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MEASURING LAND USE PERFORMANCE: POLICY, PLAN, AND OUTCOME

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A White Paper from the National Center for
Sustainable Transportation

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National Center
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Measuring Land Use Performance: Policy, Plan, and Outcome

Introduction

The impact of land use patterns on travel behavior is well established in the scholarly literature. In particular, much research in the transportation-land use domain has measured the impact of land use on vehicle miles traveled (VMT) or on travel behavior indicators like mode choice that suggest VMT, where it cannot be measured directly (Ewing & Cervero, 2001, 2010; National Research Council, 2009; Salon *et al.*, 2012). Indeed, Ewing and Cervero reviewed 200 studies published between 2001 and 2010 alone, summarizing evidence from this abundant literature that increases in such land use attributes as residential density, land use mix, accessibility, network connectivity, and jobs-housing balance generally correlate with modest reductions in VMT (2010).

Such evidence has fostered consensus in California and elsewhere supporting public policy that promotes higher density development, greater mixture of land uses, and improved access to employment and housing. By passing the Sustainable Communities and Climate Protection Act of 2008, known as SB 375, California lawmakers acknowledged that land use planning could attenuate automobile use and, consequently, help to reduce greenhouse gas (GHG) emissions. Further, the law raises expectations for California communities to grow more equitably, with attention to affordable housing. It syncs local housing planning with regional transportation planning, requires local governments to specify actions to meet low-income housing needs, and can compel rezoning to speed affordable housing production where local inertia would delay it.

The research terrain of the land use-VMT relationship may be well trodden, but important upstream linkages bearing on that relationship have been less closely studied. What are the intermediate cause-and-effect relationships between broad land use policy crafted by states or regions and specific land use plans and polices adopted by local governments? How are specific local plans and policies reflected in implementation? Finally, what ultimate impacts can be observed in urban form and travel behavior after local plans are implemented?

This white paper explores the current knowledge and knowledge gaps about linkages between upstream land use policy and downstream land use impacts. Understanding these connections is critical for gauging how well SB 375 and policies like it might perform. Focusing specifically on the land use and transportation relationship, the paper synthesizes the research relevant to SB 375's potential for shaping local land use to reduce VMT (and hence, GHG emissions). It reviews major works addressing the upstream relationships linking policy to observable VMT impacts. The paper speaks to an informed general audience, including planners and decision makers in land use and transportation policy and planning, at state, regional and local levels. Its organization reflects three main concerns fundamental to land use planning and policy performance:

- the effectiveness of state, regional, and local policies intended to influence land use;
- the evaluative frameworks for assessing the state local land use planning and policy; and
- the data and measures used for observing on-the-ground impacts of land use.

Overall, this review concludes that policymakers, planning practitioners and researchers have a significant interest in better understanding the causal linkages between land use policy and subsequent land use plans and plan provisions, and ultimate on-the-ground land use outcomes. The paper finds that evidence is mixed that public policies crafted at state, regional, and local levels have a discernible and positive impact on land use. What’s more, the frameworks used to assess land use and land use planning largely emphasize planning process and plan policies; evaluations seldom address implementation or outcomes, like VMT reduction.

Where state, regional, or local governments seek to influence land use and development through policy, there exists both need and opportunity to monitor resulting land use changes. This need is particularly urgent in California, where state law pins the achievement of GHG reduction goals to changes in local land use and development patterns. The insights revealed here lead us to recommend the development of a strategic, standardized, and ongoing monitoring program to evaluate change in on-the-ground land use in California, at the local level.

Encouragingly, this review highlights a variety of practical approaches that could be applied to measure land use change and land use planning performance. Studies of land conversion and development intensification, urban form attributes, and transportation accessibility use various data sources to evaluate land use in different ways. They offer a starting point for identifying the data and measurement approaches that may best serve a broad statewide effort for monitoring land use in light of SB 375 objectives.

Background and Context

California’s SB 375 has placed local land use in the climate policy spotlight—and with it, the linkage between land use *policy*, *policy adoption* and *implementation*, and on-the-ground *impacts*. It is the first law in the U.S. to connect local land use with regionally organized, state-directed climate policy; SB 375 anticipates that less automobile-reliant land use in California cities will contribute to regional GHG reductions. The law reflects California’s commitment to reduce GHG emissions significantly and to shepherd the state’s transition to a sustainable, low-carbon future, as articulated in the 2006 Global Warming Solutions Act.

How does this law work and where does land use figure in? Under SB 375, California’s metropolitan regions and local governments alike play key roles in state efforts to reduce transportation-related GHGs. To foster integrated transportation and land use planning, SB 375 requires each California metropolitan planning organizations (MPOs) to develop a “Sustainable Communities Strategy” (SCS) as part of its regional long range transportation plan. The SCS is expected to include land use strategies that, paired with supportive transportation investments, would reduce automobile reliance and associated GHG emissions.

Beneath SB 375's policy framework lies a fundamental contradiction. The law tasks *regional* MPOs with developing land use strategies that would help to reduce automobile reliance and associated GHG emissions. Yet, in California as in most of the U.S., land use authority is tightly held by *local* governments, and MPOs exercise no land use powers. Under federal and state law, MPOs develop regional long range transportation plans and identify needed near-term transportation investments; their decision-making boards are composed of local mayors, county commissioners, and state and local transportation agency representatives. Decisions concerning where and how land development occurs and whether it might reduce or intensify automobile reliance are made by individual cities and counties. SB 375 fully affirms local jurisdictions' control over land use.

The incongruity between the regionally crafted SCS and locally implemented land use raises questions about whether SB 375 can be successful and how to observe if it is. SB 375's success is premised on the assumption that nonbinding regional land use policy will shape land use in individual municipalities. Will this occur? Local governments have no obligation to adopt or implement land use policies reflecting the SCS. Those that do stand better chances, in principle, of securing federal transportation funds through the MPO's capital budgeting process. But, are those transportation funding incentives enough? Further, when local governments do adopt SB 375-supportive land use policies, how do we discern whether subsequent implementation decisions are consistent with them and whether implementation in fact has the desired impact?

