Clearing the air in Atlanta: Transit and smart growth or conventional economics?

By Alain Bertaud
Duatreb@msn.com

Summary:

The Atlanta Regional Commission's Regional Transportation Plan addresses the problems of pollution and congestion in Atlanta by proposing to expand the existing transit network and to reform land use to promote a more intensive use of the existing built-up area. This paper argues that neither of these proposals is feasible: the current spatial structure of Atlanta is incompatible with a sizable transit market share; and Atlanta's spatial structure cannot be changed significantly in the next 20 years, even if draconian land use regulations were adopted. As a result, in Atlanta technology and congestion pricing are the only way to solve the problems of congestion and pollution. The paper concludes that as long as voters believe that federally-subsidized transit and smart growth will solve the congestion and pollution problems they are unlikely to support solutions which address the problems.

Acknowledgement and personal note

I want to thank all the professionals who spent time with me during my visit to Atlanta in February 2001. Their candid discussions of Atlanta's problems and the superb database available through ARIS gave me a unique view of this fascinating metropolis. My conclusions might disappoint some of the very people who assisted me during my stay. For those who might be tempted to dismiss my conclusions as probably coming from a SUV freak, I want to present my credentials. I am a regular transit user and I enjoy high density cities. I have always lived in apartments, from my childhood in Marseille to the present in the US. During my 20 years of professional life in Washington, daily, I either bicycled or took the subway to work. However, as a European, I am struck by the difference in consumer tastes between Americans and Europeans. This difference helps explains the contrasting spatial structures between European and American cities. Americans have an unquenchable need for space which puzzles me. We Europeans value a city's amenities more than space. Atlanta represents the extreme of the tradeoff between space and central city amenities. But this tradeoff is rational. Atlanta's peculiar spatial structure is not the product of design failure but of consumer choice, admittedly made under some distorted pricing conditions. The large number of households and firms who have moved to Atlanta during the last decades knew what they were doing. It is just another type of city. It offers good jobs, good income, and inexpensive housing. Its pollution and congestion problems still need to be solved taking into account the specificity of its extreme spatial structure.

I.Introduction

A. The price of success: pollution, congestion and a need for Federal funds

Atlanta is among the most congested and polluted cities in America.[1] These conditions have led the federal Government to block allocations for additional highway investments between 1998 and 2000[2] .

The reason for interrupting federal transfer was that more road investments would only increase pollution and traffic congestion. The Federal shot across the bow of Atlanta's region has resulted in a new strategy and a new program of investments prepared by the Atlanta Regional Commission (ARC). These apparently satisfied Federal authorities as subsidies resumed after July 2000.

The high level of pollution and traffic congestion in Atlanta is linked to its fast rate of growth, and to its spectacular economic success story. The metropolitan area has been a magnet for migration for the last 20 years. Between the two census years of 1990 -2000 the population of the metropolitan area has been growing at an annual average rate of 3.14%, one of fastest growing urban area in the US. In 2001 unemployment was 3.5 % of the labor force, well below the national average of 4.8%. Atlanta was ranked 6th for lowest unemployment among the 28 larger US metropolitan areas. Per capita income was $27,241 ranking 11th among the 46 US Metropolitan areas with over 1 million population.

While income and population were rising very fast, Atlanta managed to keep a very low cost of living. A worldwide cost of living survey conducted by the Economist Intelligence Unit in 2002 found that Atlanta had the lowest cost of living among major US cities and ranked 63rd among major cities around the world. This achievement is remarkable in view of the rapid rate of growth of the metropolitan area over the last 20 years. It shows that while demographic and economic growth has certainly contributed to generate pollution and congestion, the various actors responsible for the management of metropolitan Atlanta must have done a lot of things right. High income growth and high demographic growth combined with a low cost of living suggests that labor markets are functioning well and that housing does not encounter important supply bottlenecks. When passing a judgment on the spatial organization of Atlanta, it will be necessary to keep in mind that while it generates a high level of pollution, it has also been able to provide jobs, housing, and business space in sufficient quantity to match its high demographic growth. This is not a small achievement, but it does not decrease the urgency to solve the pollution and congestion problem.

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[1] Atlanta is not alone in this situation. According to EPA, 24 other metropolitan areas in the US face similar or worse ozone pollution. EPA clean air act non attainment standard divides non complying metropolitan areas air quality into 3 categories: "Serious", "Severe", and finally "Extreme". Atlanta has the distinction of belonging, together with 13 other metropolitan area, to the serious category. Los Angeles is alone in the extreme category.

[2] Washington Post July 23, 2001 "Pollution Already Has Cost Atlanta Federal Funds for Roads".

B. The new strategy

Understandably enough, the main priority of the Regional Development Plan prepared by Atlanta Regional Commission (ARC) is to reduce pollution and traffic congestion. The ARC planned strategy, following the prevailing smart growth orthodoxy, aims at reducing the number and length of vehicular trips by increasing the number of transit trips. The strategy includes two main components: first, a large public investment in various types of transit – new buses, light rail and metro lines extension – and second, a reform of land use regulations which would encourage "transit-oriented development".

The ARC strategy to solve the pollution and congestion problem rests on two assumptions:

1. Demand for mass transit will grow if supply is increased; and,
2. Atlanta's land use can be modified to allow transit to become a practical alternative to cars for a large number of users.

I would like to challenge these two assumptions. I will show that, first, Atlanta's spatial structure, and in particular its density, is very different from the cities of the world where transit is an important mode of transport; and second, that in the foreseeable future it is a geometrical impossibility for Atlanta to increase its density to reach the threshold level which would allow an effective operation of transit.

Atlanta's current spatial structure, while precluding an extension of transit, might well be part of its success story. However, pollution and congestion are not necessarily a corollary of that structure. I believe that there are means of reducing pollution and congestion which are compatible with Atlanta's existing spatial structure.

II. How exceptional is Atlanta spatial structure?

In his book "The Transit Metropolis" , Robert Cervero tells the story of successful adaptations of transit in a number of cities around the world[3] . Some cities have adapted their spatial structure to transit; others have adapted transit to their structure; some did both. The transport/land use policies described by Cervero are very similar to those contained in the ARC strategy for Atlanta. However, none of Cervero's success stories takes place in a US city.

It is unavoidable, while reading Cervero's book, to ask whether there is anything in the spatial structure of US cities which is different from other cities of the world. The lack of transit success stories in the US might well be explained by the fact that US urban structures are exceptional by world standards and are not well adapted for a wide use of transit.

We will see that whether we look at average densities, density profiles or job dispersions, American cities are markedly different from other cities of the world. In addition, Atlanta is an outlier even within the restricted universe of American cities, making it even more unfit for transit than some other denser American cities.

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[3] The "Success stories" cities described by Cervero are: Stockholm, Copenhagen, Singapore, Tokyo, Munich, Ottawa, Curitiba, Zurich, Melbourne, Karlsruhe, Adelaide and Mexico city.

A. Average Density

Average density is a crude measure of a city's spatial structure, but it is a significant and robust indicator if density measurement is done by using a consistent methodology and if density is obtained by dividing total population by built-up area rather than by administrative area. Figure 1 shows the average built-up density in 46 metropolitan areas around the world. On the graph, bars representing cities' density are color coded by continent. Asian cities have on average a much higher densities than European and Latin American cities and US cities are all clustered in the very low range. New York density is high compared to other American cities, but it is within the low range of the European cities' cluster.

