2.6%	2.4%

In 1992 when the city of San Diego was rolling out its TOD Design Guidelines, they targeted an "ambitious" 40 percent non-auto mode split goal.[146]

FUTURE GROWTH

METRIC: FUTURE GROWTH

8. **Growth of population, housing, and jobs in transit priority areas**
   a. **Share of housing growth in transit priority areas, targeting measures of how many large (3-4) bedroom, senior housing, and low-income units will be built**
   b. **Proportion of projected population growth located in transit priority areas**
   c. **Proportion of projected jobs in transit priority transit areas**

EVIDENCE BASE

Health impacts

Transit-oriented development (TOD) is effective for regional reducing vehicle use and associated air pollutant emissions (including greenhouse gas) and noise, and for improving traffic safety, access to goods and services, and access to schools and jobs. Provided that local air quality and traffic collision impacts near TOD sites are mitigated, this metric is positively associated with health.

- Transit-oriented development can increase physical activity.[147] In San Francisco, transit neighborhoods had 120 percent more trips by walking or biking to work than did auto-orientated neighborhoods. Mode share for work trips by pedestrians was between 1.2 and 10.6 percent higher for the transit neighborhoods. In Los Angeles mode share for walking to work was 1.7 to 24.6 percent higher in the transit neighborhoods.[148]
- A dense mix of uses, well served by mass transportation systems, can ensure access to essential goods and services while reducing vehicle miles traveled (VMT), thereby reducing environmental and health costs associated with personal vehicle trips.[149]

Transit-oriented development is generally positive for health at the regional level but local health impacts may not always be positive. Due to decreasing amounts of urban land available for infill, many of these developments are now placed close to freeways and their associated air pollution and noise. Additionally, access to public transit stops can increase local traffic, leading to an increase in risk for pedestrian and bicycle injury.

- Transit-oriented development areas can be associated with increased vehicles on a local level, even as it reduces vehicle miles traveled overall. Consequently, high VMT per capita leads to higher accident and injury rates associated with vehicle-vehicle, vehicle-pedestrian, and vehicle-bicycle collisions.[150] In addition, there are typically more pedestrians in dense TOD areas, which leads to greater risk of pedestrian collisions. [151]
- While transit-oriented development is often associated with reduced vehicle trips and VMT regionally, it can be associated with greater air pollution locally.[152]

Equity impacts

Increasing the share of growth in transit accessible areas can have positive or negative outcomes for low-income people and people of color, depending on the other policies in place.
Positive equity impacts include:

- Decreased transportation costs. Building more affordable housing near transit allows more people to take advantage of the transportation cost savings provided by these locations.[153]
- Increased economic opportunity. As more jobs are accessible by transit, low-income workers (who may already be living in transit-rich neighborhoods) may be able to take transit to those jobs. Nationally, the

number of households earning $35,000 and under is 10 percentage points higher in neighborhoods around transit than it is in the transit zones' host regions.[154]

Negative impacts are also possible if proactive policies and planning measures are not in place:

- Because many transit areas have a higher share of low-income households, negative public health impacts (e.g., pedestrian injuries) could have a disproportionate affect on those families.
- In addition, there are significant current and historical environmental injustices related to low-income communities and communities of color having disproportionate exposures to hazardous air quality associated with freeways, which may be perpetuated by increasing growth in places with these characteristics.[155]
- The demand for housing near transit is equally strong amongst all income groups.[156] New development, including transit-oriented development, can lead to a risk of displacement for existing low-income populations. This can be mitigated by providing affordable housing in TOD areas[157] and by stabilizing rent prices for local small businesses.

METHODOLOGY

Through the SB375 Sustainable Communities Strategy process, MPOs should use their region-specific analysis of housing, population and workforce growth in proposed transit priority areas.

RESOURCES

- Brookings Institute Report: State of Metropolitan America – On the front lines of demographic transition http://www.brookings.edu/~/media/Files/Programs/Metro/state_of_metro_america/metro_america_report.pdf
  This report uses the Census Bureau's Population Estimates Program. Using data from the last decennial census, more recent national surveys, and administrative records at all levels of government, the Population Estimates Program produces annual estimates of population, and its "components of change" (natural increase, domestic migration, and immigration), for all incorporated municipalities, counties, and states nationwide. The program also estimates state and county populations by age and race/ethnicity annually. http://www.census.gov/popest/topics/schedule.html
- ABAG (The Association of Bay Area Governments) is responsible for making long-term forecasts or population, housing, and employment for the nine-county Bay Area. These forecasts assist local governments in planning for our changing environment. ABAG produces updated forecasts every 2 years and publishes them as Projections. In recent updates, the Projections forecasts have presented a realistic assessment of growth in the region, while recognizing trends in markets and demographics, while also recognizing local policies that promote more compact infill- and transit-oriented development. http://www.abag.ca.gov/planning/currentfcst/

STANDARDS

See standards suggested for **Metric #4**.

Frank & Pivo's 1995 study on the impact of smart growth on modal shift[158] may offer useful benchmarks:

- Nearly all travel is done by car until residential density reached 13 persons per acre;
- Employment density levels greater than 75 employees per acre is necessary before there is a substantial increase in transit and pedestrian travel for work trips.

