"LOCATION EFFICIENCY" & TRANSIT-ORIENTED DEVELOPMENT: A POTENTIAL CDM OPTION IN SANTIAGO DE CHILE

Activity Brief

Introduction

This brief outlines the basic concepts of "location efficiency" and transit-oriented development and identifies the principal steps required to understand the potential for the Clean Development Mechanism (CDM) to move these concepts into practice in Chile. The focus on location efficiency evolves from the initial identification (by the IISD/CCAP/CC&D Team together with the Chile Transport CDM Project Steering Committee) of urban densification as a possible CDM area of focus for Santiago. Further conversations with MINVU, SECTRA and the Steering Committee led to the more general concept of "location efficiency," as this concept aligns more closely with policy goals of Chilean authorities and also more directly complements other work to be undertaken with support of the Global Environment Facility (GEF) and other sources.

The ultimate goal of this initiative is to come up with a pre-feasibility study of the potential for location efficiency to reduce transportation greenhouse gases and thereby attract investment via the CDM. In this sense, this particular initiative is somewhat "project specific." The IISD/CCAP/CC&D Team will, however, in parallel work explore the possibility of using the CDM to support broader – and related – policy initiatives, such as MINVU's efforts to promote densification of and revitalization of the Anillo Central Metropolitano (ACM). That work is not detailed here.

While this project is aimed at developing a specific pre-feasibility study, we recognize that this work forms only a small part of a larger research and policy agenda in Chile. We anticipate that this project, regardless of whether it ultimately results in "location efficient" CDM projects, will contribute positively to existing and ongoing related activities in Chile, such as the MINVU work on location efficiency and general efforts to establish rigorous methodologies to evaluate transportation impacts of site-level changes in land uses.

Concepts

This project intends to explore the feasibility of promoting "location efficient" urban development in Santiago de Chile, with a particular focus on so-called "transit-oriented development" – increasing urban development near public transport (Metro) stations and/or corridors in order to increase the use of this less-polluting transport mode as a substitute for more polluting modes. The basic idea is to identify the potential use of the Clean Development Mechanism (CDM) to attract financial resources for "location efficient" urban development projects and in this way make such projects more attractive as investments.

As a first stage in the analysis, we propose to focus on potential location-efficient development near the Metro, because of anticipated *relative* methodological ease related to key CDM challenges, such as establishing the project baseline and monitoring and verifying project impacts. We expect, however, that the methodologies developed for this project can be expanded upon and generalized in order to more broadly estimate the potentials for "location efficient" development in Santiago and, ultimately, in other Chilean cities. In this sense, this project should be viewed as a first-step contribution to the existing plans of MINVU and other Chilean authorities to develop and implement the location efficient concept (through, for example, GEF-supported activities).

At the metropolitan level, the spatial distribution of residences, offices, schools, etc. and the associated distribution of trip generators and attractors are the underlying factors which drive virtually all transportation activity. Such effects are normally modeled in regional travel forecasting exercises, sometimes in coordination with land use models and, for the purpose of air quality modeling, mobile source models (such as the ESTRAUS/MUSSA/MODEM modeling suite in use in Santiago). Moving beyond just the metropolitan level, however, the concept of location efficiency focuses as well on local level factors, under the belief that land use and urban form can influence travel behavior by influencing what some researchers call "neighborhood accessibility" (see Krizek, 2003). The concept of neighborhood accessibility rests on the principle that neighborhood-scale factors – such as the local mix of land uses, the street design and layout, and the density of different activities – can influence travel behavior, such as people's propensity to take pedestrian trips.

From a transportation perspective, the basic premise is that local-level urban form characteristics can influence individual travel behavior in three basic ways: (1) reducing the number of motorized trips; (2) increasing the share of non-motorized trips; and, (3) reducing travel distances of and increasing vehicle occupancy rates of motorized trips. These local-level urban form characteristics can be categorized along three general lines – density, diversity, and design, or the so-called 3Ds of the built environment (Cervero & Kockelman, 1997):

- Density – i.e., lot size, residential density
- Diversity – i.e., mix of land uses and their proximity;
- Design – i.e., street widths and layout, block size, sidewalks, building set back, amenities (parks, shade), parking provision.

