Chapter 2. Policies that Enhance Community Design and Promote Active Transportation

2 Introduction: Policies that Enhance Community Design and Promote Active Transportation

Active transportation is self-powered or human-powered transportation that engages people in healthy physical activity while they accomplish the task of traveling from place to place. When an active transportation trip—walking or bicycling—replaces a motor vehicle trip, there is the added benefit of reduced congestion and harmful emissions, and improvements in quality of life.

Physical activity lowers the risk of early death, heart disease, stroke, Type 2 diabetes, high blood pressure, adverse blood lipid profile, metabolic syndrome, and some kinds of cancers. Lack of

physical activity contributes to obesity in conjunction with dietary factors. Remaining physically active can help prevent falls and reduce depression among older adults.[126]

Chapter 2 explores policy changes to encourage greater use of active transportation on a population-level scale, resulting not only in greater physical activity, but also in fewer car trips. We must make active transportation easier, more convenient, and more attractive. One way this can be done is through the creation of new community environments that have: improved connectivity between destinations; infrastructure that encourages walking and bicycling; community design that incorporates the needs of pedestrians and bicyclists as legitimate road users; and strengthened connections between public transit and walking and bicycling. These measures can change the shape and nature of our communities, so that active transportation can become a more attractive choice for all Americans.

Opportunities for Enhancing Community Design and Promoting Active Transportation

Through policies already known, very substantial progress can be made toward enhancing community design and promoting active transportation. We have identified 15 such policies within four areas. The four areas are:

- Provide better connectivity for pedestrians and bicyclists
- Increase investments in infrastructure that supports active transportation
- Consider the needs of all road users in planning and design standards
- Make public transit easier to use for pedestrians and bicyclists.

Provide Better Connectivity for Pedestrians and Bicyclists

Land use, development patterns, and the need for and preference for motor vehicle travel have combined to create community environments in which many Americans rarely walk to a destination, in many cases because they believe that distances are too long.[127]

Among school-aged children in the U.S., the share who walk or bicycle to school has dropped by more than half since 1969,[128] while the share of children traveling to school by car more than tripled, so that, now, half of all children travel to school by car.[129] Distance and community

[126] U.S. Department of Health and Human Services. 2008. *Physical Activity Guidelines for Americans.* Available at: http://www.health.gov/PAGuidelines/Report/Default.aspx [accessed May 2, 2011].

[127] National Household Travel Survey. 2010. NHTS Brief. *Active Travel.* December 2010. Available at: http://nhts.ornl.gov/briefs/ActiveTravel.pdf [accessed May 2, 2011].

[128] Ham, S., S. Martin and H. W. Kohl, III. 2008. Changes in the percentages of students who walk or bike to school—United States, 1969 and 2001. *Journal of Physical Activity and Health, 5* (2): 205-215.

[129] National Household Travel Survey. 2008. NHTS Brief. *Travel to School – The Distance Factor*. January 2008. Available at: http://nhts.ornl.gov/briefs/Travel%20To%20School.pdf [accessed May 19, 2011].

design are factors in these choices. In 1969, a little more than half of students lived within a mile of their schools. By 2001, that was down to 25 percent.[130]

Reducing the size of street blocks, locating key community destinations in closer proximity to home and work, and providing incentives to develop land in dense, mixed-use patterns will enhance community design and support active transportation.

Increase Investments in Infrastructure that Supports Active Transportation

In recent years, federal transportation policy has begun a more concerted investment in infrastructure that makes active transportation easier. Facilities include sidewalks, multi-use trails, bicycle lanes and paths, pedestrian crossing improvements, and street designs that narrow roadways and reduce traffic speed.

Expanding the existing Safe Routes to School national program and encouraging development of an investment in Complete Streets design will provide support for active transportation infrastructure investments. Additionally, encouraging development of bicycle boulevards—a way to integrate bicycle transportation into the street network while maintaining safety—and encouraging more signage aimed at pedestrians and bicyclists will make community design more conducive to active transportation.

Consider the Needs of All Road Users in Planning and Design Standards

Transportation projects have historically placed the highest priority on achieving efficiencies for motor vehicles, coming at the cost of safety and comfort for pedestrians and bicyclists, and having the effect of reducing the practicality and comfort of active travel.

Incorporating active transportation users' needs into transportation planning and design can be accomplished by setting goals for pedestrian and bicycle levels of service in any project, and encouraging route analysis to include pedestrian and bicycle access. Finally, adjusting vehicle design standards to incorporate elements that are more forgiving to pedestrians and bicyclists in the event of crashes would make walking—and bicycling—safer.

Make Public Transit Easier to Use for Pedestrians and Bicyclists

A recurring obstacle to transit use is the so-called last/first mile problem, which refers to barriers transit users experience in either reaching a transit facility to start their journey, or completing the final leg that brings them to their destination. Walking and bicycling are modes that are suited for

[130] McDonald, N. 2007. Children's Mode Choice for the School Trip: The Role of Distance and School Locations in Walking to School. *Transportation*, 35 (1): 23-35.

short trips. While federal support for transit has increased over the past decade or so, there has been little effort to coordinate pedestrian and bicycle facilities with transit spending.[131]

Public transit can be made easier for pedestrians and bicyclists to use by making ample room for bicycles on trains and buses, making transit stops and stations more accessible by foot and bicycle, providing route maps and other information about routes and schedules, and by fostering transit-oriented development.

Chapter 2 at a Glance

In this chapter we will examine four policies that could enhance community design in order to promote active transportation. They are:

2.1 Provide Better Connectivity for Pedestrians and Bicyclists

2.2 Increase Investments in Infrastructure that Supports Active Transportation

2.3 Consider the Needs of All Road Users in Planning and Design Standards

2.4 Make Public Transit Easier to Use for Pedestrians and Bicyclists

[131] Schneider, R. 2005. *TCRP Synthesis 62: Integration of bicycles and transit.* Transportation Research Board: Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf [accessed on June 19, 2011]

2.1 Provide Better Connectivity for Pedestrians and Bicyclists

2.1.1 Background: Provide Better Connectivity for Pedestrians and Bicyclists

Definition

Connectivity is defined as how often streets or roadways intersect, or how closely intersections are spaced. Grid-like street patterns usually have greater connectivity than those with curving streets and cul-de-sacs.[132]

Current Status

"Context-sensitive design/solutions" and "Complete Streets" are the two most widely used approaches that incorporate connectivity. Context-sensitive design incorporates elements such as livability, sense of place, human-scaled urban design, and environmental protection into transportation projects without sacrificing traditional objectives of safety, efficiency, capacity, and maintenance.[133,134] Complete streets explicitly includes the needs of all road users in road design and planning, and specifically sets connectivity as one of the goals for all projects.[135]

History

Initially, older cities were laid out in shorter blocks in a grid-like pattern that enhances connectivity. This changed in the middle of the 20th Century as freeways were built through urban areas, and suburban land was developed at considerably lower densities. Cities were laid out with street designs employing longer blocks, and suburbs had frequent cul-de-sacs.[136] Additionally, communities were more spread out, and key destinations were located far apart.[137,138]

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[132] Turley, B. M. 2008. *Mobilizing Connectivity: Applying Connectivity Tools in the Arterial Planning Process.* Presented at the 11th National Conference on Transportation Planning for Small and Medium-Sized Communities. Transportation Research Board and Federal Highway Administration. Available at: http://pubsindex.trb.org/view.aspx?id=899091 [accessed on June 19, 2011].

[133] NCHRP REPORT 480. 2002 *A Guide to Best Practices for Achieving Context Sensitive Solutions.* Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_480.pdf [accessed May 2, 2011].

[134] Hasson, P., Bradley, S., Walvatne, P., Lutkevich, P., C. Leone. 2009. Trees, Lighting, and Safety in Context-Sensitive Solutions. *Transportation Research Record: Journal of the Transportation Research Board:* 101-111.

[135] National Complete Streets Coalition. *FAQ.* Available at: http://www.completestreets.org/complete-streets-fundamentals/complete-streets-faq/ [accessed September 29, 2010].

[136] Saelens, B.E. and S.L. Handy. 2008. Built Environment Correlates of Walking: A Review. *Medicine in Science and Sports and Exercise*, 40 (7): S550-S556.

[137] Kochtitzky, C.S., H. Frumkin, R. Rodriguez, A.L. Dannenberg, J. Rayman, K. Rose, R. Gillig and T. Kanter. 2006. Urban Planning and Public Health at CDC. *Morbidity and Mortality Weekly Report* 55 (SUP02): 34-38. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/su5502a12.htm [accessed October 2010].

[138] Centers for Disease Control and Prevention. 2010. *Healthy Places: About Healthy Places.* National Center for Environmental Health. Available at: http://www.cdc.gov/healthyplaces/about.htm [accessed October, 2010].