ECONOMIC

METRIC: ECONOMIC

9. a) Percent of household income consumed by housing and transportation combined; b) Percent of income going towards housing costs; c) Percent of income going towards transportation costs

EVIDENCE BASE

Health Impacts

Income is one of the strongest and most consistent predictors of health in the public health research literature.[159] [160] As transportation and housing costs rise, the less money households have to spend on medical resources (health care and health insurance), healthy food, schooling costs, leisure activities and exercise.[161] Prevalence of obesity and Type 2 diabetes is higher among groups with the lowest levels of income and education, living in deprived areas.[162] Additionally, individuals with less income are more likely to report experiencing traumatic life events as well as the harmful psychosocial effects of neighborhood violence or disorder, residential crowding, and struggles to meet daily challenges with inadequate resources.[163] [164] [165] [166]

Equity Impacts

The distribution of income has become increasingly concentrated among a smaller segment of people in the United States over the past decades, and the gap between the highest and lowest-earning 20 percent continues to grow.[167] Racial/ethnic inequities in income are particularly striking. In 2004, for example, the median household income was approximately $30,000 among blacks and nearly $50,000 among whites.[168]

While public officials, renters, homeowners and bankers often use 30 percent of a household's income as the benchmark of affordability, this measure omits transportation costs, which can vary significantly by neighborhood, city and region. In order to obtain affordable housing, people often live far away from work, believing they'll save money on housing costs. However, the time and money spent on long commutes can place further stress on tight budgets.[169] In the Los Angeles metro area, 46 percent of communities would be considered affordable using the standard measure of 30 percent of income. However, this statistic drops to only 29 percent when both housing *and transportation* costs are considered.[170] Low-income households living in the city cores of the Bay Area and/or near transit tend to have a much lower housing and transportation costs than households living in outer areas.[171] In neighborhoods highly susceptible to gentrification, housing and transportation costs that are disproportionately high indicate that residents are unlikely to be able to stay in the absence of supportive housing policies and may be more likely to be displaced.[171]

The lack of affordable housing constrains choices about where families and individuals live, often relegating lower-income families to the periphery and/or to substandard housing in unsafe, overcrowded neighborhoods with higher rates of poverty and fewer resources like parks, bike paths, recreation centers and other health promoting activities.[172] This type of housing instability also has health impacts. One study found that children living in areas with higher rates of unaffordable housing tend to have worse health, more behavioral problems and lower school performance.[173]

METHODOLOGY

The Center for Neighborhood Technology (CNT), in collaboration with the Center for Transit-Oriented Development, has devised a methodology to estimate how much households of different income levels pay for both housing and transportation (H+T).[174] The CNT's Housing + Transportation Affordability Index covers most regions in California. We recommend that MPOs use the CNT's methodology in order to measure these affordability metrics.

RESOURCES

CNT H+T Affordability Index: http://www.htaindex.org/index.php.

LIMITATIONS

While a majority of California has been analyzed by CNT's H+T Affordability Index, there are some rural areas that have not been captured. Also, data instability at the block group level make estimates at that level of specificity unreliable. Therefore we recommend that MPOs use the H+T methodology and their region-specific data, when available.

STANDARDS

Housing: Federal standards for housing affordability suggests no one should spend more than 30 percent of household income on housing (rent and utilities). Households that spend more than 50 percent of their income on their homes are classified by the National Low Income Housing Coalition as severely cost-burdened.[169]
Transportation: CNT has found 18 percent of Area Median Income (AMI) to be an attainable standard for transportation affordability and have set 15 percent as a goal.[175]
Housing & Transportation: Combining the 15 percent level with the 30 percent housing affordability standard, CNT recommends that 45 percent of AMI be established as the affordability target for combined housing and transportation costs in the U.S.[175]

ENVIRONMENTAL POLLUTION

METRIC: ENVIRONMENTAL POLLUTION

10. For all daily trips, per capita miles traveled by mode (walking, biking, transit, vehicle)

EVIDENCE BASE

Transit mode share is an indicator of how many people are driving, driving alone, taking public transit, or using active transportation such as biking or walking.

Health impacts

There are a variety of negative health outcomes associated with increased amounts of driving. These include increased stress and musculoskeletal injuries as well as health outcomes associated with noise and air emissions, and a decrease in physical activity and social cohesion.

- For example, less driving means more time for physical activity and therefore reduced obesity rates. In a landmark study, each additional hour spent in a car was shown to be associated with a 6 percent increase in the likelihood of obesity, and each additional hour walked was associated with a 4.8 percent reduction in obesity.[176] [177] VMT and commute times correlate with obesity and have an inverse relationship to amount of physical activity.[178] [179]
- Also, time spent driving puts drivers at risk for musculoskeletal pain. People who drive more have higher odds of shoulder pain compared to those who spend less time driving. People who drive 9,000 – 18,000 annual miles are 75 percent more likely to have neck and back pain than those who travel 3,000 miles annually.[180]
- Vehicle trips are a significant cause of stress for many people.[181]
- Higher VMT impacts time for family and social activity.[182] Social connectivity helps manage stress, and is connected with longer lifespan and access to emotional and physical resources.[183] [184]
- Building or expanding freeways in an effort to reduce time spent driving, and thereby adding lane miles, has not proven to be a long-term solution to congestion and can, in fact, exacerbate the problem by inducing travel.[185] [186] [187] [188] [189] Transportation Demand Management strategies lead to better health outcomes than road expansions.
- Higher traffic volume increases the risk of pedestrian, cyclist and motorist injury and death, with pedestrians, cyclists, and motorized two-wheeled vehicle users bearing a disproportionate share of road injury burden.[48] [190]
- The Environmental Protection Agency's Greenhouse Gas (GHG) Emissions Inventory for the U.S. showed that in the 1990s GHGs from mobile sources increased 18 percent, primarily from VMT.[191] California has less coal in it's electricity mix, so the transportation sector is the largest source of emissions; thus transportation was responsible for 38 percent of California's GHG emissions in 2004.[192]

