

## **TRANSPORTE URBANO Y DESARROLLO ECONÓMICO URBANO**

### **(URBAN TRANSPORT AND ECONOMIC GROWTH)**

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#### **1. Introduction**

The purpose of this presentation is to examine the relationship between better urban mobility and economic growth --- or stated another way, the relationship between better urban mobility and poverty alleviation.<sup>1</sup> Virtually all nations seek to improve economic growth. However, as will be shown, some urban transport and land use policies can work against this objective. Economic growth may be stymied where economics and the impacts on lower income households are not sufficiently considered in policy development.

This can be illustrated by the present policy environment. Efforts are underway to reduce greenhouse gas (GHG) emissions. Policy initiatives that restrict or impair urban mobility are likely to lead to less economic growth and higher levels of urban poverty. Godard notes the potential policy conflict between policies that would limit mobility to reduce GHG and the need to increase mobility to reduce poverty (Godard, 2007). On the other hand, GHG emission reduction policies might be neutral with respect to alleviating urban poverty or could even have a positive impact. There is a need to ensure that policies do not result in negative externalities with respect to poverty alleviation and economic impacts. This may be best accomplished by objective analysis that is not constrained by preconceived notions. As will be shown below, such an analysis may not always lead to the expected conclusions.

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<sup>1</sup> Supporting charts and tables will be supplied in the slides to be presented at the seminar.

## 2. Urban World

For decades (and even centuries), the dominant demographic trend in the world has been urbanization. The movement to cities accelerated during the industrial revolution in Western Europe and North America and continues today. By 1965, the region called “Northern America”<sup>2</sup> by the United Nations reached 75 percent urbanization, while by 1990, Europe, Oceania *and* Latin America (and the Caribbean)<sup>3</sup> had achieved 70 percent urbanization.

The United Nations estimates that within the last few years, the number of people living in urban areas exceeds that of the rural population, for the first time in history. The trend toward urbanization is so strong that United Nations projections place *all* population growth in urban areas between 2005 and 2030. That means the rural (non-urban) population is expected to decline.

**Urbanization in Latin America:** Latin America is one of the world’s most urbanized regions, with 77 percent urbanization in 2005. This compares to just 42 percent in 1950. If current rates continue, Latin America will reach an urbanization level of more than 85 percent by 2050. Among the major regions defined by the United Nations, only Northern America had a higher rate of urbanization than Latin America.

The urban population of Latin America exceeded the rural population shortly after 1960. Since 1960, Latin America’s urban population has increased approximately 325 million, more than 16 times the population of the Mexico City or Sao Paulo urban areas. Between 2005 and 2050, it is expected that another 230 million people will be added to the urban areas of Latin America, more than 11 times the population of the Mexico City or Sao Paulo urban agglomerations.

At the same time rural growth has stagnated. Between 1960 and 2005, the rural population grew approximately 15 million, or only five percent of the urban area growth. In more recent years, the rural population has fallen (3.5 million from 1995 to 2005). Between 2005 and 2050, it is expected that the rural population will drop by nearly 20 million.

One of the most important urban trends of the past 50 years has been the emergence of megacities --- the urban areas with more than 10,000,000 population.<sup>4</sup> In 1950, there was a single megacity (New York). Today, there are 21 megacities.<sup>5</sup> Four of the megacities are in Latin America, Mexico City, Sao Paulo, Buenos Aires and Rio de Janeiro. Lima and Bogota could reach megacity status by 2025.

However, there appears to be a significant shift in urban population growth. The urban areas of Latin America with more than 10.0 million population are projected to grow at

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<sup>2</sup> Bermuda, Canada, Greenland, St. Pierre & Miquelon and the United States.

<sup>3</sup> All references to Latin America include the Caribbean.

<sup>4</sup> For a definition of urban terms, see Appendix A.

<sup>5</sup> *The Megacity Book*, [http://www.rentalcartours.net/megacity\\_book.pdf](http://www.rentalcartours.net/megacity_book.pdf).

an annual rate of only 0.88 percent from 2003 to 2015 by the United Nations. In contrast, urban areas between 5.0 million and 10.0 million are to grow 1.53 percent, those from 2.5 million to 5.0 million 1.67 percent and those between 1.0 million and 2.5 million 2.47 percent.<sup>6</sup>

Indeed, all four megacities are projected to be among the 10 *slowest* growing out of the 54 urban areas with more than 1,000,000 population; by contrast, all but one of the 10 fastest growing urban areas (Brasilia) had a 2003 population below 2.5 million.

Conversely, the greatest number of people are to be added in the smaller urban areas. Those with 1.0 to 2.5 million are projected to grow nearly 14 million between 2003 and 2015. The urban areas between 2.5 million and 5.0 million are projected to grow 8 million. Urban areas with 5.0 to 10.0 million population are projected to grow 5 million, while the megacities are projected to grow less than 7 million. Among the 10 largest urban areas in Latin America, the slowest growing are the four megacities.