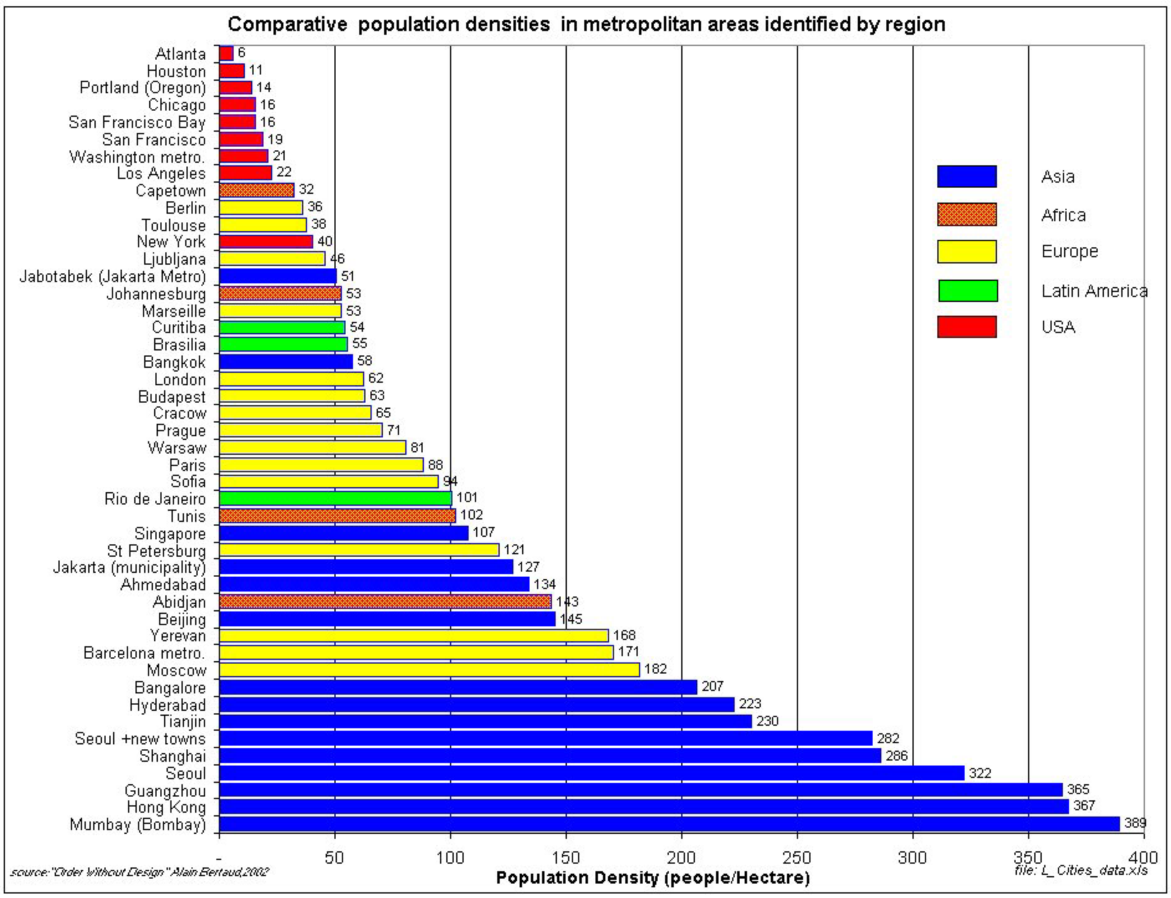

Figure 1: Comparative Average Population Density in the Built-up areas of 46 Metropolitan areas.

Atlanta with 6 people per hectare has the lowest density in the sample and the lowest density of the American cities group. The difference between the density of Atlanta and the density of European cities is not trivial; it is about an order of magnitude. While US cities have much lower densities than their Latin, European or Asian counterparts, compared to other US cities Atlanta density is still very low. Even Los Angeles' density is more than three times higher than Atlanta's.

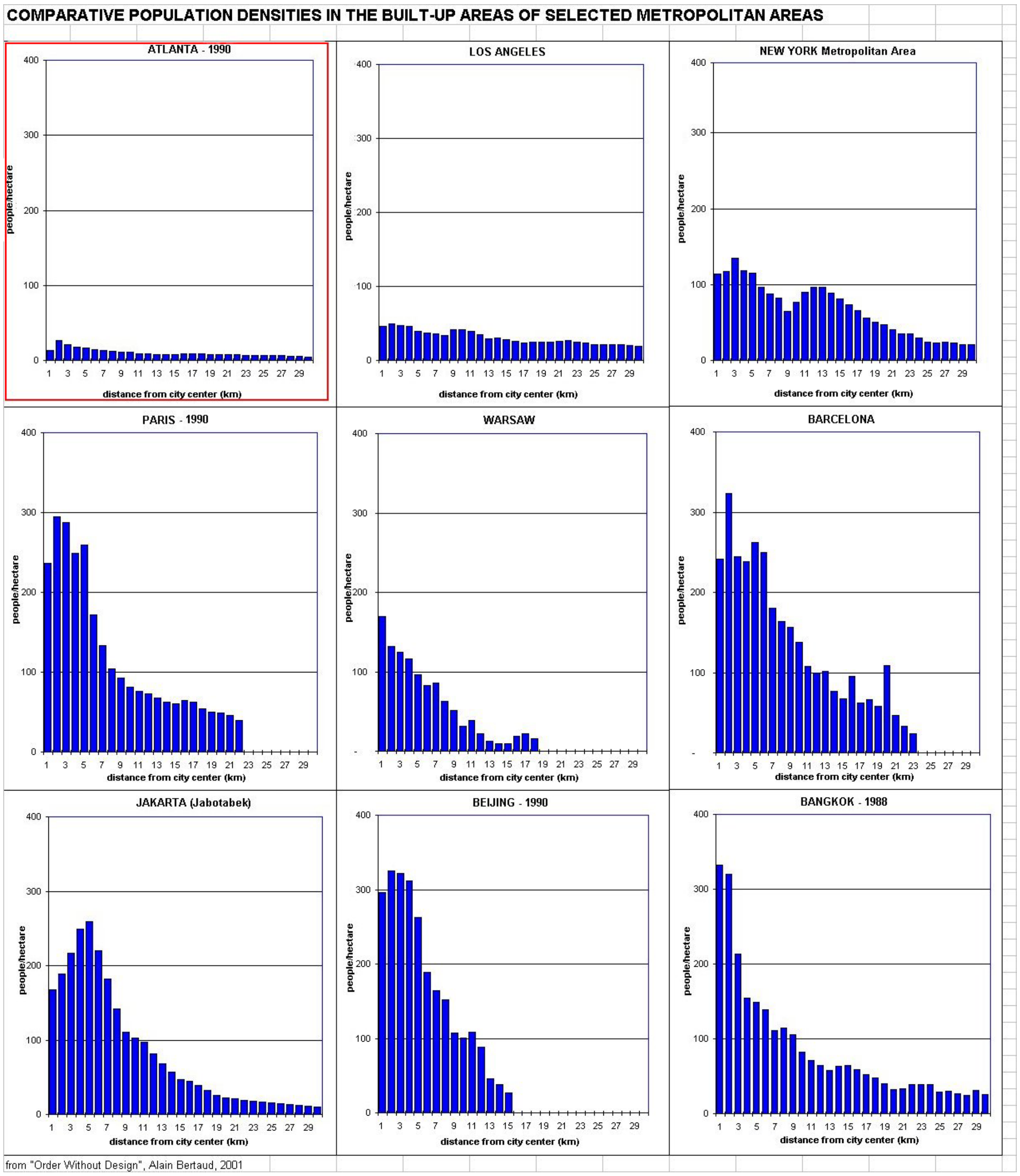

Figure 2: Comparative Population density Profile in built-up areas in selected Metropolitan areas

B. Density profile

Average density has the merit of being simple to calculate and to interpret. However, while more complex, the profile of density within a city, i.e. the variation of density within concentric rings from the center to the periphery, is a more subtle indicator of a city spatial structure. The shape of the density profile shows whether the city center is a strong attractor for jobs and people or whether people and jobs tend to be distributed more evenly across the metropolitan area. Because it would be tedious to present the density profile of all the 46 cities shown on Figure 1, Figure 2 shows the profile of only 9 cities, 3 US cities, 3 European cities and 3 Asian cities.

The density profile of Atlanta contrasts with the other non US cities by being particularly flat and because of the very low density of its city center, in absolute terms, and in relation with its suburban density. In Atlanta the highest density per 1 km ring is 25 people/ hectare at 1km from the city center, as compared to nearly 300 p/ha at the same distance from the center in Paris! We can see also that the difference between the density near the city center and the suburbs is very large in all cities in the sample except for Los Angeles and Atlanta. We should note also that New York density profile is somewhat closer to European cities than to Atlanta's or Los Angeles'. (see annex 1 for a more detailed view of Atlanta's density profile).