There are positive as well as negative health outcomes associated with use of alternative modes of transportation:

- Americans who use public transit get more exercise.
  - Public transit users spend a median of 19 minutes daily walking to and from transit; of these individuals, 29 percent achieve at least 30 minutes of physical activity a day by walking to and from transit.[49] [193]
  - In fact, 16 percent of all recorded walking trips are part of transit trips, and these tend to be longer than average walking trips, according to an analysis of U.S. travel survey data.[194]

  - When comparing train commuters to car commuters, train commuters averaged 30 percent more walking, more frequently reported walking for 10 minutes or more, and were 4 times more likely to achieve 10,000 daily steps recommended for fitness and health.[195]
  - Transit users average 1.05 daily miles of walking a day – ten times more than the 175 yards of walking averaged by non-transit users.[196]
  - This level of physical activity enables people to reach the Centers for Disease Control's recommended amount of daily physical activity simply by taking public transit.[197] Meeting recommended levels of physical activity lowers risks for obesity, cardiovascular disease, diabetes, cancers, depression, and can increase strength for bone health.[198] Higher use of public transit has been shown to be beneficial for air quality and decreases greenhouse gases.[199]
- More active transport increases the amount of physical activity people get. Walking and biking have direct health benefits, for example lower rates of premature mortality, heart disease, diabetes, high blood pressure, colon cancer, depression and anxiety, obesity, osteoporosis, and psychological well-being.[200]
- Using public transportation also offers more opportunities for decreasing isolation by encouraging casual contact from unplanned social interactions. Mortality rates of socially isolated people are two or more times the rates of people with more social support.[201]
- Increased use of car sharing has been shown to reduce vehicle travel by 47 percent and increased use of public transit, walking and cycling.[202]
- There are increased rates of crime near subway stations, however this increased risk as well as perception of safety can potentially be mitigated.[203]
- Active transport is associated with increased exposure to pedestrian or bicycle injury, but with well-designed communities, this risk can be mitigated.

Equity impacts

Lower income residents are less likely to own automobiles – about 26 percent of low-income households do not own a car compared to 4 percent of other households. Thus, lower-income residents are more likely to use public transportation; 5 percent of lower-income households use public transit vs. 2 percent of other households. Also, lower-income residents are more likely to walk; 5 percent of lower-income households report walking to work and work-related trips vs. 3 percent for other households.[204] Those walking and biking and taking transit can gain all of the health benefits associated with those modes.

Low-income households also spend a higher percentage of their income on transportation costs than high income households.[205] Car ownership can be estimated to cost a household about $5,000 annually, including the costs of gas and insurance. Households that take more transit, or walk and bike, spend less than this on transportation.

METHODOLOGY

MPO-specific Travel Demand Models include information on per capita miles traveled by mode.

RESOURCES

For an example of an MPO data set and forecast of number of trips by mode by trip length, see the Bay Area's Metropolitan Transportation Commission (MTC)'s Change in Motion analysis, available at http://www.mtc.ca.gov/planning/2035_plan/tech_data_summary_report.pdf (pg 110). This analysis gives some level of background methodology in the text portion and tables defining their performance measures for the 2009 Regional Transportation Plan: Vision 2035. Table D4 beginning on page 81 is also of interest for this metric.

STANDARDS

Walking & biking

The Surgeon General recommends that adults engage in moderate-intensity physical activity five times per week for at least 30 minutes each time, or in vigorous-intensity physical activity three times per week for at least 20 minutes each time, in order to achieve adequate levels of physical activity.[206]

Averages across California and in different regions are supplied here as a level at which to compare each region's performance.

- CA: 0.8% of people biked to work (in SF county 1.7%, in LA county 0.6%, in Placer County 0.4%)
- CA: 2.7% of people walked to work (in SF county 7%, in SF county 2.8%, in Placer County 1.5%)[207]
- Metropolitan Transportation Commission. Low-income households in the Bay Area have an average of 11 minutes per day of physical activity due to active transport currently. Non low-income households in Bay area haveare 9 minutes per day currently.

Public transit

- In the 2005 – 2007 American Community Survey of the U.S. Census: 5% of Californians took public transit.[208]
- In 2008 in the U.S., transit participation grew between 3% – 16%. In California overall, there was a 6% increase in transit ridership in 2008, and a corresponding 5% decrease in VMT. A report about the impact of high gas prices on transit ridership suggests a "high but realistic" goal of increasing public transit ridership by 10%.[209]

Vehicle Miles Traveled (VMT)

- According to Caltrans Data Branch, in 2005, the average VMT per capita in California counties was 5,053.[210]
- Rural counties had much higher VMT; in the 10 counties with highest VMT per capita had an average population of just under 23,000 people. In the 10 counties with lowest VMT per capita included Los Angeles, Orange, Santa Clara, Sacramento, and San Francisco.
    - Bay Area: 5,407 per capita per month
    - Solano: over 8,000
    - San Francisco: 1,752
    - Average for Los Angeles, Riverside, Orange: 4,858
    - Los Angeles: 4,034
    - Riverside: 5,861

METRIC: ENVIRONMENTAL POLLUTION

11. Working with a local public health department, university and/or air quality management district: Estimate pre-mature mortality attributed to traffic-related ambient PM 2.5, and estimate asthma incidence and asthma exacerbations attributed to traffic related NO2.