The same decentralization of urban population is evident within individual nations. In only one of the nations with more than one urban area over 1,000,000 is the capital the fastest growing (Brasilia). In none of the nations with more than one urban area over 1,000,000 is the largest urban area the fastest growing. For example:

- **Brazil:** Out of the 16 urban areas of Brazil with more than 1,000,000 population, the slowest growing are Rio de Janeiro (16<sup>th</sup>) and Sao Paulo (15<sup>th</sup>).
- **Mexico:** Out of the 9 urban areas of Mexico with more than 1,000,000 population, Mexico City ranks 8<sup>th</sup> in growth.
- **Argentina:** Out of the 4 urban areas of Argentina with more than 1,000,000 population, Buenos Aires ranks last in growth.
- **Colombia:** Out of the 5 urban areas of Colombia with more than 1,000,000 population, Bogota ranks last in growth.
- **Venezuela:** Out of the 4 urban areas of Venezuela with more than 1,000,000 population, Caracas ranks last in growth.

### 3. Mobility and Affluence

Why have so many people moved from rural areas to urban areas? The answer appears to be simple --- for better lives. Urban areas have emerged as generators of wealth. People flock to large urban areas to gain economic advantages that are simply not available in rural or small urban areas.

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<sup>6</sup> Estimated based on United Nations population projection trends.

Thus, unprecedented size of urban areas had developed because of the higher incomes and better opportunities that they offer compared to rural areas. Low-income world urban may portray an image of intense poverty to high-income world observers. However, poor as they may be, people who migrate to the low-income urban areas and other large urban areas do so because their economic prospects appear better than where they came from. The millions of people who live in the favelas of Sao Paulo, Rio de Janeiro and other urban areas in Brazil did not move there because their lives were better where they came from. The same is true of informal housing residents from Caracas to Mexico City, Jakarta and Manila. Urban areas are creators of wealth. In that role large urban areas serve an indispensable role in alleviating poverty.

**Transport & Economic Growth:** Transport is an important element in the economy of urban areas. Prud'homme and Lee find that as the percentage of jobs that can be reached increases in a particular period, urban economic production (gross regional product) improves by a factor of 0.18 (Prud'homme and Lee, 1998). Thus, a 10 percent improvement in employment access would theoretically lead to an improvement in economic output of 1.8 percent. At the same time, more efficient transport aids in the movement of freight, which results in lower product prices, which allows people to purchase more with their incomes.

Freight transport often fails to receive appropriate attention. However, when traffic congestion slows personal travel, it also slows the movement of goods. This can slow the rate of economic growth and as a result can slow the alleviation of poverty. The importance of efficient freight movement is indicated in recent research on Portland, Oregon (Economic Development Research Group, 2005) and Vancouver, BC (Delcan and Economic Development Research Group, 2003), which shows the necessity to maintain traffic movement to improve urban area competitiveness.

Our urban area research found that urban travel is strongly associated with higher urban income levels. This econometric analysis of data from the 99 urban areas indicates that average gross product per capita is strongly related to at least two factors --- (1) the extent of economic freedom, as measured by the Heritage Foundation *Index of Economic Freedom*, and the amount of travel (Johnson and Sheehy, 1996).<sup>7</sup> This research finds much weaker relationships between higher incomes as other factors, such as public transport market share, public transport service intensity, and total population. Moreover, our more recent analysis shows a strong historic relationship between personal transport improvements and economic growth (using OECD data<sup>8</sup>) and between a higher number of daily motorized trips per capital and economic output (using information from the *Millennium Cities Database*).<sup>9</sup>

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<sup>7</sup> Both of these independent variables were significant at the 99 percent level of confidence, and had high elasticities the overall "R squared was 0.74 (89 cases from the UITP *Millennium Cities Database* and 10 additional urban areas from the United States,

<sup>8</sup> Data from Maddison, 2003.

<sup>9</sup> *Presentation to Avenir Transports Summer University* (Slides 26 & 27), <http://www.rentalcartours.net/db-avtransports2007.pdf>.

Thus, the research indicates that the efficiency of urban economies is improved as travel speeds are improved and mobility maximized, whether for people or freight.

**The Advantages of Personal Mobility:** The mechanisms of personal mobility, principally the automobile and the motorcycle, have an advantage over public transport in this regard. Public transport requires longer travel times for most trips in urban areas. In the United States, the average one-way work trip travel time by public transport was more than double that of the car in 2006 --- 47.7 minutes compared to 23.7 minutes.<sup>10</sup> Despite the fact that most US urban is by car, in increasing traffic congestion, the average (mean) one-way work trip travel time in 2006 was 25 minutes, only three minutes more than in 1969.<sup>11</sup> The median travel time was 22 minutes. The fastest growing category of commuting is “telecommuting,” or working at home, which will exceed public transport in market share by 2020 if the trends of the 2000’s continue.<sup>12</sup>

In 2005, the average public transport work trip travel time was 80 percent higher in Canada than the average automobile commute.<sup>13</sup> Public transport work trip travel times in the Paris urban area are approximately double the automobile commute time (Gerondeau, 1997). Of course, travel can be faster by public transport to the largest urban cores. However, most travel is not to urban cores.