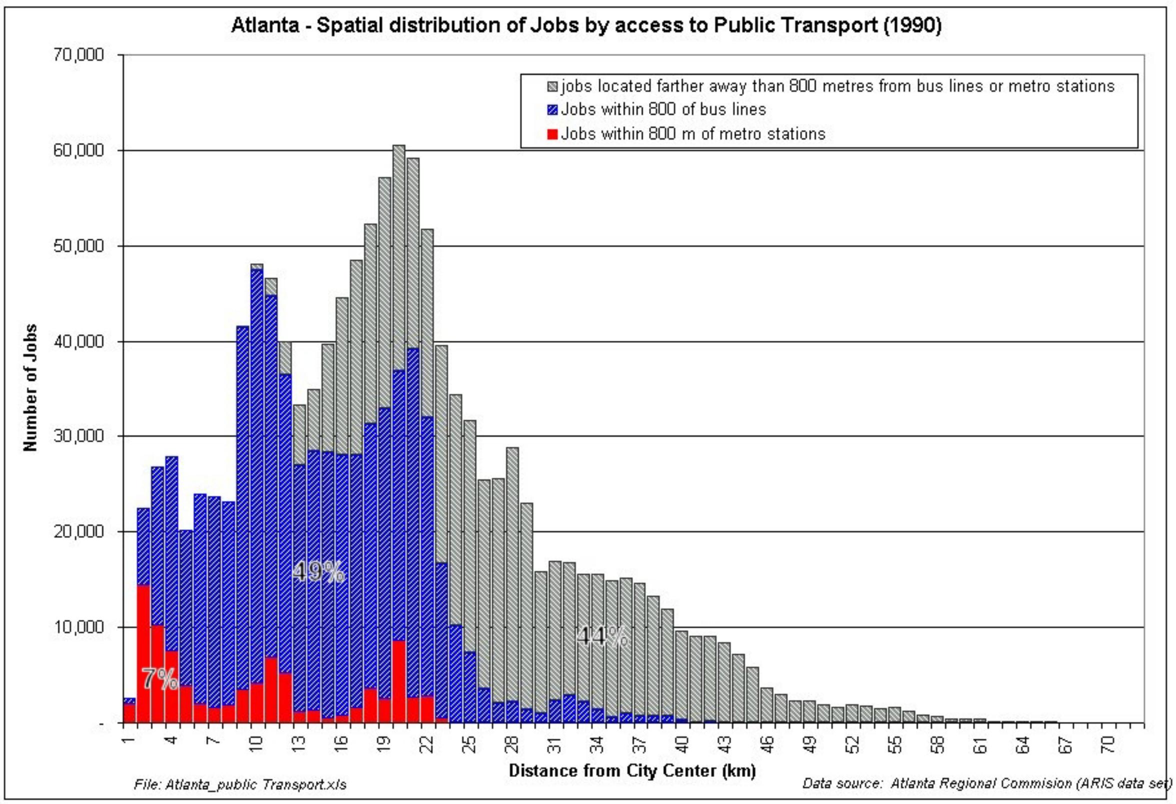

Figure 3: Spatial Distribution of jobs in Atlanta's Metropolitan Area

Atlanta's flat density profile suggests that its city center is a weak attractor of population and jobs. The spatial distribution of jobs across the metropolitan area (Figure 3) shows that in 1990 only 2% of the total jobs were in the CBD and only 8% were within 5km from the city center. Only 7% of the jobs were accessible by metro (i.e. located at less than 800 meters (1/2 mile) from a metro station) and 44% of the total jobs were not within walking distance from a bus stop or a metro station.

C. Atlanta's spatial structure is exceptional

Atlanta spatial structure is not only exceptional among world cities but also among US cities. It is characterized by an extremely low density and an extreme dispersion of jobs and people across its metropolitan area. Does it matter? If one looks at economic viability, Atlanta's success suggests that the answer is obviously no. But urban structure matters when designing a strategy that rests on the development of transit as a major mode of transportation.

European and Asian cities that have a well developed transit systems (London, Paris, Hong Kong, Singapore) have much higher densities and a heavier concentration of business and retail in the city center than Atlanta. In cities where transit is well developed, averaged density is higher than Atlanta's by an order of magnitude and density profile is much steeper. Is it just a coincidence? Or is there a density threshold below which demand for transit is very limited? And is there a type of spatial organization, as measured by the density profile, for which transit is not viable? We will explore these possibilities in the next section.

III.Why is density important for transit?

A. Atlanta and Barcelona

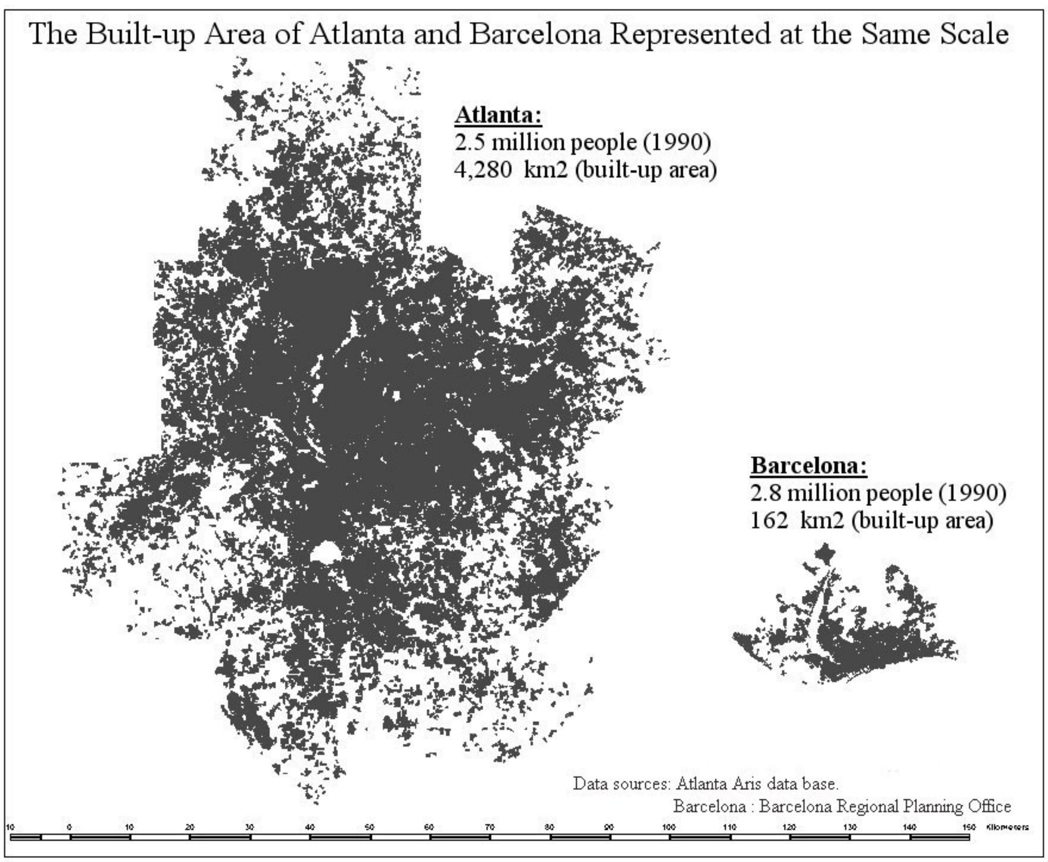

Figure 4: Atlanta and Barcelona built-up area represented at the same scale.

To understand better why density is important in the operation of transit, let us use a concrete example and compare Atlanta with Barcelona, one among many European cities where transit represents a significant share of daily trips. Atlanta and Barcelona have about the same population[4]; both cities have recently emerged as regional economic power houses; both cities recently hosted Olympic Games. However, the spatial structures of the two cities are extremely different: the average built-up density of the Barcelona metropolitan area (171 p/ha) is 28 times larger than Atlanta's (6 p/ha). The difference of density implies that in Atlanta the area covered by the transport network has to be 28 larger than in Barcelona, while carrying about the same number of people (see Figure 4).

