Integrated Policies for Sustainable Transportation: The Bogotá Experience

Darío Hidalgo, PhD
hidalgo_dario@bah.com

Workshop on Sustainable Transport and Air Quality
World Bank
Washington D.C., April 8, 2005
Contents

• Sustainable Transport Strategies

• Current Conditions in Bogotá

• Opportunities
NMT, BRT, Car Restrictions

- Low cost
- High Impact: reductions in accidents, pollution and trip time
- More compact cities, socially integrated
- Development of the local industry
- Fast Implementation (3-5 years from idea to commissioning)

More attractive cities

Sao Paulo

Santiago

Manila

Londres
1. Non Motorized Transport

- Priority to Pedestrians and Bicycles over Private Automobiles
- Recovery of Previously Invaded Public Areas
- Construction of Infrastructure
- Promotion and Incentives
- Safe Bike Parking
- Road Safety
1. Non Motorized Transport

BOGOTA, CARRERA 15
Photo: IDU
1. Non Motorized Transport

BOGOTA
ALAMEDA EL PORVENIR
Photo: FPPQQ
1. Non Motorized Transport

Photo: FPPQQ
2. Bus Rapid Transit

- Curitiba
- Quito
- Adelaide
- Rouen
- Brisbane
- Los Angeles
- Boston
- Miami
- Seattle
2. BRT Systems

BOGOTA, TRANSMILENIO
AVENIDA CARACAS
Photo: TRANSMILENIO S.A.
2. BRT Systems

- Well defined economic structure; concession contracts with Private Operators
- Organized Operations in High Capacity Buses
- Specialized Infrastructure: Bus Lanes, Stations, Terminals
- Electronic Fare Collection and Advanced Control Systems
- Distinctive Image
3. Car Restrictions

- Plate Restriction (40% in Peak Hour)
- Car free days
- No curb parking
- Gas tax
Contents

• Sustainable Transport Strategies
  • Current Conditions in Bogotá
  • Opportunities
Important Improvements...
Changes 1997-2003

- **Regulation:**  
  - New mechanisms for public-private interaction through concession contracts

- **Institutions:**  
  - Capacity building for better planning, development and control

- **Resources:**  
  - Increase in ordinary and extraordinary rents

- **Infrastructure:**  
  - New corridors for Public Transport, Recovery of Public Space, Bikeways Network, Parks, Road Maintenance

- **Citizen Culture:**  
  - Sense of Pride and Belonging and Respect of Regulations
Changes in Modal Split

BRT System Impacts

- TransMilenio, as a component of the mobility strategy, has improved the urban equilibrium conditions.

- The transport system has also effects on:
  - Regional Accessibility
  - Recovery of Urban Areas
  - Creation and enhancement of sub-centers
  - Improvement and Generation of Public Space
  - Increase in Density (Developments, Increase in Land Rent)
Towards a more equilibrated metropolis

Source: Tito Yepez, World Bank, with Data from DAPD Y DANE (Household Surveys)
Towards a More Equilibrated Metropolis: Trip Time (minutes in peak hour)

Average Minutes Saved

Source: Tito Yepez, World Bank, with data from TRANSMILENIO S.A.
Towards a more equilibrated metropolis: Changes in Accessibility

Average Commuting Time 1999

Average Commuting Time 2002

Improvements in accessibility 1999-2002

Troncales y Alimentadores Fase I

Colors tending to dark Means higher % change

Fuente: Tito Yepez, Banco Mundial, sobre datos de TRANSMILENIO S.A.
Towards a more equilibrated metropolis: Use of TransMilenio BRTS

<table>
<thead>
<tr>
<th>Strata (Average Income)</th>
<th>TransMilenio 2001</th>
<th>TransMilenio 2003</th>
<th>Bogotá</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (US$4.2/día)</td>
<td>1%</td>
<td>37%</td>
<td>7%</td>
</tr>
<tr>
<td>2 (US$5.9/día)</td>
<td>16%</td>
<td></td>
<td>37%</td>
</tr>
<tr>
<td>3 (US$11.4/día)</td>
<td>65%</td>
<td>47%</td>
<td>43%</td>
</tr>
<tr>
<td>4 (US$24.1/día)</td>
<td>16%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>5 (US$39.2/día)</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>6 (US$62.3/día)</td>
<td>0%</td>
<td></td>
<td>2%</td>
</tr>
</tbody>
</table>