United States research demonstrates the economic advantages of personal mobility:

Raphael and Stoll, at the University of California, estimate that if automobiles were available to all African American households, the gap between non-Hispanic-white and African-American unemployment would be reduced by nearly one-half (Raphael and Stoll, 2000). A Brookings Institution report concluded: “Given the strong connection between cars and employment outcomes, auto ownership programs may be one of the more promising options and one worthy of expansion” (Blumenberg and Waller, 2003)

A study by the Progressive Policy Institute, a research organization affiliated with the Democratic Leadership Council (of the Democratic Party), noted (Waller and Hughes, 1999) also indicated the importance of personal mobility in providing access to opportunity, concluding: *The most important response to the policy challenge of job access for those leaving welfare is the continued and expanded use of cars by low-income workers.*

**Cars, Smaller Vehicles, Informal Transport and Rapid Busways:** Cars, however, are not the only way to provide personal mobility. Small vehicle, highly intensive and often informal public transport services can be effective. Such systems are in operation in many Latin American urban areas, throughout Africa and in some Asian urban areas. The world’s most intense public transport service is in Manila, which is served by thousands

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<sup>10</sup> This does not include access and waiting times, which make public transport travel times even longer relative to car travel times.

<sup>11</sup> If working at home is included, the mean travel time is 24.0 minutes.

<sup>12</sup> All 2006 data from 2006 American Community Survey, <http://www.census.gov/acs/www/>.

<sup>13</sup> Calculated from Statistics Canada data for 2005. See Turcotte, 2006.

of “jeepneys,” which provide a high level of service throughout the urban area. While formal (legally authorized), jeepneys are small vehicles and are not conventional public transport. Despite having built three Metro lines, the bulk of urban transport travel is by jeepney in Manila, along with a smaller market share for cars.

Conventional public transport can be organized to replicate personal mobility more effectively. Latin American urban areas such as Porto Alegre, Curitiba, Belo Horizonte, and Leon (Mexico) have built inexpensive surface busways that significantly expanded mobility to a far greater degree than could have been achieved by more expensive conventional strategies.

More recently, Bogota’s *Transmillineo* busway system has achieved unprecedented increases in both ridership and speed at a fraction of what would have been required for a comparable urban rail system. Bogota is expanding this system and strengthening connecting bus service. Bogota’s fortunate urban form, comparatively linear, may be optimally situated to permit conventional public transport to provide mobility that is comparatively competitive with personal modes.

Latin American rapid bus leadership is being followed in other parts of the world, such as in Jakarta, and urban areas both in China and the United States.

In the final analysis, however, personal mobility’s principal advantage is time. The old saying that “time is money” is true in urban transport. Much of the reason that better urban mobility is associated with poverty alleviation and economic growth is that when people spend less time traveling, they have more time for productive and leisure activities, the support of which adds to employment demand.

#### **4. Urban Transport: The Situation**

Around the world, urban travel is becoming more decentralized. This is occurring because both jobs and residences have become spread over much larger urban footprints, in response to the significant population growth. This trend, which is largely irreversible, can be seen in the Latin American megacities.

**Mexico City:** The Distrito Federal lost population between 1980 and 2005, at the same time that the urban area increased in population by nearly 50 percent. *All* growth has been in the suburbs. The majority of the urban area population is now outside the Distrito Federal, in the state of Mexico. This means that all growth has been *outside* the area served by Mexico City’s Metro, one of the most successful in the world. The four central delegaciones (boroughs) have lost more than 35 percent of their population since 1960, while all but two of the delegaciones in the central area and first ring are below their population peaks.<sup>14</sup> At the same time, the commercial core of the city continues to move west. Much of the office growth over the past 50 years occurred in the Reforma corridor, well west of

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<sup>14</sup> *Mexico City Population and Density by District (Delegacion) from 1960*, <http://www.demographia.com/db-mxcward.htm>.

Centro (Zocalo). More recently, there has been substantial growth even further west, to Santa Fe, which abuts the mountains between Mexico City and Toluca.

**Sao Paulo:** Two-thirds of the population growth during the 1990s occurred in the suburbs. Nearly one-half of the urban area population is now outside the city of Sao Paulo. The commercial core is also moving west in Sao Paulo, from Centro to Paulista, with strong growth now even further west, to Berrini.

**Rio de Janeiro:** Two-thirds of the population growth during the 1990s occurred in the suburbs rather than the central city. Nearly one-half of the urban area population is now outside the city of Rio de Janeiro.

**Buenos Aires,** The city of Buenos Aires (capital federal) has lost population since 1947, while the suburbs have added nearly 8 million people. Approximately 80 percent of the urban area population is now in the suburbs. The capital federal and the first ring suburbs lost population in the 1990s. All growth was in the outer ring suburbs.<sup>15</sup>

Latin American urban areas exhibit relatively high densities by world standards.<sup>16</sup> Yet these high densities are well below the densities that existed in the world's largest urban areas in 1900. Then, London, New York and Paris had population densities in the range of 15,000 per square kilometer, approximately equal to that of the large urban areas of India today. Moreover, the largest urban areas were much smaller than today, with populations of 5 million or less and covering less than 300 square kilometers. By comparison, Mexico City, Sao Paulo and Buenos Aires cover 2,500 or more square kilometers today. Rio de Janeiro covers 1,500. Even medium sized urban areas, such as Belo Horizonte, Curitiba, Guadalajara and Monterey cover twice to three times the land area of London in 1900. Among Latin America's largest urban areas, only Bogota approximates the urban densities of London, New York and Paris in 1900.