The metro network in Barcelona is 99 kilometers long while 60% of the population lives at less than 600 meters from a metro station. Atlanta's metro network is 74 km long – not so different from Barcelona – but only 4% of the population live within 800 meters from a metro station. We should not be surprised if in Atlanta only 4.5% of trips are made by transit vs. 30% in metropolitan Barcelona where the high density allows also an impressive 8% of all trips to be walking trips.

Suppose that the city of Atlanta would want to provide its population with the same metro accessibility that exists in Barcelona i.e. 60% of the population within 600 meter from a metro station. Atlanta would have to build an additional 3,400 kilometers of metro tracks and about 2,800 new metro stations. Such an enormous new capital investment would allow Atlanta metro to potentially transport the same number of people that Barcelona does with only 99 kilometers of tracks and 136 stations. In short, the effect of density on the viability of transit is not trivial.

The example above illustrates the constraint that low density imposes on the operation of transit. I have been comparing metro track length and stations but a comparison between bus lines length and number of bus stops in Barcelona and Atlanta would give the same results. The same comparison could be made for the number of buses necessary to transport people in the 2 cities. With its low density of 6 people per hectare – compared to Barcelona's 171 p/ha – it is not surprising that Atlanta is encountering difficulties in developing a viable form of transit, i.e. a transit system that is convenient for the consumer and financially viable for the operator.

The comparison between Atlanta and Barcelona shows in an anecdotal form why density is important in transit operation. Empirical evidence confirms that there is indeed a density threshold below which it becomes impossible to provide transit service.

B. A minimum density to operate transit

While there is no clear causal correlation between population densities and transit share, there are well documented empirical thresholds of densities below which transit is unpractical for users and financially unsustainable for operators. Or, in other words, the lower the density the more difficult it is for transit to operate. However, high density does not guarantee a high share of transit. Atlanta's average built-up density of 6 people per hectare is well below the various density thresholds suggested by most transit operators and

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[4] In 1990, Metropolitan Atlanta had a population of 2.5 million vs. 2.8 million for metropolitan Barcelona.

researchers. The literature review conducted by Holtzclaw (1990) on transit and density suggests that there exists a density threshold around 30 people per hectare (p/ha) for intermediary bus service, 35 p/ha for light rail and 50 p/ha for metro (see table 1).

Recomended built-up and residential densities for various level of transit services

	Built-up Density p/ha	Residential Density p/ha
Boris Pushkarev and Jeffrey Zupan (1982)		
1 Bus: intermed serv, 1/2 mi between routes, 40 buses/day 7 du/res ac	29	42
2 Bus: freq serv, 1/2 mi between routes, 120 buses/day 15 du/res ac	62	89
3 Light rail: 5 min peak headways, 9 du/res ac, 25 - 100 sq mi corridor	37	53
4 Rapid tr: 5 min peak headways, 12 du/res ac, 100 - 150 sq mi corridor	50	71
The Institute of Transportation Engineers (1989) recommends the following minimums:		
1 1 bus/hour, 4 to 6 du/res. ac, 5 to 8 msf of commercial/office	21	30
2 1 bus/30 min, 7 to 8 du/res ac, 8 to 20 msf of commercial/office	31	44
3 Lt rail and feeder buses, 9 du/res ac, 35 to 50 msf of commercial/office	37	53
Peter Newman and Jeffrey Kenworthy (1989)		
"public transit oriented urban lifestyle"	35	50

Extracted from **John Holtzclaw, "Using Residential Patterns and Transit To Decrease Auto Dependence and Costs"; Natural Resources Defense Council, June 1994**

1 acre= 0.405 ha
Persons/dw= 2.4
% residential 70%

Table 1: Thresholds established for different level of transit services for North America (Holtzclaw (1990)

Population density is not the only factor affecting transit operation; the spatial concentration of jobs and people is certainly as important in determining its viability. The city center of traditional European and Asian cities is usually the place where the major number of jobs, retail space and cultural amenities are found. The steep density gradients of European and Asian cities shown in Figure 2 are an indicator of the primacy of the city center as a focal point for the majority of transit trips. It is easier for transit operators to operate transit lines with multiple origins, the suburbs, but one destination, the city center. It is much more difficult to operate transit routes linking multiple origins to multiple destinations, as recognized by a strong advocate of transit like Cervero (1998). In most "transit cities" the trips toward the center are in majority by transit while suburb to suburb trips are by car. While rail mass transit, commuter trains, metro, and light rail are well adapted to monocentric cities, buses are the only mean of transit which make sense in a polycentric city where jobs are dispersed across the metropolitan area. The more dispersed the jobs, the fewer the passengers per route, the smaller should be the buses if one wants to avoid running empty buses. At an extremely low density and an extremely high dispersion it is conceivable that the only bus size that makes sense is a bus which carries only one passenger, its driver.

If Atlanta's current city structure – characterized by a very low average density and a very flat density gradient – make it incompatible with transit, then would it still be possible to change this structure over the years? We will look into this possibility in the next section.

IV.Could Atlanta's spatial structure become more "transit oriented" in the future?

To be able to potentially increase transit trips at the expense of car trips Atlanta would therefore need to increase its density from the current 6 p/ha toward the 30 p/ha threshold. Simultaneously it will be necessary to increase the number of jobs and amenities located in the city center.

A. How to increase density?

Metropolitan Authorities have two "tools" at their disposal to stimulate an increase in built-up density: (i) increasing the supply of transit (frequency as well as increasing the number of lines), and (ii) regulating land use, for instance, allowing higher densities in areas close to transit and restricting the development of land in areas outside the reach of transit.

Increasing the supply of transit may have the effect of increasing density in the areas where demand for transit is already high. In most European cities land is more expensive around metro stations and land prices drop to much lower levels in areas not covered by transit. Higher land prices generate higher densities. However, the density effect does not depend on the transit supply itself but on demand for transit. If there is no demand for new transit, increasing supply have no effect on density. The best way to test if demand exists is to monitor the changes over time in the number of people and jobs in areas already served by transit vs. in areas not served.

Some land use regulations may also result in higher densities. However, higher land and housing prices would have to be accepted as a side effect of the new regulations. Two types of regulatory changes may result in higher densities: (i) increasing the allowable floor area ratio and the number of units per acre in already built areas, and (ii) restricting the supply of new green-field development; for instance, by establishing an Urban Growth Boundary, a la Portland.

Increasing permissible floor area ratio and number of units per acre in developed areas will increase density only if there is demand for higher density in the area. Or expressed differently, it will occur if households and firms are ready to trade off land consumption for a location that they consider privileged. From anecdotal evidence it appears that in many parts of Atlanta the authorized floor area ratio is not fully used, i.e. there is no demand yet for the higher density which is already allowed by regulations. If this proved to be true, then increasing the permissible floor area ratio would have no effect on density.

Restricting the supply of land for green field development by establishing an Urban Growth Boundary does increase density. Simultaneously increasing the permissible floor area ratio and establishing an Urban Growth Boundary should indeed result in an increase in the density of Atlanta's built up area. This result assumes that the economy of the city is not affected by the increase in land and housing prices which would occur after an urban growth boundary has been established, and that, in spite of much higher land prices, the city growth rate would stay constant over time.

The ARC strategy consists mainly in increasing transit supply and in reforming regulations allowing higher density and more mixed use, but it stops short of advocating an urban growth boundary.

ARC strategy proposes to increase the length of current Metro and bus lines and the creation of light rail. It plans for an investment "in new transit facilities accounting for 55% of the total transport investments over 25 years" (2000 – 2025 Regional Transportation Plan adopted in March 2000).

