Towards Low Carbon Cities:
Understanding and analyzing urban energy and carbon
February 17-18, 2009, Nagoya

Urban Land Use/Transport Policy, Metro and Its Impacts in Shanghai

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1. Introduction

- Total area of 6,340.5 km²

Population of around:
- 17 million (2003)
- 18.6 million (2007)

18 Districts and one County
Economic Development

- In 2007, GDP reached 1219 billion RMB, with an average annual growth rate of >10 percent for more than ten years in succession; and per capita GDP stood at US$10K
Fast Urban Expansion

Floor Space Area
(million sq.m)

Residential Floor Space Area
**Motorized Trip**

Trips (10000/day)

- 1995: 2380
- 2004: 4100

**Motorized Trips/Day**

Motorized Vehicle Trip (10000/day)

- 1995: 150
- 2004: 500

**Total Trips/Day**

- 1995: 150
- 2004: 500
Travel Distance

Average Travel Distance

1995: 4 km/trip
2004: 7km/trip
Delayed Motorization

Private Car (1K)

- Beijing
- Shanghai

Modal Split

Private Car:
- 80’s: 3%
- 90’s: 8%
- 00’s: 16%

Still High Share of NMV
Lower Private Car Share
2. Urban Transport Policy

Control for Private Car in Ownership and Parking

Car Ownership Control from 1994

Plate Auction from 2001, Cost: USD4000~7000, 5000~8000 plates/month
Reduced the 1 million car
Revenue collected: USD1.35 Billion
41% for middle ring
38% for metro

Delay the fast increasing in car ownership, 15% of plate of other city’s plate but used in Shanghai
## Parking Control at the Destination End

<table>
<thead>
<tr>
<th>Area</th>
<th>Daytime</th>
<th>Night yuan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>first hour yuan/h</td>
<td>extra half hour yuan</td>
</tr>
<tr>
<td>Key area</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>other in inner ring</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>between inner/outer ring</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>
Public Transport Encouragement

Extend Bus Service from City to Suburban
High Quality Taxi Service
Large Scale Metro Construction
Transfer discount, Bus/Bus, Bus/Metro

<table>
<thead>
<tr>
<th></th>
<th>80</th>
<th>90</th>
<th>07</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bus Routes</strong></td>
<td>270</td>
<td>500</td>
<td>991</td>
</tr>
<tr>
<td><strong>Metro Lines (Km)</strong></td>
<td>0</td>
<td>16.2</td>
<td>234</td>
</tr>
<tr>
<td><strong>Taxi (K)</strong></td>
<td>2</td>
<td>370</td>
<td>480</td>
</tr>
</tbody>
</table>
Limitation on Motorcycle, Providing Space for Bike/e-Bike/Gas-Bike

Electric bicycle

From 2001 to 2004 Electric bicycle 40 times increase
### 3. Land Use Control

<table>
<thead>
<tr>
<th>Scope</th>
<th>Area (Km²)</th>
<th>Population (10^3)</th>
<th>Density (10^3 Person /Km²)</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Wide</td>
<td>6340</td>
<td>17780</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Central City</td>
<td>660</td>
<td>11430</td>
<td>17.3</td>
<td>Outer Ring</td>
</tr>
<tr>
<td>City Core</td>
<td>108</td>
<td>4080</td>
<td>37.8</td>
<td>Inner Ring</td>
</tr>
</tbody>
</table>
Mixture of Land Use

Urban Form Characteristics in the Land Use Configurations and Street Network
Sample Modal Shares in Four Selected Neighborhoods

<table>
<thead>
<tr>
<th>Mode</th>
<th>Kang Jian</th>
<th></th>
<th>Lu Wan</th>
<th></th>
<th>Zhong Yuan</th>
<th></th>
<th>Ba Bai Ban</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Counts</td>
<td>%</td>
<td>Counts</td>
<td>%</td>
<td>Counts</td>
<td>%</td>
<td>Counts</td>
<td>%</td>
</tr>
<tr>
<td>Non-Motorized</td>
<td>166</td>
<td>36.97</td>
<td>399</td>
<td>71.51</td>
<td>344</td>
<td>53.17</td>
<td>69</td>
<td>42.33</td>
</tr>
<tr>
<td>Transit</td>
<td>225</td>
<td>50.11</td>
<td>121</td>
<td>21.68</td>
<td>265</td>
<td>40.96</td>
<td>74</td>
<td>45.40</td>
</tr>
<tr>
<td>Driving</td>
<td>58</td>
<td>12.92</td>
<td>38</td>
<td>6.81</td>
<td>38</td>
<td>5.87</td>
<td>20</td>
<td>12.27</td>
</tr>
<tr>
<td>Total</td>
<td>449</td>
<td>100</td>
<td>558</td>
<td>100</td>
<td>647</td>
<td>100</td>
<td>163</td>
<td>100</td>
</tr>
</tbody>
</table>

Non-Motorized Modes: Walk, Bicycle, E-Bike

Transit: Bus, Metro

Driving: Motocycle, Taxi, Car
## Multiple Logistic Regression of Travel Mode Choice

