CITIES AND ACCESSIBILITY: THE POTENTIAL FOR CARBON REDUCTIONS AND THE NEED FOR NATIONAL LEADERSHIP
by Keith Bartholomew

U.S. cities are a major contributor to greenhouse gas emissions. Collectively, the commercial and residential buildings that make up our urban areas contribute 38% of the nation’s human-generated carbon dioxide emissions and urban-related car and truck travel another 21%. And yet, American cities are a significant source of hope in the battle to reduce climate change impacts. True, American culture, policy, and affluence has created some of most resource consumptive landscapes in the world, but the picture is not uniformly dismal. In carbon emissions, as in real-estate, not all urban development is equal.

In fact, there is substantial variation in the resource consumption and carbon emission capacity of differing development patterns. Manhattan, for example, has been labeled one of the nation’s “greenest” places, in part because of its record of energy efficiency in transportation, while Raleigh-Durham has been identified as one of the most resource consumptive. While it is tempting to label these variations as just another dimension of the city-suburb continuum, that would be too simplistic and conclusory. Moreover, it would not offer much in the way of guidance for future action. Instead, what is needed is a framework that first provides some understanding of how people interact with their built environments and then offers constructive direction for policy development.

This article attempts to construct that framework. Part I begins by outlining the elements that should be included in the framework, using the concept of accessibility as the primary organizing structure. Part II describes how the framework might be made operational through the use of an emerging technique called land use–transportation scenario planning, and offers some indication of what deployment of that technique might mean for reductions in carbon emission

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2 See Gerald Mills, Cities as Agents of Global Change, 27 Int’l J. Climatology 1849, 1849 (2007) (“cities are directly and indirectly responsible for global changes in the atmosphere, hydrosphere, geosphere and biosphere”).
rates. Part III then assesses how well land use–transportation scenario planning fits within the dictates and limits of U.S. environmental and transportation laws.

The analysis reveals that accessibility based land use–transportation scenario planning holds substantial promise as a decision-making tool that could lead to meaningful cuts in carbon emissions. While the technique is accommodated by several important federal environmental and transportation laws, the fit is awkward. Moreover, the degree to which federal law mandates use of the technique is limited, indicating that its wide-scale deployment will likely also be limited. Given this outcome, the article concludes that national leadership is needed for the development of statutory revisions, principally in the federal transportation planning and funding law, which is scheduled for renewal by Congress in 2009.8

I. Mobility & Accessibility: Four Policy Levers

Patterns of land use and transportation investment that are carbon profligate can be differentiated from those that are carbon efficient by whether the pattern was designed and built to prioritize mobility, on the one hand, or accessibility, on the other. Strictly speaking, mobility focuses on the movement of vehicles in time and space.9 Accessibility, by contrast, focuses on the ease and convenience with which a person (or an increment of freight) can gain access to a needed activity.10 While the two concepts are related, they are not mutually dependent.11 In many circumstances increased mobility can increase a person’s level of accessibility to daily destinations.12 Assuming a constant geographic arrangement of destinations and low levels of traffic congestion, the number of places one can access in a car is frequently much greater than the number accessible by walking.13 Accessibility, however, is not dependent on mobility.14 For example, a person’s access to grocery shopping can be increased by the construction of a new store within walking distance of that person’s home or place of work. This would result in a net increase in the person’s accessibility in a way that is independent of mobility. In fact, the person’s expressed amount of mobility would likely decrease. Assuming households in Manhattan and Raleigh-Durham have roughly equivalent needs for access to basic daily

8 The article’s focus is on transportation-related energy and carbon issues, but the framework proposed here has many possible co-benefits, including farmland and open space preservation, protection of water quality, improvements in public health, and energy security. See Ewing, Bartholomew, Winkelman, Walters & Chen, supra note 4, at 10.
10 Id.; Harvey Miller, Place-Based Versus People-Based Accessibility, in ACCESS TO DESTINATIONS 63, 63 (David M. Levinson & Kevin J. Krizek eds., Elsevier 2005) (“Accessibility is a multi-faceted concept that ultimately centers on an individual ability to conduct activities within a given environment.”).
11 See Susan Handy, Planning for Accessibility: In Theory and in Practice, in ACCESS TO DESTINATIONS, supra note 10, at 131 (“mobility and accessibility are distinct concepts with vastly different implications for planning”).
12 Victoria Transport Policy Institute, Accessibility, in TDM ENCYCLOPEDIA (May 9, 2005), http://www.vtpi.org/tdm/tdm84.htm.
13 Id. This is not always the case, however. Consider the central portions of many of the world’s large cities (mid-town Manhattan, for example) where driving a car can actually provide for less accessibility than walking.
14 See Handy, supra note 11, at 133 (“Good mobility is neither a sufficient nor a necessary condition for good accessibility.” (emphasis in original)).
activities,15 Manhattanites accomplish the same tasks with substantially less mobility, especially auto-mobility, than those living in Raleigh-Durham.16

Given the environmental and climate impacts associated with increased levels of mobility,17 it would seem that the focus of land use and transportation planning, policy, and investment should be on accessibility. This, sadly, is not the case. Instead, for the past half-century, those efforts have been directed, almost exclusively, at reducing impediments to, and thereby increasing, mobility.18 The operative principles that lie behind this seeming obsession with mobility can be grouped into four basic policy “levers”: transportation infrastructure, transportation pricing, transportation education, and land use.19 These policy levers, which individually and synergistically influence individual travel choices and community level transportation patterns, have been pointed, almost uniformly, toward mobility based outcomes since the mid-20th century. Hence, moving toward an accessibility focused, and more carbon efficient, land use and transportation planning framework will require substantial readjustment to each one of the levers.

A. Transportation Infrastructure

The impact of transportation infrastructure on travel demand is sourced in the physical requirements of public investment to facilitate movement—one cannot drive on a road that does not exist. The presence of transportation infrastructure does much more than facilitate trips, however; it can, in fact, influence the timing, length, destination, and mode of a trip, or whether a trip is made at all. Although for decades transportation planning has been based on the assumption that the amount of demand for travel is set predominantly by demographic forces, it is now understood that demand also responds to the amount and nature of the supply provided. According to “Down’s Law,” demand for travel expands to fill the capacity provided to it.20

When a new or expanded facility adds significant amounts of capacity to a transportation system that formerly was near or beyond its capacity, travel on the new/expanded facility is easier and quicker compared to other travel options, at least initially. Because people, to a large degree, make travel choices that optimize for speed and convenience,21 they are apt to change their behaviors to take advantage of the new capacity. Those behavioral changes express

15 See Reid Ewing & Robert Cervero, Travel and the Built Environment, 1780 TRANSP. RES. REC. 87, 88 (2001) (showing that the number of total trips per household by all modes (i.e., “person trips”) varies little across different development patterns).

16 See Reid Ewing, Rolf Pendall & Don Chen, Measuring Sprawl and Its Impact App. 3 (2002) (showing average metropolitan levels of driving per person per day for New York and Raleigh-Durham of 15.4 and 31, respectively).

17 There are many sources that catalog environmental resources implicated in transportation systems. For a general summary of the issue, see F. Kaid Benfield, Matthew D. Raimi, Donald D.T. Chen, Once There Were Greenfields: How Urban Sprawl Is Undermining America’s Environment, Economy and Social Fabric (Natural Resources Defense Council 1999).


19 See Bartholomew, supra note 18, at 10600-610 (2007).


themselves in short-term shifts in daily travel patterns, medium-term changes in trip frequencies and lengths, and longer-term structural changes in land development patterns. These three phenomena are referred to, respectively, as triple convergence, induced travel, and induced development.

As the name implies, triple convergence connotes three ways in which travelers take advantage of a new or expanded transportation facility: by changing their time of travel, their travel mode, or their travel route. All three describe responses to the new or expanded facility’s increase in relative speed and convenience, compared to other travel choices. The temporal shifts occur among travelers who formerly avoided rush-hour congestion by traveling at other times; the new/expanded facility allows these travelers to change to traveling during the peak period. Travelers who formerly used modes of travel other than the one improved by the capacity expansion are similarly induced to switch to the improved mode. Travelers using other, parallel routes will likewise be encouraged to switch to the improved facility. Together, these three short-term adjustments to travel patterns converge to soak up substantial amounts of the new capacity offered by the new or expanded facility.

Induced travel describes the changes people make in trip frequency and length in response to transportation capacity increases. One might assume that as traveling becomes easier (i.e., faster), people would use the time saved toward some other productive activity, but this, largely, is not the case. Basic economics teaches that as a product becomes less costly, people tend to consume more of it. So it is with travel. When the cost of travel, in this case as measured by time, decreases, people tend to do more of it. This, despite the fact that travel is a “derived demand”—i.e., it is not a good in and of itself but a function that provides the means for obtaining goods or accomplishing tasks. It is now understood that people have a daily “travel time budget”—an amount of time that they are willing to devote to traveling each day. For most people, that budget is somewhere around 75 minutes, regardless of travel conditions; as average travel speeds increase or decrease, people make proportional changes to their trip-making behaviors to stay close to their travel time budget. Hence, as travel speeds increase due to a significant capacity expansion, many people respond by increasing their trip frequencies and lengths, particularly for discretionary trips such as shopping. For example, they begin making individual trips to stores they formerly visited as part of multi-destination tours—thereby increasing the rate at which they make trips—and they select stores further away than they did previously, adding to their average trip distances. These relationships are demonstrated

23 A short-term example of route convergence occurs every time travelers respond to radio traffic reports by altering their travel routes to avoid congestion and vehicle crashes.
24 Downs, supra note 22, at 82-86.
27 Hanson, supra note 9, at 3-4. But cf. Patricia L. Mokhtarian, Ilan Salomon & Lothlorien S. Redmond, Understanding the Demand for Travel: It’s Not Purely ‘Derived,’ 14 INNOVATION 355, 377 (2001) (“[W]e should begin to view travel not just as a disutility, but as a literal ‘good’ having both positive and negative characteristics.”).
29 Id.; Downs, supra note 22, at 104; Transp. Research Bd., supra note 22, at 145.
graphically, and somewhat cynically, by the cover of the April 1966 edition of Asphalt magazine (see Figure 1).

[Insert Figure 1 here]

Induced development (sometimes called induced growth) refers to the long-term changes in land use patterns resulting from significant capacity expansions, reflecting shifts in the origins or destinations of trips. Consistent with the total travel time budget outlined above, average travel times for various trip purposes (e.g., work, school, shopping) have remained relatively stable for decades, perhaps even for centuries. This has been especially true for commute trips. Throughout the last third of the 20th century, average commute times remained steady at approximately 25-30 minutes. Yet, during the same period, travel speeds increased appreciably, reflecting increases in travel capacity. Obviously, this meant that travel distances also increased. While in some cases the increased commute distances reflected shifts in workplace location, they more often reflected shifts in housing location, with commuters choosing to trade the increased travel speeds for more distant, and frequently larger, residences.

Adding or expanding a transportation facility usually also means increasing the potential traffic flow in the vicinity of the improvement, thereby increasing the number of people who can access those places—i.e., more people can now travel to those locations within a given timeframe. That increased access enhances the market attractiveness of those locations. For example, major retailers prefer highly accessible sites, as do businesses that rely on high levels of access to labor markets. The increased attractiveness, however, is relative: the locations served by the new or expanded facility have increased accessibility compared to other potential locations within a given market area. This means that the newly favored locations gain a competitive edge over the others. In time, this is likely to manifest itself through additional land

30 TERRY MOORE & PAUL THORSNES, THE TRANSPORTATION/LAND USE CONNECTION 23 (1994) (“In the long run (from one to 10 years, or longer), land uses will respond to the lower overall costs of transportation on the system. Households and businesses currently located within the urban area will consider the lower transportation costs when they decide to relocate.”).

31 See Peter O. Muller, Transportation and Urban Form, in THE GEOGRAPHY OF URBAN TRANSPORTATION, supra note 9, at 59, 61 (“[T]he spatial extent of the continuously built-up urban area has, throughout history, exhibited a fairly constant time-distance radius of about 45 minutes’ travel from the center . . . .”).

32 See Hanson, supra note 9, at 21; NEWMAN & KENWORTHY, supra note 5, at 27 (“In the United Kingdom, a government study found that travel time for work trips had been stable for six centuries . . . .”).