Potential to Support Increased Active Transportation

Disconnected or extended-scale street patterns make traveling between locations less direct and less convenient for pedestrians and bicyclists. When long distances separate destinations, or when land use is sprawling rather than compact and mixed, active transportation is not an attractive choice.[139]

High levels of street connectivity are positively associated with active transportation levels.[140,141] Active transportation also increases when there is sufficient residential density and land use mixes.[142]

Policies for Better Connectivity for Pedestrians and Bicyclists

Policy 1: Encourage block size limits that are conducive to walking

Policy 2: Encourage appropriate location of key community destinations to increase active transportation

Policy 3: Incentivize land use patterns that are conducive to active transportation

2.1.2 Impact of Policies: Provide Better Connectivity for Pedestrians and Bicyclists

Policy 1—Encourage block size limits that are conducive to walking

Definition

A block is an area of land, usually as a square or polygon, surrounded by streets or roads. Block size, the area of a given block, is highly variable. Blocks in older U.S. cities typically are less than 500 feet long on a side.[143]

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139 Harkey D.C. and C.V. Zegeer. 2004. *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System.* FHWA. Available at: http://www.walkinginfo.org/training/collateral/resources/PEDSAFEGuide.pdf [accessed on June 19, 2011].

140 Wesley, M. and N. Garrick, 2010. *The Effect of Street Network Design on Walking and Biking.* Presented at the Transportation Research Board Annual Meeting. National Academies of Science. Available at: http://www.sacog.org/complete-streets/toolkit/files/docs/Garrick%20&%20Marshall_The%20Effect%20of%20Street%20Network%20Deisgn%20on%20Walking%20and%20Biking.pdf [accessed on June 19, 2011].

141 Oakes, J.M., A. Forsyth, K.H. Schmitz and M. Hearst. 2007. The Effects of Neighborhood Density and Street Connectivity on Walking Behavior: the Twin Cities Walking Study. *Epidemiologic Perspectives & Innovations*, 4 (16): 1-9.

142 Berrigan, D., L.W. Pickle and J. Dill. 2010. Associations Between Street Connectivity and Active Transportation. *International Journal of Health Geographics*, 9: 20.

143 Ewing, R., T. Schmid, R. Killingsworth, A. Zlot and S. Raudenbush. 2008. Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity. *American Journal of Public Health Promotion*, 18 (1): 47-57.

History

In the mid-20th Century, many American downtowns were restructured and rebuilt. Block size was often enlarged in these newer sections, and street networks were re-aligned to serve higher-speed traffic and feed the highways that were being built.[144,145] In suburbs, a favored street design was a curving uninterrupted street, often ending in a cul-de-sac. These designs resulted in a decrease of neighborhood connectivity.

Effectiveness and Impact

Residents of neighborhoods with shorter block lengths are more likely to walk to their destinations,[146] along with other neighborhood factors, such as land use density and mix of commercial uses.[147,148]

Economic Factors

Neighborhood connectivity may enhance an area's "social capital," as neighborhoods with walkable, mixed-use designs have stronger social networks and interactions than neighborhoods that are car-dependent.[149] Health care cost savings also result from improving connectivity and increasing walking.[150]

Conclusion

Reducing block size can help create a community that is more accessible to pedestrians and bicyclists and thus encourages more walking and bicycling, with an accompanying increase in physical activity and fitness levels.

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144 Ryan, B.D. 2008. The Restructuring of Detroit: City Block Form Change in a Shrinking City, 1900-2000. *Urban Design International*, 13 (3): 1-13.

145 Reilly, M. and J. Landis. 2002. *The Influence of Built-Form and Land Use on Mode Choice: Evidence from the 1996 Bay Area Travel Survey.* Institute of Urban and Regional Development Working Paper. IURD WP 2002-4. Available at: http://www.uctc.net/papers/669.pdf [accessed on June 19, 2011].

146 Boer, R., Y. Zheng, A. Overton, G.K. Ridgeway and D.A. Cohen. 2007. Neighborhood Design and Walking Trips in Ten U.S. Metropolitan Areas. *American Journal of Preventive Medicine*, 32 (4): 298-304.

147 Berrigan, D., Pickle, L.W., J. Dill. 2010. Associations Between Street Connectivity and Active Transportation. *International Journal of Health Geographics*, 9 (1): 20.

148 Ewing, R., T. Schmid, R. Killingsworth, A. Zlot and S. Raudenbush. 2008. Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity. *American Journal of Public Health Promotion*, 18 (1): 47-57.

149 Leyden, K.M. 2003. Social Capital and the Built Environment: The Importance of Walkable Neighborhoods. *American Journal of Public Health*, 93: 1546-1551.

150 American Public Health Association. 2010. *Backgrounder: The Hidden Health Costs of Transportation.* Available at: http://trid.trb.org/view.aspx?id=919815 [accessed on June 16, 2011].

Policy 2—Encourage appropriate location of key community destinations to increase connectivity for pedestrians and bicyclists

Definition

A community design where key destinations are located to enhance connectivity for pedestrians and bicyclists is characterized by compact and highly mixed land use.[151]

History

Aligning facilities planning with pedestrian and bicycle connectivity has not taken place to any significant degree in the past.[152] Recently, federal transportation policies have encouraged state and regional transportation plans to integrate more compact development and land use that is amenable to walking and bicycling.[153]

Effectiveness and Impact

Locating key destinations close to the populations they serve is associated with a high degree of walking as a regular transport mode. Increasing the mix of utilitarian destinations in neighborhoods encourages inactive individuals to make purpose-driven walking trips and encourages higher levels of active travel among already-active individuals.[154] This pertains to home-school trips as well.[155] In addition, higher residential density and greater amounts of accessible retail floor area are associated with higher rates of walking.[156,157]

Economic Factors

Higher-density, compact development results in societal savings from a reduced need for infrastructure investments by encouraging development in existing communities. There are also savings related to reduced transportation-related energy use, emissions, and congestion. Households and individuals realize benefits through reduced fuel purchases and other transportation-related expenses, which, together with housing, account for 50 cents of every

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151 Cervero, R. and K. Kockelman. 1997. Travel Demand and the Three Ds: Density, Diversity, and Design. Transportation Research Part D: *Transport and Environment*, 2 (2): 199–219.

152 Steiner, R.L., Crider, L.B., M. Betancourt. 2006. *Safe Ways to School—the Role in Multimodal Planning.* Florida Department of Transportation Systems Planning Office. Tallahassee, Florida. DOT F 1700.7 (8-72) Available at: http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PL/FDOT_BD545_32_rpt.pdf [accessed on June 19, 2011].

153 U.S. Government Code of Federal Regulations. *Title 23: Highways. Part 450—Planning Assistance and Standards*. Available at: http://tinyurl.com/4y2xsg7 [accessed May 5, 2011].

154 McCormack, G.R., B. Giles-Corti and M. Bulsara, 2008. The Relationship Between Destination Proximity, Destination Mix and Physical Activity Behaviors. *Preventive Medicine*, 46 (1): 33-40.

155 Yang, Y., M. Schlossberg, R. Parker and B. Johnson. 2010. *Understanding School Travel: How Location Choice and the Built Environment Affect Trips to School.* Oregon Transportation Research and Education Consortium. Portland, Oregon. OTREC-RR-10-01. Available at: http://ipri.uoregon.edu/index.cfm?mode=research&page=projects [accessed on June 19, 2011].

156 Marshall, J.D., M. Brauer and L.D. Frank. 2009. Healthy Neighborhoods: Walkability and Air Pollution. *Environmental Health Perspectives*, 117 (11): 1752-1759.

157 Cervero, R. and M. Duncan. 2003. Walking, Bicycling, and Urban Landscape: Evidence from the San Francisco Bay Area. *American Journal of Public Health*, 93: 1478-1483.

dollar earned, on average.[158] From a governmental perspective, more compact land use generates higher revenues per acre of developed land.[159]

Conclusion

Locating key destinations in a way that creates dense land use with a high degree of mixed land use increases connectivity for pedestrians and bicyclists.

Policy 3—Incentivize land use patterns that are conducive to connectivity for pedestrians and bicyclists

Definition

A number of mechanisms that have been developed to affect land use decisions—tax incentives, expedited permits, fee or regulatory relief—can be utilized to create incentives for dense, highly mixed land use.[160,161,162,163]

History

Policies to encourage denser mixed-use development have proliferated in the past few years, with states and cities passing measures requiring denser development.[164,165]

Effectiveness and Impact

There are few systematic tests of the effectiveness of policies aimed at encouraging dense, mixed land use, largely because they are still being developed or have been deployed only recently.[166]

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158 Kooshin, C. and S. Winkelman. 2011. *Growing Wealthier, Smart Growth, Climate Change and Prosperity.* Center for Clean Air Policy. Available at: http://tinyurl.com/43cn736 [accessed May 4, 2011].

159 Calthorpe Associates. 2011. *Vision California: Charting Our Future.* Statewide Scenarios Report. March 2011. Available at: http://tinyurl.com/5v92edg [accessed May 5, 2011].