All of this seriously complicates the ability of conventional public transport to provide mobility throughout the urban area. The reason is simple. As the geographical size of an urban area increases, the amount of public transport required to maintain the same service level increases geometrically --- doubling the size of an urban area requires a four times increase in public transport service.

The same decentralization trends are evident with respect to virtually all of the other large urban areas of Latin America. Moreover, decentralization may be accelerating. Sir Peter Hall suggests that megacity development is giving way to the "global megacity region," which he defines as overlapping commuter sheds stretching up to 150 kilometers from the center (Hall, 2007). By 2020, at least three of these regions could approach or exceed a population of 100 million (compared with the current 35 million in the Tokyo urban

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<sup>15</sup> *Buenos Aires: Central City & Suburban Population Trends from 1914*, <http://www.demographia.com/db-bamsatrend.htm>.

<sup>16</sup> The average density of urban areas over 500,000 in South America and Central America is estimated at 6,350 per square kilometer. This is more than double that of the high-income world and only slightly below Asia (excluding India) and Africa. See <http://www.demographia.com/db-worldua.pdf>, page 31.

area or nearly 20 million in the Mexico City and Sao Paulo urban areas), such as the Pearl River Delta (Hong Kong-Guangzhou), Yangtze River Delta (Shanghai-Nanjing) and Jakarta-Java.

Global megacity regions are emerging in Latin America. This is illustrated by the significant growth occurring in urban areas relatively close to the largest urban areas. Examples are in the Sao Paulo area, with nearby fast growing Campinas, Baixada Santista (Santos) and Sao Jose dos Campos, in the Mexico City area, with fast growing Toluca (and slower growing Puebla) and in the Caracas area, with fast growing Maracay.

All of these trends, which echo developments virtually around the world, favor the use of transport modes that provide a high level of mobility *throughout* the urban area. This might be called *ubiquitous mobility* --- the ability to travel relative quickly from virtually any point in the urban area to any other at virtually any time. The requirement for ubiquitous mobility is best provided by personal mobility, such as automobiles, powered two wheelers<sup>17</sup> and three wheelers and small vehicle based informal transport. Generally, as is outlined below, conventional public transport (large buses on fixed routes and rail) are able to compete effectively only to or within urban cores.

Because of their slower speeds and less comprehensive coverage, conventional public transport systems, whether in high, middle or low income nations, are generally incapable of providing ubiquitous mobility that is competitive with the personal modes.

**Conventional Public Transport Markets:** Nonetheless, public transport serves important markets. In some applications, public transport can be faster than the automobile, especially to the most congested and large urban cores, such as Centro and Reforma in Mexico City, Centro and Paulista in Sao Paulo, inner London, central Paris, inside the Osaka Loop or inside the Yamanote Loop in Tokyo. The *Millennium Cities* reported that less than 20 percent of jobs in Mexico City were in the central business district, less than 20 percent in Sao Paulo and less than five percent in Rio de Janeiro.<sup>18</sup> However, for the most part, public transport travel times are considerably greater than automobile travel times for trips throughout the balance of the urban area. However, these locations do not represent a majority of the jobs in urban areas.

Transport planning may fail to consider this important distinction and assumes that public transport is an alternative for virtually all mobility in the urban area. This may be a result of focusing principally on urban cores or not comprehending the relative limitations of public transport relative to more personal modes of urban travel.

Transport planning has not sufficiently considered economic impacts. These impacts must, of course, be carefully weighed against any negative environmental factors. However, it may not be sufficient to assume that environmental factors automatically negate economic factors. That can only be determined by rigorous analysis. A policy

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<sup>17</sup> Personal mobility has become dominant in one of the world's lower income urban areas, Ho Chi Minh, with a more than 90 percent market share (mostly powered two-wheelers), according to the *Millennium Cities Database*.

<sup>18</sup> Data was not provided for Buenos Aires.

framework that is skewed toward any mode --- public transport or personal modes --- runs the risk of misallocating resources.

**Current Policy:** Nonetheless, current urban planning thinking tends to favor strategies that would require people and freight to travel for longer periods or even not to have access for some trip. The principal source of this dissonance is strategies that seek to substitute public transport use or even biking or walking for automobile use. Each of these alternatives increases travel times for most trips and, as a result, reduces the area that can be reached in a specified period. Slower travel is generally associated with lower standards of living and less economic output and higher levels of poverty.

This urban planning thinking is illustrated in a report that credits Budapest for having far lower journey to work automobile share than Sheffield (European Commission, undated). Yet, the average resident of Sheffield spends 22 minutes traveling one-way to work, while the Budapest resident spends 70 minutes each way. The research would indicate that Budapest is disadvantaged, not advantaged by the greater use of public transport, because its citizens must spend more time traveling than in Sheffield. If average work trip travel times were as extended in Sheffield as in Budapest, it is likely that economic performance would be less.

**Travel Trends:** The advantages of personal mobility have led to an inexorable reduction in the share of travel by conventional public transport. This can be witnessed throughout the lower income, middle income and higher income worlds. All of this is to be expected, given the standard of living advantages of personal mobility.