33 See Hanson, supra note 9, at 21.

34 See Barry Zondag & Martis Pieters, Influence of Accessibility on Residential Location Choice, 1902 TRANS. RES. REC. 63 (2005). Some observers have noted a recent reversal in this trend due, in part, to substantial increases in gasoline prices. See JOE CORTRIGHT, DRIVEN TO THE BRINK: HOW THE GAS PRICE SPIKE POPPED THE HOUSING BUBBLE AND DEVALUED THE SUBURBS (2008), http://www.ceosforcities.org/newsroom/pr/files/Driven%20to%20the%20Brink%20FINAL.pdf (charting how increased gas prices have resulted in significantly steeper declines housing prices and increased home foreclosures in far-out suburbs than in central cities and close-in suburbs); William H. Frey, Older Cities Hold on to More People, Census Shows, BROOKINGS, July 10, 2008, http://www.brookings.edu/papers/2008/0710_census_frey.aspx (showing population increases in older central cities as a result of increasing gasoline prices and a slowdown in the housing market); Gas Prices Shift Housing Demand toward Cities, NEW URBAN NEWS, June 2008, at 3.

35 Note that the use of the word access has shifted slightly in this in this context. People-based accessibility, as outlined supra page 3-5, refers to a person’s ease and convenience of being able to accomplish a needed task. Here, however, access refers to the ease of getting to a particular location. It is, hence, generally referred to as geographic- or place-based accessibility. See Miller, supra note 10, at 63, 64.

36 Genevieve Giuliani, Land Use Impacts of Transportation Investments, in THE GEOGRAPHY OF URBAN TRANSPORTATION, supra note 9, at 237, 240-41.
development in the areas surrounding the improved facility.\textsuperscript{37} The new or expanded facility does not create the demand for the new development, per se—in most cases the development would have occurred somewhere in the market area anyway. The new facility does, however, influence the location of the development—proximate to the expanded facility.\textsuperscript{38} This new development, of course, will have a certain amount of travel associated with it. Depending on the development’s size and type—commercial, residential, or industrial—the impacts of the added trips on surrounding transportation networks—including the newly expanded facility—could be substantial.

In the context of new or expanded highways, triple convergence, induced travel, and the travel generated by induced development conspire to swamp the additional capacity provided by a new or expanded facility.\textsuperscript{39} The extent to which these factors consume that capacity depends on a number of site-specific factors, particularly how congested the pre-existing roads were before the expansion. Studies estimate that the short-term effects could consume 40-50\% of the new capacity;\textsuperscript{40} “the longer-term effect is likely to be greater, with a higher proportion (perhaps all) of the time saved being used for further travel.”\textsuperscript{41} In other words, depending on local conditions, approximately half of the new capacity could be consumed by triple convergence and much of the rest consumed by the impacts of induced travel and induced development.\textsuperscript{42}


\textsuperscript{38} Id. The expanded facility could, additionally, influence the design of the induced development. For example, if the development attracted to an expanded suburban highway would have otherwise located in more central, transit-served areas, it is likely that the design of the development at the suburban highway location would be more auto-oriented than at the alternative sites. See, e.g., Isadore Barmash, Sears Plans Move to Site Near Chicago, N.Y. TIMES, June 27, 1989, at D5 (“The company will move its merchandising group from the Sears Tower, the 110-story downtown headquarters it has put up for sale, to a campus-like setting on a 700-acre site Hoffman Estates, 20 miles northwest of Chicago.”). This would likely lead to more auto use overall than if the development happened at the more central sites. See Hagler Bailly, Transportation and Environmental Analysis of the Atlantic Steel Development Proposal 21 (1999), available at http://www.epa.gov/projctxl/atlantic/as_51099.pdf (showing how siting a development proposed for central Atlanta at alternative suburban locations would result in increased vehicle travel of between 14.5\% and 52.3\%, depending on the location).

\textsuperscript{39} Downs, supra note 22, at 104 (“In the long run, road expansion could make congestion worse than it was initially.”).

\textsuperscript{40} Robert Cervero, Are Induced-Travel Studies Inducing Bad Investments?, 22 ACCESS 26 (2003); Robert Cervero & Mark Hansen, Road Supply-Demand Relationships: Sorting Out Causal Linkages (2000), http://www.uctc.net/papers/444.PDF.


\textsuperscript{42} See Mark Hansen & Yuanlin Huang, Road Supply and Traffic in California Urban Areas, 31 TRANSP. RES. A 205 (1997) (regression analysis showing that 1% increase in highway capacity leads to a .9% in vehicle miles traveled in five years); see also U.S. Envtl. Prot. Agency, Our Built and Natural Environments: A Technical Review of the Interactions Between Land Use, Transportation, and Environmental Quality 22 (2001) (“[I]nduced travel can occur and can absorb all new capacity.”). But cf. Transp. Research Bd., supra note 22, at 163 (“[O]nly part of the increased highway use can be attributed to the highway capacity addition.”).
Interestingly, these same relationships between supply and demand appear to apply to all transportation modes, not just to highways, although not to the same degree.\footnote{Fed. Highway Admin., U.S. Dep’t of Transp., Induced Travel: Frequently Asked Questions, http://www.fhwa.dot.gov/planning/itfaq.htm/q5 (“Improvements in any transportation system can lead to changes in travel behavior that will result in increased use of the system. A new bus route, rail transit line or commuter rail service is typically developed with the expressed purpose of ‘attracting new riders.’”).} For example, when the Utah Transit Authority added light rail service to its system for the first time in 1999, overall transit ridership increased 17% in just one year; an additional 9% increase occurred in the year after the agency opened its second line in 2001.\footnote{Utah Transit Authority, Comprehensive Annual Financial Report for Fiscal Year Ended December 31, 2004 56.} Similar effects have been observed for non-motorized travel as well.\footnote{1000 FRIENDS OF OREGON, MAKING THE LAND USE, TRANSPORTATION, AIR QUALITY CONNECTION: THE PEDESTRIAN ENVIRONMENT Vol. 4A (1993); Steven Erlanger, A New Fashion Catches on in Paris: Cheap Bicycle Rentals, N.Y. TIMES, June 13, 2008, at A6; Jan Hartman, The Delft Bicycle Network, in THE GREENING OF URBAN TRANSPORT (Rodney Tolley ed., Belhaven Press 1990) Philip Langdon, Biking Needs a Boost in American Cities, NEW URBAN NEWS, June 2008, at 11 (describing how Portland, Oregon’s aggressive efforts to provide bicycle facilities is associated with a bicycle commuting mode share four times the national average).} The effects in non-automobile contexts arise from the same factors observed with respect to highways: the added capacity provided by new or expanded facilities makes travel by those modes more attractive because of actual or perceived increases in speed or convenience.

As outlined, the provision of transportation supply through investments in infrastructure can significantly affect the choices travelers make in how, when, where, how often, and how far they travel. Rather than being fixed and pre-determined solely by demographic influences, demand tends to follow supply to a certain degree, lending credence to those who argue that regions cannot successfully build their way out of congestion.\footnote{See Downs, supra note 22, at 106.} In the end, people make smart choices that maximize the time and convenience efficiencies of their travel. If public policy and investment decisions make traveling in a certain method superior to other options, people will gravitate to that method. Since the 1950s, U.S. policy and investment decisions have made automobile driving the superior method\footnote{See, e.g., Brian D. Taylor, The Geography of Urban Transportation Finance, in THE GEOGRAPHY OF URBAN TRANSPORTATION, supra note 9, at 294, 307 (indicating that more than 87% of government spending on transportation capital facilities in 2000 went to roads and highways).} and people have responded by dramatically increasing their level of driving.\footnote{See BRUCE KATZ & ROBERT PUENTES, TAKING THE HIGH ROAD: A METROPOLITAN AGENDA FOR TRANSPORTATION REFORM 55 (2005) (indicating an approximate 300% increase in vehicle travel between 1960 and 2000, compared to a population increase of about 50%).} These increases in driving have been attended, of course, by commensurate increases in carbon dioxide emissions.\footnote{See EWING, BARTHOLOMEW, WINKELMAN, WALTERS & CHEN, supra note 4, at 22-23.}

The increased mobility that occurred as a result of these investment policies initially facilitated increased accessibility to a wide range of destinations. Over time, however, levels of accessibility steadily eroded. Through the effects of induced development, increased mobility has facilitated a steadily expanding development pattern.\footnote{See NEWMAN & KENWORTHY, supra note 5, at 31-32. But cf. CORTRIGHT, supra note 34; Frey, supra note 34.} The saturation of automobile-related infrastructure and corresponding automobile dependency within dominant segments of American society have helped lead to a dispersion of destinations, thereby increasing the distances between

\footnotesize{43 Fed. Highway Admin., U.S. Dep’t of Transp., Induced Travel: Frequently Asked Questions, http://www.fhwa.dot.gov/planning/itfaq.htm/q5 (“Improvements in any transportation system can lead to changes in travel behavior that will result in increased use of the system. A new bus route, rail transit line or commuter rail service is typically developed with the expressed purpose of ‘attracting new riders.’”).}
where people are and where they need to go. In a self-fulfilling way, this has made access to many destinations increasingly dependent on high levels of mobility, frequently achievable only by the automobile.\textsuperscript{51} These mobility levels, however, are not shared across society\textsuperscript{52} and they are increasingly difficult to maintain fiscally and environmentally.\textsuperscript{53} Even within the car owning and driving portions of society, destinations within a constantly dispersing development pattern are becoming less accessible because of increased distances\textsuperscript{54} and higher levels of automobile congestion.\textsuperscript{55}

To reverse these trends and move toward an accessibility focused planning process, the transportation infrastructure policy lever needs to shift substantially away from investments in highway expansion and toward non-highway investments that support a greater concentration of activities.\textsuperscript{56} Instead of obsessing on the need to ease or increase the flow of vehicles, transportation planning should refocus on facilitating accessibility to needed and desired activities. In other words, attention needs to shift from the needs of the machine to the needs of the operator.\textsuperscript{57}

\textsuperscript{51} See Hanson, supra note 9, at 4; Handy, supra note 11, at 133.

\textsuperscript{52} According to the U.S. Census, in 2000 more than 60.2 million Americans (21.4% of the population) were too young to drive (age 15 or younger); more than 25.4 million (9%) were 70 or older and may have limited or reduced ability to drive; more than 21.1 million (7.5%) reported a physical disability, which may impair driving abilities; and nearly 33.9 million (12.3%) had income below the poverty level, making the ownership and operation of an automobile financially prohibitive. U.S. Census Bureau, Census 2000 Summary File 1 & Summary File 3, available at http://factfinder.census.gov. See generally SURFACE TRANSPORTATION POLICY PROJECT, DRIVEN TO SPEND: PUMPING DOLLARS OUT OF OUR HOUSEHOLDS AND COMMUNITIES (2005); Michael Cameron, Transportation Efficiency and Equity in Southern California: Are They Compatible?, in JUST TRANSPORTATION: DISMANTLING RACE & CLASS BARRIERS TO MOBILITY 53, 59 (Robert D. Bullard & Glenn S. Johnson eds., New Society Publishers 1997) (“The 20 percent of the population in the lowest-income group receives 6 percent of the total regional transportation benefits . . . .”); AARP, BEYOND 50.03: A REPORT TO THE NATION ON INDEPENDENT LIVING AND DISABILITY 87 (2003) (“As people move from their 70s into their 80s, the proportion of licensed drivers drops from more than 90 percent to just over 50 percent.”), available at http://assets.aarp.org/rgcenter/il/beyond_50_il.pdf.

\textsuperscript{53} By one estimate, it would require the construction of nearly 5000 lane miles annually, at a cost of $24 billion a year, just to maintain current congestion levels in the seventy most congested urban areas in the U.S. SURFACE TRANSPORTATION POLICY PROJECT, AN ANALYSIS OF THE RELATIONSHIP BETWEEN HIGHWAY EXPANSION AND CONGESTION IN METROPOLITAN AREAS: LESSONS FROM THE 15-YEAR TEXAS TRANSPORTATION INSTITUTE STUDY, available at http://www.ucolick.org/%7Ede/AltTrans/analysis.html.

\textsuperscript{54} P.D. Prevedouros & J.L. Schofer, Trip Characteristics and Travel Patterns of Suburban Residents, 1328 TRANSP. RES. REC. 49 (1991) (indicating that residents of outer ring suburbs spend 25% more time in traffic despite higher speeds).

\textsuperscript{55} See DAVID SHRANK & TIM LOMAX, THE 2005 URBAN MOBILITY REPORT 2 (Texas Transportation Institute 2005) (“Measures in all of the population size categories show more severe congestion that lasts a longer period of time and affects more of the transportation network in 2003 than in 1982.”), available at http://mobility.tamu.edu/ums/report/.


\textsuperscript{57} See Handy, supra note 11, at 134 (“To plan for accessibility is to focus on the ends rather than the means and to focus on the traveler rather than the system: do people have access to the activities that they need or want to participate in?”).
B. Transportation Pricing

People tend to make their travel choices in response to perceptions of cost—in transportation, as in other areas of life, people look for bargains. It is not just the total cost of transportation that is influential, however, but also whether those costs are fixed or incremental. Fixed costs are those that do not vary with the amount of use. One either pays the cost—thereby gaining access to a particular travel option—or does not—resulting in the foreclosure of that option. Examples include the capital cost of buying a car or the cost of buying a monthly bus pass. In both cases, the amount of cost and the amount of use are unrelated, with neither affecting the other.