160 Freilich, R.H., N.M. Popowitz. 2010. The Umbrella of Sustainability: Smart Growth, New Urbanism, Renewable Energy and Green Development in the 21st Century. *The Urban Lawyer. Environmental Studies and Policy Collection,* 42 (1): 1-39.

161 U.S. Department of Housing and Urban Development. *Sustainable Housing and Communities.* Available at: http://portal.hud.gov/hudportal/HUD?src=/program_offices/sustainable_housing_communities [accessed March 12, 2011].

162 Salkin, P. and A. Lavine. 2008. Land Use Law and Active Living: Opportunities for States to Assume a Leadership Role in Promoting and Incentivizing Local Options. *Rutgers Journal of Law and Urban Policy*, 5.

163 Frank, L. and S. Kagave. 2009. A National Plan for Physical Activity: Enabling Role of the Built Environment. *Journal of Physical Activity and Health,* 6 (Suppl 2): S186-S195.

164 Nolon, J.R. 2009. The Land Use Stabilization Wedge Strategy: Shifting Ground to Mitigate Climate Change. *William & Mary Environmental Law and Policy Review,* 34: 1.

165 Litman, T. 2009. *Quantifying the Benefits of Nonmotorized Transportation for Achieving Mobility Management Objectives.* Victoria Transport Policy Institute.

166 Nolan, J.R. 2008. *Shifting Ground to Address Climate Change: the Land Use Law Solution.* Pace Law Faculty Publications. Available at: http://www.law.pace.edu/files/landuse/Shifting_Ground_Penultimate.pdf [accessed June 21, 2011]

Economic Factors

Specific total cost estimates of these programs, including subsidies for land use changes, are unknown. Costs would include delayed opening of buildings and higher land prices in areas that are accessible by pedestrians and cyclists. Benefits would include potential savings in pollution, congestion, and reduced needs for infrastructure and land.[167,168]

Conclusion

Utilizing mechanisms that are already in place create incentives for dense, mixed-use developments would result in land use patterns that have greater connectivity for pedestrians and bicyclists and that make walking and bicycling more attractive.

2.1.3 Conclusions: Provide Better Connectivity for Pedestrians and Bicyclists

Increasing connectivity for pedestrians and bicyclists makes walking and bicycling more attractive choices, enabling people to increase their trips by these modes. This should increase the health benefits associated with greater levels of physical activity and reduce the costs and negative impacts associated with motor vehicle travel.

There are three distinct policies reviewed in this section, and each can be an effective tool for increasing connectivity. Reducing block size makes destinations more accessible to pedestrians and bicycles, as do policies that encourage key destinations to be located closer together. Lastly, incentives to create dense, highly mixed land use complement market forces that recognize the lowered costs and increased benefits of more compact development.

2.2 Increase Investments in Infrastructure that Supports Active Transportation

2.2.1 Background: Increase Investments in Infrastructure that Supports Active Transportation

Definition

Infrastructure that supports active transportation includes: sidewalks, multi-use trails, bicycle lanes and paths, cycle tracks, bicycle boulevards (designated low-volume streets, usually

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167 Calthorpe Associates. 2011. *Vision California: Charting Our Future.* Statewide Scenarios Report. March 2011. Available at: http://tinyurl.com/5v92edg [accessed May 5, 2011].

168 Barkalow, G. and G. Bernis. 2007. *The Role of Land Use in Meeting California's Energy and Climate Change Goals.* California Energy Commission: Draft Staff Paper, 2007: 2. Available at: http://www.energy.ca.gov/2007publications/CEC-600-2007-008/CEC-600-2007-008-SD.PDF [accessed on June 21, 2011].

connected to form a network), pedestrian crossings, pedestrian/bicycle bridges, paved shoulders, striped bicycle lanes, pedestrian signals, bicycle-actuated signals, medians and other pedestrian "refuges," high-visibility crosswalk striping, raised pedestrian crossings, in-pavement lighting, overhead illuminated crosswalks, recessed stop lines, warning signs, and street designs that narrow roadways and reduce traffic speed such as sidewalk extensions and other structures.[169,170,171]

Current Status

In recent years, pedestrian and bicycle infrastructure has received more funding in absolute terms ($1.04 billion in 2010), but remains a small percentage (2 percent) of the federal surface transportation budget.[172] DOT Secretary Ray LaHood announced a new policy statement in March of 2010 on bicycle and pedestrian accommodation that expands the federal commitment to pedestrian and bicycle infrastructure.[173]

History

Federal support for pedestrian and bicycle infrastructure has risen significantly in the past 20 years. Starting with the Intermodal Surface Transportation Efficiency Act (ISTEA), federal funding for pedestrian and bicycle infrastructure reached meaningful levels, approximately $150 million a year from 1992 to 1998. With the Transportation Equity Act for the 21st Century (TEA21), that increased to an average of $360 million per year from 1999 to 2005. Under the Safe, Accountable, Flexible, Efficient, Transportation Equity Act (SAFETEA-LU) it rose dramatically to nearly $1 billion a year from 2006 to 2009.[174]

Programs that fund pedestrian and bicycle infrastructure include the Surface Transportation Program Safety Set-Aside for Transportation Enhancement Activities, the Highway Safety Improvement Programs, the Congestion Mitigation and Air Quality Improvement Program, the

169 U.S. Department of Transportation Federal Highway Administration. 2011. *Bicycle Facilities and the Manual on Uniform Traffic Control Devices.* Available at: http://www.fhwa.dot.gov/environment/bikeped/mutcd_bike.htm. [accessed May 6, 2011].

170 U.S. Department of Transportation Federal Highway Administration. *Selecting Pedestrian Safety Improvements* (Crash Types/Countermeasure Matrix). Available at: http://safety.fhwa.dot.gov/saferjourney/library/matrix.htm [accessed May 6, 2011].

171 U.S. Department of Transportation Federal Highway Administration. 2010. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations.* Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed October 5, 2010].

172 U.S. Department of Transportation Federal Highway Administration. 2009. *Federal-Aid Highway Program Funding for Pedestrian and Bicycle Facilities and Programs.* Available at: http://www.fhwa.dot.gov/environment/bikeped/bipedfund.htm [accessed March 12, 2011].

173 U.S. Department of Transportation Federal Highway Administration. 2010. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations.* Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed May 9, 2011].

174 Pucher, J., R. Buehler and M. Seinen. 2011. Bicycling Renaissance in North America? An Update and Re-Appraisal of Cycling Trends and Policies. *Transporation Research Part A: Policy and Practice*, 45 (6): 451-47.

Safe Routes to School program, the Non-Motorized Transportation Pilot Program, and the Recreational Trail Program.[175]

Potential to Increase Active Transportation

Investing in pedestrian and bicycle infrastructure has been shown to result in increases in walking and bicycling. Infrastructure investments are considered more successful in increasing active transportation when combined with a comprehensive package of complementary policies.[176]

Policies to Increase Investments in Infrastructure that Supports Active Transportation

Policy 1: Encourage investment in Complete Streets

Policy 2: Strengthen Safe Routes to School programs

Policy 3: Encourage use of street design and facilities that increase pedestrians and bicyclists' safety and comfort levels

Policy 4: Encourage bicycle boulevards

Policy 5: Encourage use of signage, maps, and other wayfinding methods for pedestrians and bicyclists

2.2.2 Impact of Policies: Increase Investments in Infrastructure that Supports Active Transportation

Policy 1—Encourage investment in Complete Streets

Definition

Complete Streets is an engineering and design approach that actively considers the needs of all road users—pedestrians, bicyclists, motorists, and transit riders—of all ages and abilities, and gives priority to street connectivity and context-sensitive designs, while measuring results.[177]

History

On March 15, 2010, the Obama administration issued formal guidance on Complete Streets concepts for state and regional transportation departments, including recommendations that states

[175] Federal Highway Administration. 2009. Federal-Aid Highway Program Funding for Pedestrian and Bicycle Facilities and Programs. Available at: http://www.fhwa.dot.gov/environment/bikeped/bipedfund.htm [accessed October 5, 2010].

[176] Pucker, J., J. Dill and S. Handy. 2009. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine* 50 (2010): S106–S125.

[177] National Complete Streets Coalition. *FAQ.* Available at: http://www.completestreets.org/complete-streets-fundamentals/complete-streets-faq/ [accessed September 29, 2010].

collect data on walking and bicycling trips, find ways to improve bike paths and sidewalks during maintenance projects, and ensure children and the elderly have adequate transportation choices.[178] As of March 2011, more than 23 states and 140 local governments had adopted Complete Streets policies.[179]

Effectiveness and Impact

Enhancing pedestrian and bicycle infrastructure environment can cause people to walk and bicycle more[180,181,182,183,184] and can also improve automobile safety.[185]

Economic Factors

Interventions that make streets more comfortable and safer for all users add little overall to the cost of a typical street improvement project and can yield a high rate of return in terms of public health, economy and environmental benefits from reducing emissions, congestion, and energy use and encouraging more active travel.[186,187,188]

Conclusion

The Complete Streets concept is being adopted by a growing number of localities and is receiving the backing of the federal government. Earlier pedestrian and bicycle infrastructure improvements similar to what are proposed in Complete Streets have resulted in increased levels of walking and bicycling and have enhanced safety for all road users while performing within accepted cost-

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178 Federal Highway Administration. 2010. United States Department of Transportation. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations.* Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed May 9, 2011].