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. The odds of choosing transit as compared to walk or bike</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trip Time</td>
<td>1.068</td>
<td>0.029</td>
<td>0.004</td>
<td>17.40</td>
</tr>
<tr>
<td>Personal Monthly Income (CNY)</td>
<td>1.156</td>
<td>0.063</td>
<td>0.070</td>
<td>2.39</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.813</td>
<td>-0.090</td>
<td>0.035</td>
<td>-4.76</td>
</tr>
<tr>
<td>Gender (female=1)</td>
<td>1.205</td>
<td>0.081</td>
<td>0.148</td>
<td>1.52</td>
</tr>
<tr>
<td>H.H. Size (# of persons)</td>
<td>0.872</td>
<td>-0.059</td>
<td>0.058</td>
<td>-2.04</td>
</tr>
<tr>
<td># of Car in H.H.</td>
<td>0.828</td>
<td>-0.082</td>
<td>0.223</td>
<td>-0.70</td>
</tr>
<tr>
<td>Home in Lu Wan</td>
<td>0.471</td>
<td>-0.327</td>
<td>0.067</td>
<td>-5.33</td>
</tr>
</tbody>
</table>
Emphasize the idea of neighborhood unit, strictly regulate to provide residential area with all kinds of public service facilities

<table>
<thead>
<tr>
<th>Residential District</th>
<th>Building Area</th>
<th>Land Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1668-3293</td>
<td>2172-5559</td>
</tr>
<tr>
<td></td>
<td>2228-4213</td>
<td>2762-6329</td>
</tr>
<tr>
<td>Education</td>
<td>600-1200</td>
<td>1000-2400</td>
</tr>
<tr>
<td>Hospital</td>
<td>78-198</td>
<td>138-378</td>
</tr>
<tr>
<td></td>
<td>178-398</td>
<td>298-548</td>
</tr>
<tr>
<td>Culture and Entertainment</td>
<td>125-245</td>
<td>225-645</td>
</tr>
<tr>
<td>Commercial</td>
<td>708-910</td>
<td>600-940</td>
</tr>
<tr>
<td>Community Service</td>
<td>59-464</td>
<td>76-668</td>
</tr>
<tr>
<td>Financial</td>
<td>20-30</td>
<td>25-50</td>
</tr>
<tr>
<td></td>
<td>60-80</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>40-150</td>
<td>70-360</td>
</tr>
<tr>
<td></td>
<td>460-820</td>
<td>500-960</td>
</tr>
<tr>
<td>Administration</td>
<td>46-96</td>
<td>37-72</td>
</tr>
</tbody>
</table>
4. Metro and its Impact on Land Use
**Land Development Intensity**

L1: High Proportion of High Density, L3: High Proportion of Low Density
Intensity Gradient

- L-1
- L-2
- L-3

Inner Buffer vs. Outer Buffer
# Trip Modes

<table>
<thead>
<tr>
<th>Trip Modes</th>
<th>Walk</th>
<th>Bicycle</th>
<th>Powered Bicycle</th>
<th>Motorcycle</th>
<th>Bus</th>
<th>Car</th>
<th>Metro</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Metro Opening</td>
<td>11.45%</td>
<td>14.48%</td>
<td>4.04%</td>
<td>1.68%</td>
<td>63.30%</td>
<td>2.36%</td>
<td>0</td>
<td>2.70%</td>
</tr>
<tr>
<td>Current</td>
<td>9.42%</td>
<td>14.86%</td>
<td>3.26%</td>
<td>0.36%</td>
<td>17.39%</td>
<td>1.45%</td>
<td>52.90%</td>
<td>0.36%</td>
</tr>
</tbody>
</table>

Big shift from bus to metro.

Less passenger in 2000 due to:

- fare too high.
- not direct link to destinations
- inconvenient for transfers
Housing Price

Data

Building:

The property price from <Shanghai real estate>

The size of the residential area

Plot ratio

Green area ratio

Urban amenity:

School

Hospital

Shopping mall

Sports facility

Park
The radius of influence area

Widely cited and applied in contemporary urban planning practice:

Over investment to increase the density of the networks

Less serviced in the area away from the metro station, more tend to use car

We have

Widely using of Bike(e-bike)

Bus networks

The typical TOD model within 500 meter radius around metro station
Connecting in far end of metro is very important
Multi-Mode Connecting Transport

Improving the Multi-Mode Connecting Transport, Extend large Service Coverage Area

Low Coverage, Low Service

High Coverage, High Cost

High Coverage, Less Cost with Connecting Transport
Bus only Provide Good Connecting along the Major Bus Route
Bike Still has an Import Role to Play
5. Conclusion:

1. Urban Transport Policy with Land Use Control does Contribute to Delay Motorization in Shanghai

2. Keep the High Share of NMV in Shanghai is Very Important to Reduce Motorized Travel by Urban Design or Facility Provision

3. Metro is very Crucial in Shaping Shanghai Sustainable Urban Spatial Structure with Multi-Mode Connecting Transport
Thanks!

Question?