Taking the Subway to Copenhagen - How Transit is Essential to Global GHG Reduction

Presentation Railvolution 2009

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www.mta.info/sustainability
Energy Consumption & Sustainability: Macroview
Energy Consumption by Sector, 2005

India

- Residential: 56%
- Agriculture: 26%
- Transportation: 12%
- Industry: 3%
- Commercial: 3%
- Other: 2%

China

- Residential: 38%
- Transportation: 40%
- Industry: 4%
- Commercial: 4%
- Other: 4%

Germany

- Residential: 29%
- Transportation: 27%
- Industry: 30%
- Commercial: 10%
- Other: 1%

USA

- Residential: 40%
- Transportation: 30%
- Industry: 17%
- Commercial: 12%
- Other: 26%

Source: World Resources Institute
Total Energy Consumption per Capita, 2005

USA: 340 MBTUs
Germany: 178 MBTUs
China: 31 MBTUs
India: 14 MBTUs

Source: Energy Information Administration
Total Energy Consumption per Capita by State, 2005

- California: 232 MBTUs
- Texas: 574 MBTUs
- New York: 217 MBTUs
- NYC: 88.5 MBTUs

Source: Energy Information Administration
Total Carbon Dioxide Emissions per Capita, 2002
Global Carbon Dioxide Emissions per Capita, 1990–2004

Source: US Department of Energy Carbon Dioxide Information Analysis Center (CDIAC)
Energy Consumption & Sustainability: Microview
# Energy Use: High-Rise vs. Low-Rise Development

<table>
<thead>
<tr>
<th></th>
<th>High-Rise</th>
<th>Low-Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of buildings</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Average floor size</td>
<td>30,612 sf</td>
<td>36,000 sf</td>
</tr>
<tr>
<td>Area of roof</td>
<td>88,000 sf</td>
<td>375,000 sf</td>
</tr>
<tr>
<td>Area of ext wall</td>
<td>343,000 sf</td>
<td>385,000 sf</td>
</tr>
<tr>
<td>Area of parking</td>
<td>0 sf</td>
<td>1,837,500 sf</td>
</tr>
</tbody>
</table>
Energy Consumption:
Low-Rise Office Park vs. Tall Urban Building
Energy Use: High-Rise vs. Low-Rise Development

Commute: 210,000 BTU/sqft-yr
- 30 mi. round trip
- Private Car, 15 mpg, 1 passenger
- 300 sq.ft. per person, 252 days per year

Commute: 41,000 BTU/sqft-yr
- 30 mi. round trip
- Diesel Bus, 4 mpg, 20 passengers
- 300 sq.ft. per person, 252 days per year
GHG Per Person: Kg CO2E (Carbon dioxide equivalent) / Year

- High Density
  - Transit - Oriented
  - Building Operations
  - Materials
  - Transportation
- Low Density
  - Auto - Oriented

Source: Journal of Urban Planning and Development, Norman, March 2006
Relative GHG Emissions

GHG Emissions of Transportation Options

- SUV (solo driver)
- Car (solo driver)
- Airplane*
- Transit Bus (1/4 full)
- Prius (solo driver)
- Amtrak
- Rail Transit (25 riders/car)
- Carpool (3 occupants)
- Vanpool (6 occupants)
- Transit Bus (3/4 full)
- Rail Transit (50 riders/car)
- Intercity bus
- Walk/bike
- Additional traveller: transit, carpool, vanpool

Pounds Co2 (or equivalents per passenger mile)

0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6

Sightline Institute (http://www.sightline.org/maps/charts/climate-CO2byMode)
The Choice
Transit GHG Emissions Typology

Emissions Produced by Transit

- Emissions from Transit
  - Tailpipe emissions from transit vehicles
  - Electricity use for traction
  - Maintenance yards, offices and other stationary sources

Emissions Displaced by Transit

- Avoided Car Trips
  - Mode shift from private autos

- Land-Use Multiplier
  - Compact land-use -> shorter trips, more walk/bike trips
    - Trip chaining
    - Lower car ownership

- Congestion Relief
  - Improved fuel efficiency from reduced congestion

Greenhouse Gas Impacts of Transit

Debit

Credit
MTA GHG Emissions, 2007

Total: 2.7 million metric tons

Transit Effect Multiplier = 8.24
For every unit of GHG that the MTA emits
It helps avoid 8.24 units
In the net it helps avoid about 20 million metric tonnes
Currently un-recognized and un-compensated
Energy/Carbon Facilities Smart Growth/TOD Materials Flow Water Management Climate Adaptation