EVIDENCE BASE

Health Impacts

Epidemiologic studies have consistently found that proximity to high traffic density or flow results in reduced lung function and increased asthma hospitalizations, asthma symptoms, bronchitis symptoms, and medical visits.[211] Children appear to be the most sensitive to adverse effects. California freeway studies show exposure levels approach background levels after a distance of 500 feet from a freeway.[212] Specific epidemiologic research findings include:

- Reduced lung function in children associated with traffic density, especially trucks, within 1,000 feet and the association was strongest within 300 feet.[213]
- Increased asthma hospitalizations associated with living within 650 feet of heavy traffic and heavy truck volume.[214]
- Increased asthma symptoms with proximity to roadways, with the greatest risk within 300 feet.[215]
- Asthma and bronchitis symptoms in children associated with high traffic in a San Francisco Bay Area community with good overall regional air quality.[216]
- Increased medical visits in children living within 550 feet of heavy traffic in San Diego.[217]
- In a prospective study of 3399 participants in Germany, living within 150m of major roads is associated with an increased risk of coronary heart disease over time even after adjusting for individual risk factors and background air pollution.[218]

Living in close proximity to busy roadways

Children living in close proximity to busy roadways have been found to suffer from increased respiratory disease symptoms and asthma, and reduced lung function.[219] [220] [221] [222] [223] [224] [225] [226] [227] [228] Studies also show higher rates of cardiovascular and respiratory disease among adults living near freeways, particularly for those living within 75 - 650 feet of heavy traffic and heavy truck volume.[229] [230] [231] [232] [233] Long-term exposure to traffic-related air pollution is associated with an increased risk of lung cancer,[234] and diabetics exposed to air pollution have an increased risk for heart disease.[235] [236] Additionally, living in areas with high levels of air pollution is a disincentive to exercise,[237] and exercise reduces risks for heart disease, diabetes, osteoporosis, and stress-related anxiety and depression.[238] CARB recommends not locating sensitive land uses within 500 feet of a highway that has traffic in excess of 100,000 vehicles per day.[239]

PM 2.5 and health outcomes

Motor vehicle emissions, power plants, and refineries are the predominant sources of fine particulate air pollution (PM2.5). Several large-scale studies demonstrate that increased exposure to PM2.5 is associated with detrimental cardiovascular outcomes, including increased risk of death from ischemic heart disease, higher blood pressure, and coronary artery calcification.[240] [241] [242]

Research in some locations based on measurements of fine particulate matter (PM 2.5) has found that a significant share of spatial intra-urban air pollution variation in ambient levels of PM 2.5 is due to local traffic sources,[243] and that traffic density explains variation in local and regional PM 2.5 concentrations.[244] [245] Individual epidemiological studies have linked roadway proximity or vehicle emissions to impairments of lung function; [246] asthma symptoms;[247] [248] [249] medical visits for asthma;[250] asthma prevalence and incidence; [251] [252] [253] [254] [255] and ischemic heart disease.[256] [257]

Nitrogen Dioxide and health outcomes

While traffic pollution comprises a diverse mix of chemicals, NO_2 is a good proxy measure for cumulative exposure. The Health Effects Institute states that a good surrogate for traffic should have the following attributes: (1) traffic should be its major source; (2) emissions vary with motor vehicle type; (3) it can be measured reasonably accurately at low concentrations, and is inexpensive; and (4) it does not have independent health effects.[258] NO_2 can feasibly be measured at a large number of locations, and it has been widely used as a proxy for the mixture of traffic-related pollutants that vary markedly depending on distance from roadways, season, wind speed, and wind direction.[259] [260] [261]

Research from the Los Angeles region shows that ambient NO_2 within 150 meters was associated with 2.18 times the risk of new-onset asthma in children.[262] Further research shows that there is an 8 percent increased risk of asthma diagnosis with early life exposure to NO_2 (150 meters from highway and 50 meters from major road) and a 12 percent increased risk of asthma diagnosis with early life exposure to NO_2.[263]

Equity impacts

Poorer residents and people of color are more likely to live near roadway sources of air pollution. In California, the proportion of children of color living in high traffic density blocks is inversely related to median family income, and children of color are three times more likely to live in high-traffic areas than white children.[264] Thus, poorer children of color are more likely to be disproportionately exposed to respiratory-disease causing emissions.

METHODOLOGY

Regarding premature mortality related to PM2.5: Find the population weighted average transportation-attributable PM2.5 concentration and NO_2 (either by measurement or estimate by modeling e.g., CAL3QHCR or AERMOD Dispersion model using local traffic volumes, vehicle emissions models, topography, meteorology). Estimate parcel level population as share of total area residential building volume. To find premature mortality, asthma incidence and asthma exacerbations, apply the Exposure-Response Function (ERF) to population exposure. Use California ARB consensus on PM2.5-Mortailty ERF.

Regarding asthma incidence and exacerbations related to NO_2: contact Human Impact Partners for further assistance and information. Kim Gilhuly, kim@humanimpact.org.