With incremental costs, on the other hand, costs and use are proportional: the more you use, the more you pay. Here, the best example is bus fare. Every time someone boards the bus, they pay a fare (assuming they do not have a pass). Other examples include highway tolls, parking (at meters or pay lots), fuel, and the exertion of pedaling a bicycle. Time and convenience costs are incremental, as well: the time spent sitting in traffic congestion or trolling for an on-street parking spot are paid per instance.

The basic rule is that people seek to maximize the use of transportation modes that are based predominantly on fixed-costs and minimize the use of incremental cost options. From a personal utility perspective, this makes sense. The fixed cost option is already paid for; using it more will not cost more. In fact, increased use of a fixed-cost transportation option lowers the calculated amortized per use cost of that option, often to the point where continued use is perceived to be free. In contrast, an incrementally charged option will, by definition, always...

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58 Tommy Gärling & Reginald G. Golledge, Cognitive Mapping and Spatial Decision-Making, in COGNITIVE MAPPING: PAST, PRESENT AND FUTURE 44, 51 (Rob Kitchin & Scott Freundschuh, eds., 2000); see TRANSP. RESEARCH BD., supra note 22, at 142 (“All else being equal, the lower the cost of highway travel, the greater the propensity to travel and the less priority residents and businesses will give to transportation relative to other preferences and costs of doing business.”); Kirk Johnson, Gas Prices Alter Habits of Many, But Far From All, N.Y. TIMES, Aug. 9, 2006.
59 See John E. Evans, IV, Kiran U. Bhatt & Katherine F. Turnbull, Road Value Pricing, in TRAVELER RESPONSE TO TRANSPORTATION SYSTEM CHANGES: CHAPTER 14, 2 (Transportation Research Board 2004) (outlining the arguments in favor of incremental road pricing); see also Hal R. Arkes & Catherine Blumer, The Psychology of Sunk Cost, 35 ORGANIZATIONAL BEHAV. & HUM. DECISION PROCESSES 124, 124 (1985).
60 See HAROLD H. KASSARJIAN & THOMAS S. ROBERTSON, PERSPECTIVES IN CONSUMER BEHAVIOR xii (outlining the standard micro-economic theory that “[c]onsumers will behave in such a way as to maximize utility.”).
61 Elizabeth Shay & Asad J. Khattak, Automobile Ownership and Use in Neotraditional and Conventional Neighborhoods, 1902 TRANSP. RES. REC. 18 (2005) (“[V]ehicles generally are treated by their owners as sunk costs.”).
62 See EDWARD BEIMBORN, ROB KENNEDY & WILLIAM SCHAEFER, INSIDE THE BLACKBOX: MAKING TRANSPORTATION MODELS WORK FOR LIVABLE COMMUNITIES 22 (Environmental Defense Fund n.d.), available at http://www.environmentaldefense.org/documents/1859_insideBlackBox.pdf (outlining why travel forecasting models exclude the fixed costs of vehicle ownership and maintenance from calculations to estimate the number of trips made by automobile versus the number made by transit); CAMBRIDGE SYSTEMATICS, POTENTIAL PUBLIC POLICY IMPLICATIONS OF PAY-AS-YOU-DRIVE (PAYD) LEASING AND INSURANCE PRODUCTS 1-1 (2006), available at http://www.lrrb.org/pdf/200639C.pdf (“Since vehicles depreciate whether or not they are driven, people are often motivated to drive more so that they ‘get their money’s worth’ from their ownership investment in the car.”).
cost more with additional use. Hence, travelers that have comparable fixed cost and incremental cost alternatives will almost always chose the former over the latter.63

On balance, most of the costs associated with car ownership and use are fixed. Of the $835 billion Americans spent on owning and operating private vehicles in 2001, 53% was spent on fixed costs—purchase price, financing, insurance, licensing, and registration—while only 20% was spent on incremental costs—fuel and tolls.64 Although some time and convenience costs associated with car use, such as those associated with traffic congestion, are paid incrementally, these are generally offset by the automobile's many time and convenience benefits, which also accrue incrementally.

By contrast, many of the costs associated with transit use are imposed incrementally. As mentioned, with the exception of monthly passes, fares are generally charged on a per use basis, which is by definition an incremental cost. In addition, transit travel tends to be significantly slower than auto travel,65 with much less geographic and temporal flexibility. These time and convenience costs are also paid incrementally.

Given these conditions, a casual observer would have to conclude that U.S. transportation policy either favors driving or is indifferent: well over half of the costs of driving are paid through fixed-cost methods, whereas the costs of using non-automobile modes, in both out-of-pocket and time costs, are paid incrementally. Intentional or not, the current transportation pricing methods are partially, but significantly, responsible for America’s automobile dependency66 and its resulting dispersal of destinations and decrease in accessibility.67 The transportation pricing policy lever of an accessibility focused planning paradigm would seek to reverse those conditions by shifting more of the costs of driving to incremental pricing methods,68 while charging more of the costs of using alternative modes through fixed-cost methods.69

63 See, e.g., Brian E. McCollom & Richard H. Pratt, Transit Pricing and Fares, in TRAVELER RESPONSE TO TRANSPORTATION SYSTEM CHANGES: CHAPTER 12, 24 (Transportation Research Board 2004) (explaining how the introduction of unlimited use passes in New York resulted in a 6.6% increase in ridership).
64 U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2006 694 (2005). The remaining 27% was spent on maintenance and parking. Maintenance has attributes of being both fixed and incremental, while parking could be either fixed or incremental depending on whether it is purchased through a permit (fixed) or by amount used (incremental). Of course, the recent increases in fuel costs are changing the balance.
65 See ALAN E. PISARSKI, COMMUTING IN AMERICA III: THE THIRD NATIONAL REPORT ON COMMUTING PATTERNS AND TRENDS 109 (2006) (average travel time by solo car commuters was 24.06 minutes in 2000, compared with 45.88 for bus commuters).
67 The recent spikes in gasoline prices demonstrate this price/dispersal relationship, though in reverse. See CORTRIGHT, supra note 34; Frey, supra note 34.
68 See, e.g., CAMBRIDGE SYSTEMATICS, supra note 62, at 3-5 (showing that households participating in a pay-as-you-drive auto insurance program drive 8% fewer miles than similar households that buy fixed-cost auto insurance); JAMES M. WHITTY, OREGON’S MILEAGE FEE CONCEPT AND ROAD USER FEE PILOT PROGRAM vi (2007) (showing a 22 percent decline in peak period driving in response to the imposition of a congestion-based mileage road user fee). See generally, FEDERAL HIGHWAY ADMINISTRATION, CONGESTION PRICING: A PRIMER (2006), available at http://ops.fhwa.dot.gov/publications/congestionpricing/index.htm.
69 See, e.g., Sungyop Kim & Gudmundur F. Ulfarsson, Curbing Automobile Use of Sustainable Transportation: Analysis of Mode Choice on Short Home-Based Trips, 35 TRANSP. 723, 735 (2008) (“bus pass holders have a higher propensity towards both bus and bike for short trips”); McCollom &. Pratt, supra note 63, at 12-7; William Neuman, In Decade of Unlimited Rides, MetroCard Has Transformed How the City Travels, N.Y. TIMES, July 16, 2008, at B3 (describing how the introduction of unlimited ride transit passes resulted in steep
C. Transportation Education

In addition to transportation infrastructure and pricing, education plays an important role in influencing travel choices. People will consider only those travel options contained in a “choice set” comprised of alternatives they deem to be viable methods for meeting their needs. Because options not contained in a choice set will not be considered, understanding and influencing the cognitive processes behind the formation of choice sets is crucial to affecting ultimate travel decisions. Factors used in choice set formation processes include the physical availability of options, cultural and familial influences, and lifestyle preferences. Also relevant is the amount and quality of information a user has about various travel options; one cannot choose an option that is fully or partially unknown. Making rational travel choices, consequently, is dependent on having complete information about the choices available; having incomplete information will artificially restrict formation of the choice set, leading to a skewed selection process.

The transportation information provided in modern America is dominated, almost universally, by information about automobiles. From parental and societal conditioning, to blanket advertising in the media, to drivers’ education courses in school, Americans are bombarded with information about how to use streets and highways to drive cars. Information about other travel choices is much harder to come by. Nevertheless, in those comparatively limited instances when marketing is attempted to promote non-auto modes, it has been effective in changing travel patterns.
The impact of transportation-related education on travel choices demonstrates its importance in creating an accessibility focused planning system. Under such a system, the transportation education policy lever would shift to aggressively promote non-auto modes and discourage driving, particularly solo driving.77

D. Land Use

The built environment through which a transportation system traverses can have a substantial effect in how people choose to travel.78 Land use patterns can determine whether it is cost-effective to run a bus through a neighborhood, whether it is feasible to run mid-day errands without a car, and whether it is possible to safely and conveniently cross the street on foot. If transportation is about getting from here to there, land use defines the nature of here and there and in so doing defines the range of transportation options that are feasible. For convenience, land use issues are frequently sub-categorized into five “Ds”: density, diversity, destination proximity, distance to transit, and design.79

1. Density

Density is a representation of land use intensity that directly or indirectly measures the concentration of human activity. Persons living in higher density neighborhoods tend to be less automobile dependent,80 own fewer cars,81 and drive them less often82 and for shorter distances83 than persons living in lower density neighborhoods. Conversely, denser neighborhoods are generally associated with higher use levels of non-automotive modes.84 The relationship between density and travel patterns is sourced in accessibility. People living and working in denser

http://www.vtpi.org/tdm/tdm23.htm (“Given adequate resources, marketing programs can often increase use of alternative modes by 10-25% and reduce automobile use by 5-15% . . . .”).
78 See DOWNS, supra note 22, at 200 (“A principal cause of the massive amount of daily travel in nearly every U.S. metropolitan area is the low density of residential and other settlements there.”).
80 Zhang, supra note 70, at 59.
83 See NEWMAN & KENWORTHY, supra note 5, at 100-103; Reid Ewing, Is Los Angeles-Style Sprawl Desirable?, 63 J. AM. PLAN. ASS’N, 107, 113 (1997) (“By various estimates, doubling urban density results in a 25-30 percent reduction in VMT, or a slightly smaller reduction when the effects of other variables are controlled . . . .”); Kuzmyak, Pratt & Douglas, supra note 79, at 13-23; Shay & Khattak, supra note 61, at 19.
84 See 1000 FRIENDS OF OREGON, supra note 45, at 22; PUSHKAREV & ZUPAN, supra note 82, at 29-35; TRANSYSTEMS CORP., supra note 76, at 2-12 (“For bus routes, and indeed for transit in general, perhaps the most important single factor affecting ridership is the density of development in the corridor served by the route.”); Kuzmyak, Pratt & Douglas, supra note 79, at 30-35.
neighborhoods usually have access to a much greater range of potential activities within close proximity than those in lower density neighborhoods. That increased accessibility makes lower rates of auto use possible and use of alternative modes convenient, even preferable. People in higher density neighborhoods are not staying home more than those in low density neighborhoods; they make just about as many total trips as their low density cousins, but they rely much more on non-automobile modes and they travel substantially fewer miles.

2. Diversity

Diversity refers to the mix of land uses within a small geographic area. The focus is not just on the traditional broad categories of residential, commercial, and industrial, but also on land use types within those categories. For example, the commercial component of a diverse environment might include small real estate offices, a large law firm, a couple of travel agencies, hair salons, tax accountant offices, health spas, music shops, a large department store, restaurants and cafes, and a book store. Suburban developments frequently have very little land use diversity; often they are comprised of a narrow range of land use types within a single category. Residential areas will not only be just residential, but will frequently contain only a limited number of product-types aimed at a rather narrow socio-economic market; for example, single-family detached houses within a set range of sizes and prices. By comparison, city or town centers may contain a wide variety of residential uses (e.g., single-family detached houses, rental apartments, condos, and assisted living buildings) mixed in with a host of office, retail, manufacturing, cultural, educational, and entertainment organizations and businesses.