179 National Complete Streets Coalition. *Complete Streets Atlas.* Available at: http://www.completestreets.org/complete-streets-fundamentals/complete-streets-atlas/ [accessed October 5, 2010].

180 Saelens, B.E. and S.L. Handy. 2008. Built Environment Correlates of Walking: A Review. *Medicine and Science in Sports and Exercise*, 40 (7SL): S550-S566.

181 Ewing, R. and R. Cervero. 2010. Travel and the Built Environment: A Meta-Analysis. *Journal of the American Planning Association*, 76 (3): 265-294.

182 The Community Guide to Preventive Services: *Promoting Physical Activity: Environmental Approaches*. Available at: http://www.thecommunityguide.org/pa/environmental-policy/index.html [accessed February 2, 2011].

183 Pucher, J.; Dill, J. and S. Handy. 2010. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine*, 50 (1): S106-S125.

184 Staunton, C.E., D. Hubsmith and W. Kallins. 2003. Promoting Safe Walking and Biking to School: The Marin County Success Story. *American Journal of Public Health*, 93 (9): 1431-1434.

185 Heath, G.W., R.C. Brownson, J. Kruger, R. Miles, K.E. Powell, L.T. Ramsey, and the Task Force on Community Preventive Services. 2006. The Effectiveness of Urban Design and Land Use and Transport Policies and Practices to Increase Physical Activity: A Systematic Review. *Journal of Physical Activity and Health*, 3 (1): S55-S76.

186 Woodcock, J., et al. 2009. Public health benefits of strategies to reduce greenhouse-gas emissions: Urban land transport. *The Lancet*. 374:1930-1943.

187 Minnesota Department of Transportation. 2009. *Complete Streets Final Report.* Available at: http://www.dot.state.mn.us/planning/completestreets/legislation.html [accessed September 24, 2010].

188 *Benefit-Cost Analysis of Bicycle Facilities.* National Cooperative Highway Research Program, Minnesota Department of Transportation, Midwest Regional University Transportation Center. Available at: http://www.bicyclinginfo.org/bikecost/index.cfm [accessed February 2, 2011].

benefit parameters. This supports the value of a dedicated funding program devoted to Complete Streets, as well as additional investment in permanent, long-term performance measures and other types of accountability systems.

Policy 2—Strengthen Safe Routes to School programs and improve infrastructure

Definition

Safe Routes to School (SRTS) employs a combination of evaluation (surveying parents to find out why children are being driven to school), engineering (new signals, crosswalks, sidewalks), education (school-based safety programs), encouragement (activities involving parents and children to encourage walking and bicycling), and enforcement (speed enforcement, yielding in crosswalks, etc.) to improve the safety of the physical environment surrounding schools and encourage children to walk and bicycle to school.

History

Congress established the SRTS program in 2005 to address the fact that the number of children walking or bicycling to school had fallen steeply and to encourage active travel to school by improving safety along the routes. As of 2010, schools in all 50 states and the District of Columbia had implemented SRTS programs.[189]

Effectiveness and Impact

Perceived traffic safety threats have been cited as an important factor when parents choose whether their children will walk or bicycle to school rather than travel to school by car.[190] Walking and bicycling increases at schools with SRTS programs,[191,192] and SRTS infrastructure improvements create safety benefits for all road users.[193]

Economic Factors

The long-term benefits of increased physically active travel—including most notably reductions in childhood obesity, greenhouse gas emissions, pollution, congestion, and traffic injuries—

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189 National Center for Safe Routes to School. 2010. *2010 SRTS Program Tracking Brief*. Available at: www.saferoutesinfo.org/sites/default/files/Fall%20**2010**.pdf [accessed October 3, 2010].

190 Carver, A., A. Timperio and D. Crawford. 2008. Playing it safe: The Influence of Neighbourhood Safety on Children's Physical Activity—A Review. *Health & Place*, 14 (2): 217-227.

191 Boarnet, M.G., K. Day, C. Anderson, T. McMillan and M. Alfonzo. 2005. California's Safe Routes to School Program: Impacts on Walking, Bicycling, and Pedestrian Safety. *Journal of the American Planning Association*, 71 (3): 301-317.

192 Orenstein, M.R., N. Gutierrez, T.M. Rice, J.F. Cooper and D.R. Ragland. 2007. *Safe Routes to School: Safety and Mobility Analysis.* Report to California Legislature. Available at: http://escholarship.org/uc/item/5455454c [accessed June 21, 2011].

193 Watson, M. and A.L. Dannenberg. 2008. Investment in Safe Routes to School Projects: Public Health Benefits for the Larger Community. *Preventing Chronic Disease: Public Health Research, Practice and Policy*, 5 (3): 1-7.

would suggest that SRTS produces a net benefit, but these benefits have not been quantified in direct association with SRTS.[194]

Conclusion

SRTS appears to lead to a decline in pedestrian injury and an increase in walking and bicycling, among a key population—school children—that is experiencing a sharp decline in physical activity. The large demand for project funds suggests that there is considerable local support and enthusiasm for SRTS.

Policy 3—Encourage use of street design and facilities that increase pedestrians' and bicyclists' safety and comfort levels

Definition

Design that increases pedestrians' and bicyclists' sense of safety and comfort creates a sense of security and separation from traffic by the use of lighting, sidewalk layout, bike lanes and paths, sidewalk furniture, street trees, protected crossings, and medians.[195,196,197,198]

History

The 1998 Transportation Equity Act for the Twenty-first Century (TEA21) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005[199] have included efforts to promote designs that answer pedestrian and bicyclist needs. The 2010 federal statement endorsing Complete Streets has added more support.[200]

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194 General Accountability Office. 2008. *Safe Routes to School. Progress in Implementing the Program, but a Comprehensive Plan to Evaluate Program Outcome is Needed.* July 2008. GAO-08-789. Available at: http://www.gao.gov/new.items/d08789.pdf [accessed October 5, 2010].

195 Gandhi, T. and M.M. Trivedi. 2007. Pedestrian Protection Systems: Issues, Survey, and Challenges. *IEE Transactions on Intelligent Transportation Systems,* 8 (3).

196 American Association of State Highway and Transportation Officials. 2010 *AASHTO Guide for the Planning, Design, and Operation of Bicycle Facilities.*

197 Centers for Disease Control and Prevention. 2010. *Healthy Community Design*. Available at: http://www.cdc.gov/Features/HealthyCommunities/ [accessed October, 2010].

198 National Association of City Transportation Officials. 2011. *NACTO Urban Bikeway Design Guide*. 2011. Available at: http://www.apbp.org/news/62832/NACTO-Urban-Bikeway-Design-Guide.htm [accessed on June 21, 2011].

199 U.S. Department of Transportation Federal Highway Administration. 2005. *A Summary Of Highway Provisions in SAFETEA-LU*. Available at: http://www.fhwa.dot.gov/safetealu/summary.htm [accessed October, 2010].

200 U.S. Department of Transportation Federal Highway Administration. 2010. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations.* Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed October 5, 2010].

Effectiveness and Impact

Examining a few elements of this package of design approaches suggests there are beneficial effects. Adequate lighting is a top facilitator for walking.[201] Continuous bike lanes or trails are some of the top facilitators for cycling[202] and give pedestrians a buffer from traffic.[203] Bicyclists choose routes based on bicycle facilities rather than travel distance.[204]

Economic Factors

Pedestrian and bicyclist improvements increase property values in some settings.[205] There is emerging evidence that pedestrian and bicycle infrastructure is cost effective.[206]

Conclusion

Designs that increase pedestrians' and bicyclists' sense of security and safety enhance the overall street environment and promote walking and bicycling without substantial added costs.

Policy 4—Encourage bicycle boulevards

Definition

A bicycle boulevard usually runs parallel to busier streets, providing bicyclists with a lower-speed, alternate route to popular destinations.[207]

History

Bicycle boulevards are a relatively new concept in the U.S., although the first ones were implemented in the 70s in Berkeley[208] and Palo Alto and, more recently, in Portland, Oregon. Cities in New Mexico and South Carolina have also recently installed them.[209,210]

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201 Hasson, P., S. Bradley, P. Walvatne, P. Lutkevich and C. Leone. 2009. Trees, Lighting, and Safety in Context-Sensitive Solutions. *Transportation Research Record: Journal of the Transportation Research Board*, 101-111.