Metro Transportation Authority State of New York

Greening the MTA
Greening Mass Transit & Metro Regions: The Final Report of the Blue Ribbon Commission on Sustainability and the MTA
• 80% Renewable Energy by 2050
• Revenue from carbon avoidance
• Reduce energy use and GHG emissions on a per passenger-mile basis by 25% by 2019
• Build all new projects and major renovations to LEED Silver standard
• Recommission existing buildings to meet LEED Silver standard
• Create LEED-based MTA Green Guidelines for other building types
Energy Saving through Alignment Design: Humped Tracks
Vegetated, green roofs (MNR Harmond Yard, MTA Bus Far Rockaway Depot, B&T Queens Midtown Tunnel) and white roofs (LIRR Hillside)
• Adopt Life Cycle Accounting
• Quantify and track materials flow
• Green the procurement and budget process
• Flex market power in purchasing
<table>
<thead>
<tr>
<th>Summary of Lightweighting Technologies</th>
<th>Mass Impact (kg)</th>
<th>Fleet-wide Annual Electrical Demand Impact (kWh)</th>
<th>Cost Per 10 Car Train ($k)</th>
<th>Payback Period (Years)</th>
<th>Technology Maturity</th>
<th>Ease of Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Free Axle on 1 non-motorized truck replacing OSMES (speed measurement)</td>
<td>3636</td>
<td>3,708,720</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Floor pans stamped on R160 (540lbs) vs. fabricated on R143 design (600lbs)</td>
<td>282</td>
<td>1,036,611</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Eliminate OSMES, brackets and equipment</td>
<td>327</td>
<td>763,996</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Eliminate flip up seats</td>
<td>164</td>
<td>409,268</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Eliminate unnecessary structural redundancy: secondary center collision posts (2 per A-car)</td>
<td>327</td>
<td>333,785</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Eliminate 1 of 2 coupler adapters on all NMTs units</td>
<td>200</td>
<td>254,908</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Advertisement card clips – changed from metal to plastic</td>
<td>45</td>
<td>53,631</td>
<td>0</td>
<td>0</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Investigate using Giga Cell Battery with alternative battery box</td>
<td>1658</td>
<td>7,514,129</td>
<td>4.5</td>
<td>0</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Idea</td>
<td>Rating</td>
<td>Weight (lbs)</td>
<td>Savings</td>
<td>Weight</td>
<td>Rating</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
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<td>Investigate using Giga Cell Battery with alternative battery box</td>
<td>4.5</td>
<td>7,514,129</td>
<td>0</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>&quot;Utilize single draft gear (tube style) link bar (used at B-Car link bar interfaces only) &quot;</td>
<td>1.5</td>
<td>3,988,605</td>
<td>2</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>Corrugated Wheels / Lightweight Wheels</td>
<td>5</td>
<td>4,491,430</td>
<td>6.4</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>Composite instead of plymetal panel flooring</td>
<td>15</td>
<td>12,546,309</td>
<td>7</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>Reduction in heater grill weight</td>
<td>0.5</td>
<td>77,374</td>
<td>36</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>Reduce number and load on air compressor – Utilize Oilless Compressor concepts</td>
<td>12.5</td>
<td>2,018,598</td>
<td>37</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
</tr>
<tr>
<td>Redesign of trip cock linkage – (reduce weight from 53 lbs/truck on R142A/R143 design)</td>
<td>0.5</td>
<td>263,925</td>
<td>38</td>
<td><img src="Images/HighlyRated.png" alt="Highly Rated" /></td>
<td><img src="Images/LowRated.png" alt="Low Rated" /></td>
<td></td>
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| ![Highly Rated](Images/HighlyRated.png) | ![Low Rated](Images/LowRated.png) |

**Materials Flow: Smart Fleets**

**MTA Metropolitan Transportation Authority**
State of New York
Energy Savings through Material Innovations: Al Third Rail
Is Transit for Everywhere? Cincinnati’s Close Brush
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Is Transit for Everywhere? Cincinnati’s Close Brush
Is Transit for Everywhere? What happened in NYC
Is Transit for Everywhere? What happened in NYC

[Graph showing population changes in Manhattan, Brooklyn, The Bronx, and Queens from 1900 to 2008]

Metropolitan Transportation Authority
State of New York
Is Transit for Everywhere? What happened in NYC
Is Transit for Everywhere? What happened in NYC
Conclusions

As societies develop/industrialize, their energy needs rise.

Transportation emerges as a major consumer of energy.

Automobile-based paradigm with corollary suburban sprawl is wasteful and unsustainable.

It negates the good effects of “green” building methods and technologies.

Sustainable urban growth has to embrace mass-transit and support density.

Designing the right carbon-constrained system can make this happen.
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