As with density, the amount of diversity correlates with a range of variation in travel patterns: as the amount of diversity increases, the amount of single-occupant automobile driving decreases and the use of other transportation modes increases. People living in more diverse neighborhoods tend to own fewer cars and drive them less frequently than those living in more homogenous environments. Those who commute to work sites located in diverse neighborhoods are more likely to travel by non-auto modes than those working in single-use locations. As with density, having a wider choice of land uses in closer proximity means that it

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88 See Hess & Ong, supra note 81, at 41 (“Households in neighborhoods with mixed land use are 31 percentage points more likely to be without an automobile than households in homogeneous neighborhoods.”).
89 See Cervero & Kockelman, supra note 79, at 218; K.M. Kockelman, Travel Behavior As a Function of Accessibility, Land Use Mixing, and Land Use Balance — Evidence from the San Francisco Bay Area, 1607 TRANSP. RES. REC. 116 (1997).
90 See CAMBRIDGE SYSTEMATICS, THE EFFECTS OF LAND USE AND TRAVEL DEMAND MANAGEMENT STRATEGIES ON COMMUTING BEHAVIOR (U.S. Dept. of Transp., Travel Model Improvement Program 1994) (quoted in Victoria Transport Policy Institute, TDM Encyclopedia “Land Use Impacts on Transport,” http://www.vtpi.org/tdm/tdm20.htm); ROBERT CERVERO, AMERICA’S SUBURBAN CENTERS 165 (Unwin Hyman
is more likely that daily activities will be more accessible with less travel. Although there is overlap among the two concepts, they are each based on different questions: density asks How much stuff is there?; diversity asks What kind of stuff is there?

3. Destination Proximity

Destination proximity measures the degree to which a development pattern is centralized and compact. On average, people living in neighborhoods that are closer to a region’s center tend to drive less than those living in comparable neighborhoods located at the fringe. An analysis done for the Atlantic Steel redevelopment project in downtown Atlanta demonstrates this phenomenon. The study compared the relative transportation impacts of the proposed development at the downtown site with equivalent amounts of development at three suburban locations: a perimeter beltway site (Perimeter Center), a suburban site (Cobb/Fulton), and an exurban site (South Henry County). The analysis shows that the amount of driving associated with the development varies dramatically, depending on the location. At the Perimeter Center site, the development would generate 14.5% more vehicle miles traveled (VMT) than if it were located downtown; at the South Henry County site, the difference was 52.3% (see Table 1).

As with the two prior Ds, the issue is accessibility. Central locations are closer to a larger number and wider range of potential activities than fringe sites. This makes the use of non-auto travel modes more feasible and reduces the length of most trips, regardless of mode.

4. Distance to Transit

Proximity to transit services is another important way land use influences travel patterns. The closer the origin or destination of a trip is to a station on a high-capacity transit network, the less likely that daily activities will be more accessible with less travel. Although there is overlap among the two concepts, they are each based on different questions: density asks How much stuff is there?; diversity asks What kind of stuff is there?  

1989) (“Among all the site variables examined, the degree of land use mixing appears to have the greatest influence on the modal choices of . . . workers.”).

See Michael J. Greenwald & Marlon G. Boarnet, Built Environment as Determinant of Walking Behavior: Analyzing Nonwork Pedestrian Travel in Portland, Oregon, 1780 TRANSP. RES. REC. 33, 41 (2001) ("[T]he most important determinant of walking behavior appears to be trip distances: shorter distances increase the likelihood of individual walking trips for nonwork activities.").

Kuzmyak, Pratt & Douglas, supra note 79, at 93-94.

Ewing & Cervero, supra note 15, at 92 (“Total household vehicular travel . . . is primarily a function of regional accessibility”).

The analysis was completed to qualify the project and associated transportation improvements as a Transportation Control Measure under the Clean Air Act. See 42 U.S.C. § 7408(f)(1)(A) (2000).


Id. at 2-5.

Some writers, in fact, refer to this variable as regional or destination accessibility. See Ewing, BARTHOLOMEW, WINKELMAN, WALTERS & CHEN, supra note 4, at 67; Ewing & Cervero, supra note 15, at 92. The phrase destination proximity was used here to avoid confusion with the other applications of accessibility used in this article.

See Kim & Ulfarsson, supra note 69.
(usually rail-based), the more likely a person is to use transit for at least some trips. Similar to the other D variables, proximity translates as convenience. The closer one is to a transit station, the easier it is to walk to that station. As distance from the station increases, driving becomes relatively more convenient. Studies show that the major break-off point between being close enough and being too far appears to be around ¼ mile: within ¼ mile, transit ridership is approximately twice as high as it is between ¼ and ½ mile. After ½ mile, ridership rates fall even faster.

5. Design

While all of the previous D variables are related in some way to physical proximity between trip origins and destinations, design is targeted at the specific ways in which origins and destinations are connected. Design, in this context, refers to a wide array of small-scale features in the built environment that make travel by one mode or another relatively easy and convenient or cumbersome and problematic. For example, a landscape designed for the convenience of car drivers might include multi-lane arterials, few intersections, large blocks, and ample parking lots located in front of buildings. Those same features, however, would likely make pedestrian travel unpleasant, indirect, and perhaps unsafe. Pedestrians tend to prefer narrow, slow-speed streets, frequent crosswalks, small blocks, ample sidewalks, street-fronting buildings, and various amenities that make walking pleasant (e.g., street trees, street furniture, and visually interesting building facades). Logic suggests that such features can either facilitate or confound certain travel options. While the evidence is not conclusive, it appears that people do respond, at some level, to the indicated transportation design preference in a way that is consistent with that preference—e.g., people accessing environments with high-quality

99 See Jennifer Dill, Transit Use and Proximity to Rail: Results from Large Employment Sites in the San Francisco, California, Bay Area, 1835 TRANSP. RES. REC. 19 (2003).
101 Dill, supra note 99, at 23.
102 See, e.g., JAMES HOWARD KUNSTLER, THE GEOGRAPHY OF NOWHERE 115 (Touchstone 1993) (“The suburban streets of almost all postwar housing developments were designed so that a car can comfortably maneuver at fifty miles per hour—no matter what the legal speed limit is.”); MICHAEL SOUTHWORTH & ERAN BEN-JOSEPH, STREETS AND THE SHAPING OF TOWNS AND CITIES 4 (McGraw-Hill 1997) (“Design of the residential street network is based on statistical information and research that is primarily oriented to facilitating vehicle movement on large-scale streets and highways.”); Kuzmyak, Pratt & Douglas, supra note 79, at 15-58.
104 See Allan B. Jacobs & Donald Appleyard, Toward an Urban Design Manifesto, 53 J. AM. PLAN. ASS’N 112, 119 (1987) (“It is not enough to have high densities and an integration of activities to have cities.”).
pedestrian features are more likely to travel by non-auto modes than those accessing environments dominated by automobile design features.105

The definition of what design features are important in determining mode orientation is not firmly set.106 Many studies focus on the layout of local streets: a street pattern containing smaller blocks arranged in a rectilinear orientation with a high density of four-way intersections is thought to be more conducive to pedestrian and bicycle movement than large block patterns with irregularly shaped blocks and few intersections. The rationale is that when people are traveling under their own power they are much more sensitive to travel distance, in general, and out-of-direction travel, in particular.107 A route that is more direct and, hence, shorter is more likely to induce someone to walk or bike than a route that is long and circuitous.108 A mid-1990s study attempting to measure the impacts of street connectivity in combination with other pedestrian design attributes—sidewalk connectivity, frequency of street crossings, and topography—found that households located in neighborhoods with a high level of these attributes had 10% fewer vehicle miles traveled than households in neighborhoods with only average levels.109 The location of parking at commercial buildings—in the front or side of the building versus in the back—also appears to be important in affecting travel choices.110

Identifying quantifiable travel responses with neighborhood-scale design elements is a relatively new research area,111 and many methodological issues have yet to be resolved.112 As a result, the degree of significance between specific design elements (e.g., street furniture, sidewalk and intersection density, street widths) and variations in travel choice is not well defined, making a precise articulation of optimal design elements difficult. In the studies

105 See U.S. ENVTL. PROT. AGENCY, supra note 95, 2-4 to 2-9 (showing that rearranging the proposed site plan for the Atlantic Steel redevelopment project to include a finer grain of streets and a more mixed land use pattern would reduce vehicle miles travel by 5.8%).
106 See Terri Pikora, Billie Giles-Corti, Fiona Bull, Konrad Jamrozik & Rob Donovan, Developing a Framework for Assessment of the Environmental Determinants of Walking and Cycling, 56 SOC. SCI. & MED. 1693, 1694 (2003) (“[I]t is unclear which specific features of the environment are important and how they influence physical activity.”).
107 Greenwald & Boarnet, supra note 91, at 41.
108 Kuzmyak, Pratt & Douglas, supra note 79, at 93 (“If a destination is close enough, walking or bicycling in lieu of motorized travel becomes a viable option.”).
109 1000 FRIENDS OF OREGON, supra note 45, at 32 (the results came from a multiple regression analysis that controlled for a variety of household demographic variables, as well as land use density and job accessibility); see CAMBRIDGE SYSTEMATICS ET AL., SAN FRANCISCO TRAVEL DEMAND FORECASTING MODEL DEVELOPMENT: FINAL REPORT (San Francisco County Transportation Authority 2002); MICHAEL REPKGLE, INTEGRATING PEDESTRIAN AND BICYCLE FACTORS INTO REGIONAL TRANSPORTATION PLANNING MODELS: SUMMARY OF STATE-OF-THE-ART AND SUGGESTED STEPS FORWARD (Environmental Defense Fund 1995). But cf. SUSAN HANDY, ROBERT C. PATERSON & KENT BUTLER, PLANNING FOR STREET CONNECTIVITY: GETTING FROM HERE TO THERE 16-17 (American Planning Association 2003) (outlining controversy among studies, some showing that grid street patterns may increase trip making (including by car) while others showing gridded streets resulting in less driving).
110 See Cervero & Kockelman, supra note 79, at 214 (“[S]omeone heading to a shop within their neighborhood is, on average, 56% more likely to drive alone if all buildings are surrounded by front- and side-lot parking vs. if all buildings have rear-lot parking.”); see also 1000 FRIENDS OF OREGON, MAKING THE LAND USE, TRANSPORTATION, AIR QUALITY CONNECTION: BUILDING ORIENTATION Vol. 4B (1994); ANNE VERNEZ MOUDON, EFFECTS OF SITE DESIGN ON PEDESTRIAN TRAVEL IN MIXED USE, MEDIUM-DENSITY ENVIRONMENTS (Washington State Transportation Center 1996).
111 See Ewing & Cervero, supra note 15, at 87 (the study of the travel impacts of land use design is “the newest frontier in travel research”).
112 See, generally, BOARNET & CRANE, supra note 21.
identified above, researchers were not able to discern whether the identified design features—street crossings, sidewalk networks, etc.—were solely responsible for the observed variations in travel patterns or partly responsible in combination with other, unidentified design elements, or whether the features acted merely as proxies for other characteristics.\(^{113}\) The difficulty in quantifying the transportation impacts of precise design components reflects, in part, the nature of neighborhood design issues and a mismatch of scales of analysis: travel patterns are assessed at a regional scale, while neighborhood design issues are articulated and addressed in very specific and localized contexts that vary greatly from neighborhood to neighborhood. In one neighborhood, increasing pedestrian-friendliness will require the construction of a new mid-block street crossing, in another, the widening of a sidewalk and planting of street trees, in still another, the narrowing of travel lanes on an arterial.\(^{114}\) Moreover, most design components considered important to travel choice processes usually appear in groups of attributes, not as single features,\(^{115}\) suggesting the possibility of overlapping and synergistic relationships. Regardless of the difficulty of identifying a precise list of components, the evidence indicates that some combination of small scale design features is important in influencing transportation choice processes.\(^{116}\)

Collectively, the five Ds of density, diversity, destination proximity, distance to transit, and design distinguish built environments that facilitate access to desired activities and functions from those that frustrate such access. These spatially based elements are, hence, at the root of accessibility.\(^{117}\) Unfortunately, for most of the last century, the five Ds in American land use patterns have been largely directed toward decreased levels of accessibility: low density, single use developments in isolated locations with poor access to transit and auto-oriented design.\(^{118}\) An

\(^{113}\) See 1000 FRIENDS OF OREGON, supra note 45, at 34 (the factors used in the study to assess pedestrian friendliness “do not represent a taxonomy of attributes which support pedestrian activity”); see also BOARNET & CRANE, supra note 21, at 109-11 (articulates the potential for “self-selection” bias, i.e., that pedestrian-designed neighborhoods tend to attract people who are predisposed to walk).

\(^{114}\) See, e.g., ANN FORSYTH & STEPHEN A. GOLDSMITH, TOWARDS A WALKABLE DOWNTOWN: URBAN DESIGN STRATEGIES TO IMPROVE THE PEDESTRIAN ENVIRONMENT IN DOWNTOWN SALT LAKE CITY (2000) (outlining specific proposed improvements to the pedestrian environment in Salt Lake City on a block-by-block basis).

\(^{115}\) See, e.g., DAVID SUCHER, CITY COMFORTS 66-99 (outlining 37 neighborhood design strategies to increase pedestrian and transit travel).