202 Lee, C. and A.V. Moudon. 2008. Neighborhood Design and Physical Activity. *Building Research and Information*, 36 (5): 395-411.

203 American Association of State Highway and Transportation Officials. 2010 *AASHTO Guide for the Planning, Design, and Operation of Bicycle Facilities*.

204 Winters, M., K. Teschke, M. Grant, E.M. Selton and M. Brauer. 2010. How Far Out of the Way Will We Travel? Built Environment Influences on Route Selection for Bicycle and Car Travel. *Transportation Research Record: Journal of the Transportation Board.*

205 Snyder, R. *The Economic Value of Active Transportation: A Fact Sheet.* Ryan Snyder Associates. Available at: http://www.rsa.cc/images/EconomicValueOfActiveTransportation.pdf [accessed May 19, 2011].

206 Gotschi, T. 2011. Costs and Benefits of Bicycling Investments in Portland, Oregon. *Journal of Physical Activity and Health* 8 (Suppl 1): S49.

207 Dill, J. 2009. Bicycling for Transportation and Health: The Role of Infrastructure. *Journal of Public Health Policy* 30: S95–S110.

208 DeRobertis, M. 2001. *Berkeley's Bicycle Boulevard Network.* ITE Annual Meeting.

209 Alliance for Bicycling and Walking. 2010. *Bicycling and Walking in the United States 2010 Benchmarking Report*. Washington, DC. Available at: http://green-changemakers.blogspot.com/2010/02/alliance-for-biking-and-walking-2010.html [accessed on June 21, 2011]

Effectiveness and Impact

Bicyclists go out of their way to use bicycle boulevards,[211] which can provide a feeling of security.[212] They are most effective at encouraging bicycling when they provide continuity over the two- to-five-mile distance of an average urban bicycle trip.[213]

Economic Factors

Costs include implementation and maintenance.[214,215]

Conclusion

Bicycle boulevards encourage bicycle travel.

Policy 5—Encourage use of signage, maps, and other wayfinding methods for pedestrians and bicyclists

Definition

Wayfinding devices include signs, maps, landscape cues,[216] and pavement or sidewalk markings.[217] There are also online tools for wayfinding via GPS-enabled cell phones[218] and Web sites.[219]

History

The term "wayfinding" was first used in 1960 by the architect Kevin Lynch in his book, *The Image of the City.*[220] In the transportation context, wayfinding was first developed with an

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[210] Pucher, J., J. Dill and S. Handy. 2010. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine* 50 (2010) S106-S125.

[211] Ibid.

[212] Dill, J. and T. Carr. 2007. *Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them.* Transportation Research Board Record 1828. 2007. Paper No. 03-4134.

[213] American Association of State Highway and Transportation Officials. 2010. *AASHTO Guide for the Planning, Design, and Operation of Bicycle Facilities.*

[214] Ibid.

[215] Walker, L. 2009. *Fundamentals of Bicycle Boulevard Planning and Design, Initiative for Bicycle and Pedestrian Innovation.* Center for Transportation Studies. Portland, Oregon.

[216] Kaplan, R. 1983. *The role of nature in the urban context.* In: Altham I. and J. Wohlwill, Eds. Behavior and the Natural Environment. New York: Plenum.

[217] U.S. Department of Transportation Federal Highway Administration. *Pedestrian Crossings.* Available at: http://www.fhwa.dot.gov/environment/sidewalk2/sidewalks208.htm [accessed June 29, 2011].

[218] Young, M., N. Stanton, G. Walker, D. Jenkins and W. Smart. 2008. Where do we go from here? An assessment of navigation performance using a compass versus a GPS unit. *Cogn Tech Work* (2008) 10:231–236. Available at: http://www.springerlink.com/content/r35420t5044p6627/fulltext.html [accessed October 10, 2010].

[219] Helft, M. Google Maps Adds Directions for Cyclists. *New York Times*. March 9, 2010. Available at: http://gadgetwise.blogs.nytimes.com/2010/03/09/google-maps-adds-directions-for-cylists/ [accessed October 11, 2010].

[220] Reeder, L. Wayfinding. *The American Institute of Architects. Architect's Knowledge Resource*. Available at http://www.aia.org/practicing/akr/AIAB079690?dvid=&recspec=AIAB079690 [accessed October 10, 2010].

emphasis on motorized road users.[221] Until recently, wayfinding for pedestrians has largely focused on guides for blind and deaf pedestrians or those using assistive devices. In the past 10 years, more attention has been paid to the array of pedestrian road users.[222] Wayfinding for bicyclists is undergoing a major revision in the draft guidelines being developed by the American Association of State Highway and Transportation Officials (AASHTO), the standards-setting group for the transportation profession.[223]

Effectiveness and Impact

The availability of wayfinding has indirect impacts on people's decision to walk or bicycle. Pedestrians and bicyclists consider numerous factors when they select a route—not just the shortest or easiest path.[224,225] While providing information about pedestrian and bicycle options will make active transportation easier and more pleasant, more research is needed to determine the degree of impact it has on travel choices.[226]

Economic Factors

Wayfinding costs can vary widely.[227] For example, map postings may be expensive to set up and maintain compared to signs. There is little information on the economic benefits of enhancing wayfinding.

Conclusion

Increased and more effective usage of signage, maps, and wayfinding devices aimed at pedestrians and bicyclists can increase the ease and convenience of these modes of transportation.

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221 U.S. Department of Transportation Federal Highway Administration. 2009. *Manual on Uniform Traffic Control Devices (MUTCD). 2009 Edition*, Chapter 2D. Guide Signs—Conventional Roads. Available at: http://mutcd.fhwa.dot.gov/htm/2009/part2/part2d.htm#section2D50 [accessed October 10, 2010].

222 May, A., T. Ross, S. Bayer and M. Tarkiainen. 2003. Pedestrian Navigation Aids: Information Requirements and Design implications. *Pers Ubiquit Comput* 7: 331–338.

223 American Association of State Highway and Transportation Officials. 2010. *Draft AASHTO Guide for the Planning, Design, and Operation of Bicycle Facilities*.

224 Schlossberg, M., A.W. Agrawal, K. Irvin and V.L. Bekkouche. 2007. *How Far, by Which Route, and Why? A Spatial Analysis of Pedestrian Preference*. Mineta Transportation Institute. Washington, D.C: Federal Highway Administration. FHWA/CA/OR-2006/24.

225 Dill, J. and J. Gliebe. 2008. *Understanding and Measuring Bicycling Behavior: a Focus on Travel Time and Route Choice*. Oregon Transportation Research and Education Consortium. Report OTRC-RR-08-03. Available at: http://www.lulu.com/items/volume_64/5687000/5687029/1/print/OTREC-RR-08-03_Dill_BicyclingBehavior_FinalReport.pdf [accessed February 2011].

226 Winters, M. 2010. How Far Out of the Way Will We Travel? Built Environment Influences on Route Selection for Bicycle and Car Travel. *Transportation Research Record: Journal of the Transportation Research Board*.

227 Bicyclinginfo.Org. Do Bicyclists and Pedestrians Have the Same Wayfinding Needs? Available at: http://www.bicyclinginfo.org/bikesafe/countermeasure.cfm?CM_NUM=48&lngFlag1=1&X=999&GRP_NBR=7&CM_maingroup=Support%20Facilities%20and%20Programs [accessed on June 21, 2011].

2.2.3 Conclusions: Increase Investments in Infrastructure that Supports Active Transportation

There has been a considerable increase in interest by the federal government in expanding transportation infrastructure investments that support active transportation—including sidewalks, multi-use trails, bicycle lanes and paths, bicycle boulevards, and street designs that narrow roadways and reduce traffic speed. Funding for such activities has risen substantially in the past 20 years.

As more research has established a link between infrastructure improvements and increases in active transportation, new comprehensive approaches are being developed. One concept that is being adopted currently is Complete Streets, which has resulted in increased levels of walking and bicycling and has enhanced safety for all road users.

SRTS has helped fund pedestrian and bicycle infrastructure improvements aimed at increasing active transportation choices for the trip to and from school. It has proven extremely popular. Incorporating pedestrian and bicyclist needs in overall design of infrastructure through measures such as improved lighting, better crosswalks, and slower speeds makes active transportation a more attractive choice. Additional pedestrian and bicyclist improvements that encourage active transportation are bicycle boulevards, which create low-speed networks of routes parallel to higher-speed auto routes, and added wayfinding and signage oriented to the non-motorized user.

2.3 Consider the Needs of All Road Users in Planning and Design Standards

2.3.1 Background: Consider the Needs of All Road Users in Planning and Design Standards

Definition

There are three aspects of transportation system operations that directly affect users' comfort and safety: the "level of service" (LOS) that the system provides them; the ease with which they can access and exit the transportation network when reaching their destinations (measured by means of "route analysis"); and the physical impact of vehicles on road users when crashes occur.

LOS is a systematic measure of the quality of the road user's experience. "Route analysis" examines the ease with which a user can access a destination within the transportation system. Vehicles' physical impact is a function of their design.