MEASUREMENT RESOURCES/EXAMPLES

- SFDPH: Air Quality Measurement and Modeling: http://www.sfphes.org/HIA_Tools_Air_Quality.htm
- Bhatia, R & Rivard, T. (2008). Assessment and Mitigation of Air Pollutant Health Effects from Intra-urban Roadways: Guidance for Land Use Planning and Environmental Review. http://www.sfphes.org/publications/Mitigating_Roadway_AQLU_Conflicts.pdf
- BAAQMD 2010: Estimation of health effects as related to PM2.5. http://www.baaqmd.gov/~/media/Files/Planning and Research/Plans/2010 Clean Air Plan/Resource and Tec/Multi-Pollutant Evaluation Method Technical Document-April 2010.ashx
- CARB 2009: Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California. http://www.arb.ca.gov/research/health/pm-mort/pm-mort_final.pdf
- Human Impact Partners Health Impact Assessments using air modeling and health prediction methodology (both available at http://www.humanimpact.org/past-projects):
  - Pittsburg Railroad Ave. Specific Plan Health Impact Assessment
  - San Pablo Avenue Corridor

- SFDPH Road Pricing HIA. http://www.sfphes.org/HIA_Road_Pricing.htm
- Resource for NO2 and asthma incidence/exacerbations: Chen, Lisa C. (2011). A Method to estimate the cumulative impact of traffic-related pollution on childhood asthma: A meta-analysis. (Master's thesis) Berkeley: University of California, School of Public Health.
  For a copy of this paper, please contact Kim Gilhuly, kim@humanimpact.org

STANDARDS

Healthy People 2020[265]

Respiratory Disease Objectives

Reduce asthma deaths

- RD 1.1 Reduce asthma deaths in children under age 5 years
  - Baseline: There were 3.4 asthma deaths per million children under age 5 years in 2007
  - Target: None listed; assuming target of 0 deaths for children
- RD 1.2 Reduce asthma deaths in people age 5 - 64 years
  - Baseline: There were 11 asthma deaths per million in people age 5 - 64 years in 2007
  - Target: 6 deaths per million in children and adults age 5 - 64 years
- RD 1.3 Reduce asthma deaths in adults age 65 and over
  - Baseline: There were 43 asthma deaths per million in adults over age 65 years in 2007
  - Target: 23 deaths per million in adults over age 65 years

Reduce hospitalizations for asthma

- RD 2.1 Reduce asthma hospitalizations in children under age 5 years
  - Baseline: There were 41 asthma hospitalizations per 10,000 children under age 5 years in 2007
  - Target: 18 asthma hospitalizations per 10,000 children under age 5 years
- RD 2.2 Reduce asthma hospitalizations in children and adults age 5 - 64 years
  - Baseline: There were 11 asthma hospitalizations per 10,000 in children and adults age 5 - 64 years in 2007
  - Target: 9 deaths per 10,000 in children and adults age 5 - 64 years
- RD 2.3 Reduce asthma hospitalizations in adults age 65 and over
  - Baseline: There were 25 asthma hospitalizations per 10,000 adults over age 65 years in 2007
  - Target: 20 hospitalizations per 10,000 adults over age 65 years

Reduce hospital emergency department visits for asthma

- RD 3.1 Reduce asthma hospitalizations in children under age 5 years
  - Baseline: There were 133 asthma hospitalizations per 10,000 children under age 5 years in 2007
  - Target: 96 emergency department visits per 10,000 in children under age 5 years
- RD 3.2 Reduce asthma hospitalizations in children and adults age 5 - 64 years
  - Baseline: There were 56 asthma hospitalizations per 10,000 children and adults age 5 – 64 years in 2007
  - Target: 49 emergency department visits per 10,000 in children and adults age 5 – 64 years
- RD 3.3 Reduce asthma emergency department visits per in adults age 65 and over
  - Baseline: There were 21 asthma emergency department visits per 10,000 adults over age 65 years in 2007
  - Target: 13 emergency department visits per 10,000 in adults over age 65 years

California and Federal Air Quality Standards are provided in the following table:

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.08 ppm (157 µg/m^3)		
Respirable Particulate Matter (PM10)	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	15 µg/m^3		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2) *	Annual Arithmetic Mean	0.030 ppm (56 µg/m3)	Gas Phase Chemiluminescence	0.053 ppm (100 µg/m^3)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (338 µg/m^3)		—		
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	—	Ultraviolet Fluorescence	0.030 ppm (80 µg/m^3)	—	Spectrophotometry (Pararosaniline Method)
	24 Hour	0.04 ppm (105 µg/m^3)		0.14 ppm (365 µg/m^3)	—	
	3 Hour	—		—	0.5 ppm (1300 µg/m^3)	
	1 Hour	0.25 ppm (655 µg/m^3)		—	—	—
Lead[8]	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 µg/m^3	Same as Primary Standard	High Volume Sampler and Atomic Absorption
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[8]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

* The Nitrogen Dioxide ambient air quality standard was amended on February 22, 2007, to lower the 1-hr standard to 0.18 ppm and establish a new annual standard of 0.030 ppm. These changes become effective after regulatory changes are submitted and approved by the Office of Administrative Law, expected later this year.

See footnotes on next page …

For more information please call ARB-PIO at (916) 322-2990 **California Air Resources Board (02/22/07)**

Source: CARB. 2007. California Ambient Air Quality Standards. California Air Resources Board. Available at http://www.arb.ca.gov/research/aaqs/aaqs2.pdf.