\(^{116}\) TRANSP. RESEARCH BD., DOES THE BUILT ENVIRONMENT INFLUENCE PHYSICAL ACTIVITY? EXAMINING THE EVIDENCE 158 (2005) (“[P]ositive perceptions about shade, scenery, traffic, people, safety, and walking incentive and comfort were positively correlated with numbers of walking trips to neighborhood commercial areas.”).

\(^{117}\) See Levinson, Krizek & Gillen, supra note 18, at 1 (“Like a house is a machine for living, cities are the machine for accessibility.”). Cf. Miller, supra note 10, at 63 (“A place-based approach to accessibility by itself is no longer viable in a world where transportation and [information and communication technologies] are drastically changing the relationships among place, space and person.”).

\(^{118}\) See HENRY DIAMOND & PATRICK E. NOONAN, LAND USE IN AMERICA 4 (1996) (showing increases in developed land between 1970 and 1990 of up to six times the rate of population increase); Downs, supra note 22, at 251 (indicating that less than 20% of the jobs in the 11 largest U.S. metropolitan areas are located within three miles of the regional center); NEWMAN & KENWORTHY, supra note 5, at 31-32 (outlining the increasing dominance of “Auto City” development patterns after 1945); Joseph J. Persky & Wim Wiewel, Introduction, in SUBURBAN SPRAWL: PRIVATE DECISIONS AND PUBLIC POLICY xiii-xiv (Wim Wiewel & Joseph J. Persky eds., 2002) (“from 1970 to 1990 the amount of urbanized land [in the Chicago region] grew by 46 percent, while the population increased by only 4 percent”); U.S. ENVTL PROT. AGENCY, supra note 42, at 4-8 (tracing land use trends in the second half of the 20th century toward more dispersed, low density, and auto-oriented development patterns).
accessibility focused planning process would seek to reverse these trends and use the five Ds to promote built environments where potential origins and destinations are within close proximity and conveniently connected to each other.\(^{119}\)

II. Accessibility Based Scenario Planning

Having identified four policy levers that can be used to prioritize accessibility, how can those levers be made operational? One option is a technique known as scenario planning.

A. Asking “What if”?

Scenario planning asks a series of questions about the future that impliedly, if not literally, begin with what if. What if we arranged future land use development patterns a certain way and integrated them with transportation investments? What if we added a new parking pricing policy? What if gas prices double in the next decade or two? What if the climatic conditions changed drastically in our region? What would happen to our residents’ quality of life should any of these scenarios come to pass? Because all of these “what ifs” are about the future, we can never be certain that any of them will come to pass or, if they do, to what degree. Scenario planning is a way of thinking that can bound the range of these uncertainties and bracket the risks inherent in planning for a future that no one can predict.\(^{120}\)

A scenario is “an internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome.”\(^{121}\) Scenarios, fundamentally, are stories about the future, with beginnings, middles, and endings.\(^{122}\) In fact, the use of scenario in the planning context is derived from the term’s use in Hollywood screenwriting.\(^{123}\) Scenarios need not—and indeed, cannot—be unerringly predictive. Rather, their job is to present a vision of the future that is internally coherent and plausible in light of known information.\(^{124}\)

A process that uses scenarios to assess the future—a “scenario planning” process—employs a series of scenarios to define a range of possible future conditions. The scenarios are crafted around the key driving forces in local and macro environments that are both most important to the resulting decision and most uncertain.\(^{125}\) The expectation is that through the

\(^{119}\) See Eliot Allen & F. Kaid Benfield, Environmental Characteristics of Smart-Growth Neighborhoods 17 (National Resources Defense Council 2003) (found that a neighborhood in Tennessee with modestly higher density, mix and connectivity had 25% fewer per capita VMT than an otherwise comparable nearby neighborhood), available at http://www.nrdc.org/cities/smartGrowth/char/charnash.pdf; Asad J. Khattak & Daniel Rodriguez, Travel Behavior in Neo-Traditional Neighborhood Developments: A Case Study In USA, 39 TRANSP. RES. A 481 (2005) (found that residents of a “New Urbanist” neighborhood in North Carolina generated 22.1% fewer automobile trips and made three times as many walking trips than residents of an otherwise similar neighborhood, even when controlling for demographic factors and preferences).


\(^{124}\) Gill Ringland, Scenarios in Public Policy 176 (2002).

process of conceiving, crafting, and evaluating a series of scenarios, an appropriate course, or series of courses, of action can be identified.\textsuperscript{126} Hence, through this process, the wide-open question of what the future might bring can be narrowed down to a more manageable set of possibilities.\textsuperscript{127}

The historic roots of scenario planning are based in military contexts and are reflected in writings that date back as far as Sun Tzu’s fourth century BCE treatise \textit{The Art of War}.\textsuperscript{128} In the 1950s, scenario planning was used by the RAND Corporation to assess a range of potential nuclear conflict situations.\textsuperscript{129} In the early 1970s, the technique migrated to corporate strategic planning circles, where it was used to analyze economic conditions.\textsuperscript{130} Undoubtedly, the most famous application of the technique from that period was Royal Dutch/Shell’s study that effectively anticipated the 1973 OPEC oil embargo.\textsuperscript{131}

\section*{B. Land Use–Transportation Scenario Planning}

During the 1990s, a form of scenario planning emerged that essentially grafted the military/business practice onto the more customary transportation planning structures of the metropolitan transportation planning process required by the Federal-Aid Highway Act of 1962\textsuperscript{132} and the alternative analysis requirements of the National Environmental Policy Act of 1969 (NEPA).\textsuperscript{133} The resulting hybrid infuses the more traditional alternatives analysis procedures with a new set of variables drawn from land use and transportation demand management fields.\textsuperscript{134}

The motivation behind the merger was a growing dissatisfaction with the traditional practice of using a single geographic allocation of future household and employment growth for transportation modeling and forecasting.\textsuperscript{135} That practice ignored well-established knowledge about the interactive relationship between transportation investments and land use patterns,\textsuperscript{136} outlined in the previous section. To incorporate those relationships, several leading transportation studies in the late 1980s/early 1990s employed a range of growth allocations.

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{126} Michel Godet, \textit{Scenarios and Strategic Management} 22 (1987).
\item \textsuperscript{127} Geogantzazas & Acar, \textit{supra} note 120, at 138
\item \textsuperscript{128} See \textit{Sun Tzu on the Art of War: The Oldest Military Treatise in the World} 46 (Lionel Giles trans., Project Gutenberg 1910) (analogizing military strategy to the properties of water, the writer praises the captain who can “modify his tactics in relation to his opponent”); cf. Ute von Reibnitz, \textit{Scenario Techniques} 11 (1988) (“The earliest traces of a method for viewing or knowing the future are to be found in the writings of Seneca.”).
\item \textsuperscript{129} Ringland, \textit{supra} note 123, at 12.
\item \textsuperscript{130} Reibnitz, \textit{supra} note 128, at 12; see Ringland, \textit{supra} note 123, at 17.
\item \textsuperscript{131} Schwartz, \textit{supra} note 125, 7-10.
\item \textsuperscript{132} 87 Pub. L. No. 866, 76 Stat. 1145.
\item \textsuperscript{133} 42 U.S.C. § 4332(2)(C)(iii) (2000).
\item \textsuperscript{134} Keith Bartholomew, \textit{Land Use–Transportation Scenario Planning: Promise and Reality}, 34 \textit{Transp. 397, 398} (2007).
\item \textsuperscript{136} See generally Reid Ewing, Transportation & Land Use Innovations: When You Can’t Pave Your Way Out of Congestion (1997); Ewing, Bartholomew, Winkelman, Walters & Chen, \textit{supra} note 4, at 55-89; Gerrit-Jan Knaap & Yan Song, \textit{The Transportation–Land Use Policy Connection}, in \textit{Access to Destinations}, \textit{supra} note 10, at 91 (tracing understanding about land use–transportation connections to the Dutch purchase of Manhattan from Native American inhabitants in the 17th century).
\end{itemize}
\end{footnotesize}
essentially using future land use as an input variable instead of as a static assumption.\textsuperscript{137} Although earlier academic studies pioneered the use of this approach,\textsuperscript{138} the later projects formalized the method and brought it into public planning and decision-making contexts. Assisted by substantially expanded computing capacity and methods, the practice mushroomed over the following two decades, becoming common enough to be considered part of the state-of-the-practice.\textsuperscript{139}

The typical land use–transportation scenario planning process compares a “trend” scenario to one or more alternative future “planning” scenarios. In the trend scenario, urban development and transportation investment patterns of the recent past are assumed to continue through the planning horizon (20 to 50 years in the future). The trend scenario—usually some version of urban sprawl—is assessed for its impacts on transportation measures and other regional outcomes.\textsuperscript{140}

This is followed by the formulation of one or more planning scenarios that differ from the trend scenario with respect to transportation infrastructure and land use—the first and fourth accessibility policy levers described in the previous section. Compared to the trend scenario, the planning scenarios usually contain higher gross densities; mix land uses to a greater extent; and have pedestrian/transit-oriented design features, more development in urban centers, and a variety of alternative transportation infrastructure investments. Some studies also include transportation pricing policies—the second policy lever. These planning scenarios are then assessed for their impacts using the same travel forecasting models and set of outcome measures as was used for analysis of the trend scenario. Vehicle miles of travel (VMT) is almost always among the outcomes forecasted. The resulting comparison of scenarios provide a basis for rational urban policy development.\textsuperscript{141}

A 2004 nationwide survey identified eighty land use–transportation scenario planning projects, all of which were completed between 1989 and 2003.\textsuperscript{142} These projects are concentrated in large metropolitan areas along the east and west coasts (Figure 2). They are also concentrated toward the end of the period studied (Figure 3), suggesting a trend toward greater use of scenario

\begin{footnotes}
\item[139] Reid Ewing, Research You Can Use: Regional Scenario Plans and Meta-Analysis, 73 PLANNING, March 2007, at 38.
\item[141] Id.
\item[142] Bartholomew, supra note 134. An annotated bibliography of the projects is available at http://content.lib.utah.edu/u?/ir-main,101. Many of the original project reports that were used as source data are available at http://www.lib.utah.edu/digital/collections/highways/.
\end{footnotes}
planning technique. Most of the studies test three or four scenarios (including a trend scenario) that vary in density, mix, and arrangement of future land uses. Half of the studies also test alternative transportation infrastructure investments. Twelve incorporate a transportation pricing element. Three quarters of the studies evaluate scenarios for transportation impacts; over half for impacts on open space and resource lands; thirty-three for impacts on air quality; eighteen for impacts on fuel use; and ten for greenhouse gas emissions.143

A study by Bartholomew and Ewing used twenty-three of these projects to analyze relationships between land use, transportation, and carbon emissions.144 Together, these studies include a total of eighty-five scenarios—one trend scenario per study, plus sixty-two planning scenarios, which are represented by the bars in Figure 4. For each bar, the value shown is the percentage difference in VMT between that scenario and the study’s trend scenario. As indicated, there is a wide variation in values across scenarios, from +5.2% to -31.7%. The variation in scenario density is similarly spread across a wide range (from -14.8% to +64.3%) and inverse in direction from VMT (see Figure 5), suggesting a possible inverse correlation between the two variables, which is further demonstrated in the scatterplot in Figure 6.

A multi-variate analysis tested this and related land use–transportation relationships to determine the possible transportation and carbon emission effects that could accrue if scenarios of the type and nature assessed in the study were implemented in metropolitan areas nationwide. The analysis shows that increasing average density by fifty percent145 and emphasizing infill development, mixed land uses, and coordinated transportation investments would, by 2050, result in 17% fewer VMT than under projected trend conditions.146 Accounting for “cold start” effects147 and possible engine efficiency reductions,148 this number translates into a CO2 emissions reduction of 15.3%.149

Although 15.3% is, admittedly, not a large number, it is very likely a conservative estimate for two reasons. First, limitations in the models and methods used to generate the data for the analysis likely underestimated the travel reduction effects of the land use strategies included in many of the scenarios.150 Second, all of the scenarios assumed the continuation of

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143 Bartholomew, supra note 134, at 402.
145 A density increase of fifty percent, which is within the density range of the scenarios depicted in Figure 5, is probably conservative, given the major demographic shifts anticipated through the first half of the 21st century. See Ewing, Bartholomew, Winkelman, Walters & Chen, supra note 4, at 23-27; Arthur C. Nelson, Leadership in a New Era, 72 J. AM. PLAN. ASS’N 393 (2006).
146 Bartholomew & Ewing, supra note 144.
149 Bartholomew & Ewing, supra note 140.
150 The limitations of standard travel modeling practices, particularly with respect to estimating the impacts of land use strategies, are well documented. See generally Beimborn, Kennedy & Schaefer, supra note 62; DKS Associates & University of California, Assessment of Local Models and Tools for Analyzing Smart-Growth Strategies (2007),
trend national and global economic and environmental conditions; it is very possible that these
conditions will change in ways that would make continued reliance on personal vehicle travel
less tenable, suggesting that the difference between the planning and trend scenarios would be
even greater.151

III. Federal Transportation and Environmental Mandates

Overall, these results are encouraging. They demonstrate that an effective planning
method exists—and is growing in popularity—for redirecting at least two of the four policy
levers (transportation infrastructure and land use) toward an accessibility based approach to land
use and transportation planning, and that this approach could lead to decreased travel and carbon
emissions. Still unresolved, however, is how an accessibility based scenario planning approach
might be integrated into processes mandated by federal transportation planning and
environmental laws. A cursory analysis suggests that such an approach could be employed at two
levels of planning—long-range transportation systems planning and project-level planning—that
utilize at least three different statutory regimes.