If anything, this trend is likely to accelerate in the future. Car ownership is exploding in China. India's Tata Motors intends to bring to market a US\$2,500 car in the next few years --- a vehicle that could make automobile ownership a reality for many millions of households not yet able to afford cars. In Latin America, per capita automobile ownership has approximately doubled over the past two decades

In Western Europe, the continuing market share losses and rising costs led Remy Prud'homme, of the University of Paris, and a team of researchers to question whether public transport is sustainable (Prud'homme, Darbara, Newbury, Diekman, and Elbeck, 1999).

## 5. Land Use Policy

Urban land use and transport are closely associated. There is a current planning preference for compact city policies. At the same time, such policies are coming under increasing criticism.<sup>19</sup> Perhaps the most important objections related to the impact of compact city policies on housing costs. Compact city strategies are being cited by some of the world's leading economists as an important factor in the unprecedented loss of housing affordability that has occurred in some urban areas. This includes Kate Barker, a

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<sup>19</sup> For a critique of compact city policies, see Wendell Cox, *War on the Dream: How Anti-Sprawl Policy Threatens the Quality of Life*, New York: IUniverse, 2006, pp. 175-182.

member of the Monetary Policy Committee of the Bank of England (Barker, 2004 & 2006), Arthur C. Grimes, chairman of the board of the New Zealand Reserve Bank, Don Brash, former governor of the New Zealand Reserve Bank, Ian MacFarland, former governor of the Reserve Bank of Australia, and the present governor, Glenn Stephens. The principal causes appear to be the rationing of land for residential development, such as through urban growth boundaries, growth areas and other policies that increase the price of housing (principally the price of land).

All of this is despite projections that would suggest the opposite. One U.S. study predicted that compact city policies would lead to 4 percent and \$12,000 lower per detached housing unit development costs from 2000 to 2025, relative to more liberal land use policies (Burchell et al, 2002). However, the data indicates that, to the contrary, between 2000 and 2006, urban areas with compact city policies experienced a 75 percent increase in house prices (more than \$115,000) relative to prices in markets without such policies (more liberal markets).<sup>20</sup>

Our *Third Annual Demographia International Housing Affordability Survey* suggests a strong relationship between unaffordable housing markets and stringent land use regulation. This review of 159 metropolitan markets in six nations finds that historical housing affordability ratios have been retained in markets that have permitted the natural city to exist by not applying stringent land use regulation. For example, Atlanta, Dallas-Fort Worth and Houston, three of the fastest growing major metropolitan areas in the high-income world, have Median Multiples (median house price divided by median household incomes) of one-half to one-third that of highly regulated markets such as San Francisco and Sydney.

Hernando DeSoto notes the importance of clearly defined property rights to the economic growth of urban areas (Desoto, 2000). Millions of households do not have title to their property, which makes it difficult for them to produce wealth. Without the rule of law and property rights, modern high-income economic performance cannot occur. According to North and Thomas, property is at the very heart of wealth creation (North and Thomas, 1973); indeed, “economic growth will occur if property rights make it worthwhile to undertake socially productive activity.”

The compact city policies to which excessive housing cost escalation has been traced could increase housing prices in Latin America as they have in many urban areas of the English speaking world. This could retard economic growth by slowing expansion of home ownership in the formal sector and provide additional impetus to informal, less environmentally friendly housing development (favelas or shantytowns). Based upon his work for the United Nations and the World Bank, Angel urges that governments undertake a program of performance indicators to ensure that housing markets work properly, so that home ownership is within reach of more households (Angel, 2000)

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<sup>20</sup> *Comparison of House Cost Increases: 2000-2006 by Type of Urban Planning Market*, <http://www.demographia.com/db-2000-6med.pdf>.

Finally, compact city policies have been associated with retarded economic development. A paper by Raven Saks of the Federal Reserve Board concluded, “metropolitan areas with stringent development regulations generate less employment growth than expected given their industrial bases (Saks, 2006).” Australia’s state of New South Wales has long been known as the “first state.” Lead by Sydney, the capital, New South Wales has dominated economic growth for at least the last century. Yet as the state’s compact city policies, the most stringent in Australia have driven housing prices up to unprecedented levels, New South Wales has become the slowest growing state or territory of the nation. Similar effects can be seen in US domestic migration data, which shows that more than 4,000,000 people have moved from less affordable metropolitan areas to more affordable metropolitan areas in just six years (2000-2006). Thus, slower economic growth may be an negative externality of compact city policies.

Like policies that focus on urban transport, land use policies are best implemented in an environment in which the full impacts on poverty and economic growth are considered.

## **6. Greenhouse Gas Emissions Reduction: Reality v. Preconceived Notions**

The world has embarked upon a program to reduce greenhouse gas emissions (GHG) emissions for the purpose of minimizing climate change. As with any important endeavor, it is important to ensure that the strategies employed are, in fact, effective and serve the overall objective. This means, at the outset, that strategies should be based upon genuine research and information and that there is no place for relying upon preconceived notions that may be ineffective.

This is a risk with respect to emissions reductions. Reliance on preconceived, yet unproven notions could lead to ineffective policies that fall far short of objectives. This could be a particularly problem in transport and land use.

There is a general assumption that GHG reduction will require abandoning cars for public transport and moving from low-density suburbs to high density urban cores. The predominant view in urban planning is that automobile use must be curbed and that urban areas should become more dense (more compact). However, the economic externalities of such policies have generally received little attention.