The California Air Resource Board, *Air Quality and Land Use Handbook: A Community Health Perspective*[212] provides the following recommends for locating sensitive receivers near sources of air pollution:

CARB 2005 Guidance on Preventing Air Quality—Land Use Conflicts

Source of Air Pollution	Air Resource's Board Recommendations
Freeways and High-Traffic Roads	Avoid siting sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day.
Distribution Centers	Avoid siting sensitive land uses within 1,000 feet of a distribution center (that accommodates more than 100 trucks per day, more than 40 trucks with operating TRUs per day, or where TRU unit operations exceed 300 hours per week). Take into account the configuration of existing distribution centers and avoid locating residences and other sensitive land uses near entry and exit points.
Rail Yards	Avoid siting sensitive land uses within 1,000 feet of a major service and maintenance rail yard. Within one mile of a rail yard, consider possible siting limitations and mitigation approaches.
Ports	Consider limitations on the siting of sensitive land uses immediately downwind of ports in the most heavily impacted zones. Consult with local air districts for the latest available data on health risks associated with port emissions.
Refineries	Avoid siting sensitive land uses immediately downwind of petroleum refineries. Work with local air districts to determine an appropriate separation.
Chrome Platers	Avoid siting sensitive land uses within 1,000 feet of a chrome plater.
Dry Cleaners Using Perchloro-ethylene	Avoid siting sensitive land uses within 300 feet of any dry cleaning operation. For large operations with two or more machines, provide 500 feet. Do not site sensitive land uses in the same building with perc dry cleaning operations.
Gasoline Dispensing Facilities	Avoid siting sensitive land uses within 300 feet of a large gas station (defined as a facility with a throughput of 3.6 million gallons per year or greater). A 50 foot separation is recommended for typical gas stations.

METRIC: ENVIRONMENTAL POLLUTION

12. Proposed housing near busy roadways will require:
- **a. Assessment by local air district or public health department of the need for environmental/health impact analysis when housing is proposed near (within 1,000 feet) busy roadways (over 100,000 Average Annual Daily Traffic (AADT)) or other significant pollution sources (e.g., rail yards, port terminals, refineries, power plants, etc); and**
- **b. Best practice mitigation requirements by local governments when the above assessment determines that environmental quality is below standard for such proposed housing, and if such housing is determined to be safe by local air districts and public health departments with identified mitigation.**

For MPOs representing highly urban regions, we suggest an alternate metric due to the ongoing concern about the lack of developable land, the need for housing, and equity concerns about placing low-income residents near polluting emissions of cars and trucks.

Alternate Metric 12: Working with a local public health department, university and/or air quality management district:
- c. **Estimate the number of sensitive sites (homes, schools, daycares, parks, etc.) within 1,000 feet of freeways and other major pollution sources, based on standards such as BAAQMD's listed below ("Standards").**
- d. **Estimate proportion of affordable housing units vs. market rate units within above identified areas.**

EVIDENCE BASE

Health and Equity Impacts

See **Metric # 11** for health and equity evidence.

METHODOLOGY

1) The MPO should engage the local air district or public health department to assess need for environmental/health impact analysis according to protocol similar to the Bay Area's CEQA guidelines for all development located within 1,000 feet of busy roadways (see Resources below for link to detailed methodology)
2) The MPO should document whether local general plans and other policies require mitigations for housing proposed in areas with poor air quality.

This metric has raised some concerns about the potential conflict between the health dangers of placing homes and other sensitive uses near busy roadways and the need and desire in urban areas of California to create infill development that is often near freeways, in particular affordable housing options. Because there has been an ongoing statewide conversation regarding this issue, an effort was made to solicit input about which indicator would be best. Many organizations and agencies that have been most involved in the statewide discussion participated in the decision on this health and equity metric. Those organizations and agencies were: the American Lung Association of California, the California Department of Public Health, the Natural Resources Defense Agency, ClimatePlan, the Bay Area Air Quality Management District, the Sacramento Air Quality Management District, Housing California, the Sacramento Council of Governments, the San Diego Association of Governments, the Los Angeles County Public Health Department, Human Impact Partners, the Environmental Health Coalition, the Coalition for Clean Air, Reconnecting America,

Prevention Institute, Public Health Law and Policy, the San Mateo County Health Systems, the Central Valley Air Quality Coalition, and East Yard Coalition for Environmental Justice.

Methodology for Alternate Metric 12 also exists. The San Francisco Department of Public Health has worked closely with the Bay Area Air Quality Management District to conduct hot spot analysis in the City and County of San Francisco to guide healthy development.

RESOURCES

- Bay Area Air Quality Management District. CEQA Guidelines. Tools and Methodology. http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Tools-and-Methodology.aspx
- Example mitigation recommendations: SFDPH HDMT (see "Policies/Design Strategies") http://www.thehdmt.org/objectives/view/55
- San Francisco's Air Quality Ordinance and Frequently Asked Questions: http://www.sfphes.org/Policy_Air_Quality.htm
- Lepe, C. 2008. Addressing air quality related health impacts associated with siting residential development near high traffic roadways in California and the city of San Jose. Master's Thesis, Dept. of Urban Planning. San Jose State University. For a copy of this resource email Kim Gilhuly at kim@humanimpact.org.
- San Francisco Department of Public Health Environmental Health: Air Quality: Assessment. Planning, Policy Development, and Regulation. Article 38 addition to San Francisco Health Code. Available at http://www.sfdph.org/dph/EH/Air/default.asp

STANDARDS

The Natural Resources Defense Council has compiled the following list of policies and thresholds for action regarding siting of housing near busy roadways.