A. Long-Range Systems Planning

1. Transportation Planning Statutes

Although planning for metropolitan-wide transportation systems began in the 1950s, the
practice came of age with passage of the Federal Aid Highway Act of 1962,152 which required
metropolitan transportation system planning as a condition for receiving federal transportation
funds.153 To qualify, the planning process needed to be continuing, comprehensive, and
cooperative (the “3Cs”—meaning that planning had to be ongoing, not just a single event,
incorporating a broad range of subjects and values, and carried out with the cooperation of state
and local government agencies.154 Although the Bureau of Public Roads155 implementing
regulations required consideration of land use and zoning in the a 3C planning process,156 they

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151 See ICF INT’L, INTEGRATING CLIMATE CHANGE INTO THE TRANSPORTATION PLANNING PROCESS 31
(2008); Bartholomew & Ewing, supra note 144.
153 Id. § 9, 76 Stat. at 1148.
154 Id.
155 Predecessor to today’s Federal Highway Administration.
did not require the consideration of alternative development patterns. Moreover, the purpose to be achieved through the planning process was increased mobility, not improved accessibility.\textsuperscript{157}

Transportation systems planning has changed markedly since the 1962 Act, with the most significant changes coming from the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).\textsuperscript{158} ISTEA revolutionized systems planning, principally, by allowing for greater flexibility in how federal transportation funds could be used, and by providing a more expansive list of considerations that had to be incorporated into systems planning, including the possible effects of transportation investments on development patterns and the consistency of transportation plans with land use and development plans.\textsuperscript{159} Many of ISTEA’s innovations were carried forward, first into the Transportation Equity Act for the 21\textsuperscript{st} Century (TEA-21)\textsuperscript{160} and then into the current transportation statute—the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).\textsuperscript{161}

Together, the innovations from ISTEA, plus several provisions originating with SAFETEA-LU, could provide a basis for an accessibility based systems planning process. According to the policy statement that introduces the metropolitan planning requirement section, it is in the national interest to promote “transportation systems that will serve the mobility needs of people and freight and foster economic growth and development within and between States and urbanized areas, \textit{while minimizing transportation-related fuel consumption and air pollution}.”\textsuperscript{162} The planning factors for systems planning processes reflect this purpose statement, requiring consideration of projects and strategies that will “increase the accessibility and mobility of people and for freight” and “protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns.”\textsuperscript{163}

These provisions have facilitated and encouraged several metropolitan planning organizations (MPOs)\textsuperscript{164} to prioritize accessibility in their transportation systems planning processes. A leading example comes from the Sacramento Area Council of Governments (SACOG), the MPO for the Sacramento, California region. In its landmark study, the Sacramento Region Blueprint Transportation–Land Use Study, SACOG crafted a future growth strategy for the region by developing a series of neighborhood, county, and regional scenarios that assume different growth rates, land use mixes, housing types, densities, and

\textsuperscript{157} See \textsc{Bureau of Public Roads, U.S. Dept. of Commerce, Highway Planning Program Manual} (1963); \textsc{Mark Solof, History of Metropolitan Planning Organizations} 16 (North Jersey Transportation Planning Authority 1997), \textit{available at http://www.njtpa.org/public_affairs/mpo_history/MPOhistory1998.pdf}; \textsc{Weiner, supra} note 138, at 42 (“The goal for the overall highway planning process was to develop a master plan for highway development.”).


\textsuperscript{159} Id. § 1024(a), 105 Stat. at 1957-58.


\textsuperscript{163} Id. § 134(h)(1)(D), (E).

\textsuperscript{164} Metropolitan planning organizations, first required by section 112 of the Federal-Aid Highway Act of 1973, 87 Stat. 250, 257, are the entities through which federal funds for metropolitan area transportation projects must be planned and programmed. 23 U.S.C. § 134(d)(1) (2000) (“To carry out the transportation planning process required by this section, a metropolitan planning organization shall be designated for each urbanized area with a population of more than 50,000 individuals . . . .”).
infill/redevelopment proportions. These scenarios were analyzed for their land use and transportation impacts, leading to the adoption of a Preferred Blueprint Scenario, which has a substantially smaller urban footprint and 26% fewer VMT than the trend scenario (see Figure 7 & Table 2). The Preferred Blueprint Scenario is now being implemented through amendments to local government land use plans and through the region’s new long-range transportation systems plan. Similarly structured planning processes have also occurred in the San Francisco Bay, Salt Lake City, and Portland, Oregon regions.

As encouraging as these examples are, they represent fewer than 1% of the nation’s 385 MPOs. For all its purported advances in systems planning processes, the planning provisions in SAFETEA-LU are advisory only—they require only consideration of accessibility related factors. Even that permissive standard is unenforceable: failure to consider any of the planning factors cannot be challenged in court and the resulting systems plans are not reviewable under NEPA. For this and other reasons, some commentators have suggested that the promise behind the innovations of ISTEA and its progeny, while significant, have not been realized in practice.

2. Transportation–Air Quality Conformity

While SAFETEA-LU’s planning requirements might provide a weak reed to base a change to accessibility based planning, the transportation–air quality conformity requirements of the Clean Air Act Amendments of 1990 (CAAA) offer a firmer basis for such an evolution, though the scope of change to date has been limited. The Clean Air Act of 1977, the predecessor to the CAAA, prohibited direct inconsistencies between long-range transportation system plans and state air quality plans, but provided little guidance on how this was to be determined and the mandate was largely ignored. Frustrated by perceived bureaucratic disregard of the

standard, Congress beefed up the requirement in the CAAA, mandating that transportation system plans in air quality nonattainment or maintenance areas conform to an air quality plan’s “purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and achieving expeditious attainment of such standards.” Instead of merely avoiding direct conflicts between transportation and air quality plans, the new conformity provisions created an affirmative duty for transportation planners to create plans that would work to achieve the aims of providing citizens with healthy air.

Though not specifically targeted at the tension between mobility and accessibility, the CAAA conformity provisions and their implementing regulations give at least some impetus for engaging those issues. The most direct, and obvious, point for this engagement would be the selection of transportation projects to be included in long-range system plans. A 1999 EPA-sponsored study, however, shows that in only a handful of high-growth metropolitan areas has the conformity process led to the scaling back or elimination of proposed highway projects and the promotion of transit investments. Aside from Atlanta’s high-profile conformity lapse settlement agreement, conformity’s impact on project selection has been difficult to detect. A later study by the Congressional Research Service shows that while sixty-three nonattainment or maintenance areas experienced conformity lapses between 1997 and 2004, “[m]ost of these areas . . . returned to conformity quickly without major effects on their transportation programs: . . . only 5 areas had to change transportation plans in order to resolve a conformity lapse.”

As with project selection, conformity’s influence on land use policy, while notable, has not been widespread. Although the Clean Air Act specifically disavows any “infringement on the

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176 See id.
178 See id. §7505(a).
179 The National Ambient Air Quality Standards (NAAQS) set maximum ambient concentration levels for seven “criteria” pollutants: ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), lead (Pb), and particulate material at both 10 microns (PM10) and 2.5 microns (PM2.5). See 42 U.S.C. § 7409 (2000); U.S. ENVTL. PROTECTION AGENCY, NATIONAL AMBIENT AIR QUALITY STANDARDS (2008), http://www.epa.gov/air/criteria.html; WEINER, supra note 138, at 170.
181 See id. §7506(c)(2) (2000).
183 See ARNOLD M. HOWITT & ELIZABETH M. MOORE, LINKING TRANSPORTATION AND AIR QUALITY PLANNING: IMPLEMENTATION OF THE TRANSPORTATION CONFORMITY REGULATIONS IN 15 NONATTAINMENT AREAS 80 (1999) (noting expectations that the conformity requirements would result in less highway expansion and more investment in transit even though “these results were not specifically prescribed goals of the Clean Air Act’s conformity provision, nor of the 1993 regulations.”).
185 HOWITT & MOORE, supra note 183, at 75.
186 MCCARTHY, supra note 185, at i.
existing authority of counties and cities to plan or control land use,\textsuperscript{188} many had hoped that the CAAA’s restrictive conformity requirements would lead to “tighter coordination of land use and transportation planning to promote development patterns that require less travel.”\textsuperscript{189} The EPA has finessed the tension between statutory prohibition and popular expectation by sponsoring research and providing specific guidance on how land use policies might fit into air quality planning and conformity analyses,\textsuperscript{190} but the agency stresses that its efforts are advisory only.\textsuperscript{191} Government agencies in several metropolitan areas have, in fact, used EPA’s research and guidance to take air-quality credit for land use initiatives; leading examples include the Atlantic Steel redevelopment project in Atlanta,\textsuperscript{192} Portland, Oregon’s metropolitan growth management policies,\textsuperscript{193} and the Chicago region’s reassessment of infill development potential.\textsuperscript{194} Probably the most dramatic change credited to the influence of the conformity process, at least on land use institutions if not directly on land use policies, was the creation in 1999 of the Georgia Regional Transportation Authority (GRTA),\textsuperscript{195} which has substantial veto power over land use and transportation decisions in the Atlanta region.\textsuperscript{196}

In addition to these voluntary actions, the conformity implementing regulations contain mandatory regional emissions analysis standards that, indirectly, influence land use policies. In nonattainment and maintenance areas classified as serious or worse for ozone or carbon monoxide and that are greater than 200,000 in population, agencies preparing long-range transportation system plans must ensure that future land use development assumptions are


\textsuperscript{189} HOWITT, supra note 183, at 80; see Michael R. Yarne, Clean Air Act–Urban Development: Conformity as Catalyst: Environmental Defense Fund v. Environmental Protection Agency, 27 ECOLOGY L.Q. 841, 843 (2000) (court’s decision “strengthened the case for coordinated regional transportation, air quality, and land use planning”).


\textsuperscript{191} U.S. ENVTL. PROT. AGENCY, supra note 190, at i, 2.

\textsuperscript{192} HAGLER BAILLY, supra note 38.

\textsuperscript{193} HOWITT, supra note 183, at 86.

\textsuperscript{194} U.S. ENVTL. PROT. AGENCY, supra note 190, at 35.

\textsuperscript{195} Alan Ehrenhalt, The Czar of Gridlock, GOVERNING, May 1999, at 20 (“Air quality has forced the regional planning process.”).

consistent with the transportation system alternatives under consideration.\textsuperscript{197} In other words, planners must account for the induced development effects that might be associated with different investment decisions. This, in essence, requires the consideration of integrated, internally consistent land use–transportation scenarios. Consideration of changes in land use policies to increase accessibility, however, is not required. Nevertheless, at least some acknowledgement of the potential sprawl inducing effects of transportation investments is mandated.\textsuperscript{198}

B. Project-Level Planning

Generally, individual transportation projects need to be drawn from system-level plans that comply with the planning and conformity requirements outlined above, particularly if they are to be federally funded.\textsuperscript{199} Hence, opportunities to look at transportation from an accessibility perspective will have already occurred at the systems stage by the time a project moves to final decision-making and possible construction. There remain, nevertheless, several important points at the project decision stage for consideration of the accessibility policy levers.

1. Alternatives Analysis

Depending on the circumstances, several federal environmental laws may require agency consideration of alternative courses of action before proceeding with a proposed project. In addition to the NEPA,\textsuperscript{200} the dredge and fill provisions of the Clean Water Act\textsuperscript{201} and Section 4(f) of the Department of Transportation Act of 1966\textsuperscript{202} may also require alternatives analysis if wetlands, historic resources, or parklands are involved. Because of the predominance of NEPA in transportation project decision-making, however, this discussion will focus on the requirements of that Act, acknowledging that the different standards of the other statutes could lead to different conclusions.\textsuperscript{203}

Alternatives analysis has long been recognized as the “heart” of NEPA.\textsuperscript{204} The underlying purpose for engaging in an alternatives analysis is to address the general question of whether the stated purpose and need for the proposed project can be met by means that have lower environmental costs, including those options that would make the proposed project


\textsuperscript{198} See Robert Johnston, The Urban Transportation Planning Process, in The Geography of Urban Transportation, supra note 9, at 122.