SB 375 thus pushes to the forefront in California issues concerning land use planning and policy performance, and it draws attention to these salient questions for land use policy more broadly. Larger trends in U.S. growth management or "smart growth" rely conjoint or co-produced approaches, not top down edicts. Typically, state government establishes larger growth management goals and then requires or encourages broad local planning procedures. Yet, local governments choose how much planning to do and which specific policies to adopt (Norton, 2005).

Consistent with such trends, SB 375 depends on voluntary local compliance with regional land use visions in the SCS. This policy framework assumes four key outcomes:

1. regional SCS plans will influence local plans and policies;
2. locally adopted plans and policies will reflect VMT and GHG reduction goals;
3. local plans and policies will be implemented; and
4. implementation actions will have the desired impact.

As such, SB 375 draws attention to the complex relationships between state or regional land use policy, local land use plans and policy, local implementation, on-the-ground development impacts, and—ultimately—individuals' travel behavior (See Figure 1). These intermediate linkages between upper level policies and on-the-ground impacts are implicit in SB 375, and

they are also familiar, if under-explored, by planning scholars (Norton, 2005; Talen, 1996b; Talen & Knapp, 2003).

In the sections that follow, this white paper explores these upstream relationships between land use policy and land use outcomes. It synthesizes research bearing on the potential for state and regional policy to influence local land use and on empirical approaches that might be used to observe that influence. First, the paper reviews studies of existing or past policies that, like SB 375, are enacted at state, regional, and even federal levels but are intended to influence *local* land use policy. What were these non-local policies, and were they effective? How were they implemented? Next, the paper considers studies on the state of local land use policy itself, and whether local land use policies in their adopted form support sustainable mobility. How are local plans and policies themselves measured or characterized? Third, the paper summarizes literature examining linkages between adopted land use policies and on-the-ground land use impacts and development patterns. How is land use change observed or measured over time? How do we detect whether observed changes result from adopted or implemented policies, or from other incidental factors? How was their impact observed or measured?

In a final section, the paper reflects on connections among these three streams of research and the policy implications of the findings reviewed.

The Effectiveness of State, Regional, and Local Efforts to Nudge Local Land Use

To unpack the new policy landscape introduced by SB 375, it is informative to consider what is known about governmental policies to influence local land use and their effectiveness. Efforts termed variously “growth management,” “smart growth,” and “sustainable land use” have sought in different ways to limit sprawl development and its undesirable consequences, including automobile dependency, and worsening congestion and GHG emissions. Key smart growth principles—including promoting compact, higher-density development; reinforcing existing developed areas; expanding mixed land uses; and emphasizing public transit (Downs, 2005)—are consistent with land use measures associated in the literature with reduced VMT. A sizable literature examines relationships between state and local government efforts to shape land use and the local plans, implementation activities, and ultimate development that follow. (See Figure 1). Regions are increasingly engaging in efforts to direct and manage growth and urbanization (Margerum *et al.*, 2013, p.30), a trend visible in California. Yet, far less is known about regional efforts.

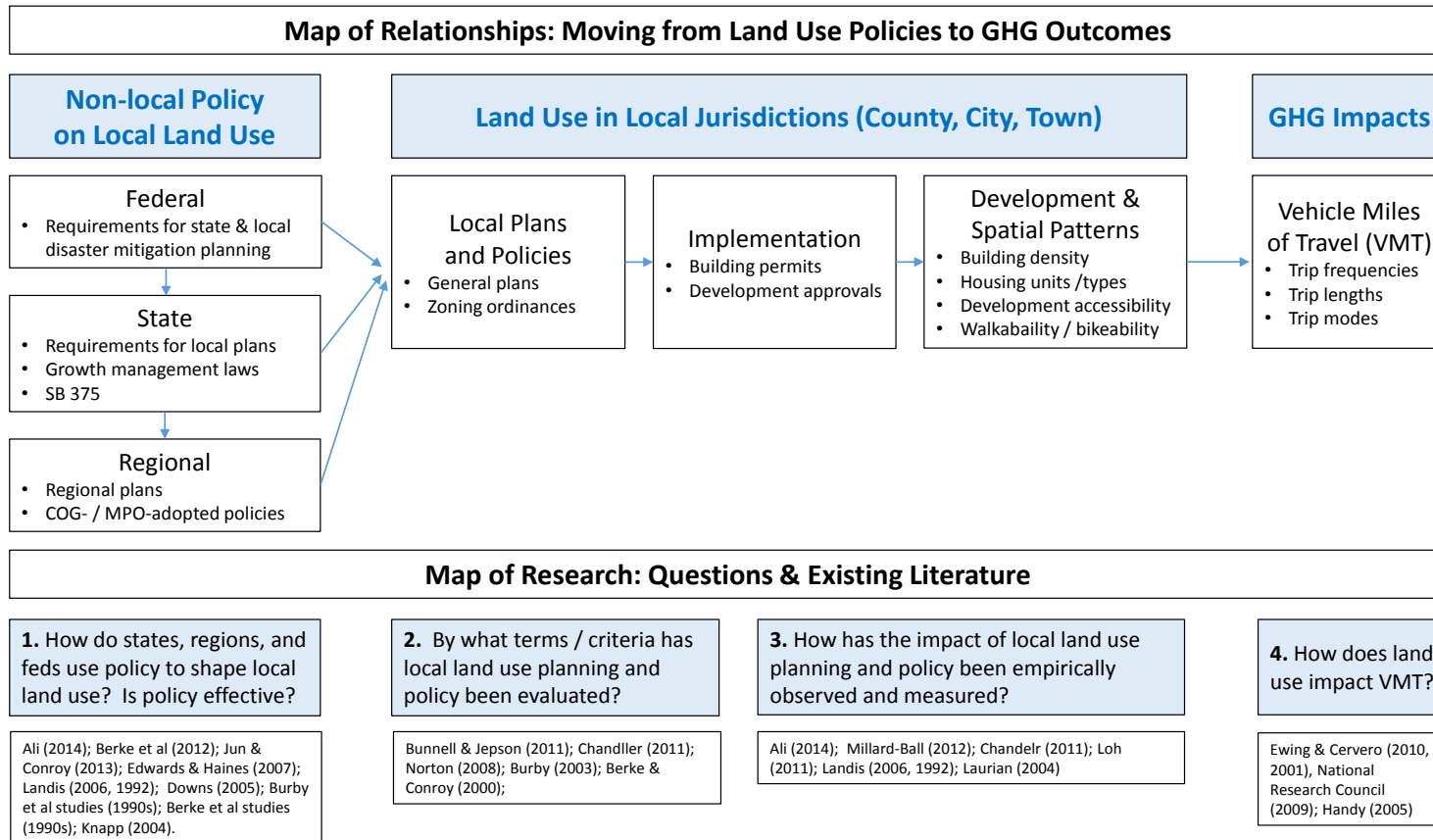
State Efforts to Influence Local Land Use and Development