The evidence indicates that matters may not be so simple. The purpose here is not to suggest final conclusions. It is rather to urge that strategies be based upon serious and objective analysis. The test of GHG reduction strategies is not whether they are consistent with current planning notions --- it is rather whether they are the most effective strategies and, just as importantly, whether they are likely to be accepted by the people. The gulf between reality and preconceived notions is illustrated by various points below.

**Cars and Public Transport: Diminishing Difference:** There are difficulties with the idea that substituting public transport for automobile will yield material benefits. This is indicated by detailed data on the United States. It is true that public transport GHG emissions per passenger kilometer are less than those of the automobile. However, the

public transport data is driven down by New York's intensively used system, which represents 40 percent of the national total. Outside New York, public transport is nearly as GHG intensive as the average automobile in urban driving. Public transport buses in the United States are *less* fuel efficient than cars according to U.S. Department of Energy, which means that they are *more* GHG intensive than cars. But that is just the beginning. Technology is well on the way toward removing even this small difference. The currently proposed congressional fuel economy standards would set the nation on a course toward which automobiles would nearly equal the national public transport GHG emissions average (including New York). Further, Peugeot will soon be marketing a diesel-hybrid car that will achieve GHG emissions comparable to the New York public transport system. Improved "plug in" cars, based upon nuclear power, could remove GHG emissions from cars altogether. Thus, in the longer run, there may be little or no material gain from moving demand from cars to public transport. Given the relationship between personal mobility, economic growth and poverty alleviation, however, policies that lengthen travel times could impose a substantial societal cost, and possibly for no reason.

**Electric Public Transport Modes and Power Generation Method:** Much of the misunderstanding between public transport and automobile performance results from failing to include GHG emissions from power generation for urban rail systems. Fossil fuels, for example, produce twice as much in GHG emissions in generation and transmission as the eventual consumption in operating trains. By comparison, petroleum refining is comparatively efficient, with 80 percent of GHGs consumed in vehicle operation. Of course, nuclear power and hydro solve this problem; however there are serious political barriers to expansion in some nations. Moreover, in some parts of the world most new power generation has been by fossil fuels, and little by hydro or nuclear.

**Most Trips Not Available by Public Transport:** Moreover, public transport cannot be readily substituted for most automobile use. Public transport is very efficient and effective in providing mobility to and within very dense urban cores. However, the dense cores generally do not house the majority of the urban population or jobs. Much urban travel never reaches the core. Yet travel occurs from virtually any point within the urban area to any other point (the *ubiquitous mobility* cited above). Our research (Table 1) indicates that it could take a substantial share of an urban area's gross domestic product (GDP) to provide a ubiquitous conventional public transport (bus or rail) system that is time competitive with the automobile (Ziv and Cox, 2007).

The research indicated the following with respect to the megacities of Latin America:

- **Mexico City:** A ubiquitous automobile competitive public transport system would require from 52 percent to 79 percent of the urban areas gross domestic product.
- **Sao Paulo:** A ubiquitous automobile competitive public transport system would require from 51 percent to 75 percent of the urban areas gross domestic product.

- **Buenos Aires:** A ubiquitous automobile competitive public transport system would require from 67 percent to 102 percent of the urban areas gross domestic product.
- **Rio de Janeiro:** A ubiquitous automobile competitive public transport system would require from 64 percent to 98 percent of the urban areas gross domestic product.

Income Category & Urban Area	Skeletal Cost per Capita: Underground Metro	Skeletal Cost per Capita: Elevated Metro	GDP Share: Underground Metro	GDP Share: Elevated Metro
LOW INCOME	\$4,900	\$3,300	1.69	1.14
MIDDLE INCOME	\$10,000	\$6,700	1.18	0.79
Buenos Aires	\$13,400	\$8,800	1.02	0.67
Mexico City	\$7,900	\$5,200	0.79	0.52
Rio de Janeiro	\$8,200	\$5,400	0.98	0.64
Sao Paulo	\$6,300	\$4,300	0.75	0.51
HIGH INCOME	\$17,400	\$11,500	0.53	0.35
ALL	\$9,700	\$6,700	0.76	0.53

Includes all urban areas expected to achieve 10,000,000 population by 2015.  
From Ziv and Cox, 2007.

An alternative method for analyzing the requirements for automobile competitive public transport throughout an urban area is to estimate the population density that would be required to generate sufficient economic output to support the system at current financial rates. It is estimated that (Ziv and Cox, 2007):

- **Low-income urban areas** would need, on average, urban densities of from 430,000 to 640,000 per square kilometer. This is from 31 to 47 times the current average density for such urban areas and equals or exceeds the population densities of the most dense small areas in Hong Kong.<sup>21</sup>
- **Middle-income urban areas** would need, on average, urban densities of from 160,000 to 225,000 per square kilometer. This is from 24 to 34 times the current average densities for such urban areas.
- **High-income urban areas** would need, on average, urban densities of from 45,000 to 65,000 per square kilometer. This is from 10 to 12 times the current average densities for such urban areas.