\textsuperscript{201} 33 U.S.C. § 1344(b) (2000); 40 C.F.R. § 230.10 (2008).


\textsuperscript{203} See id. § 303(c)(1) (requiring consideration of “prudent and feasible” alternatives); 40 C.F.R. § 230.10(a) (2008) (requiring consideration of “practicable” alternatives).

\textsuperscript{204} See 40 C.F.R. § 1502.14 (2008) (the alternatives section “is the heart of the environmental impact statement”). See also Ctr. for Biological Diversity v. Nat’l Highway Traffic Safety Admin., No. 06-71891, 2008 U.S. App. LEXIS 17629, at *116 (9th Cir. Aug. 18, 2008); Ilio ’ulaokalani Coalition v. Rumsfeld, 464 F.3d 1083, 1095 (9th Cir. 2006); NRDC v. U.S. Forest Serv., 421 F.3d 797, 813 (9th Cir. 2005).
unnecessary. To address this question, NEPA requires consideration of a “no action” alternative, plus all other “reasonable” alternatives.

Determining which alternatives are reasonable and, hence, appropriate for inclusion in NEPA analyses has been controversial. With very little guidance from the Council on Environmental Quality (CEQ) regulations that implement NEPA, the term reasonable has eluded precise definition, leading to an unsettled body of jurisprudence, not unlike that which surrounds regulatory takings under the 5th Amendment. As a consequence, reasonableness has primarily been defined in the negative.

Per se, alternatives that do not accomplish the need or purpose of the proposed action are unreasonable. This conclusion, however, merely begs the question of how an agency has defined the purpose and need for the project. In theory, stating the need more broadly will allow for a wider range of alternative methods to meet that need, while a more narrow definition will tend to restrict the universe of alternatives. For example, in an environmental impact statement (EIS) for proposed transportation improvements, the need to “provide greater personal and commercial accessibility for the residents and businesses of southwest Acme City” will lead to consideration of a greater range of alternatives than the need to “build a highway from Acme City to West Hinsdale.” Although courts will occasionally reject a statement drawn so narrowly that only the proposed action will accomplish it, deference is usually given to an agency’s judgment with regard to a statement of purpose and need, and the literature is full of instances where courts have refused to invalidate a statement of purpose and need that a facility or service must be increased, enlarged, or expanded.

Also beyond the “rule of reason” are alternatives that are remote, speculative, uncommon, or unknown at the time an action is proposed. This standard, however, implies a definition of what is reasonable and what is not based on context. What was unreasonable in the

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206 40 C.F.R. § 1500.2(e).
207 See City of Alexandria v. Slater, 198 F.3d 862, 867 (D.C. Cir. 1999).
208 See Lingle v. Chevron, 544 U.S. 528, 537-38 (2005) (“In Justice Homes’ storied but cryptic formulation, ‘while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking.’ The rub, of course, has been—and remains—how to discern how far is ‘too far.’” (citations omitted)).
210 Colorado Envtl. Coalition v. Dombek, 185 F.3d 1162, 1174-76 (10th Cir. 1999).
211 O.L. Schmidt, The Statement of Underlying Need Determines the Range of Alternatives in an Environmental Document, in ENVIRONMENTAL ANALYSIS: THE NEPA EXPERIENCE 42, 49 (Stephen G. Hildebrand and Johnnie B. Cannon, Eds. 1993) (“When an agency defines the underlying need very narrowly, it wins. And when it defines the need very broadly (or not at all), it loses.”).
213 See Lee v. U.S. Air Force, 354 F.3d 1229, 1238 (10th Cir. 2004); Dinah Bear, Alternatives and the Scope of Analysis, C981 ALI-ABA Course of Study 353, 360 (Feb. 15, 1995).
past may become reasonable over time due to changes in technology, science, society, economics, and professional practice: “the concept of alternatives is an evolving one, requiring the agency to explore more or fewer alternatives as they become better known and understood.”

A primary example of this evolution comes from the area of energy conservation. In 1972, challengers to a proposed off-shore oil lease sale were unsuccessful in attacking the sale’s underlying EIS for failure to include a conservation alternative; the Federal Court of Appeals for the D.C. Circuit held such alternatives fell outside the rule of reason. Shortly after that decision, however, the CEQ and a number of other federal agencies began promoting energy conservation research and policy development in response to the 1973 OPEC oil embargo. The effect of the change in global economic/environmental conditions, and the consequential governmental responses, brought the topic of conservation into the mainstream. Reflecting these changes, the D.C. Circuit held, just four years after its ruling in the off-shore oil case, that the EIS for a proposed nuclear power facility was deficient because it had not included an energy conservation alternative. Although the U.S. Supreme Court reversed that ruling, the basis of the high court’s holding reflected more on the plaintiffs’ failure to adequately articulate the proposed conservation alternative than on the reasonableness of the concept of conservation.

Energy conservation’s transition from “remote and speculative” to “reasonable” is implicit in the Supreme Court’s decision, and subsequent cases treat it as such.

Have alternatives based on changes in land use policy as well as transportation infrastructure similarly crossed over the boundary from being remote and speculative to being reasonable? There is evidence to suggest that they have. As outlined above, in the mid-1980s, analyses investigating alternative land use patterns were rare and pursued mainly by academics. Then, in the late 1980s, two ground-breaking studies brought integrated land use—transportation alternatives analysis to both systems- and project-level planning contexts.

At the systems level, Montgomery County, Maryland—an established leader in progressive land use planning practices—developed its 1989 Comprehensive Growth Policy Study based on an analysis of alternative arrangements of future land use patterns. Looking thirty years ahead, the county explored its vision of the future using a series of scenarios that integrated various land use patterns with different transportation investments and pricing policies—three out of the four accessibility policy levers described in Section I, above. The county used the

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216 Vermont Yankee, 435 U.S. at 552-53.
217 Morton, 458 F.2d at 837.
218 Aeschliman v. U.S. Nuclear Regulatory Comm’n, 547 F.2d 622, 629 (D.C. Cir. 1976) (“Energy conservation was clearly a colorable alternative relevant to the goals of the project”), rev’d Vermont Yankee, 435 U.S. 519.
219 Vermont Yankee, 435 U.S. at 552.
220 See Natural Res. Def. Council, Inc. v. Hodel, 865 F.2d 288, 296 (D.C. Cir. 1988) (opinion by Ginsburg, J.); Forelaws on Board v. Johnson, 743 F.2d 677, 685 (9th Cir. 1984) (Bonneville Power Admin. negotiated 140 contracts that involved policy choices affecting energy conservation but failed to prepare EIS); Taubman Realty Group Ltd. v. Mineta, 198 F.Supp.2d 744 (Federal Aid Highway Act requires consideration of energy conservation as a factor in planning new interchange).
221 See references in note 138, supra.
222 DOUGLAS R. PORTER, MANAGING GROWTH IN AMERICA’S COMMUNITIES 55-64 (2nd ed. 2007).
223 MONTGOMERY COUNTY, MARYLAND, supra note 137.
output of the Growth Policy Study as the basis for changes to its transportation and land use policies, plans, and ordinances.\textsuperscript{224} At the project-level, 1000 Friends of Oregon—a respected land use planning nonprofit organization\textsuperscript{225}—launched Making the Land Use, Transportation, Air Quality Connection (LUTRAQ), also in 1989, seeking to articulate an integrated land use, transportation, demand management alternative to the Western Bypass, a proposed new suburban freeway west of Portland, Oregon.\textsuperscript{226} Having successfully delayed the freeway through legal action,\textsuperscript{227} 1000 Friends worked with a team of internationally recognized experts to craft an alternative that centered transit-oriented developments along two extensions of the region’s transit network and incorporated a transportation pricing system to provide free transit passes to commuters and charge solo car commuters for parking.\textsuperscript{228} As with the Comprehensive Growth Policy Study, LUTRAQ effectively used three of the four accessibility policy levers. The Oregon Department of Transportation incorporated the LUTRAQ alternative into its Major Investment Study for the Western Bypass, making it the first NEPA document in the country to include a land use-based alternative for a proposed new highway.\textsuperscript{229}

At the time, the LUTRAQ project was viewed as unique\textsuperscript{230} and cutting edge.\textsuperscript{231} As mapped out above in Section II, however, in the nearly twenty years since the project began, land use–transportation scenario planning has become commonplace enough for one commentator to observe:

\begin{quote}
"...to help refine the scope of projects to be included in a region’s long-range transportation plan." Kip Strauss, Taking the High Road, PLANNING, Oct. 1997. Although technically not part of NEPA’s EIS process, many agencies—including the Oregon Department of Transportation, the lead agency for the Western Bypass—integrated MIS and EIS analyses. See Management and Administration, PUBLIC ROADS, Spring 1995 (citing a multi-agency agreement in Florida merging MIS and EIS processes); K.J. Hess & L.E. Pesesky, Tiered Environmental Studies in the National Environmental Policy Act Process for Highway Projects, 1792 TRANSP. REC. 101 (2002). The MIS process was not carried forward in subsequent Acts after ISTEA.
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\textsuperscript{225} Sam Lowery, Oregonians Reverse on Measure 37, PLANNING, Jan. 2008, at 60.

\textsuperscript{226} See 1000 Friends of Oregon, supra note 137.

\textsuperscript{227} Sensible Transp. Options for People v. Metro. Service Dist., Or. LUBA No. 89-030 (1989) (reversing a decision to include the Western Bypass in the regional transportation system), appeal dismissed, 787 P.2d 498 (1990) (finding the agency decision not yet ripe for appeal); 1000 Friends of Oregon v. Washington County, 17 Or LUBA 671 (1989) (reversing a decision to include the Western Bypass in the county transportation plan).

\textsuperscript{228} 1000 Friends of Oregon, supra note 137, at 12.

\textsuperscript{229} See Daniel Carlson, Lisa Wormser & Cy Ulberg, At Road’s End: Transportation and Land Use Choices for Communities 67 (1995). The Major Investment Study (MIS) process was an ISTEA innovation, 23 C.F.R. § 450.318(a) (1994), designed “to help refine the scope of projects to be included in a region’s long-range transportation plan.” Kip Strauss, Taking the High Road, PLANNING, Oct. 1997. Although technically not part of NEPA’s EIS process, many agencies—including the Oregon Department of Transportation, the lead agency for the Western Bypass—integrated MIS and EIS analyses. See Management and Administration, PUBLIC ROADS, Spring 1995 (citing a multi-agency agreement in Florida merging MIS and EIS processes); K.J. Hess & L.E. Pesesky, Tiered Environmental Studies in the National Environmental Policy Act Process for Highway Projects, 1792 TRANSP. RES. REC. 101 (2002). The MIS process was not carried forward in subsequent Acts after ISTEA. See Lisa Wormser, Two for TEA, PLANNING, August 1998.


The rise of scenario planning coincided with the recognition that state and local governments could not “pave their way out of congestion.” Instead, they would have to reduce the need for car travel by smarter land-use planning. . . . [A study] of 80 scenario planning projects from 48 U.S. metropolitan areas\(^{232}\) . . . shows that *regional scenario planning has become a common best practice.*\(^{233}\)

This suggests, rather strongly, that land use-based alternatives to proposed transportation projects meet *Morton’s* “rule of reason.”\(^{234}\) If they were once “uncommon or unknown” they are no longer.\(^{235}\)

The “pleading” requirements of *Vermont Yankee*\(^{236}\) still apply, of course: participants in NEPA processes cannot just assert the need to study land use-based alternatives; they must articulate such alternatives with sufficient specificity to “allow the agency to give the issue meaningful consideration.”\(^{237}\) This lesson is illustrated by *Utahns for Better Transportation v. U.S. Department of Transportation,*\(^{238}\) where plaintiffs who made general assertions of the need to study land use-based alternatives to the proposed Legacy Parkway in Utah were rebuffed in their subsequent challenge of the Parkway EIS.\(^{239}\) During a remand on other grounds, however, the plaintiffs developed a detailed “Citizens Smart Growth Alternative,” which became the basis for a settlement of the litigation.\(^{240}\) Tellingly, in a subsequent study of another proposed highway associated with the Legacy Parkway, the Utah Department of Transportation—the primary defendant in the Legacy litigation—decided on its own accord to incorporate land use-based alternatives in the analysis.\(^{241}\)

\(^{232}\) See Bartholomew, *supra* note 134.

\(^{233}\) Ewing, *supra* note 139, at 38 (emphasis added).

\(^{234}\) 458 F.2d at 837.

\(^{235}\) Neither can they be considered “technologically infeasible.” See Bartholomew, *supra* note 134, at 410 (noting that the rise of easy to use GIS-based software in the last decade has made land use–transportation scenario planning projects “too numerous to count”).

\(^{236}\) 435 U.S. at 553 (NEPA participants must “structure their participation so that it . . . alerts the agency to the [parties’] position and contentions”).