A number of state governments sought in the 1980s and 1990s to curb urban sprawl. Scholars began to ask how state growth management and general planning mandates worked and whether they were effective. Studies assessed different state policy levers employed to influence local land use, from incentive-based, bottom-up to more coercive, top-down

frameworks, to targeted development zones, to requirements for policy-planning consistency among different government levels. They also used different empirical measures of impacts. Overall, the effectiveness of state interventions is mixed.

State-led policy using any number of mechanisms to target land use has yielded mixed results. One study examined early-adopter growth management states like Hawaii, Vermont and Oregon; states that began programs later; and states without such programs. It found neither the presence of state growth management policy nor its length of time in effect significantly impacted urban population density (Anthony, 2004). From the early 80s to mid-90s, urban population density decreased in an overwhelming majority of states, though such decreases were smaller in states with than without growth management regulations. Instead, sheer population growth and agricultural protection programs significantly shaped urbanization patterns. Separate, longitudinal analysis of marginal land consumption rates across U.S. metro areas was also inconclusive. “[M]ore highly regulated regions and stronger planning states have lower marginal land consumption rates, while regional containment policies...do not appear to reduce the size of urban areas” (Paulsen, 2013, p. 193).

Figure 1: Conceptual Map



Maryland's Incentive-based State Approach to Smart Growth

Maryland's smart growth policies have developed over two decades and been widely studied. Since 1997, the state has encouraged local governments to steer development to Priority Funding Areas (PFAs) meeting density criteria or targeted for economic revitalization. Development in PFAs is eligible for state incentives, like funds for supportive infrastructure and brownfield cleanup, business tax credits, and homebuyer assistance. Complementary "rural legacy" funds support local conservation of natural lands (Ali, 2014; Shen & Zhang, 2007). Since 2009, new state legislation has encouraged local governments to reflect state smart growth principles in zoning, subdivision regulations, and state-required comprehensive plans.

Yet, research suggests these efforts have had limited impact. One study of ag-land conversion in exurban Frederick County concluded Maryland's incentive-based policy could not fully prevent sprawl (Hanlon *et al.*, 2012). Chances that an agricultural parcel would be converted to urban use increased when located in a PFA; however, the parcel's size, distance from urban parcels, highway proximity, and agricultural productivity also significantly influenced those chances. Further, parcels facing greatest development pressure were outside targeted development areas. In matched pair studies of counties in smart-growth Maryland and in Virginia, which lacks comparable growth management policy, Maryland counties appeared more successful in preserving farmland but still followed low density development patterns and, in some cases, sprawled more than their Virginia counterparts (Ali, 2014).

Another study of Maryland development before and after the PFA policy was more optimistic. Non-urban areas targeted for development were significantly more likely to change to urban areas post-1997 than were non-urban areas not targeted for development (Shen & Zhang, 2007). Other work also concluded that Maryland's policy steered development positively, if not exclusively, to the PFAs and preserved agricultural land outside them (Howland & Sohn, 2007; Irwin *et al.*, 2003). Local governments were more likely to concentrate water and sewer projects within PFA boundaries the greater the state subsidy in a project and the higher the county's per capita income (Howland & Sohn, 2007).

State Mandates (General and Single-purpose) for Local Planning

One stream of literature has found that state mandates for general comprehensive planning and for specialized hazard planning can influence local land use for the better, with potential consequences for smart growth. To assess so-called plan quality and effectiveness, a series of studies in the mid-1990s by Berke, Burby, Dalton, and French compared local plans from states that did (California, Florida, and coastal North Carolina) and did not (Texas, Washington, mountain region of North Carolina) mandate hazards planning. Though not focused on smart growth mandates per se, these works show that local governments in states with stronger planning mandates are more likely to restrict development or recommend development limits in hazardous areas than those in states without mandates.

Without state requirements for local planning attentive to natural hazards, some local governments would not use planning, development limits, or land use regulations to reduce

hazards risks (Burby & Dalton, 1994). Further, single-purpose planning mandates more effectively generated local planners' commitment to state objectives than did general mandates (Dalton & Burby, 1994). Also, local adoption of strong development management required both good plans and planners committed to state policies, suggesting focus was needed on increasing planners' commitment to state objectives.

In one study, state mandates for local planning yielded better plan quality, including enhanced plan fact bases, goals, and policies (Berke & French, 1994). Moreover, state mandates with supportive "structural" and "facilitating" features could impact the strength of local plan policies (p. 247). Another before-and-after study measured local hazard plan quality under both Florida's coercive natural hazard planning mandate and Washington's incentive-based mandate; it found both kinds of mandates could spur social learning and improve plan quality over time (Brody, 2003), particularly where a participatory planning process focused on collective, participatory decision making was in place.

Consistency Requirements in State Approaches to Smart Growth

Another group of studies highlights the smart-growth land use impacts of state requirements for planning consistency. Declines in metropolitan density nationwide were counterintuitively more rapid in states with growth management policy requiring state review of local comprehensive plans (vertical consistency) than in states without growth management. Fulton *et al.* reasoned that growth management states had likely adopted such policies precisely because of rapid population growth and declining density (2001). Also, some state growth management programs may have been unable to monitor local compliance and implementation.