The situation is similar with respect to the megacities of Latin America. Based upon the analysis above, densities of 160,000 to 225,000 per square kilometer would be required to support automobile competitive public transport systems throughout the urban areas. This

<sup>21</sup> Based upon analysis of Hong Kong constituency area data, see <http://www.demographia.com/db-hkca.htm>.

compares to densities of 7,150 in Mexico City, 6,900 in Rio de Janeiro, 6,400 in Sao Paulo and 4,300 in Buenos Aires.

This analysis above indicates that it may be generally infeasible financially to provide ubiquitous mobility throughout the modern urban area with conventional public transport strategies. Thus, public transport expectations can be beyond its capabilities. This is not to suggest the impossibility of a technological breakthrough that could permit public transport to attract material amounts of personal mobility demand in an urban area. However that cannot be accomplished without genuine point to point automobile competitiveness throughout the entire urban agglomeration.

**Slower, More Erratic Traffic: More GHG Intensive:** More dense urban areas may result in *higher* GHG emissions from traffic congestion. One important, but often missed factor is the role of speed and smooth traffic flow in GHG emissions. As cars slow down in urban traffic, they require more fuel per kilometer. As traffic flow becomes interrupted, fuel economy suffers even more. As a result, it is a mistake to simply assume that GHG emissions from cars are a function of vehicle kilometers. GHG emissions are a function of fuel consumption, which depends not only on distance, but also on speed and the smoothness of traffic flow. International data demonstrates that traffic congestion is more intense and speeds are slower in higher density urban cores.

**Construction Related GHG Emissions:** Preconceived notions are so strong that there may even be the temptation to suggest that the very urban form must be substantially altered, forcing people to move to the dense urban cores from the lower-density suburbs. Any objective and genuine review would consider the GHG emissions produced in any such re-construction. This might exceed any longer term day-to-day operational gains. Similarly, the construction impacts of major transport projects should be a part of the “cost-benefit” GHG equation. For example, research indicating that it would take 45 years to recover the GHG emissions from construction of a Seattle light rail line has been certified by the US federal government. Construction intensive policies could be seriously counter-productive unless they produce strong positive results.

**Higher Density May be More GHG Intensive:** Even the idea that high-density living is preferable to low-density living is open to question. The *Australian Consumption Atlas*, by researchers at the University of Sydney illustrates the point. The *Australian Conservation Atlas* data is based upon final residential consumption and finds, generally, that GHG emissions are the highest the exactly the areas where the opposite would be expected --- where densities and public transport use are the greatest. In the Sydney area, for example, GHG emissions per capita in the higher-density, public transport oriented areas average 55 percent more than in the most distant, lowest-density suburbs (Figure 2). The same is true of the other large Australian urban areas. There are a number of contributing factors, such as that greater affluence is associated with more intense GHG emissions and that high-rise residential buildings are more GHG intensive (principally because of GHG emissions produced, for example, by common areas lighting, heating, air conditioning and lifts). In this environment, policies based upon pre-conceive notions could lead to greater poverty (certainly less affluence), as residents in distant suburbs,

who are necessarily more dependent upon cars, could find their mobility and economic prospects seriously eroded by mobility restricting measures, despite their overall more favorable GHG emission patterns. The Australian example illustrates the importance of not viewing transport in a vacuum, but rather proceeding from a “holistic” perspective that considers all GHG emissions, not just those from transport and land use.

**Technology: The Hope of the Future?** Conservation through GHG reductions will not be enough. Much of the world lives well below Western European or American standards. The governments of India and China, for example, are not likely to tell their citizens “No” with respect to economic advance. Indians and Chinese would like to live as well as Western Europeans and Americans, and who can deny them that? If India and China, and, for that matter Latin America are not permitted to achieve western-style affluence, then when will Americans and Western Europeans start living like Indians, Chinese or Latin Americans?

As in the past, technology may be the hope of the future. We already have a model in the highly successful programs that have reduced local air pollution emissions from automobiles. For example, in the United States, automobile use has increased 150 percent since 1970; yet total automobile air pollution has dropped by more than one-half. Behavior modification has played no role in this success. Indeed, the air pollution reduction has been 100 percent the result of technological advances.

Similar success is already evident in making the automobile far more “GHG friendly.” Efforts are under way around the world to reduce the GHG footprint of housing, including suburban detached housing. US research indicates that the highest potential for reducing greenhouse gases from cars is from improving vehicle technology, principally by improving fuel efficiency. The same study finds comparatively little potential for reducing greenhouse gas emissions from land use policies (Green and Schafer, 2003). Thus, the necessary economic growth may be sustained, while technological advances improve the performance of the personal mobility system.

**The Importance of Economics:** Finally, GHG emissions policy is best developed in a context that considers all related factors. Economics may be the most important. There may be a temptation to suggest that GHG emission reduction is so important that economics must be ignored. This could be a serious mistake.

In fact, the unprecedented economic gains have been closely associated with transport improvements and suburbanization. The most impressive gains have occurred since 1950, with the Western European gross domestic product per capita rising at least three times, adjusted for inflation. During this period there has been an explosion of personal mobility, as car ownership has spread and a broad middle class has been created, with people moving to their own homes in the suburbs where they have accumulated wealth by paying mortgages instead of rent. There is an association between cars, suburbanization and increased prosperity.

Thus, any policy that would restrict mobility could result in a less productive economy, which means lower incomes and higher levels of poverty. If and where there is a public transport alternative, it will be successful only if it can compete in speed and convenience with available personal modes of transport.