Current Status

Level of service has recently been expanded significantly beyond its traditional emphasis on motor vehicle volumes, speeds, and efficiency. Route analysis and vehicle design have not changed substantially in this direction, with route analysis still focused on motor vehicle access, and vehicle design concerned almost solely with the safety of vehicle occupants.

History

Design guidelines originally placed an emphasis on moving vehicles through the system with the greatest speed possible within the bounds of acceptable safety. The needs of non-motorized road users were secondary. Route analysis has not incorporated pedestrian and bicycle concerns to any large degree. While vehicle design, starting in 1967, has significantly increased the safety of occupants, there has been little concern for safety of road users outside the vehicle.

Potential for Increasing Active Transportation

Developing standards for incorporating the needs of pedestrians and bicyclists in transportation projects and making vehicles more forgiving to pedestrians and bicyclists when crashes do occur, are expected to improve safety for these road users.[228,229,230]

The following policies are considered:

Policy 1: Incorporate the use of multimodal level-of-service measures in transportation departments

Policy 2: Encourage use of pedestrian/bicycle route analysis as part of site and building concept development

P**olicy 3:** Encourage adoption of pedestrian-friendly vehicle design standards

[228] U.S. Department of Transportation Federal Highway Administration. 2010. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed May 9, 2011].

[229] Bhatt, N., C. Peppard and S. Potts. 2010. *Getting Back on Track: Aligning State Transportation Policy with Climate Change Goals.* Natural Resources Defense Council and Smart Growth America.

[230] U.S. Department of Transportation Federal Highway Administration. *Pedestrian Safety in Communities, Resource Material.* Available at*:* http://safety.fhwa.dot.gov/ped_bike/ped_cmnity/ped_walkguide/resource7.cfm [accessed March 14, 2011].

2.3.2 Impact of Policies: Consider the Needs of All Road Users in Planning and Design Standards

Policy 1—Incorporate the use of multimodal level of service measures in transportation departments

Definition

Level of service (LOS) is a rating of the speed, convenience, comfort, and security of transportation facilities and services as experienced by users. Multimodal LOS measures how various modes—motor vehicles, walking, transit, and bicycling—interact or how changes in the LOS for one mode may affect the LOS for another.[231]

History

Traditionally, LOS focused on automobiles. Beginning in 2003, the National Cooperative Highway Research Program (NCHRP), the research group that is a partnership among state departments of transportation, in cooperation with the Federal Highway Administration began to investigate ways to include other perspectives—those of pedestrians, bicyclists, and transit users—in assessing LOS.[232] In 2008, it released its final report that included four models to help measure LOS for different modes, along with a user's guide.[233] The newest edition of the *Highway Capacity Manual*, the most authoritative reference, released in early 2011, contains expanded sections addressing a much broader population of road users, explicitly naming transit riders, pedestrians, and bicyclists.[234] Additionally, the United States Department of Transportation (U.S. DOT) has issued a policy statement that declares walking and bicycling "important" elements of projects that it funds.[235]

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231 Victoria Transport Policy Institute. 2010. *Multi-Modal Level-of-Service Indicators, Tools for Evaluating the Quality of Transport Services and Facilities.* TDM Encyclopedia. Available at: http://www.vtpi.org/tdm/tdm129.htm [accessed March 16, 2011].

232 Transportation Research Board. 2007. *Multimodal Level of Service Analysis for Urban Streets*. National Academies of Science. Washington, D.C. Available at: http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=824 [accessed May 19, 2011].

233 Transportation Research Board. 2008. *Multimodal Level of Service Analysis for Urban Streets*. NCHRP Report 616. National Academies of Science. Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_616.pdf [accessed May 19, 2011].

234 Transportation Research Board. *Highway Capacity Manual 2010.* National Academies of Science. Washington, D.C. http://trb.org/Main/Blurbs/Highway_Capacity_Manual_2010_HCM2010_164718.aspx [accessed May 19, 2011].

235 U.S. Department of Transportation Federal Highway Administration. 2010. *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. Available at: http://www.fhwa.dot.gov/environment/bikeped/policy_accom.htm [accessed May 9, 2011].

Effectiveness and Impact

Currently there is little actual use by agencies of multimodal LOS for the planning and design of urban streets for transit, bicycle, and pedestrian modes.[236]

Economic Factors

Costs to state or local entities include obtaining software and paying for training to use the new models developed by the NCHRP, or to make modifications to existing transportation models to include multimodal LOS.

Conclusion

There is not yet sufficient data to measure the effectiveness of establishing requirements for states to employ multimodal LOS in the design of transportation projects. However, the number of states adopting such methods is growing, and more results should be available in coming years.[237]

Policy 2—Encourage use of pedestrian/bicycle route analysis as part of site and building concept development

Definition

A pedestrian/bicycle route analysis examines the routes that pedestrians and bicyclists will take into or out of a site.

History

Pedestrian and bicycle route analysis has not historically been a significant part of site or building concept development.[238]

Effectiveness and Impact

Encouraging pedestrian and bicycle route analysis as part of site development would expand on traditional route analysis.[239] It would assist in future planning for sidewalks, bike lanes, bike

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[236] Dowling and Associates. *State Laws and Policies Relating to Multimodal LOS Analysis*. Available at: http://www.dowlinginc.com/pdf/Legislation_CompleteStreets.pdf [accessed May 19, 2011].

[237] Ibid.

[238] U.S. Department of Transportation Federal Highway Administration. 2004. *Traffic Analysis Tools*. Office of Operations. Available at: http://ops.fhwa.dot.gov/aboutus/one_pagers/analysis_tools.htm [accessed October 10, 2010].

[239] Ibid.

racks, and medians and could aid in the location of entrances and exits and make walking and bicycling more attractive.[240]

Economic Factors

There are currently no studies that examine the economic costs or benefits of encouraging use of pedestrian and bicycle route analysis as part of a site's concept development. Requiring pedestrian and bicycle route analysis would help planners, landscape architects, architects, and developers determine how to position buildings most effectively for these active transportation modes. This could result in an offset for parking requirements if the information gathered could be used to estimate the number of people who would use active transportation to access the location, thus decreasing trip generation by vehicles and lessening the amount of parking needed.

Conclusion

Incorporating pedestrian and bicycle route analysis into site concept development would increase the understanding of how a site affects active transportation choices. Having information generated through pedestrian/bicycle route analysis would guide future planning for sidewalks, bike lanes, bike racks, and medians, making walking and bicycling more attractive.

Policy 3—Encourage adoption of pedestrian-friendly vehicle design standards

Definition

Pedestrian-friendly vehicle design reshapes the vehicle to reduce the injury caused to pedestrians when crashes with vehicles occur.[241, 242,243,244,245]

History

There are no specific standards in the U.S. for pedestrian-friendly vehicle design standards.

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240 Nara, A. and P.M. Torrens. 2007. *Spatial and Temporal Analysis of Pedestrian Egress Behaviour and Efficiency*. Proceedings of the 15th Annual ACM International Symposium on Advances in Geographic Information Systems. Seattle, Washington. 2007.

241 Schuster, P.J. 2006. *Current Trends in Bumper Design for Pedestrian Impact.* SAE 2006 World Congress & Exhibition, Detroit, USA.

242 World Health Organization. 2004. *World Report on Road Traffic Injury Prevention.* Geneva: World Health Organization.

243 Paine, M.P. and C.G. Coxon. 2000. *Assessment of Pedestrian Protection Afforded by Vehicles in Australia.* Presented at Impact Biomechanics & Neck Injury Conference. Sydney, March 2000.

244 Euro NCAP. 2010. *Vision and Mission*. Available at: http://www.euroncap.com/Content-Web-Page/60c0772f-99e6-4afa-bdb9-c147f9505706/vision-and-mission.aspx [accessed December 1, 2010].

245 Schuster, P.J. 2006. *Current Trends in Bumper Design for Pedestrian Impact.* SAE 2006 World Congress & Exhibition, Detroit, USA.

Effectiveness and Impact

Most deaths of pedestrians struck by vehicles are the result of traumatic brain injury resulting from the hard impact of the head against the hood or windshield.[246] Impacts with bumpers cause injuries to the lower limbs.[247] Universal adoption of pedestrian-oriented designs would prevent significant numbers of deaths and injuries.[248]

Economic Factors

The cost of implementing pedestrian-friendly vehicle designs can be very low, especially compared to occupant protection designs.[249]

Conclusion

Re-designing vehicles to reduce their impacts on pedestrians when crashes occur would reduce the number of fatalities and injuries.

2.3.3 Conclusions: Consider the Needs of All Road Users in Planning and Design Standards

There has been considerable progress toward incorporating the needs of all road users in the use of multimodal LOS in measuring the transportation system's effect on pedestrians and bicyclists and using those measures to design projects that take into account their needs. There has been little consideration of pedestrian and bicyclist needs in route analysis for understanding how pedestrians and bicyclists experience the transportation system around their destinations and of how vehicle design can be changed to reduce vehicles' impacts on pedestrians when crashes occur. For all three areas, considerably more data is needed to determine the extent of the likely benefits from such policies.