Wisconsin's Smart Growth Law provides funding incentives for cities to develop comprehensive plans addressing state smart growth goals and requires cities' land use decisions to be internally consistent with their comprehensive plans. One study of 30 plans found inclusion of smart growth goals was mixed; some cities addressed goals comprehensively, others narrowly, and still others not at all; better evaluation of local planning outcomes was needed (Edward & Haines, 2007). In Michigan, a hodge-podge of state, regional, and local initiatives address smart growth, but coordination of existing efforts was deemed difficult and their success unlikely without "state legislation that mandates regional planning and...comprehensive planning and plan consistency" (Boyle & Mohammed, 2007, 692).

Georgia's Planning Act of 1989 encouraged cities to adopt comprehensive plans and made those that do eligible for certain state funding and permitting programs. Tightening its approach in 2005, the state outlined standards for local comprehensive planning, depending on a local government's size and growth rate. It also required cities to assess existing community conditions, including local consistency with state sustainable development objectives, like open space preservation and infill development. One study examined comprehensive plans adopted by 22 exurban Georgia jurisdictions after the 2005 rules and, using content analysis, compared them to plans from similar jurisdictions in Ohio, which does not require comprehensive planning. Georgia's incentive-based, vertically oriented comprehensive planning program

positively impacts local plan quality (Jun & Conroy, 2013, 2014). Still, exurban Georgia localities generally do not pursue sustainable development.

A separate study of 452 U.S. urban areas found that state growth management reduced urban dispersion, if either vertical consistency between state visions and local plans, or horizontal consistency among land use plans of adjacent localities was required (Wassmer, 2006). However, under weaker state programs requiring only internal consistency between local plans and local decisions, urban area size increased. In contrast, another study found similar impacts of state growth management across states, regardless of whether or not programs required vertical consistency between state objectives and local planning (Dawkins & Nelson, 2003). State programs were effective overall; central cities in growth management states attract a larger share of metropolitan area development (measured as new residential building permits) than central cities in other states.

Regional Efforts to Influence Local Land Use and Development

Regionally organized efforts to influence local land use are less common than state or local initiatives. Still, a handful of studies examine regional efforts and their impacts. Overall, the evidence of effectiveness of regional efforts is limited, largely indirect, and suggests such efforts have limited impacts on improving smart growth.

Regional oversight over local development did little to contain urban sprawl in one study of growth management in New Jersey, Vermont, and Georgia. Approval of local development plans in these states happened at the regional level, “through negotiated consensus among local governments...using state and regional planning criteria” (Anthony, 2004, p. 388). Yet, such oversight failed to increase urban population density, an indirect proxy. If an assortment of individual interests, not clear policy direction, guides local stakeholders’ consensus, regional oversight may be ineffective. State level oversight over growth management implementation may be more effective.

Regional urban containment may not restrain dispersion either, but it may increase racial diversity and stem downtown decay. Longitudinal analysis of marginal land consumption rates suggests that regional containment—observed via Nelson, Sanchez & Dawkins’ MPO survey data and analysis of MPO plans (2004)—does not reduce the size urban areas over time (Paulsen, 2013). Using the MPO survey data, Nelson *et al.* found that strong urban containment significantly accelerated racial desegregation among Anglos and African Americans in metro regions. Such policies, whether strong or weak, did not impact Latino or Asian desegregation (2004). A third study using Nelson *et al.* (2004) regional containment data found such policies helped to reduce central city blight (Hortas-Rico, 2015).

Metropolitan livability or sustainability programs organized by some MPOs are visible, regionally scaled efforts to shape local land use and development, but their impacts are not well studied. Such programs typically encourage local governments to undertake smart growth projects or activities by offering MPO grants or preferential treatment in the MPO’s allocation

of transportation funding (Margerum *et al.*, 2013). One review of five such programs (see Table 2) provides few details about what the programs funded, but finds that MPOs typically assessed program performance by measuring project delivery, percentage of regional development occurring in targeted areas, additional funding leveraged with grants, and transportation accessibility, via such indicators as transit proximity, induced transit ridership, and bicycle and pedestrian access (Fabish & Haas, 2011).

Table 2: Regional Smart Growth / Center-oriented Policies and Programs

Metropolitan region	Regional Smart Growth Policy / Program	Sponsoring MPO
Atlanta	Livable Centers Initiative (1)	Atlanta Regional Commission
Dallas-Fort Worth	Sustainable development initiative (1)	N. Central Texas Council of Governments
Denver	Metro Vision Regional Transportation Plan (2); Mile High Compact (2)	Denver Regional Council of Governments
Minneapolis–Saint Paul	Livable Communities Act Grant Program (1)	Metropolitan Council
Portland	Transit-oriented Dev. & Centers Program (1); 2040 Growth Concept (2)	Portland Metro
San Diego	Regional Comprehensive Plan (2); Smart Growth Incentive Program (2)	San Diego Association of Governments
San Francisco Bay Area	Transportation for Livable Communities (1)	Metropolitan Transportation Commission
Seattle	Puget Sound Vision 2040 (2)	Puget Sound Regional Council

1=(Fabish & Haas, 2011); 2=(Margerum *et al.*, 2013)

A separate study of four MPO efforts (see Table 2) measured “program effectiveness” indirectly. It concluded from reports by survey and interview respondents familiar with the programs that regional incentive policies had limited impact because they were new and offered small grants relative to local government need and market forces. However, combined with plans, policies, and transit investment, such incentives could work to promote growth around centers (Margerum *et al.*, 2013).

Local Efforts to Influence Local Land Use and Development

Beyond state efforts to temper urban dispersion, scholars have also examined similar local planning and policy efforts. Rising adoption of so-called growth control and management polices began to attract scholars’ attention in the early 1990s. What actions do local governments take to pursue to smart growth or growth management, and are they effective?