ARC is more timid when it comes to regulating land use. Under the title "Land Use Strategies Are Foundational" , ARC' Regional Development Plan summarizes its land use strategy in a very cautious way:

> "- *Encourage new development to be more clustered in portions of the region where such opportunities exist.*
>
> *- Encourage Traditional Neighborhood Developments.*
>
> *- Encourage focused land fill and redevelopment when acceptable to communities"*
>
> *-Support the preservation of stable, single-family neighborhoods."*

There is no mention of an Urban Growth Boundary (UGB) which would be the only way to trigger densification. This omission is quite understandable as an UGB would certainly meet popular resistance because it would increase housing costs and significantly decrease housing consumption in the long run.

In the following section, I will explore the possible impact of increasing transit supply and regulating land use on the future shape of Atlanta.

B. Trend: Transit served areas did not attract much new people or jobs between 1990 and 1998

The Metropolitan Atlanta Rapid Transit Authority (MARTA) has been operating bus services since 1972 and rail since 1980. The stations are well designed; MARTA has a history of innovation to attract passengers. With the construction of "Lindbergh center" It has recently initiated one of the largest "transit oriented development" projects in the US which will integrate shopping, office and residential space. The operation of the MARTA network has won the "safest Transit System in America" award 17 times in the past 20 years.

With this impressive track record one would expect that there would be a lot of demand for housing within walking distance of a metro or bus station. Many employers would normally prefer a location close to transit because the higher accessibility would increase the size of the pool of workers from which they can recruit. Unfortunately, the changes in population and job data between 1990 and 1998 suggest that in Atlanta none of the above assumptions are correct.

Between 1990 and 1999 the share of the total population living within 800 meter from a metro station or a bus line has decreased from 40% to 34%. Among the 690,000 people added to Atlanta Metropolitan Area during these 9 years period, 85% have settled outside the reach of transit, bus or metro[5] . This pattern suggests that the competent operation of the MARTA network over these 9 years has not been sufficient to reverse the dispersion of population and a flattening of the density profile. (see Figure 5) The area of major population growth has been within a belt at a distance between 30 and 45 km from the city center, mainly outside the reach of the transit network.

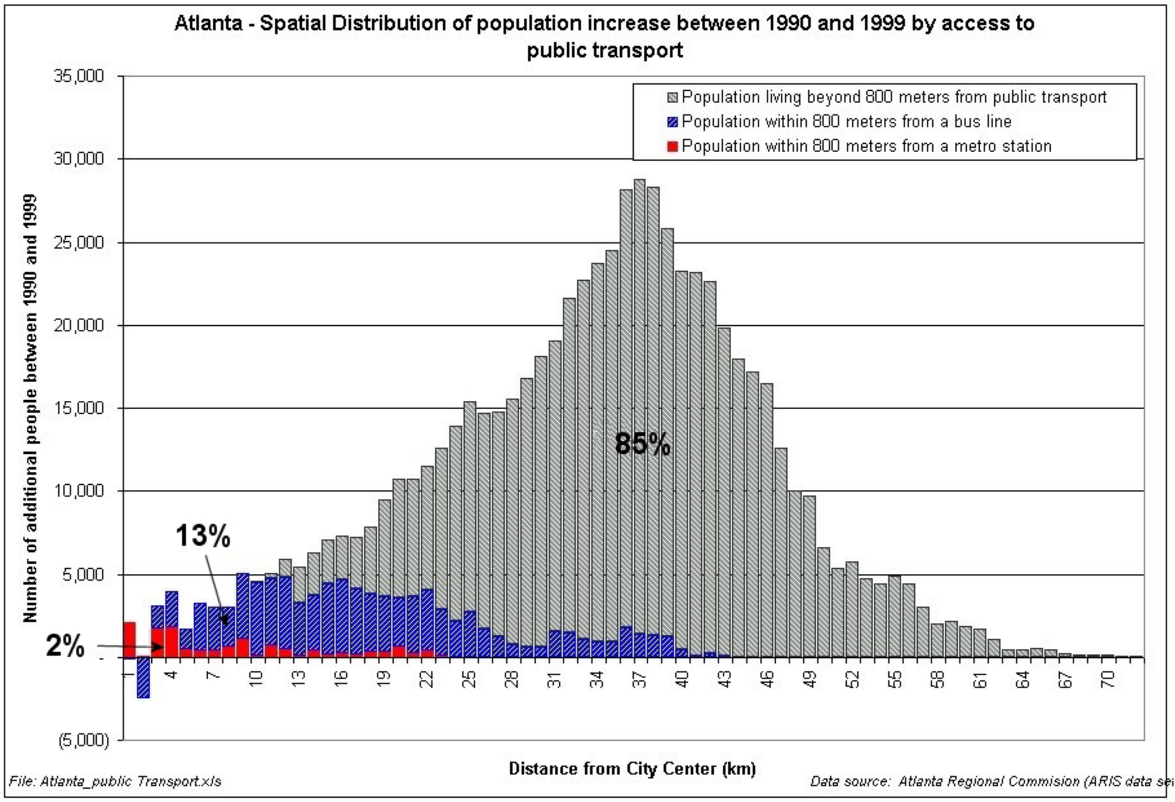

Figure 5:Spatial Distribution of additional population between 1990 and 1999 by access to transit

Between 1990 and 1998 about 400,000 new jobs have been created in the Atlanta metropolitan area. However, in spite of this spectacular increase, by 1998, the downtown area, the area best served by metro, has lost 10,000 jobs or 2.5% of the total jobs which existed in the area in 1990[6]. Of the new jobs created in the metropolitan area 1% are within 800 meters from a metro station, 22% are located within 800 meters from a bus line and 77% are located outside the reach of the transit system. By contrast with Asian and European cities, access to transit does not seem to be a major consideration when locating a business or developing new housing in Atlanta.

In Atlanta, the spatial trend between 1990 and 1998 therefore does not seem to support the idea that the provision of transit increases density or tends to reinforce the concentration of employment in the downtown area or even along transport corridors.

[5] These figures are based on a GIS analysis of census data, built-up area and transit network provided by ARIS (Atlanta Region Information System, volume 1a, 2000). Supporting map and detailed tables are provided in annex1.
[6] Defined as a circle of 5km radius around Five Points metro station

This spatial diagnosis is also confirmed by the evolution of the number of transit linked trips (Kain, 1996). Using MARTA's data, Kain shows that "…by 1993 transit ridership, as measured by linked trips (and not by total boardings) was only 2.5% higher than its 1979 level, the year before MARTA initiated rail service." [7] Between 1979 and 1993, Atlanta's population increased by 45%. During this period of extraordinary demographic growth, the number of trips using transit has stayed about the same in spite of the creation of the metro, confirming the result of the spatial analysis. In Atlanta, increasing transit supply does not necessary increase demand.