Towards a more equilibrated metropolis:

**Travel cost**
- 51% trips are integrated: 500,000 por día laboral (2005).
- Daily savings for users that formerly required double payment is equivalent to COP $1,800, that is 14% of the average income of a person belonging to stratum 1 (10% de stratum 2)

**Reduction in accidents**
- 6 fatalidades en 2004, compared to 66 en 1998 (86% reduction)
- 5 out 26 crashes and 4 out of 18 injured de 1998 a 2002

Fuentes: TRANSMILENIO S.A., Bogotá ¿Cómo Vamos?, TRANSMILENIO S.A.
Towards a more equilibrated metropolis:

**Emission reduction**
- Kilometers traveled by passenger: 1.5 traditional buses, 5.3 in articulated buses
- 1,500 obsolete buses replaced by 470 articulated and 235 conventional buses (with Euro II standards)
- Modal change: 9% of the passengers formerly used private car

**Sentiment of Pride and Belonging**
- 37% of the people say are very proud of Bogotá in 2002; 26% in 2000 (Average rating from 3.72 to 3.79)
- Perception of TransMilenio was extremely positive at the beginning (90% good or very good). Ratings are above 70% currently. The challenge is to continuously improve the quality of service rating.

Fuentes: TRANSMILENIO S.A., Bogotá ¿Cómo Vamos?, TRANSMILENIO S.A.
Regional Accessibility
Integration of Intercity Public Transport

*332,000 pasajeros semanales en Portales Autonorte y Calle 80 (Julio, 2004) equivalentes al 6.5% de los viajes del Sistema TransMilenio*

Fuente: Plano DAPD, Datos www.transmilenio.gov.co
Urban Renewal

Plaza San Victorino

1998

2000

Foto: FPPQQ, 2003
Urban Renewal
Calle 13 – Av. Caracas
Urban Renewal

Eje Ambiental Avenida Jiménez

Eje Ambiental Avenida Jiménez Carrera 7a – Foto DHG, Octubre 2003
Urban Renewal

Eje Ambiental Avenida Jiménez

Eje Ambiental Avenida Jiménez – Fotos DHG, Abril 2004
Urban Renewal
Avenida Caracas

Av. Caracas Calle 72, Foto Akiris, 2002
Urban Renewal

Avenida Caracas Sur

1997 2004
Creation and Consolidation of Subcenters

Fase I
- Usaquén
- Toberín

Fase II
- Suba
- Bosa
- Engativá

Fase III
- Usme
- Ciudad Bolívar
- Kennedy
- Bosa
- Soacha
- Z I
Improvement and Generation of Public Space

Avenida Caracas Sur
Improvement and Generation of Public Space

Calle 80

Calle 80 Avenida Cali - Intermedia Av. Cali – Foto DHG, Octubre 2003; Abril 2004
Improvement and Generation of Public Space

Calle 80

Portal de la 80, Calle 80 Carrera 96 – Fotos DHG, Abril 2004
Improvement and Generation of Public Space

Eje Ambiental Avenida Jiménez
Improvement and Generation of Public Space

Eje Ambiental Avenida Jiménez
Improvement and Generation of Public Space

Troncal Américas

Fotos Noviembre 2003
Developments
Calle 80

Centro Comercial Portal de la 80, Calle 80 Carrera 98, Foto DHG, Abril 2004
Developments

Calle 80

Centro Comercial Surtimax, Calle 80 Carrera 90, Foto DHG, Abril 2004
Developments
Avenida Caracas

Almacén Éxito, Avenida Caracas Calle 53, Fotos DHG, Abril 2004
Developments
Avenida Caracas

Centro Comercial y Deportivo First 56, Avenida Caracas Calle 56,
Fotos DHG, Abril 2004
Change in Land Rent

Hedonic Prices, Study 1

• Vivian Barrios, Facultad de Economía, Universidad de los Andes, 2002

• Telephonic and field interview of housing leases, supported by TRANSMILENIO S.A.