Early work documented a range of growth management measures used by California local governments in the 1990s (Glickfield & Levine, 1991; Levine, 1999), and tested whether impacts of local initiatives differ by type or stringency of land use policy. One match-pair case analysis found that more stringent growth controls like population caps, housing permit caps, and commercial square footage caps were less useful for limiting population and housing growth than supporters anticipated, but also less damaging to housing affordability than critics claimed (Landis, 1992). Later work found that local growth controls and management programs in California had modestly restricted the amount, pace, and location of growth; impacted local housing prices; and displaced growth from places with controls to those without them (Landis, 2006). Different controls also had different effects: residential caps, annexation controls, and supermajority approval requirements limited population growth, and annexation limits and

super-majority requirements limited housing construction. Yet, milder urban growth boundaries mostly redistributed growth within communities (p. 420). Recent work suggests that local policy can temper urban area decentralization by “eliminating or reducing the stringency of minimum lot-size zoning and maximum FAR [floor-area ratio] or building-height restrictions, while imposing or increasing the stringency of maximum lot-size zoning, maximum building-permit restrictions, minimum persons per room limits, and impact fees.” (Geshkov & DeSalvo, 2012, 672).

A related assessment of 44 U.S. metro areas showed housing starts were 45% lower and housing demand was significantly less elastic in regions dominated by jurisdictions with stringent land use controls (Mayer & Somerville, 2000). Different regulatory strategies also had larger and more significant impacts on new construction than others. The study used data about time required for subdivision approval, number of growth management techniques prevalent in a region, and use of development or impact fees in cities in a region, all drawn from a planners’ survey.

Other evidence on regulatory stringency found that the simple existence of local urban containment policies (e.g. urban growth boundaries) does not reduce urban area size. Rather, the longer such policies were in place, the greater effect they had. Also, more restrictive urban containment reduced urban area size than more accommodating forms (Wassmer, 2006). In terms of extent, the number of land use controls increases where homeowners associations are prevalent (Cheung & Meltzer, 2013). For rezoning, one study suggests that subjecting site-specific rezoning decisions to citizen referenda reduces new housing construction, regardless of the vote’s outcome (Staley, 2001). It analyzed construction activity in 63 Ohio cities over 14 years, controlling for population growth, per-capita transportation spending, municipal fiscal health, and region-specific effects.

Abundant works recommend smart growth principles and practices for facilitating more sustainable land use and local development, from the Charter of New Urbanism to the American Planning Association’s Comprehensive Plan Standards for Sustaining Places; yet, empirical study of the impacts of such practices is less well developed. One exception studies up-zoning in two New York City industrial waterfront neighborhoods (Wolf-Powers, 2005). A planning environment favoring property-led urban development together with land appreciation and speculation pressures led to the conversion of Greenpoint-Williamsburg and Long Island City from industrial/manufacturing zones to mixed-use zones where residential conversion was allowed as-of-right without community review. Up-zoning led to the displacement of industry users unable to pay premium rents; the potential dispersive impacts are not explored. Another study examines the degree of land use mixture in the Rotterdam City Region and finds that mixed-use neighborhoods combining residential, business service, and leisure uses have a positive effect on housing values (Koster & Rouwendal, 2012).

Conceptual Frameworks for Evaluating Land Use Planning and Policy

In this section, existing studies on local land use planning and policy assessment are considered for the different frameworks, performance dimensions, and criteria they employ to assess or characterize local land use plans and policies. Studies are grouped by different conceptual approaches to evaluation: whether based on process-oriented planning outcomes, plan alignment with specific policy goals (in particular, sustainability and sustainable mobility goals), levels of plan or policy implementation, or impacts on specific policy outcomes. Also discussed are some studies with a deliberate methodological focus and that consciously weigh methods for assessing land use plans and policy.

Process-based Frameworks for Local Plan Evaluation

The evaluation of local land use planning and policy has focused largely on planning outcomes that are process-oriented. Studies in this vein consider what makes a “good” plan or policy. They focus less on empirically observable plan or policy impacts, and more on the quality of planning, plans, and policies themselves. They consider plan fact bases, goals, and policies; the extent of stakeholder involvement; and the persuasiveness of local plans as outcomes in themselves. Plan implementation is generally assumed, and “good” or “high quality” plans are more likely to influence local governments’ development decisions (Burby & Dalton, 1994). In such assessments of plans and plan making, the regulatory extent, or stringency, of land use policy matters as well.

The basic approach for measuring plan quality was developed by Berke, Burby, Dalton, and French in their mid-1990s research on local planning for natural hazards. Berke and French (1994) measure plan quality in three key dimensions: a plan’s fact basis (presentation of existing conditions in the community); its goals or statements of aspirations and values; and its policies, or actions, to guide specific development decisions. Many plan quality studies follow this framework (Berke, Smith, & Lyles, 2012; Bunnell & Jepson, 2011; Norton 2005). In general, results from such studies suggest that higher quality local plans are more likely in states with local planning mandates than states without mandates (Berke & French, 1994; Berke, Roenigk, Kaiser & Burby, 1996; Dalton & Burby, 1994).

Plan quality studies typically use content analysis to rate or score plans numerically along the key dimensions. In general, higher plan quality is demonstrated when plans provide more detailed information (fact bases) and policy goals and recommendations that are stronger and more implementation- or action-oriented. For each dimension, basic points are awarded when a content item defined as desirable is mentioned in the plan. Additional points are earned when the plan discusses a desired fact, goal, or policy item in detail, and when policies are mandatory rather than simply suggested or encouraged. In one assessment of local housing plans, this framework was used to find that high-quality plans provided a detailed housing inventory, included comprehensive goals addressing a range of housing issues, recommended policies that were clear and connected to plan goals, and identified detailed funding strategies for plan implementation (Connerly & Muller, 1993).