246 Hamer, M. 2005. *Stopping the Slaughter of Innocent Pedestrians*. *New Scientist* (2514). Available at: http://www.drive.com.au/editorial/article.aspx?id=10477 [accessed June 21, 2011].

247 Jain, S.L. 2004. Dangerous Instrumentality: The Bystander as Subject in Automobility. *Cultural Anthropology* 91 (1).

248 Breen, J. 2002. Protecting Pedestrians: Editorial. *British Medical Journal*, 324: 1109-110.

249 Ibid.

2.4 Make Public Transit Easier to Use for Pedestrians and Bicyclists

2.4.1 Background: Make Public Transit Easier to Use for Pedestrians and Bicyclists

Definition

A recurring obstacle to public transit use is the so-called last/first mile problem, which refers to the ending or starting leg of a journey. Walking and bicycling can be a solution.

History

While successive federal transportation bills, starting with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, have increased funding for bicycle and pedestrian facilities, there has been little effort to coordinate pedestrian and bicycle facilities with transit spending.[250]

Current Status

There has been a significant increase in transit systems' efforts to carry more bicycles on their vehicles.[251]

Potential to Increase Active Transportation

Improving pedestrian and bicycle features on public transit vehicles and facilities surrounding transit stations and stops has a measurable effect on increasing the amount that people walk or bicycle to transit. Enhancing other aspects of the transit experience through route maps, smart fare cards, and other transit aids will also make transit a more attractive alternative for pedestrians and bicyclists.[252,253]

Policies to Make Public Transit Easier to Use for Pedestrians and Bicyclists

Policy 1: Establish dedicated bicycle sections and bicycle carriers on transit vehicles

Policy 2: Increase pedestrian and bicyclist access to transit stops and stations

Policy 3: Provide route maps, arrival times, schedules, and integrated fare systems

Policy 4: Encourage transit-oriented development

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250 Schneider, R. 2005. *TCRP Synthesis 62: Integration of Bicycles and Transit.* Transportation Research Board: Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf [accessed on June 19, 2011].

251 American Public Transportation Association. 2009. *2009 Public Transportation Fact Book.* Available at: http://www.apta.com/gap/policyresearch/Documents/APTA_2009_Fact_Book.pdf [accessed May 19, 2011].

252 Ewing, R. and R. Cervero. 2010. Travel and the built environment. *Journal of the American Planning Association,* 76 (3): 265-294.

253 Pucher, J., J. Dill and S. Handy. 2010. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine*, 50: S106-S125.

2.4.2 Impact of Policies: Make Public Transit Easier to Use for Pedestrians and Bicyclists

Policy 1—Establish dedicated bicycle sections and bicycle carriers on transit vehicles

Definition

A bus bicycle carrier can hold two to three bicycles and can be used without assistance from the bus operator. On fixed- and light-rail transit systems entire cars or sections of a car can be designed to accommodate bicycles without interfering with other riders.

History

By 2008 70 percent of buses had bicycle racks.[254] On rail-based modes, most systems permit bicycles in cars, but with restrictions during peak periods. Folding bicycles are permitted on many trains and buses at all times.[255]

Effectiveness and Impact

Given that 53 percent of public transit trips in the U.S. are made by bus,[256] bus-bicycle integration has a significant potential impact. For rail transit, creating dedicated bicycle cars or areas for bicycles would extend the reach of bicycle travel considerably, given rail transit's generally greater speed.[257] Both efforts provide more transportation options.[258,259]

Economic Factors

There is limited data on the cost-benefit of investing in bicycle accommodations for rail transit.[260] For buses, accommodating bicycles with exterior racks is extremely cost-beneficial given that

254 American Public Transportation Association. 2009. *2009 Public Transportation Fact Book.* Available at: http://www.apta.com/gap/policyresearch/Documents/APTA_2009_Fact_Book.pdf [accessed May 19, 2011].

255 Metropolitan Transportation Authority. *MTA Bike & Ride.* Available at: http://www.mta.info/bike/ [accessed May 19, 2011].

256 American Public Transportation Association. 2010. *2010 Public Transportation Fact Book.* Available at: http://www.apta.com/resources/statistics/Documents/FactBook/APTA_2010_Fact_Book.pdf [accessed October 21,2010].

257 Martens, K. 2004. The Bicycle as a Feeding Mode: Experiences from Three European Countries. *Transportation Research Part D*, 9: 281-294.

258 Pucher, J. and R. Buehler. 2009. Integrating Bicycling and Public Transport in North America. *Journal of Public Transportation*, 12 (3): 79-104.

259 Hegger, R. 2007. Public Transport and Cycling: Living Apart or Together? *Public Transport International*, 2: 38-41.

260 McClintock, H. and D. Morris. 2003. Integration of cycling & light rapid transit: Realising the potential. *World Transport Policy & Practice*, 9 (3): 9-14.

they are inexpensive, easy to operate, and do not take up capacity within the vehicles themselves.[261]

Conclusion

Establishing dedicated bicycle areas and carriers on public transit vehicles helps make bicycling a more attractive option for a greater number of trips.[262]

Policy 2—Increase bicyclist and pedestrian access to transit stops and stations

Definition

Improvements to make transit more accessible to bicyclists and pedestrians include secure bicycle parking and storage[263, 264] and pedestrian-scale amenities such as wide walkways, protected crossings, and dedicated paths. Pedestrian improvements would result in calmer traffic movements directly adjacent to the station, increasing the safety of both bicyclists and drivers.[265, 266]

History

While bicycle parking around transit has increased, little attention has been paid to secure or covered facilities that would allow transit users to store their bicycles while they were on their trip. For pedestrians, barriers exist because many U.S. transit stations, built with automobile users in mind, are surrounded by large parking lots, which can make access to the stations difficult for non-motorized users.[267]

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261 Hagelin, C.A. 2005. *A Return on Investment Analysis of Bikes-on-Bus Programs*. National Center for Transit Research. Florida Department of Transportation: Tallahassee, Florida. NCTR 576-05. Available at: http://www.nctr.usf.edu/pdf/576-05.pdf [accessed on June 21, 2011]

262 Pucher, J., J. Dill and S. Handy. 2010. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine*, 50: S106-S125.

263 Martens, K. 2004. The Bicycle as a Feeding Mode: Experiences from Three European Countries. *Transportation Research Part D*, 9: 281-294.

264 Pucher, J., J. Dill and S. Handy. 2010. Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. *Preventive Medicine*, 50: S106-S125.

265 Pucher, J. and R. Buehler. 2009. Integrating Bicycling and Public Transport in North America. *Journal of Public Transportation*, 12 (3): 79-104.

266 Nabors, D., R. Schneider, D. Leven, K. Lieberman and C. Mitchell. 2008. *Pedestrian Safety Guide for Transit Agencies*. U.S. Department of Transportation Federal Highway Administration. FHWA-SA-07-017.

267 The Mineta Transportation Institute College of Business San José State University. 2002. *Envisioning Neighborhoods with Transit-Oriented Development Potential*. Available at: http://transweb.sjsu.edu/publications/envisioning/Envisioning.htm [accessed May 19, 2011].

Effectiveness and Impact

If access to transit is easy, safe, and convenient, more people will use it.[268] Supporting bicyclists at transit stations encourages transit ridership.[269,270,271] Limited study has been devoted to the ridership effects of making transit stops and stations safer and more "walkable."

Economic Factors

The space needed to store one automobile can accommodate 10 to 12 bicycles, making bicycle parking a more efficient use of land per unit of transportation than automobile parking.[272] Similarly, pedestrian infrastructure improvements are much less costly and have much broader benefits in terms of space and infrastructure than those for motor vehicles.[273]

Conclusion

Infrastructure improvements can increase bicyclist and pedestrian accessibility to transit and, in the case of bicyclists, increase the use of transit and the use of bicycles.[274]

Policy 3—Provide route maps, arrival times, schedules, and integrated fare systems

Definition

With the growth of smart phones and wider use of vehicle tracking devices, it is possible to deliver real-time information to transit patrons before they are on the system and while they are using it. [275,276] Smart card technology allows riders to pay fares for multiple agencies—bus, subway, light rail—with only one fare card, which makes using transit easier.[277,278,279]

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271 Martens, K. 2004. The bicycle as a feeding mode: Experiences from three European countries. *Transportation Research Part D*, 9: 281-294.

272 Schneider, R. 2005. *TCRP Synthesis 62: Integration of Bicycles and Transit.* Transportation Research Board: Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf [accessed on June 19, 2011].

273 Pucher, J. and L. Dijkstra. 2000. Making walking and cycling safer: Lessons from Europe. *Transportation Quarterly*, 54: 25-50.