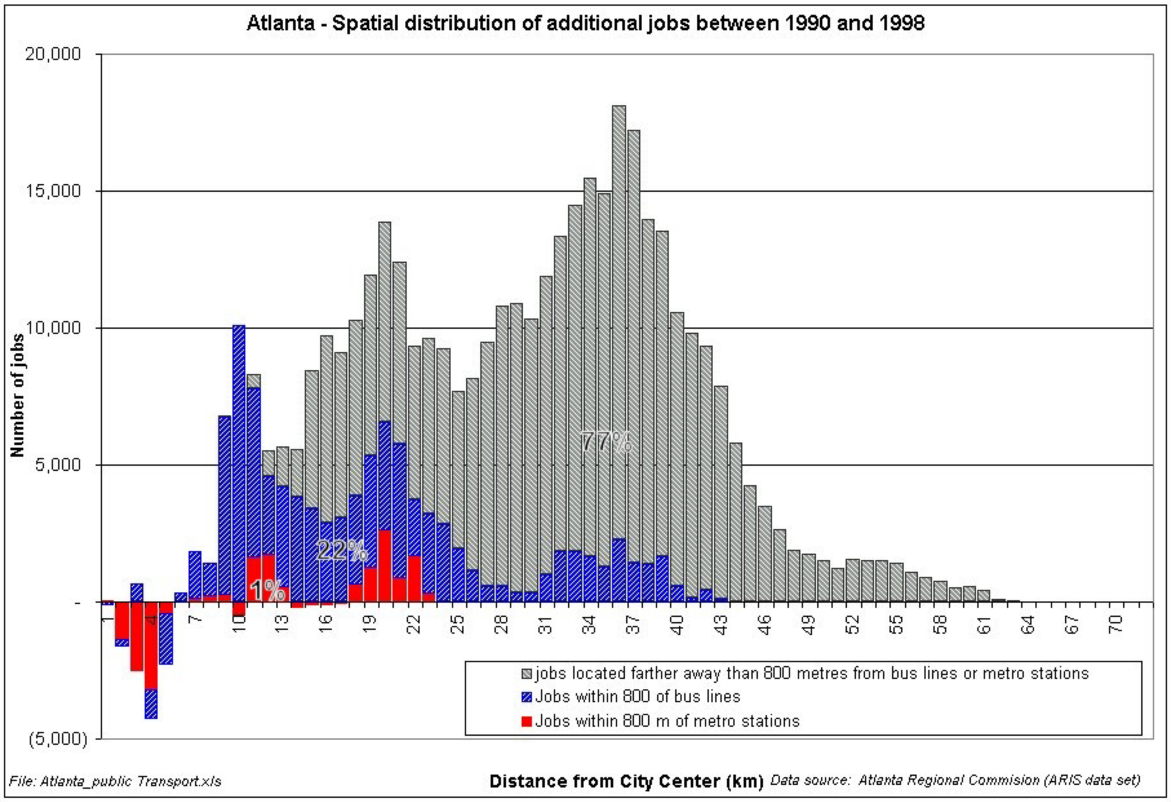

Figure 6: Spatial Distribution of additional jobs between 1990 and 1998 by access to transit

C. The densification scenarios

We have seen that the current trend does not show any evidence of high demand from households or firms for locating within reach of the existing transit network. But it could be argued that demand could change overtime, for instance if the US was exposed to another oil shock, transit might become more attractive. It is therefore useful to look at the possibility of densification from a purely geometric point of view. Is there any "geometric" possibility for Atlanta to reach an average built-up density of around 30 p/ha, assuming that this change would have to be triggered either by an abrupt change in consumers preference or by some dictatorial urban planning regulations? While neither of these 2 assumptions

[7] Boarding is the number of time a passenger board a transit vehicle, linked trips are the number of trips taken by transit. A trip including a transfer from, say, bus to metro is not counted as 2 trips.

seems likely, it is necessary to address the argument of future densification as it is central to many "smart growth" strategies.

I have developed 2 densification scenarios; the first scenario calculates what would be the built up area of Atlanta if a density of 30 p/ha were reached over a period of 20 years; the second scenario calculates the density that would be reached if no additional green field developments were authorized during a period of 20 years[8] . Under both scenarios, the historical demographic growth rate of 3.14% between 1990 and 2000 stays constant (see Table 2).

Scenario 1 : Atlanta reaches a density of 30 p/ha by 2010

	1990	2010	Difference	% change
Population	2,513,000	4,664,000	2,151,000	86%
Annual Population Growth Rate	3.14%			
Built-up Density (p/ha)	5.87	30.00		
Built-up Area (km2)	4,280	1,555	(2,725)	-64%

Scenario 2 : No addition to build-up area, infill only and densification of existing built-up area

	1990	2010	Difference	% change
Population	2,513,000	4,664,000	2,151,000	86%
Annual Population Growth Rate	3.14%			
Built-up Density (p/ha)	5.87	10.90		
Built-up Area (km2)	4,280	4,280	-	0%

Table 2: Densification scenarios

Under the assumptions of the first scenario, Atlanta reaches a density of 30 people per hectare over a period of 20 years; it is assumed that the historical population growth rate of 3.14% per year between 1990 and 2000 continues uninterrupted until the end of the 20 year period. In order for Atlanta's density to reach 30 p/ha, and taking into account the increase in population, the current built-up area would have to be no more than 1,555 km^2 compared to the 4,280 km^2 today or, in other words, the current built-up area will have to shrink by 64 %. To reach 30 p/ha about 2/3 of the existing real estate stock would have to be destroyed over a period of 20 years, 2/3 of the built up area would have to revert to nature and its population and jobs would have to be moved into the 36% of the city which would remain. The likelihood of such a scenario does not require any further comments. We can therefore safely affirm that Atlanta will never come even close to the 30 p/ha density threshold required to justify an extension of transit.

Under the second scenario, during a period of 20 years the city grows at its historical growth rate of 3.14%. The local government takes the drastic measure of allowing only densification of existing built-up area without any greenfield extensions (regulatory measure much more draconian than Portland's urban growth boundary which

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[8] The projection are done using the 1990 census base as at the time this article was written the 2000 census was not available. The results however, are robust enough to show that the same conclusion would be obtained if the base year had been 2000 and the target year 2020.

permits new greenfield areas). Assuming that the effect of these measures on real estate prices have no impact on the 3.14% growth rate, the density of Atlanta after 20 years would only reach 11 people per hectare (less than half of the current density of Los Angeles). If Atlanta's growth rate decreases, the resulting density would be much less. The likelihood of such a scenario does not require any comments either.

The physical implausibility of the two scenarios illustrates the difficulties in changing the density of a large metropolitan area, even when using draconian land use regulations over periods as long as 20 years. It demonstrates also that the timid but politically realistic land use reforms proposed by ARC consisting in "- *Encouraging new development to be more clustered in portions of the region where such opportunities exist."* or any advocacy of "new urbanism" including construction of town houses, would have no measurable effects on the average density of Atlanta and therefore no impact on the future number of transit trips.

This does not mean that the land use policy advocated by ARC is without merit. On the contrary, Atlanta needs better neighborhood design, and better ways for pedestrians to move around the city. All the urban design measures advocated by ARC are certainly worthwhile; they will make Atlanta a more pleasant city in which to live. However, one must be conscious that these reforms will not have any impact on pollution or congestion. By the same token, the type of neighborhood design advocated by the "new urbanists" is a welcome design innovation which will increase housing consumer choices and therefore should not be discouraged by arbitrary land use regulations. But it should be made clear that all the proposed improvements in urban design proposed by the "New Urbanists" will have no measurable impact on the spatial structure of Atlanta and therefore no impact on pollution and congestion.

The large increase in the supply of transit is a different matter. It will absorb a very high amount of resources for very little in the way of results because the current density will never support a viable transit system. Only if the only objective of extending transit is to keep Federal dollars flowing into Atlanta does the current strategy has merit.

Pollution and traffic congestion in Atlanta are real problems however, and somehow these problems will have to be addressed. It is suggested that the extraordinary spread of Atlanta is due to subsidized highways, a pricing failure. It is therefore logical to consider an improvement in pricing as the best way to correct this problem.

D. How can Atlanta become a less polluted and less congested city?

While urban congestion and pollution problems are related, they do not completely overlap and it is important to address them separately.

Only after we abandon the illusion that new transit and innovative land use planning will decrease pollution and congestion, is it possible to look at more realistic solutions. We should look for solutions in areas that have a proven track record: technology and traditional economics, i.e. pricing.

Let us look first at technology. Pollution due to transport, when measured per vehicle and per passenger mile has decreased enormously in the last few years. A car built in 2000 emits about 90% less nitrogen oxides per mile than a car built 25 years ago (Walsh 2000). There is no reason to think that progress in this area will not continue. However, stimulating technological research and bringing new less-polluting vehicles to market is beyond the mandate of ARC. The role of ARC is limited to the enforcement of stricter emission controls and inspection and maintenance programs. Indeed the ARC 2025 Regional Plan budgets $202 million in this area. It is a small component of the total transport investment, but probably the one which will have the most impact on pollution.