Geographic Scope, Agency, and Start Date	**Recommended Distance**	**Threshold or Trigger**	**Process**
Bay Area Air Quality Management District, 2011	1,000 ft of permitted source, a highway, or roadway w/ >10,000 AADT	0.3 ug/m^3 PM2.5; 10 additional cases of cancer/million; >1.0 non-cancer Hazard Index, chronic or acute.	CEQA requirements for screening relative to thresholds; Health Impact Assessment required if over thresholds + mitigation
San Francisco, Dept. of Public Health, 2008	150m of a road >100,000 AADT; 100m of road >50,000 AADT; 50 m of road >10,000 AADT	0.2 ug/ m^3 average annual exposure from roadway vehicles within 150m buffer of sensitive receptor	Health Effects Analysis and Hierarchy of Mitigations
Sacramento Air Quality Management District, 2011	500 ft of roads with 100,000 AADT, urban or 50,000 AADT, rural	Increased individual cancer risk of 276/million	Site-specific Health Risk Assessment. Estimate cancer risk at 6 model receptors 50, 100, 200, 300, 400, and 500 ft from source roadway. Report cancer risk publicly.
South Coast Air Quality Management District, 2005	"close proximity"	CEQA thresholds published in 2011: P10 - 110 lbs/day; PM2.5 – 55 lbs/day; max increase in cancer risk 10/million; hazard index > 1.0	Consider mitigations such as separating source and receptor, decreasing source emissions, siting, permitting and zoning policies, and capping cumulative impacts

			of various pollution sources.
Los Angeles County DRAFT General Plan 2035	"Discourage" development within 500 ft of freeway	N/A	"Encourage mitigation" for sites within 1500 ft of freeway
Los Angeles City "Green Zones" under consideration by the Council for some EJ neighborhoods, 2011	Select environmental justice neighborhoods in LA City		
San Diego Air Pollution Control District (county)	None	Does the proposed project affect a sensitive receptor (not defined as a residence) as determined by the environmental analyst? If so, use AAQS as guideline. 24 hr standard 35 ug/$m^{3.}$, annual arithmetic mean12 ug/m^3	Prepare an EIR
CARB Statewide, 2005	500 ft of roadway	California and National Ambient Air Quality Standards for PM2.5; 24 hr standard 35 ug/$m^{3.}$, annual arithmetic mean12 ug/m^3	

EQUITY

METRIC: EQUITY

13. Measure and stratify all indicators by race/ethnicity; income; geography (neighborhood, census block or tract, or Community of Concern); age; disability.

EVIDENCE BASE

Health Impacts

Neighborhoods are shaped by specific policies that guide development and, consequently, individual well-being.[266] A growing body of research demonstrates a strong relationship between health and the environments in which people live. The disproportionately high rates of heart disease, asthma, diabetes, and other chronic diseases among residents living in high-poverty neighborhoods – often disproportionately residents of color[267] – can be linked to many aspects of the built environment, including access to healthy foods and physical activity, quality affordable housing, and transportation options. Such cumulative inequities can have dire health outcomes. For example, African American children growing up in high-poverty urban neighborhoods (such as Harlem or Chicago's South Side) are more likely to die or become disabled far before reaching old age; in these neighborhoods, one-third of African American girls and two-thirds of boys who reach their fifteenth birthdays do not live to celebrate their sixty-fifth.[268] [269] In comparison, only 10 percent of girls and about 25 percent of boys nationwide fail to live to age sixty-five.[270]

Alameda County is an example of an area of California with large differences in placed-based health outcomes. A recent report by the Alameda Department of Public Health highlighted the ways inequities clustered in certain neighborhoods over time.[271] Through their research they found:

- Compared with a White child in the Oakland Hills, an African American born in West Oakland is 1.5 times more likely to be born premature or low birth weight and seven times more likely to be born into poverty.
- As a toddler, this child is 2.5 times more likely to be behind in vaccinations. By fourth grade, this child is four times less likely to read at grade level and is likely to live in a neighborhood with twice the concentration of liquor stores and more fast food outlets.
- As an adult, he or she will be five times more likely to be hospitalized for diabetes, twice as likely to be hospitalized for and to die of heart disease, and twice as likely to die of cancer. This person can also expect to die almost 15 years earlier than a White person born in the Oakland Hills.
- West Oakland residents also breathe air that contains three times more diesel particles than in the rest of the Bay area.
- Alameda County households earning less than $20,000 per year spend over half of their income on transportation.

The United States spends more than any other nation in the world on health care.[272] Yet despite consistent increases in spending, health disparities among different demographic groups persist. David Satcher, former Surgeon General of the United States, stated that "Although critical to eliminating disparities, access [to health care] only accounts for 15 to 20 percent of the variation in morbidity and mortality that we see in different populations in this country."[273] In order to address the root causes that account for the other 80 to 85 percent of poor health, we must look beyond health care and health insurance and towards the policies that affect where we live, how we get to work, what we eat and the air we breath.

Because each of the proposed Health & Equity metrics has the potential to affect various populations differently, and often disproportionate burdens accumulate in low-income populations and populations of

color, we recommend that disparities be specifically measured. We advocate that social equity be integrated into each performance metric, and we have built equity considerations into each of the recommended metrics within this analysis. We recommend stratification by demographics (e.g., race/ethnicity, income, age, and/or other indicators of vulnerability to health risks) as well as place-based (i.e., neighborhood) stratification within all performance metrics.

METHODOLOGY

Not only is it important to understand the equity dimensions of each metric, but also the cumulative impact across all the metrics. Through the Strategic Growth Council, California Department of Public Health has developed indicators of Healthy Communities. As part of that process CDPH has proposed three different composite scores that are used to demonstrate levels of equity with regard to race/ethnicity, income and place. Depending on data availability, each equity score can be applied city-, county-, or region-wide by drawing on information from census tracts and individuals. We suggest that MPOs use a similar analysis in order to stratify the proposed metrics by these equity dimensions and identify communities with high or low levels of equity.

LIMITATIONS

Not all data is available at the stratified level. We recommend that future data be collected so that it can be stratified to assess equity issues.

RESOURCES

For more information regarding CDPH methodology, contact Neil Maizlish, PhD, MPH. California Department of Public Health at Neil.Maizlish@cdph.ca.gov.