Ultimately, both neighborhood-level characteristics and regional location characteristics (i.e., relative location of a neighborhood in a region) influence travel demand – so that in looking at overall travel characteristics of a specific location, both factors must be considered in some way.

Precedents

To a certain degree, this initiative aims to extend upon relevant work developed in recent years in the industrialized world, particularly the United States. In some parts of the US, growing concerns over ongoing dependence on automobile travel and some belief in the potential for local land use measures to help mitigate demand for automotive travel have led some authorities to explore local land use interventions as a means to reduce travel demand. This interest has been matched by a large amount of research over the past 15 years that has attempted to theoretically and empirically demonstrate the influence of land use (or urban form, or the "built environment") on travel behavior. In very recent years, the public concerns and parallel research activities have converged to produce policy products, perhaps most relevantly the "Location Efficient Mortgage" (LEM) program. The LEM, currently a pilot program running in several US cities and sponsored in part by the federal mortgage underwriting agency, Fannie Mae, offers favorable home mortgage terms for households that choose to purchase homes in "efficient" locations. The basic premise underlying the program is that by choosing to live in "location efficient" homes, households reduce their overall transportation expenses (by traveling, especially by private cars, less) and thus can better afford mortgage payments.

Underlying the LEM is empirical work relating neighborhood characteristics, socioeconomic characteristics, and other factors to travel demand (specifically automobile ownership and use) (see Holtzclaw, et al, 2002). The United States Environmental Protection Agency (EPA) has also recently incorporated travel demand effects into its Smart Growth Index (SGI) model, a GIS-based software tool used to help communities measure the impacts of land use changes on various indicators of community well-being. In an attempt to account for the effects of higher densities, mixed land uses and "pedestrian-friendly" designs on travel (vehicle distances traveled (VDT) and vehicle trips (VT)), SGI uses generalized elasticities of VDT and VT with respect to land use and design variables, drawing from a broad number of relevant recent studies, as summarized in Ewing and Cervero (2001).

Both the LEM concept and the SGI model are based on the assumption that there is some degree of "generalizability" of the research underlying the models. Several researchers have, however, questioned this assumption, arguing that the lack of a microeconomic behavioral theory underlying most of the relevant analysis makes it difficult to support any causal conclusions and adequately defend attempts at generalization (see, i.e., Boarnet & Crane, 2001; TRB, 2002). As such, attempting to apply the location efficiency concept to Chile requires, at least: 1. consensus on an adequate theoretical framework (i.e., behavioral construct) to conduct the work; 2. empirical application of that framework using recent relevant data (i.e., the 2001 Origin-Destination Survey and comparable relevant data on land uses).

Proposal

This ultimate goal of this pre-feasibility study is to identify specific real estate development opportunities, quantify the travel behavior impacts of those developments, estimate the net impacts on transportation greenhouse gas emissions of the developments if they were to be realized, and identify the potential mechanisms for CDM investment. To achieve this goal requires several steps:

<u>1. Establishing the theoretical framework and specifying the model.</u> A basic theoretical framework must be agreed upon as an underlying foundation for the work. Such a framework should ultimately be able to defensibly demonstrate the influence of land use on travel behavior and emissions (and, possibly, other impacts of interest such as congestion). The framework would likely rest on basic microeconomic (i.e., consumer choice) theory, although the possibility of a less theoretically rigorous but possibly more empirically tractable approach (i.e., more simple correlative relationships) should not be rejected outright. One potential approach would be to develop transportation profiles for particular land use types at specific locations with specific urban form characteristics, for example:

$$T_h = f(S_h, D_h, L_h)$$

Where T_h is the transportation profile for household, h, of socioeconomic characteristics, S, demographic characteristics, D, located in a place with land use characteristics, L. The transportation profile, T_h, might be mode share, vehicle trips, and travel distances, or some other combination of derivable and relevant transportation indicators. The vector L would be comprised of relevant variables representing the (for example) local-level 3 Ds (discussed above) as well as variables representing metropolitan-wide accessibility (captured, for example, through gravity function measures or other measures of accessibility obtained, for example, through ESTRAUS/MUSSA). Ultimately, the profile, T_h, would have to be converted to an emissions profile, E_h.

2. Empirically estimating the model. Empirically, the model specified in Step 1 would have to be estimated using data from Santiago. Fortunately, the 2001 Origin-Destination (OD) Survey provides a rich and recent data source on travel behavior of households and individuals in the metropolitan area – data that was collected and coded at a level of spatial dis-aggregation that in theory should allow for travel behavior at the neighborhood (i.e., block) level to be measured. Reportedly, data on land uses (number of firms of different types, number of households, etc.) also exists at a similar level of spatial dis-aggregation (i.e., block level) that would allow for the estimation of land use effects on travel behavior. The types of data expected to be needed at the block level to estimate the model are shown in Table 1.

Table 1: Examples of Types of Data Needed for Model Estimation

Household Socio-Demographic and Economic Variables	Trip Variables	Land Use Variables
Gender, Age, Education, Income, Number of Children, Number of Motor Vehicles, Number of Drivers, Number of Workers	Number of Trips by Different Modes by Individuals, Trip Duration	Population Density, Street Grid Layout, Density of Retail Employment, Density of Service Employment, Public Transport Level of Service, Pedestrian Amenities

The ultimate estimation technique used will depend, in part, on the form of the model specification. However, it seems likely that a multinomial logit (MNL) estimation method would be the most appropriate choice, as the MNL model is aimed at identifying individual choice from among a set of competing alternatives (i.e., mode choice). It is expected that the model would be estimated broadly for the metropolitan area, in order to effectively capture the range of neighborhood types in Greater Santiago.

The results of the MNL model, which aim to estimate a land use's transportation profile, T_h, would have to then be converted into an emissions profile, E_h.

3. Developing the CDM Methodology. While this step will build on the results of the model estimation (Step 2), it can to a large degree be developed concurrently (i.e., we do not need to wait for the results from Step 2 before beginning work on Step 3). This crucial step would aim to incorporate the results into a methodology that could be used to estimate the CDM potentials of real estate projects based on their potential for reducing transportation greenhouse gas emissions. At this stage, several important questions would need to be answered:

a. Determining the baseline and project additionality. Where would the developments have otherwise located and what would have been the travel characteristics and subsequent emissions of those alternative locations? Over what time period can the emissions reductions be realistically credited? To what degree are the reductions "additional" to business-as-usual?
b. Establishing a monitoring and verification program. How can the emissions reductions be adequately monitored and verified? Could surveys be incorporated into the real estate projects to determine trip-making behavior (including all non-motorized trips)? Could public transport ridership be monitored (i.e., Metro boardings)?
c. Understanding project's broader development impacts and estimating co-benefits. Does the project meet broader development goals (traffic reduction, health improvements, etc.)? How can co-benefits (i.e., local air pollution reduction, other social benefits (costs)) be calculated and effectively incorporated into the methodology?

It is expected that the methodology ultimately developed would serve as a screening tool for CDM developers to help them to assess potential investment projects.

4. Identifying the Specific Mechanisms for CDM Implementation. Finally, this step would aim to identify the mechanisms through which the CDM might be utilized. For example, real estate developers themselves might sell the resulting CDM credits; joint ventures between local developers and industrialized country (Annex I) partners might be pursued; a fund might be developed through the CDM credit sales to fund a mortgage guarantee fund (thereby "buying down" the cost of credit for homebuyers), etc.

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