Another comparison between Atlanta and Barcelona shows an interesting example of the impact of technology on urban air pollution, but this time to the advantage of Atlanta. In Atlanta, in 1999, the average yearly level of nitrogen oxides was 47 $\mu g/m^3$ compared with 55 $\mu g/m^3$ In Barcelona. Air pollution due to traffic in Barcelona is higher than in Atlanta, is spite of the fact that Barcelona has a density 28 times higher than Atlanta and that 30% of trips are by transit and 8% are walking trips. The high pollution level of Barcelona is apparently due to laxer emission standards for vehicles, in particular allowing the use of diesel fuel for cars – about 55% of private cars use diesel in Barcelona. In addition, vehicles tend to be older in Spain than they are in the US, and possibly emission control and inspections are less systematic than in Atlanta.

The latest development in technology, hybrid cars and fuel cell engines are showing that a nearly pollution-free individual transport vehicle, while still in a distant future, is not out of reach. It is legitimate to think that market forces alone will not bring this pollution free car in the near or medium range future and, therefore, that appropriate government action could accelerate technical innovation in this area. This government action, however, cannot come from local government.

But pollution free vehicles do not solve the problem of congestion. There is a rare consensus among environmentalists and neo-classical economists that the current pricing of roads is inadequate, and that free roads lead to overuse and congestion (Gomez-Ibanez,1999, Hau 1992).

The simplest way to increase the price of a trip and discourage overuse is of course to increase the gasoline tax. The problem with a gasoline tax, however, is that it is a very blunt instrument, and it taxes all the trips within a State in the same way, whether they cause congestion or not. A gasoline tax does encourage the use of smaller vehicles, however, therefore further decreasing pollution.

A better way is to introduce tolls on the most congested roads. There is a vast literature on the subject and it is hardly a new idea for intercity highways or bridges and tunnels. But urban toll roads are seldom used because toll booths are often a source of congestion when tokens or coins are used to recover the toll. The transaction costs involved in throwing quarters or tokens in a basket at a gate are also very high. But recent transponder technology eliminates congestion at urban toll booth and reduces transaction costs. Ga 400 is the only toll road in Atlanta metropolitan area. The objective of the toll on Ga 400 was not to price congestion but to pay for the construction of the road and there is currently a debate about whether the toll should be removed once the road has been paid for.

The main advantage of paying tolls by transponders is that the toll can be modulated depending on the time of the day, therefore pricing congestion much more efficiently, the way, for instance, phone calls and electricity are priced[9] . The technology has now been routinely used in California route 91 and of course in Singapore and Hong Kong. The most modern toll booths used in Singapore allow drivers to pass through the toll booth at normal driving speed, thus avoiding the congestion common at coin-operated booths.

Charging for highway use provides a strong incentive to increase vehicle occupancy and car pooling in general without the diseconomies and road design problems linked with HOV lane. It is possible that in the case of Atlanta, a decrease in congestion caused by tolls, combined with a higher cost for using a one passenger vehicle may boost some minibus transit traffic. Minibuses carrying a dozen passengers would of course pay a very low toll per person and benefit from the free flowing traffic. Less congestion would also make the existing buses more competitive with cars for some trips in terms of cost. Because of the charges induced by car trips on highway, people would tend to drive less and consolidate their trips in order to save on tolls. It should also be noted that less congestion, i.e. higher speed, also means less pollution.

What would be the impact of tolls on poor people? For those who do not own a car, or at least who mostly use buses to go to work, the effect would be probably positive as the existing bus system would be more reliable and faster with less congestion. Under the present system in Atlanta, people who cannot afford a car, or cannot drive a car because of a disability, are at a great economic disadvantage because the majority of the jobs are not accessible to them. Their employment opportunity is reduced to the 48% of the jobs which are within reach of public transport – assuming that their own dwelling is within access to the transit network.

For the poor who own cars, the pricing of highways would be expensive as it would save them time but would increase their commuting costs. It should also be recognized that increasing emission standards hurts the poor who tend to own older and poorly maintained cars. This issue will have to be addressed, but if a toll or car subsidy was to be required it would be much better targeted to the poor than the current subsidy for transit.

If Atlanta were to generalize the use of toll roads, transit could be considered a niche transport market for the very poor and the disabled. The transit network, in the way it is organized and priced, would then be completely different from what it is now. Minibuses or even subsidized taxis would be a much more efficient way to cater to this niche market than would metro and light rail.

What should be the peak hour toll to significantly reduce congestion in Atlanta? Probably nobody knows at this moment. Because of the current spatial structure the number of trips might be initially price inelastic – i.e. a large increase in price would result in a small decrease in trips. It is also possible that the introduction of tolls while not changing densities might change the spatial distribution of retail. Smaller neighborhood retails like "Seven-Eleven" might develop – zoning permitting – at the expense of larger supermarkets. The introduction of congestion pricing would change the current

[9] Transponders are used to pay tolls on a large number of highways in the US, but they are few example of congestion pricing, route 91 in California use a toll which varies from $1 to $4.75 depending on the hour of the day and day of the week. Singapore and Hong Kong were pioneers in using transponder toll congestion pricing.

equilibrium. This change will create winners and loosers. The political feasibility of pricing depends on whether the perception of the benefits that would accrue from reduced pollution and congestion would out-weight the losses due to increase transport costs for individual car users. As the price increase will have to precede the reduction of pollution and congestion, it is far from certain that the project is politically feasible at this moment. Only the public perception of an extremely acute and dangerous pollution and an intolerable level of traffic congestion would create the conditions for the implementation of congestion pricing. This level has apparently not been reached yet in Atlanta.

V.Conclusion

We have seen that, first, because of the very low density of and the spatial dispersion of jobs, transit in Atlanta cannot capture any significant share of trips; second, that density is unlikely to ever increase significantly and that the dispersion of jobs is likely to increase with time. It is therefore unrealistic to hope that the serious congestion and pollution problems of Atlanta will be solved by an increase in the number of transit trips and a comparable decrease in car trips.

Existing urban spatial structures limit policy options. Urban spatial structures are also very resilient; they evolve very slowly, it is not realistic to hope to change them in a radical way. In the case of Atlanta, low density and dispersion preclude the use of transit as a significant means of transportation, now and in the foreseeable future.

The transit conceit, which is holding the current policy hostage, diverts people from looking at much more feasible solutions. Now is the time to look realistically at the strategy options that are available to reduce pollution and congestion which are open to cities with a spatial structure like Atlanta's.

Significant progress in reducing pollution will be achieved by improving emission standards and enforcing them carefully. While enforcement is clearly a local government role, setting emission standards for the industry is either a State or a Federal role. The best way to deal with congestion is through pricing highways. Technology now allows to price trips depending on the time of the day and the location with low transaction costs. Making people pay for something which was previously free, and correspondingly overused, is difficult to sell politically. It is easier to sell the idea of increasing Federal transfers to expand a transit system. The reduction of congestion in Atlanta is therefore a political problem, much more than it is a technical one. The idea that pollution and congestion problems will be solved by people paying directly for more expensive cars and for using highways is not going to be popular, when for years people have been told that the problem could be solved by Federal transfer to expand transit and by few "new urbanism" developments.

People appear to have a preference for hidden indirect taxes over direct costs. This tendency is one possible explanation for the persistent resilience of the idea that transit and smart growth will solve urban pollution and congestion problems in the US in spite of the evidence that it does not work for most low density cities. What level of congestion is needed to convince the public that paying for road usage is the only way to solve the problem? Obviously this level has not been reached in Atlanta so far. With the exception of congestion pricing on Route 91 in California, it seems that a sufficient level of congestion has not been reached yet either in most low density US cities.