• Simple random sampling 490 leases February-April 2002 (5% error, 95% confianza)

• Some results:
  – Price elasticity is -0.0421 with distance
  – Every 100 metros (one block) from the corridor reduces rent in $2000-$2500 pesos por mes (0.8-1.1 US$)

<table>
<thead>
<tr>
<th>VARIABLE INDEPENDIENTE</th>
<th>DOBLE-LOG</th>
<th>DAP MARGINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constante</td>
<td>9.5542</td>
<td>(40.281)**</td>
</tr>
<tr>
<td>Área</td>
<td>0.4549</td>
<td>(8.495)**</td>
</tr>
<tr>
<td>Número de baños</td>
<td>0.1175</td>
<td>(2.501)**</td>
</tr>
<tr>
<td>Número habitaciones</td>
<td>0.2364</td>
<td>(5.027)**</td>
</tr>
<tr>
<td>Piso</td>
<td>0.0988</td>
<td>(5.050) **</td>
</tr>
<tr>
<td>Estrato</td>
<td>0.8127</td>
<td>(12.800)**</td>
</tr>
<tr>
<td>Baño - cuarto servicio</td>
<td>0.0446</td>
<td>(1.151)</td>
</tr>
<tr>
<td>Sala- comedor Independiente</td>
<td>0.0309</td>
<td>(5.065)**</td>
</tr>
<tr>
<td>Años de construido</td>
<td>0.0639</td>
<td>(2.375)**</td>
</tr>
<tr>
<td>Distancia - vial</td>
<td>-0.04215</td>
<td>(-2.103)**</td>
</tr>
<tr>
<td>R-cuadrado</td>
<td>0.65695</td>
<td></td>
</tr>
</tbody>
</table>
Data Location

494 leased flats in 2002 (out of 600 data collected)

Fuente: Targa University of North Carolina Chappel Hill, 2003
Change in Land Rent

Hedonic Prices Study 2
• Felipe Targa, “Examining Accessibility and Proximity-Related Effects of Bogotá’s Bus Rapid System Using Spatial Hedonic Price Models”, Department of City and Regional Planning, University of North Carolina at Chapel Hill, 2003

Accesibilidad
• Every 100 meters from a station results in 3.71% reduction in rent. Price elasticity of accessibility is -0.31.

Proximity
• If distance from the corridor increases in 100 meters, rent increases 7.0% for residential use. Price elasticity of proximity is 0.44.

Suggests preferential commercial or institutional use on the corridor.
## Land Values Comparison 2001-2002

**LONJA DE PROPIEDAD RAIZ DE BOGOTA**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>No. OF ZONES</th>
<th>PARTICIPATION</th>
<th>REAL CHANGE IN PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL STUDY</td>
<td>98</td>
<td>100,00%</td>
<td>-3,17%</td>
</tr>
<tr>
<td>ZONES WITH REAL PRICE INCREASE</td>
<td>28</td>
<td>28,57%</td>
<td>100,00%</td>
</tr>
<tr>
<td>ZONES WITH REAL PRICE INCREASE THAT ARE WITHIN 1 KM OF TRANSMILENIO</td>
<td>15</td>
<td>15.31%</td>
<td>53.57%</td>
</tr>
</tbody>
</table>
ZONAS WITH REAL PRICE INCREASE (2001-2002) WITHIN 1 KM. OF TRANSMILENIO