One variation on the plan quality framework assesses “plan strength” and “stakeholder involvement” in plan making (Burby, 2003). For hazard mitigation planning by 60 jurisdictions in Florida and Washington, “plan strength” is measured as the ratio of hazard mitigation proposals in a single plan versus the universe of proposals a plan could include. “Stakeholder involvement” is measured as the ratio of stakeholder types represented in the plan-making process to the total number of potential stakeholder types. It also reflects whether stakeholders called attention to hazard mitigation in the planning process. The study found that greater involvement in plan making made for stronger comprehensive plans.

The plan quality framework has been extended further to assess the “communicative and persuasive qualities” of local plans. A good plan, Bunnell and Jepson argue, “should clearly and effectively communicate key principles and ideas, and energize, engage, and inspire residents in support of those principles and ideas” (2011). A comparison of 20 plans from states with local planning mandates to 20 plans from states without mandates finds that, in communicative dimensions, mandated plans performed no better—and sometimes worse—than non-mandated plans. Effective plan communication is identified and measured via the use of photos and illustrations, avoidance of long goal lists, visually attractive layouts, relevant tables and data, and an attractive, readable and informative executive summary.

Plan stringency offers another way to characterize local land use regulation or policy. Mayer and Somerville (2000) measure the stringency—the extent or restrictiveness—of local land use control in a metropolitan region via local regulations. Specifically, they quantify the estimated number of months for subdivision approval, and note the use of development or impact fees in metro area cities. Also, they enumerate, of five possible growth management techniques (citizen referendum, legislative action by municipalities, counties, and the state, and administrative action by public authorities), the number prevalent in the metropolitan area. More extensive land use regulation, they conclude, is associated with significantly lower rates of new housing construction. An index of land use restrictiveness reflects for individual areas the percentage of land zoned at different levels of restrictiveness; residential development ceilings in growth controls have been also been indexed (Pollakowski & Wachter, 1990).

Norton (2008) provides valuable methodological critique of content analysis as it has been used to evaluate local plans and zoning codes. He examines the potential threats to validity of such plan quality measures, and also explains how the reform of planning and plan quality requires several steps that are seldom accounted for in the literature.

Frameworks Using Policy Goals for Local Plan Evaluation

Some studies evaluate land use plan and policy content in light of discrete policy goals. One example compares metropolitan Atlanta local plans that explicitly used sustainability principles as a planning framework to plans that did not (Berke & Conroy, 2000). No differences in substance were observed between the two kinds of plans, and the plan that performed best for

promoting sustainability actually did not acknowledge sustainable development as a framework or guide.

Berke and Conroy's approach is similar to plan quality measurement and uses systematic measurement of policy-oriented plan content. The policy objective of interest (sustainable development) is translated into planning principles and development management techniques that are measurable, and that when implemented are expected to achieve the policy objective. Like general plan quality assessments, this system awards a plan points for articulating policies reflecting desired principles and for suggesting or requiring specific implementation strategies. Ultimately, an overall "sustainability score" is computed for each of 22 plans studied. The method provides a logical and replicable way to measure plan content in light of specific policy goals. Further, the approach has been adapted to examine plan-policy alignment in sustainable transportation planning (Lee *et al.*, 2002), smart growth reforms (Norton 2008), and coastal preservation (Norton, 2005), and to examine the correlation between the quality of plan content and measurable community welfare outcomes (Chandler, 2011).

Alignment with policy goals is a relevant question not just only land use plans but also for land use regulations. Talen and Knapp (2003) examine local zoning regulations for their alignment with smart growth policy aims. They asked how much such regulations promote progressive forms of urban development, and whether local regulations also hinder compact walkable communities. Overall, Illinois cities and counties "employ relatively low levels of smart growth-related prescriptive policies" in their land use regulation.

Implementation-based Frameworks for Local Plans and Policy Evaluation

Other local land use plan and policy evaluations focus on whether and how plans and policies are implemented or likely to be implemented. A "good" plan holds little value if it is not used. One fundamental, unresolved question for such studies is how best to measure "plan implementation."

In one study, personal interviews with planning staff are used to ascertain the fate of hazard mitigation planning proposals (Burby 2003). Plan implementation is measured as the ratio of proposed mitigation actions later implemented to proposed actions not implemented, and implementation levels are found to vary considerably. On average, the number of mitigation actions implemented by a jurisdiction is 1.8 times greater than the number of actions rejected, suggesting that "in a typical jurisdiction some degree of action on planning proposals took place." Still, in 25% of jurisdictions, mitigation actions that went nowhere outnumbered mitigation actions implemented. Further, 10% of jurisdictions studied adopted none of their plan's proposed actions.

A study of local plans in 36 North Carolina coastal communities also points to mixed evidence of "plan use" (Norton, 2005). Reports from local administrators are used to gauge the extent to which a jurisdiction's plan guided local elected officials' land use decisions. Some localities encountered no or few occasions to use their plans, making no land use decisions in the study

period. In other jurisdictions, plans were not used often, but they were said to play an important role informing certain decisions. Also, survey results suggest “elected officials saw land use planning as a useful policy tool” (p. 61). One earlier study estimated that two-thirds of zoning decisions are made without the benefit of a plan (Rudel 1989), suggesting planning may be ineffective.

Another approach to assessing implementation examines planning implementation tools (i.e. zoning ordinances and subdivision regulations) rather than local comprehensive plans themselves. In a large sample of Illinois cities (42%) and counties (59%), Talen and Knapp examine the prevalence of local regulations across four categories (regional, process-oriented, spatial, and site specific policies) to quantify empirically “the degree to which a smart growth regulatory ‘culture’...actually exists” (2003, p. 346). Overall, they report that local land use regulations in Illinois “employ relatively low levels of smart growth-related prescriptive policies.” Further, regulations such as large minimum lot size requirements, large setback requirements, and high parking standards and pavement widths generally counter smart growth development ideals. The authors expected that jurisdictions with higher incidences of smart growth policies in one category would have higher incidences of such policies in another. However, correlation analysis of “inter-regulatory consistency” across cities and counties suggested a lack of inter-policy association. Overall the authors conclude that local land use regulation in Illinois is not well focused on smart growth implementation.