HOW TO USE THE HEALTH AND EQUITY METRICS

These metrics can be used in a variety of ways to elevate the consideration of the health and equity impacts in the RTP/SCS processes going on around the state.

When can I use Health and Equity Metrics?

There are a variety of places in the SCS decision making process where you can request that health and equity be considered through the use of these metrics. Throughout their planning processes, MPOs invite stakeholder input:

- **Visioning for the RTP/SCS.** MPOs typically have a period of time in which they reach out to the public in a structured way to get input on what the RTP/SCS should look like. Use the health and equity metrics as a comment about how the RTP/SCS should consider these important outcomes.
- **Performance Measures**. MPOs develop a set of performance measures and then score alternative scenarios for their RTP/SCS, including transportation projects that they might fund over the next 25 years, against these measures. Suggest that MPOs incorporate the health and equity metrics as performance measures.
- **Baseline analysis.** The RTP/SCSs include an analysis of Existing Conditions. Including health and equity metrics in the Existing Conditions analysis is important because the RTP/SCSs gets updated every three years, and thus so does the Existing Conditions analysis. Evaluating the metrics regularly would serve as a way to show how each metric had changed based on the transportation projects that had been implemented.
- **Release of the RTP/SCS.** When the RTP/SCS is released publicly, the MPO will seek stakeholder and community feedback. At this time, you can evaluate what has been included and what still needs to be included, with regard to health and equity.
- **Environmental Impact Review.** When the RTP/SCS is ready, the MPO will conduct an environmental impact review of it. This is another public process with several different points for suggesting different ways to analyze prospective changes due to the proposals included in the RTP/SCS. The health and equity metrics can be evaluated as part of the environmental review process.
- **Local planning processes.** There may be ways through County Transportation Commissions or city planning agencies to also suggest the use of the health and equity metrics in evaluating individual projects. Sometimes these bodies make the decisions around dispersion of funds, and also require environmental impact analyses and community participation in planning.

How can I interact with MPOs?

There are many ways to interact with MPOs or other planning bodies. Every region is different, and thus the openness to public input varys. MPOs are required to accept stakeholder input and tend to be open to doing so. They may do so through a variety of means, including:

- **Community engagement workshops.** The creation and vetting of the RTP/SCS is a long process that has many points along the way where MPOs are required to solicit stakeholder engagement. For example, in the Southern California Association of Governments' RTP/SCS planning process, they are holding 18 community meetings in the different counties of the region to vet alternative scenarios. Go to a community engagement workshop and speak up about health and equity using these metrics.
- **Subcommittee meetings.** Many MPOs divide the work into separate committees, so researching the different subcommittees and attending their meetings is another way to suggest use of these metrics.
- **One on one meetings with MPO staff.** Finding the staff person responsible for the RTP/SCS and meeting with them about the incorporating the health and equity metrics is a powerful way to suggest use of the metrics as well as hear back about what is possible for the MPO.
- **Meetings with MPO Board members and other decision-makers.** MPO staff is very important and can shape suggestions to the Board members and subcommittees. However, ultimately the Board of the MPO will be making the final decisions, so reaching out to them is important as well. Boards have representatives from different districts and different agencies, so strategically planning with coalition members about how to reach them all is important.
- **Comment letters**. Sending in comment letters before key decisions is an effective way to advocate for inclusion of the metrics. MPOs are required, at different times, to respond to public comment.
- **Media**. A strategic way to reach decision-makers and staff is by placing stories in local or statewide media. It is not always the right strategy, as sometimes your message may not be conveyed clearly by a reporter.

Who can help if I have questions?

There are organizations that are engaged statewide in these discussions with MPOs, and are also connected to local public health agencies and groups in each region. These include:

- **Climate Plan:** http://www.climateplan.org/
- **American Lung Association of California:** http://www.lungusa.org/associations/states/california/
- **Prevention Institute**: http://www.preventioninstitute.org/
- **Public Health Law and Policy:** http://www.phlpnet.org/
- **Natural Resources Defense Council:** http://www.nrdc.org/

Appendix: Metrics recommended for future study

Metric	Reason for exclusion and research recommendation
Population exposed to ambient noise >55dB (WHO community standard)	Methodology exists to model noise exposure on a local level, however, it is resource intensiveness led to its exclusion, . MPOs should work with health experts and others to develop an efficient way to do this, as well as consider regional level noise
Basic pedestrian and bicycle infrastructure	If MPOs don't measure this, they cannot plan for it. For this reason, we suggest that MPOs research best and most efficient practices for assessing pedestrian and bicycle infrastructure quality. It was excluded in the final version due to current resource constraints and lack of an agreed-upon methodology, however models exist, such as the Pedestrian Environmental Quality Index and the Bicycle Environmental Quality Index from SFDPH.
Participation in RTP planning process throughout all stages.	Have full participation in RTP planning processes. Potential ways of measuring this could include public documentation of notes from meetings including attendance (number and what groups/individuals attend); advocates' scoresheets on participation in planning. This was excluded as partners recognized that this was not a "metric" but rather something that would be requested and monitored, but not written into RTP/SCS.
Pollutants generated by travel (CO, NOx, PM2.5, PM10, Sox, VOC, ozone, diesel emissions)	Collecting pollutants is important. We recognize that 1. This information can be extrapolated from VMT per household and 2. MPOs do not collect this data sub-regionally. Thus it was excluded recognizing the methodological limitations currently. However, we recommend that MPOs partner with academics and other groups to investigate measuring methodologies that exist but might be time-consuming at this point, such as air quality modeling based on traffic counts for sub-regional prediction of pollutants.

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