<table>
<thead>
<tr>
<th>NUMERO</th>
<th>NOMBRE</th>
<th>GRUPO</th>
<th>TASA REAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AVENIDA JIMENEZ</td>
<td>COMERCIALES Y DE SERVICIO CENTRO</td>
<td>1.60%</td>
</tr>
<tr>
<td>28</td>
<td>ZONA ROSA</td>
<td>COMERCIALES Y DE SERVICIO NORTE</td>
<td>1.60%</td>
</tr>
<tr>
<td>29A</td>
<td>PARQUE DE LA 93</td>
<td>COMERCIALES Y DE SERVICIO NORTE</td>
<td>2.54%</td>
</tr>
<tr>
<td>40</td>
<td>TOBERIN</td>
<td>INDUSTRIAL</td>
<td>1.08%</td>
</tr>
<tr>
<td>52</td>
<td>LA CABRERA</td>
<td>ZONA RESIDENCIAL DE ESTRATO ALTO</td>
<td>1.08%</td>
</tr>
<tr>
<td>53</td>
<td>NOGAL RETIRO</td>
<td>ZONA RESIDENCIAL DE ESTRATO ALTO</td>
<td>8.49%</td>
</tr>
<tr>
<td>61</td>
<td>SANTA BIBIANA-SAN PATRICIO-NAVARRA</td>
<td>ZONA RESIDENCIAL DE ESTRATO ALTO</td>
<td>5.12%</td>
</tr>
<tr>
<td>62</td>
<td>SANTA BARBARA OCCIDENTAL</td>
<td>ZONA RESIDENCIAL DE ESTRATO ALTO</td>
<td>4.05%</td>
</tr>
<tr>
<td>63</td>
<td>CALLEJA BAJA</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-ALTO</td>
<td>1.08%</td>
</tr>
<tr>
<td>66</td>
<td>CHAPINERO ALTO</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-ALTO</td>
<td>2.20%</td>
</tr>
<tr>
<td>69</td>
<td>PUENTE LARGO - PASADENA</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-ALTO</td>
<td>1.42%</td>
</tr>
<tr>
<td>71</td>
<td>NUEVA AUTOPISTA-CONTADOR-LAS MARGARITAS</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-ALTO</td>
<td>1.42%</td>
</tr>
<tr>
<td>74</td>
<td>LOS CEDRITOS</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-MEDIO</td>
<td>1.99%</td>
</tr>
<tr>
<td>82</td>
<td>ESPAÑOLA-QUIRIGUA-BACHUE</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-BAJO</td>
<td>5.66%</td>
</tr>
<tr>
<td>86</td>
<td>LA CANDELARIA</td>
<td>ZONA RESIDENCIAL DE ESTRATO MEDIO-BAJO</td>
<td>3.77%</td>
</tr>
</tbody>
</table>

TASA REAL PROMEDIO: 2.87%

Fuente: Lonja de Propiedad Raíz de Bogotá
ZONAS WITH REAL PRICE INCREASE (2001-2002) WITHIN 1 KM OF TRANSMILENIO

Fuente: Lonja de Propiedad Raíz de Bogotá
Air Quality (Citywide)

Average Annual Concentrations

Source: Environment Department; Air Quality Network
But there still is a long way to go...

Particules

Max 24 Hours PM-10 u/m3

Source: Environment Department; Air Quality Network 2002

Ozone

Max 8 Hours Ozono ppb

Source: Environment Department; Air Quality Network 2002
But there is still a long way to go...

Carrera 10a Calle 19, 2004
BRT Expansion is necessary...

Roads with large concentration of traditional public transport:

- Carrera 10
- Carrera 7
- Carrera 13
- Av. Boyacá
- Av. Carrera 68
- Calle 26 Av. 1o de Mayo
- Av. 3a
- Av. Cali
- Av. Calle 68
Contents

• Sustainable Transport Strategies

• Current Conditions in Bogotá

• Opportunities
Lessons

- Environmental and urban effects are important; they should be incorporated in planning and funding BRT systems.
- BRT is just one component of the overall city strategy to improve mobility, environment and urban conditions.
- The largest urban impact is in improving the equilibrium of the urban area.
- Accessibility impacts are larger for the poorest population (feeder services in low income areas and integrated fare).
- Effects include time and cost savings and reductions in accidents and pollution, but also in pride and belonging sentiment as well as cultural changes.
Opportunities

- Use BRT to generate urban renewal and densification
  - Land Use Plan
  - Interventions (Public, Private, Mixed)
  - Improving and generating public space and integration with NMT (safe bike parking)
  - Regional transport integration
- Introduce value capture mechanisms to redistribute land rent increases
- Introduce joint development (without affecting the main activity of moving people)
¡MUCHAS GRACIAS!