On the whole, studies of plan implementation are uncommon. This remains true despite earlier appeals urging planning researchers to focus on implementation (Talen, 1996) and, specifically, on data collection and methods for measuring and evaluating smart growth regulations like “mixed use” (Talen & Knapp, 2003). Many studies instead measure the effects of planning or land use regulation, by monitoring development patterns or housing prices. In such works, plan or regulation implementation is assumed.

Other studies examine why some jurisdictions adopt or implement smart growth or sustainable land use plans and policies while others do not. Works of this kind do not measure policy adoption or implementation *per se*, but do explore the local factors associated with it. Rapid population growth, for instance, correlates to the adoption of local land use controls in some studies (Boarnet, 2011; Wassmer & Lacscher, 2006), but not others (Baldassare & Wilson, 1996). Additionally, high income may (Brody *et al.*, 2006) or may not (O’Connell, 2009; Nguyen, 2009) increase the likelihood of community support for growth controls. Other work has postulated the causal pathways through which plans effect outcomes, including the potential for plans to coordinate interdependent decisions, increase decision makers’ knowledge, shape or re-aggregate preferences, and deter non-compliant actions (Millard-Ball, 2012).

Explicit evaluation of plan implementation is underdeveloped, and empirical, large sample, quantitative studies are rare, in part because such analyses face methodological challenges (Talen, 1996). Theoretical uncertainty and disagreements call into question how much of an impact planning can have on urban land development. How to define plan implementation or success—whether directly by observed alignment with predetermined plans, or indirectly by

evidence that plans are being consulted—is debated. Multi-causality also makes it hard to establish direct causal links between plans and outcomes. Further, quantitative techniques for evaluating plan implementation are underdeveloped, driven largely by the absence of appropriate data.

Calls for further research on local land use planning and regulation, particularly for appropriate methods to collect data about, measure, and evaluate smart growth regulations (Talen & Knapp, 2003), continue to resonate. Implementation focused research still needs to ask (Talen, 1996b):

1. Are plans implemented? Do land use regulatory mechanisms and controls reflect plans?
2. Are those regulatory mechanisms being implemented or followed? What is their impact?
3. What is the gap between plans and impacts or outcomes?

Data and Indicators for Measuring Land Use Performance

Current policy in California makes the measurement and monitoring of land use and development patterns across the state an important issue. Under SB 375, land use is expected to help California’s metro regions achieve targets for per capita GHG reduction. The law explicitly states that “changed land use patterns and improved transportation” will be necessary for “achieving greenhouse gas reductions, and that absent “improved land use and transportation policy, California will not be able to achieve the goals of AB 32” (SB 375, Sec. 1(c)).

How will California regions and local jurisdictions discern whether integrated land use and transportation planning is producing desired outcomes? Baseline observation and ongoing monitoring of on-the-ground land use and development must be SB 375 touchstones. Yet, what data or indicators, observed over time, would highlight the regions and local jurisdictions demonstrating land use progress and SB 375-supportive outcomes, as well as those needing implementation support?

The tables below synthesize how existing studies have measured land use change over time and ascertained if change resulted from adopted or implemented land use policies, versus other factors. It covers studies that explicitly evaluate the *impacts and outcomes* of plans and policies, in terms of observable, on-the-ground change.

Questions remain about which data sources and measurement approaches would best support the kind of strategic land use monitoring called for in this paper. This white paper does not take up such questions, but it strongly recommends separate efforts to do so. The data sources highlighted here are representative, not exhaustive. Further, data coverage, granularity, accuracy, regularity of updates, and cost of collection will vary from source to source. Development of a statewide approach to land use monitoring should take these and other strategic considerations into account.

Table 3. Approaches to Data and Measurement for Land Use Evaluation

Indicator / Dimension Measured	Studies	Indicator Variables / Unit of Analysis	Measurement Approach / Data
Table 3.a. LAND USE CHANGE			
Land use change	Hanlon <i>et al.</i> (2012)	Agricultural land conversion	Parcel data (centroid of parcel)
	Shen & Zhang (2007), Landis (2006)	Change from “undeveloped” to “urban” designations	Grid cell data and cell-based land use designations
	Jun (2004)	Longitudinal analysis of Portland metro area (1980-2000) using census-based proxy variables, plus comparison to other metros.	Urbanized population; size and density of urbanized land area; central city employment; urbanized area housing units; auto users; transit users; commute time.
Land use change; proportion of development within (and outside) targeted areas	Gennaio, <i>et al.</i> (2009)	Observe development via changes in land use maps over time.	GIS-based analysis of digitized building zone boundaries from land use plans in two time periods; measure expansion of developed land, number of new buildings, building compactness/density in and out of zones.
	Fabish & Haas (2011)	Not specified	
Housing production	Landis (2006)	Relationship within a municipality of housing supply to housing demand	Residential permits published by the Construction Industry Research Board used to measure increases in housing supply; housing provided is compared to unconstrained job-related housing demand (estimated in retrospect) for each locality.
Land consumption relative to population growth	Fulton, Pendall, Nguyen & Harrison (2001)	Changes in population density based on measurement of urbanized land.	Metro population data from census; urbanized land data from the Natural Resources Inventory survey of land Use.
Land use mix	Song & Knapp (2004)	Actual land use mix	Ratio of acres of commercial, industrial, and public land uses in neighborhood to the number of housing units
	Song & Knapp (2004)	Zoned land use mix	Ratio of acres of land <i>zoned</i> for commercial, industrial, and mixed land uses in the neighborhood to the number of housing units

Table 3. Approaches to Data and Measurement for Land Use Evaluation (continued)