There is another reason that economics should be considered. Poor societies do a poor job of protecting the environment. The compelling evidence of this was provided by Soviet era Eastern Europe and the Soviet Union, with their astonishing levels of pollution. Put in stark terms, a society will eat and pay for basic necessities before it will make material expenditures for environmental protection. It would seem that sustainable development includes both environmental sustainability and economic sustainability, which requires continued economic growth and poverty alleviation.

**Acceptability: The First Principle?** Then there is the matter of acceptability, which has been the subject of work by Professor Ziv. It is no simple thing to mandate behavior change. Policies in democratic nations necessarily rely on the consent of the governed. Policies that are not broadly accepted cannot be successfully implemented. People are not likely to be taxed out of their cars onto public transport services that do not meet their needs. People are not likely to accept forcible removal from their homes, with gardens, in the suburbs, into crowded urban cores. The substantial, expensive and largely unsuccessful attempts to attract people out of their cars across Western Europe and into public transport could represent an instructive example. It would seem that the first principle of GHG emissions policy is acceptability.

## 7. Observations on the Future

Reducing GHG emissions is not a simple matter. Success will depend upon policies that are both wise and effective. At a minimum, this will require:

- A “holistic” approach that encompasses not only GHG emissions, but also related factors, such as the interaction with economics and other important factors.
- A focus on *all* GHG emissions and their interaction, rather than considering transport and land use “in a vacuum.”
- Inclusion of both day-to-day operating GHG emissions *and* the GHG emissions produced in construction and implementation.
- Genuine and objective research that excludes all preconceived notions.
- Dynamic analysis that reasonably estimates the role of technological improvements rather than static analysis that simply compares matters as they are today.
- Routine and serious consideration of economics (and poverty alleviation) impacts --- that development must be sustainable both environmentally and economically.

- Acceptable policies, which necessarily stresses improving technology and minimizes the reliance on significant behavior modification (which probably cannot be achieved in a democratic society).

Finally, the long term sustainability of modern societies requires economic growth. Benjamin Friedman argues in *The Economic Consequences of Economic Growth*, that economic growth is more than desirable; it is a necessity for social cohesion (Friedman, 2005). Public policies need to be developed in light of this reality. Urban areas are critical to economic growth and this depend, in large measure, on urban transport systems that quickly and efficiently move people and goods within, through and between urban areas.

## Appendix: Urban Terms

**City** generally means a municipality, which would typically have locally elected administration, such as a city council and a mayor. In some cases a city can *also* be a higher-level region, such as Buenos Aires, which is coterminous with the province level Distrito Federal, the ville de Paris, which is also a department; San Francisco, which is also a county; or the city of Shanghai, which is also at the national provincial level.

**Central City:** The central city or core city is the municipality in an urban area or metropolitan area that emerged historically as the most prominent in the urban area. Almost without exception, the name of the core city is also shared with the urban area and the metropolitan area. For example, the metropolitan area that includes and surrounds the city of Sao Paulo is the Sao Paulo metropolitan area or the Sao Paulo urban area.

The core city will typically be the largest in the urban area or metropolitan area. Usually an urban area or metropolitan area will have many cities (the Paris metropolitan area has more than 1,000 municipalities or communes).

**Urban Core:** Generally the urban core or the *inner city* is in the central city. Sometimes the urban core includes adjacent municipalities that developed during the same period as the core city. For example, Frederiksborg is a part of the Copenhagen urban core, L'Hospitalet is a part of the Barcelona urban core, and Cambridge is a part of the Boston urban core.

**Suburb:** Collectively, the *suburbs* are all of the continuous urbanization that extends beyond the core city (all of the urban area except the historical core municipality and other adjacent historical municipalities). For example, the municipalities of San Bernardo de Campo and Guarhulos are suburbs of Sao Paulo.

**Exurban:** Exurban refers to non-rural development that is within a metropolitan area, but outside the urban area. There are two types of exurban development: An *exurb* is a municipality (or a community) or urban area in a metropolitan area that is separated by rural territory from the principal urban area. For example, Mairipora is an exurb of Sao Paulo. Low density exurban development is generally large lot residential development that is not of sufficient density to be considered urban and is not agricultural.

**Urban Area** means an area of continuous urban development. An urban area will virtually never be the same as a municipality. Usually it will include many municipalities, though in the case of many geographically large municipalities, such as Anchorage or Shanghai, the urban area will be smaller than the core city. For example, the Mexico City urban area includes Mexico City and many other municipalities. An urban area might be thought of as defined by the lights seen from an airplane on a clear night. Demographia has developed the only comprehensive list of world urban areas over 500,000 population with land area and densities.<sup>22</sup>

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<sup>22</sup> Demographia World Urban Areas, <http://www.demographia.com/db-worldua.pdf>.

***Metropolitan area*** means a labor market, or the area from which the urban area draws its employees. A metropolitan area will nearly always be larger than the urban area, because urban areas routinely draw a large number of workers from surrounding rural territory. A metropolitan area may include smaller urban areas in addition to the principal urban area. Many nations, such as Brazil, India, Argentina, France, Canada and the United States formally designate metropolitan areas.

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