\(^{238}\) 305 F.3d 1152 (10th Cir. 2002).

\(^{239}\) *Id.* at 1172.


2. Indirect Impacts Analysis

The final way in which an accessibility based planning regime might fit within the context of federal law is through NEPA’s indirect impacts analysis requirement. NEPA, of course, requires the assessment of federal actions “significantly affecting the quality of the human environment.” The CEQ NEPA regulations, however, split the definition of effects into direct effects and indirect effects. Direct effects are those that are “caused by the action and occur at the same time and place.” Indirect effects are also caused by the action but “are later in time or farther removed in distance,” while still being reasonably foreseeable. Indirect effects include “growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems.”

The impacts of major highway projects on land use patterns—induced development—would appear to fall within this latter definition, and federal courts have largely agreed: highway related environmental documents failing to address induced development impacts have generally been found to violate NEPA. A growing number of these cases, however, are requiring more than just acknowledgement of potential induced development impacts: they are insisting that the margin of induced development—the variations in land use allocations between no-build and build alternatives—be incorporated into the modeling of travel demand forecasts.

Highways create demand for travel and expansion by their very existence. However, the final impact statement in this case relies on the implausible assumption that the same level of transportation needs will exist whether or not the tollroad is constructed. In particular, the final impact statement contains a socioeconomic forecast that assumes the construction of a highway such as the tollroad and then applies that forecast to both the build and no-build alternatives. The result is a forecast of future needs that only the proposed tollroad can satisfy. As a result, the final impact statement creates a self-fulfilling prophecy that makes

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244 Id. § 1508.8(b).
245 Id.
a reasoned analysis of how different alternatives satisfy future needs impossible.248

In other words, it is not enough for transportation planners to assess the possible induced development impacts of a proposed transportation project; they must also use the land use allocation from that assessment, as well as the allocation for the no-build alternative, as inputs to the travel demand analysis. Only then can NEPA’s requirement to take a “hard look”249 at the possible environmental impacts of the proposed project be satisfied.250

Thus, in theory, induced development analysis under NEPA produces roughly the same type of outcome as that produced through the regional emissions conformity analysis process outlined above: scenarios where the land use and transportation assumptions are consonant.251 Certainly, the recognition of the need for such congruity is an important step toward creating an accessibility oriented planning process. In practice, however, the wide variety in the quality of the analysis provided,252 and the courts’ willingness to accept shoddy work under the guise of administrative deference,253 severely limit the potential positive influences of this development.

IV. Conclusion

In the end, none of these statutory regimes, as currently constructed, works terribly well at recasting land use and transportation planning in an accessibility mold. SAFETEA-LU has accessibility oriented aspirations for what long-range systems planning could and should be, but the language is hortatory, unsupported by incentives or enforcement, and, hence, unlikely to be implemented broadly. The Clean Air Act conformity requirements, while containing a much more vigorous enforcement mechanism, has resulted in only sporadic alterations in transportation infrastructure decisions and has had almost no impact on the other three

248 Sierra Club, 962 F. Supp. at 1043 (citations omitted).
250 Sierra Club, 962 F. Supp. at 1043-44 (“information about the growth inducing impact of tollroad construction is crucial to a reasoned conclusion”).
251 The geographic scope of the two processes differ, however, with NEPA focused at the project level and conformity at the regional/systems level.
253 See Stop H-3 Ass’n v. Dole, 740 F.2d 1442, 1462 (9th Cir. 1984) (approves a “less than complete evaluation” of highway’s possible secondary impacts because “NEPA only requires a ‘reasonably thorough discussion’ that ‘fosters informed decisionmaking,’ not a ‘complete evaluation.’”); Citizens Advocate Team v. U.S. Dep’t of Transp., No. 02 C 5962, 2004 U.S. Dist. LEXIS 5419, at *16-19 (N.D. Ill. March 31, 2004) (conclusory statements about induced growth is sufficient to satisfy NEPA “where the projected impacts at issue are consistent with the overall purpose and need for the project”); Wilds v. S.C. Dep’t of Transp., No. 00-1808, 2001 U.S. App. LEXIS 8794 (4th Cir. May 9, 2001) (approves, without explanation, of agency’s cursory evaluation of induced growth).
accessibility policy levers.\textsuperscript{254} Incorporating an accessibility based alternative into a NEPA analysis may be more possible than it once was, but developing the required specification of such alternatives is costly, especially for non-governmental proponents,\textsuperscript{255} and there is a persuasive argument that incorporating accessibility based policy measures is more effective at the systems-planning level, not within a project-level EIS.\textsuperscript{256} Finally, as noted above, the state of the practice for indirect impacts analysis is uneven and immature.\textsuperscript{257}

Despite the suboptimal nature of these statutory structures, some enterprising agencies and advocates have developed innovative ways of using the existing framework to realize accessibility oriented outcomes. The successes, however, are not widespread enough for land use and transportation to contribute meaningfully to a climate stability solution. As the analysis above demonstrates, achieving that a contribution will require significant statutory changes, which, in turn, will require effective policy leadership at the national level.

Traditionally, federal transportation legislation has focused on the parceling out of federal dollars to the states. Planning came late to the system, with the first mandates for long range planning for metropolitan areas appearing in 1962 and for states in 1991.\textsuperscript{258} Even then, the emphasis was, and remains, on planning procedures, not outcomes. Given that most other federal programs that allocate funds to states and local governments—for example, those related to education, public housing, and welfare—contain performance-based requirements, it is rather remarkable that transportation funding (with some exceptions) is more or less provided with a blank check.\textsuperscript{259} It is time for transportation to incorporate performance standards as well.

Performance or goal based planning is not a new technique. Land use planning statutes in many states contain substantive standards that local government planning documents have to meet. In one of the most famous examples—Oregon—the state land use agency articulates

\begin{quote}
See McCARTHY, supra note 185, at 4-5. The impacts of conformity could be greater in the future, however, as the combined effects of increased emissions from sport utility vehicles, a tightening of the “grandfathering” provisions in the conformity regulations (as a result of the decision in \textit{Environmental Defense Fund v. Environmental Protection Agency}, 167 F.3d 641 (D.C. Cir. 1999), and more stringent standards for ozone and PM$_2.5$ come into force. \textit{Id.} at 7. In addition, eventual EPA compliance with the Court’s directive in \textit{Massachusetts v. Environmental Protection Agency}, 549 U.S. 497 (2007) to develop mobile-source emission standards for CO$_2$ could substantially affect results of future conformity analyses. See EWING, BARTHOLOMEW, WINKELMAN, WALTERS & CHEN, supra note 4, at 135-36.

For example, the LUTRAQ alternative is reported to have cost 1000 Friends of Oregon, the alternative’s proponent, $1.5 million to develop. See What’s a LUTRAQ? And Why Can’t We Build Our Highway? (2006), http://www.onethousandfriendsoforegon.org/issues/transchoice.html. Development of the Citizens Smart Growth Alternative to the Legacy Parkway cost approximately $50,000. Email from Roger Borgenicht, director of Utahns for Better Transportation (Sept. 14, 2008) (on file with author).

See ICF CONSULTING, HANDBOOK ON INTEGRATING LAND USE CONSIDERATIONS INTO TRANSPORTATION PROJECTS TO ADDRESS INDUCED GROWTH 2 (2005), available at http://nepa.fhwa.dot.gov/ReNEPA/ReNepa.nsf/All+Documents/E096B40B01B9D4B185256FC0004BBDF5/$FILE/Final%20Report%2025-25%20Task%203.pdf (“land use and transportation planning should be integrated at a broader scale than is usually used for NEPA analysis, and begun earlier than is generally done for NEPA project-level analysis”).

ICF CONSULTING, supra note 252, at 23.

WEINER, supra note 138, at 33, 183.

See Robert Puentes, Not So Fast: Key Policy Considerations for Surface Transportation Investment Needs, testimony before House Committee on the Budget 2 (Oct. 25, 2007) (“The sad fact is that now that the Interstate Highway System is completed there is no coherent national vision for addressing a complex and conflicting set of transportation challenges. As a result, America’s transportation policy is adrift with no clear goals, purpose, or ability to meet these challenges.”).
nineteen goals that cities and counties must satisfy in their comprehensive land use plans.\(^{260}\) A similar structure should be included in the next transportation bill, scheduled for adoption in 2009. That legislation—which some are calling “Green-TEA” in playful response to the acronyms for the last three Acts—should articulate a national vision for transportation—one based on increased accessibility and reduced mobility—and define a set of national goals. To ensure attainment of these goals, Green-TEA should require that all planning documents—including state and MPO long range plans and transportation improvement programs, project level environment impact statements, and MPO certifications—demonstrate compliance with these goals. The U.S. Department of Transportation, or a new independent commission,\(^{261}\) should be put in charge of reviewing planning documents for goal compliance and should be given the enforcement tools necessary to guarantee compliance. This, essentially, is the model used by California in the recently passed Senate Bill 375, which requires the state’s MPOs to include as part of their long-range transportation plans a “sustainable communities strategy” that is designed to meet greenhouse gas reduction targets set by the state Air Resources Board.\(^{262}\)

The scientific consensus is that achieving climate stabilization will require reducing carbon dioxide emissions to 60 to 80 percent below 1990 levels.\(^{263}\) Slowly, we are coming to realize the enormity of that task, and the need to rely on all sectors of our economy—industrial, commercial, residential, and transportation—to make significant shifts in business as usual. Within the transportation sector, it is also becoming apparent that meaningful reductions in CO\(_2\) emissions require not just technological shifts to more efficient vehicles and lower carbon fuels, but reductions in the amount we drive as well.\(^ {264}\) A planning regime directed toward accessibility, and away from mobility, will be essential to getting us there. Congressional and administrative action in the coming months on the next transportation bill—Green-TEA or whatever it will be called—will indicate whether we will begin the hard work of “growing cooler” toward climate stabilization or whether we will stay in denial, continually looking for technological bail-outs to keep us from facing our carbon addiction.


\(^{263}\) See EWING, BARTHOLOMEW, WINKELMAN, WALTERS & CHEN, supra note 4, at 40-42.

\(^{264}\) Id. at 43-44.
Figure 1. Cover of Asphalt, the quarterly publication of the Asphalt Institute (April 1966).
Figure 2. Location of land use–transportation scenario planning projects, 1989-2003.
Figure 3. Completion dates of land use–transportation scenario planning projects, 1989-2003.
Figure 4. Percentage difference in vehicle miles traveled between planning and trend scenarios.
Figure 5. Percentage difference in density between planning and trend scenarios.
Figure 6. Scatterplot of percentage differences in density and vehicle miles traveled between planning and trend scenarios.
Figure 7. Comparison of Basecase and Preferred scenarios from the Sacramento Region Blueprint Transportation–Land Use Study.
<table>
<thead>
<tr>
<th>location</th>
<th>VMT/day</th>
<th>percent difference vs. Atlantic Steel site</th>
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</thead>
<tbody>
<tr>
<td>Atlantic Steel</td>
<td>340,300</td>
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<tr>
<td>Perimeter Center</td>
<td>389,672</td>
<td>14.5%</td>
</tr>
<tr>
<td>Cobb/Fulton County</td>
<td>507,498</td>
<td>49.1%</td>
</tr>
<tr>
<td>South Henry County</td>
<td>518,197</td>
<td>52.3%</td>
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Table 2

*Selected Data from the Sacramento Region Blueprint Transportation–Land Use Study*

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Single-Family: Multifamily Housing</th>
<th>% Housing Growth through Infill</th>
<th>% Trips by Auto</th>
<th>% Trips by Transit</th>
<th>% Trips by Walk/Bike</th>
<th>Daily VMT per Household</th>
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</thead>
<tbody>
<tr>
<td>A: Business as usual (trend)</td>
<td>75:25</td>
<td>27.0</td>
<td>93.7</td>
<td>0.8</td>
<td>5.5</td>
<td>47.2</td>
</tr>
<tr>
<td>B: Higher housing densities than A, with growth focused at the urban fringe</td>
<td>67:33</td>
<td>39.0</td>
<td>83.2</td>
<td>4.0</td>
<td>12.7</td>
<td>37.6</td>
</tr>
<tr>
<td>C: Higher housing densities than A, with growth focused on central infill sites</td>
<td>65:35</td>
<td>38.3</td>
<td>81.8</td>
<td>4.8</td>
<td>13.4</td>
<td>36.7</td>
</tr>
<tr>
<td>D: Higher housing and employment densities, with growth focused on central infill sites</td>
<td>64:36</td>
<td>44.0</td>
<td>79.9</td>
<td>4.8</td>
<td>15.3</td>
<td>35.7</td>
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<tr>
<td>Preferred Scenario</td>
<td>65:35</td>
<td>41.0</td>
<td>83.9</td>
<td>3.3</td>
<td>12.9</td>
<td>34.9</td>
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