Indicator / Dimension Measured	Studies	Indicator Variables / Unit of Analysis	Measurement Approach / Data
Table 3.b. URBAN FORM MEASURES			
Accessibility	Lowry & Lowry (2014)	Street connectivity	Ratio streets to intersections
		Median perimeter of blocks	m.
		Dendritic street pattern	Ratio cul-de-sacs to streets
		Median length of cul-de-sacs	m.
	Song & Knapp (2004)	Blocks	Ratio of blocks to housing units
Centrality	Lowry & Lowry (2014)	Mean distance to commercial zone	km.
		Mean distance to K-12 schools	km.
	Song & Knapp (2004)	Mean distance to nearest park	
Density	Lowry & Lowry (2014)	Median single-family residential lot size	Acres
		Median no. of rooms	#
		Housing density	housing units/sq. km.
Neighborhood Mix	Lowry & Lowry (2014)	Land use contiguity	Juxtapose interspersion index
		Land use richness	Patch richness
		Pop. working outside city	Proportion
		Renter-owner balance	Ratio renters to owners
Table 3.c. TRANSPORTATION ACCESSIBILITY			
Transit accessibility	Song & Knapp (2004)	Bus access	Median distance to nearest bus stop
Pedestrian accessibility	Song & Knapp (2004)	Pedestrian access to all commercial uses	Percentage of single-family dwelling units (SFDUs) w/in ¼-mile of all existing commercial uses
	Song & Knapp (2004)	Pedestrian access to bus stops	Percentage of SFDUs w/in ¼-mile of all existing bus stops

Discussion and Conclusions

This review of existing research on land use performance has focused on upstream relationships between land use policy and on-the-ground land use changes that may reduce VMT. To consider SB 375's potential for shaping local land use to reduce VMT (and hence, GHG emissions), the paper has synthesized the research relevant literature from three angles, in particular. First, it examined evidence of the effectiveness of land use policy in changing development patterns. Next, it inventoried the evaluation frameworks that have been used for land use assessment. Third, it highlighted the data and measurement variables that have supported previous studies of land use change over time.

SB 375 sets new expectations for land use performance.

It is important to acknowledge that state policy, SB 375, creates new expectations for the performance of land use in California. Local governments' land use and development decisions should support regional Sustainable Communities Strategies (SCS), crafted to meet state and regional goals for reducing GHG emissions. To support the SCS, local land use should help to make California communities less automobile-reliant.

In the SB 375 policy environment, it is important to recognize that realization of such goals is a long term project. Physical development patterns of cities and regions evolve slowly in response to policies and plans. Change can take years to reveal itself, particularly when residential and commercial development markets are tepid.

Strategic evaluation of land use change over time is needed.

Given the long term nature of such change, a well-considered ongoing monitoring effort is needed to evaluate future land use change and planning performance in light of SB 375. Such an effort would examine two main questions at regular intervals. First, it would ask whether upstream regional and local planning is changing. Here, evidence in the form of land use plans, zoning ordinances, and development policies will be informative. Second, it would examine whether and how development patterns are themselves changing. What on-the-ground changes in land use are observable, and do they support reduced auto use? While many data sources, highlighted in Table 3, could be marshalled to support this exploration, more work is needed to identify which data could do it best.

Longitudinal land use evaluation for SB 375 would illuminate land use policy-outcome relationships.

Existing literature gaps suggest both the need for this monitoring effort and its potential to contribute to our understanding of **linkages between the higher level policy** (crafted by states, regions, or local governments); **intermediate plans** (land use plans, zoning ordinances, and development decisions subsequently adopted by local government); and **ultimate outcomes**, observed and measured in on-the-ground changes in land development.

For instance, overall evidence on the effectiveness of state policies in reducing urban sprawl is mixed, whether described as “growth management,” “smart growth,” or “sustainable land use.” Where such policies moderate land consumption, they do so at the margins. Evidence is also inconclusive about which state policy mechanisms are most effective for reducing sprawl and promoting less automobile dependent development. The designation of targeted development zones appears to make development in such areas somewhat more likely; yet, such designations do not prevent development from going to other areas. State mandates for local planning and for local plan consistency with state goals appear to improve plan quality but not necessarily reduce sprawl.

Regionally oriented land use policies are less common and less well studied, making SB 375 an important opportunity for rigorous evaluation. To date, the evidence of effectiveness of regional efforts is largely indirect and suggests such efforts have limited impacts on improving smart growth.

SB 375 also affords researchers a view of how local governments are responding to the policy. Most studies of local government policy have emphasized growth control. Such measures to control growth as population caps, housing permit caps, and commercial square footage caps have been shown to temper population and housing growth, but more modestly than anticipated. In general, more stringent land use controls that make development approvals more complex or time consuming do deter development. Still, there is little research on local land use policies promoting smart growth *per se*, though some work suggests urban growth boundaries are more effective when in place longer.

Existing research provides possible frameworks for evaluating land use planning and outcomes.

For considering the performance of local land use plans and policy in general and against SB 375 in particular, existing evaluations demonstrate a few approaches. Process-based frameworks consider so-called plan quality, including the level of information included in plans and plan policies, and the substantive content and specificity of plan goals and implementation actions. Plan or policy stringency is another approach, focused on the extensiveness and restrictiveness of land use regulation.

Evaluation based on policy goals offers a second and likely more informative framework for considering land use performance under SB 375. Land use plans and regulations are rated for their ability to reflect specific policy goals, such as SB 375’s focus on development that reduces auto reliance and GHG emissions.

Implementation based frameworks are used less frequently given empirical and methodological challenges. There is little agreement about how to define, observe or measure the success of plan implementation. Additionally, multi-causality makes it hard definitively to link on-the-ground development with upstream land use plans or policies, when other influential factors may be at play. In spite of these challenges or perhaps because of them, it is here where planning research stands to gain the most. In a policy environment that demands performance-based planning,

good processes are insufficient, and outcomes that build more sustainable and more socially just communities are needed.

Existing research also suggests possible models for evaluating land use planning and outcomes.

Existing studies also showcase the different data sources and variables that have been employed to answer questions about changes in land use, urban form, and transportation accessibility over time. What data are best and at what scales are they available? What data sources do practitioners consult to observe land use change in their community?

Available studies are one starting point for considering what data will best support statewide monitoring of land use change. A separate effort to address this question in greater depth is needed.

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