274 Schneider, R. 2005. *TCRP Synthesis 62: Integration of Bicycles and Transit.* Transportation Research Board: Washington, D.C. Available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf [accessed on June 19, 2011].

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276 Tyrinopoulos, Y. and C. Antoniou. 2008. Public Transit User Satisfaction: Variability and Policy Implications. *Transport Policy*, 15 (4): 260-272.

277 Caulfield, B. and M. O'Mahony. 2009. A Stated Preference Analysis of Real-Time Public Transit Stop Information. *Journal of Public Transportation*, 12 (3): 1-20.

History

Nearly every major transit provider offers online route mapping and schedules. Smart cards, standard in all new systems, are rapidly being adopted by older systems.[280,281,282]

Effectiveness and Impact

Investing in transit service aids increases ridership.[283,284,285] Corresponding increases in physical activity should improve health.

Economic Factors

Because there is such a wide variety of devices and systems, it is not possible to derive a definitive cost estimate. However, it is generally acknowledged that many of these innovations, such as real-time tracking of vehicles and integrated smart fare cards, create co-benefits in terms of the transit system's operations.[286]

Conclusion

Transit aids, including route maps, schedules and fare, arrival and departure information, along with smart fare cards, can lead to increased public transit ridership. Transit systems in many cities have successfully implemented such services.

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279 Taylor, B.D., H. Iseki, M.A. Miller and M. Smart. 2009. *Thinking Outside the Bus: Understanding User Perceptions of Waiting and Transferring in Order to Increase Transit Use.* California PATH research report, UCB-ITS-PRR-2009-8.

280 Smart Card Alliance. *About Smart Cards: Applications: Transportation.* Available at: http://www.smartcardalliance.org/pages/smart-cards-applications-transportation [accessed February 28, 2011].

281 Iseki, H., A. Demisch, B.D. Taylor and A.C. Yoh. 2008. *Evaluating the Costs and Benefits of Transit Smart Cards*. California PATH research report, UCB-ITS-PRR-2008-14.

282 American Public Transportation Association. 2009. *2009 Public Transportation Fact Book*. April 2009. Available at: http://www.apta.com/gap/policyresearch/Documents/APTA_2009_Fact_Book.pdf [accessed: November 1, 2010].

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Policy 4—Encourage transit-oriented development

Definition

Transit-oriented development (TOD, also known as transit-oriented design) is high-density mixed-use development within walking distance of transit stations.[287,288,289]

History

Numerous municipalities and local governments have begun adopting land use policies that support TOD, but deployment has not been uniform or predictable.[290]

Effectiveness and Impact

TOD greatly reduces the need for driving.[291] Successful TODs reinforce both the community and the transit system and involve numerous components including: optimal transit system design; community partnerships; understanding local real estate markets; planning for TOD; coordination among local, regional, and state organizations; and providing the right mix of planning and financial incentives and resources.[292,293]

When coupled with measures to create a multi-modal transportation system, measures to facilitate TOD have often resulted in significantly high rates of transit use. More research, however, is needed to determine the degree to which residents of transit-oriented developments are "self-selecting," that is, already biased toward transit use before moving to the development.[294,295]

Economic Factors

Local governments' cooperation is essential in promoting TOD through plans, policies, zoning provisions, and incentives for supportive densities and designs. Development must be more than

287 Cervero, R., C. Ferrell and S. Murphy. 2002. *Transit-Oriented Development and Joint Development in the United States: a literature review*. TCRP Report Number 52. Transportation Research Board. National Academies of Science. Washington, DC.

288 California Department of Transportation. 2002. *Statewide Transit-Oriented Development Study: Factors for Success in California*.

289 TransitOrientedDevelopment.org. *Components of Transit Oriented Design*. Available at: http://www.transitorienteddevelopment.org/tod.html [accessed March 3, 2011].

290 Ibid.

291 California Department of Transportation. 2002. *Statewide Transit-Oriented Development Study: Factors for Success in California*.

292 Ibid.

293 TransitOrientedDevelopment.org. *Components of Transit Oriented Design*. Available at: http://www.transitorienteddevelopment.org/tod.html [accessed March 3, 2011].

294 Ewing, R. and R. Cervero. Travel and the Built Environment. *Journal of the American Planning Association* 6 (3): 265-294.

295 Cao, X., P. Mokhtarian and S. Handy. 2008. *Examining the Impacts of Residential Self-Selection on Travel Behavior: Methodologies and Empirical Findings*. Institute of Transportation Studies, UC Davis.

just adjacent to transit; it must be shaped by transit regarding parking, density, and/or building orientation to be considered transit-oriented.[296]

Altering land use regulations to support TOD requires that resources be devoted to updating comprehensive and economic development plans, as well as zoning, building, and subdivision codes. This primarily takes the form of planners' salaries and the costs related to public participation. TOD has the potential, if executed in tandem with multiple transit options, of adding substantially to government revenues in the form of sales and property taxes generated by the increased commercial and retail activity and land values.[297] The cost of supplying municipal services to TOD areas might appear to be higher, but could ultimately be lower if such development is constructed instead of lower-density development in undeveloped areas. While support for TOD is growing, many developers still consider these projects to be high risk.[298]

Conclusion

TOD can attract significant numbers of motorists to transit in areas that are experiencing rapid growth and rising traffic congestion and have an extensive transit network in place.[299]

2.4.3 Conclusions: Make Public Transit Easier to Use for Pedestrians and Bicyclists

Public transit is a natural partner to walking and bicycling, and by making transit easier for pedestrians and bicyclists to use, walking and bicycling's attractiveness as transportation alternatives increases. Transit authorities can make their vehicles and stops and stations more accessible to pedestrians and bicyclists by adding racks and bicycle parking and by improving walkways, entrances, and platforms. Transit aids, such as maps, route-finding applications, smart fare cards, and real-time arrival information can also enhance the attractiveness of transit and increase pedestrians' and bicyclists' transit use. The link between transit and pedestrians and bicyclists can also be strengthened by encouraging TOD—mixed-use, compact development near transit stops and stations—increasing the convenience of access to the transit system for those who walk and bicycle.

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296 California Department of Transportation. 2002. *Statewide Transit-Oriented Development Study: Factors for Success in California*.

297 Cervero, R., S. Murphy, C. Ferrell, N. Goguts, Y.H. Tsai, et al. 2004. *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects*. TCRP Report 102. Transportation Research Board. National Academies of Science. Washington, D.C.

298 Livable Places. *Encouraging Transit Villages*. Available at: http://www.livableplaces.org/policy/todincentives.html [accessed March 3, 2011].

299 Cervero, R. 2004. *Transit Oriented Development in America: Contemporary Practices, Impacts, and Policy Directions.* International Planning Symposium on Incentives, Regulations, and Plans –The Role of States and Nation-States in Smart Growth Planning. National Center for Smart Growth Research and Education, University of Maryland Habiforum Foundation, The Netherlands September 30-October 1, 2004.

2.5 Conclusions for Chapter 2

Enhancing community design to promote active transportation creates a number of co-benefits in addition to the individual and environmental health benefits associated with the primary goal of increasing trips made by walking and bicycling. Every motor vehicle trip that is replaced by a walk or a bicycle ride means less pollution, congestion, noise, and other elements that affect quality of life and adds social capital in the form of stronger community ties and a more human-scale environment.

The elements of community design that encourage active transportation also lead to more livable communities and improved quality of life. Greater connectivity, achieved by keeping block sizes small enough to be comfortable and walkable, locating key destinations closer together, and giving incentives for more compact and mixed-use development all contribute to the vibrancy of a community.

With the increase in interest in expanding transportation infrastructure investments that support active transportation, new, more human-scale approaches to street design are being adopted. Policies like Complete Streets make roadways compatible for all users. Programs like Safe Routes to School organize the provision of pedestrian and bicycle infrastructure around children's trips to and from school, but they have the effect of enhancing infrastructure for all pedestrians and bicyclists and increasing active transportation choices for all.

Bicycle boulevards, improved lighting, better crosswalks, added wayfinding and signage oriented to the non-motorized user, and slower speeds make active transportation a more attractive choice and increase active transportation trips, while making a community more attractive and livable as well.

In roadway facilities' design and operation, the needs of all road users are being incorporated into performance measures like level of service. More consideration is needed for pedestrian and bicyclist route analysis and pedestrian-friendly vehicle design.

Finally, public transit is a natural partner to walking and bicycling, and by making it easier for pedestrians and bicyclists to use transit, walking and bicycling's attractiveness as transportation alternatives increases. While there has been some progress in transit systems' capacity for carrying bicycles, the integration of walking and bicycling with transit in terms of station and stop design can be expanded considerably, along with enhanced use of transit aids such as online arrival information and route planning. The link between transit and pedestrians and bicyclists can also be strengthened by encouraging more mixed-use, compact development near transit stops and stations, increasing the convenience of access to the transit system for those who walk and bicycle.