Technical Annex

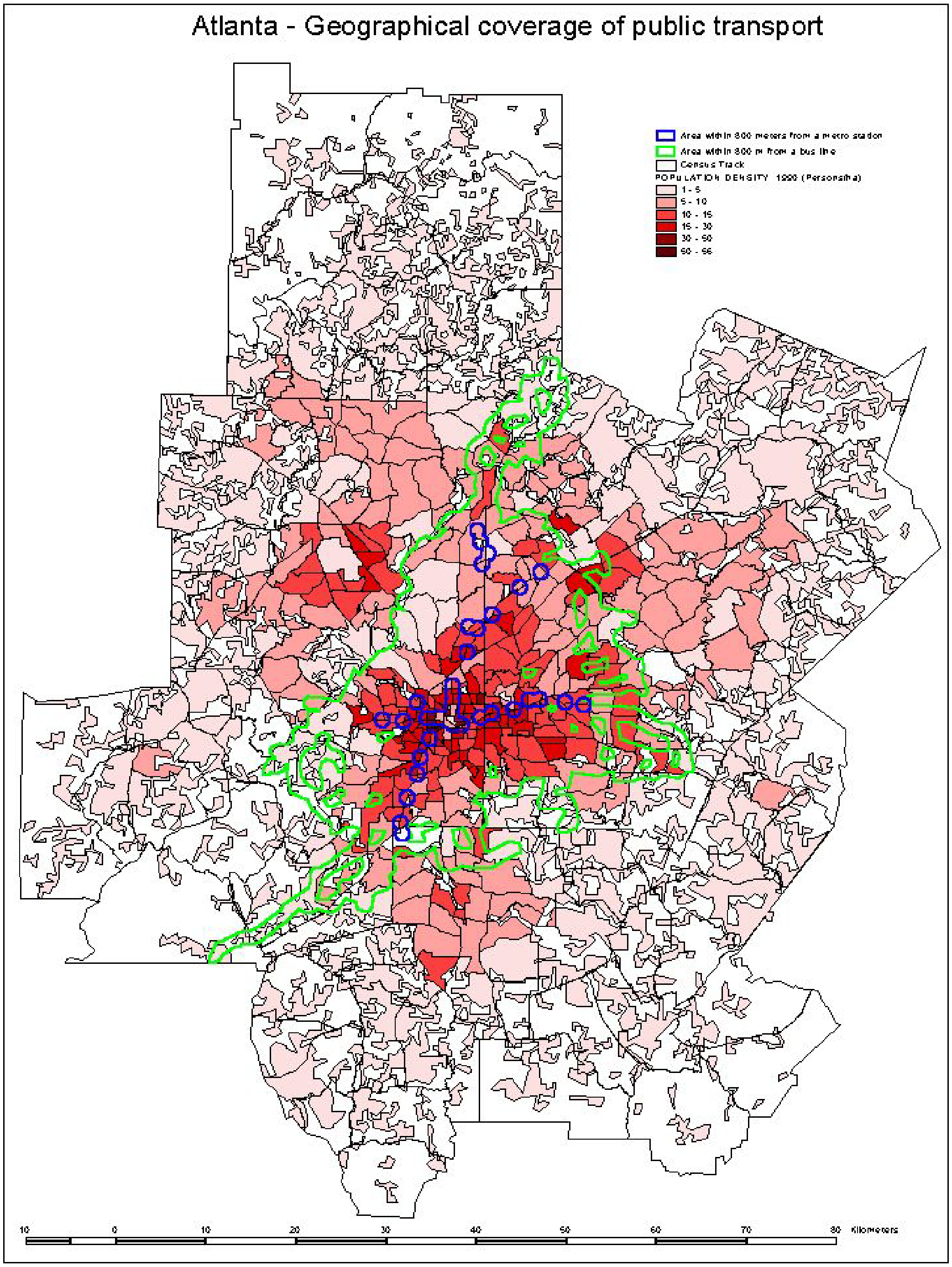

Figure 7: Atlanta Transit Catchment area and density

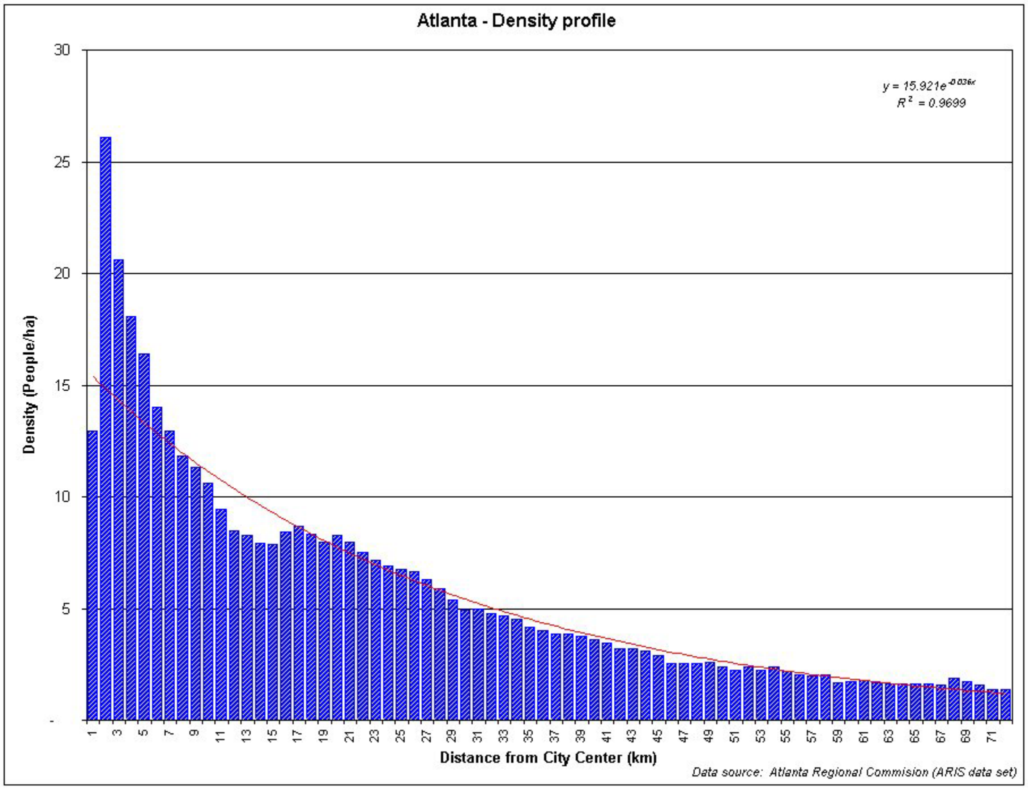

Figure 8: Density profile of the built-up area of Atlanta (1990 census)

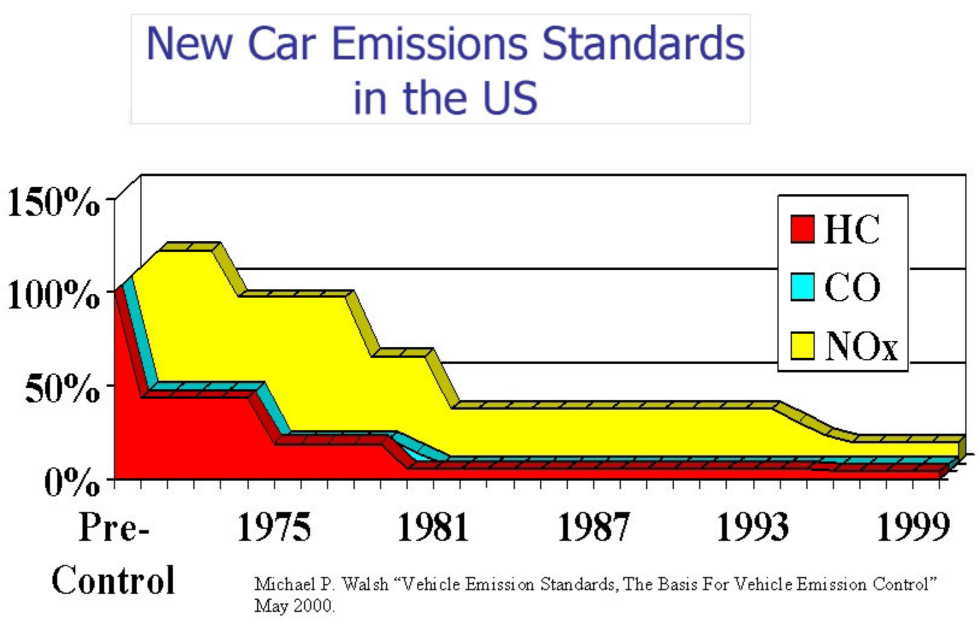

Figure 9; Change in car emission standards in the US

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