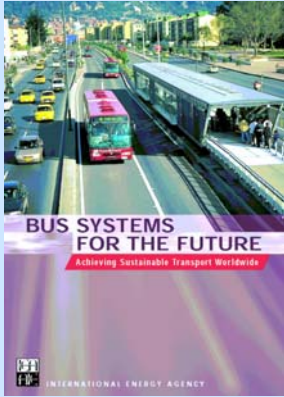


Bus Systems for the Future



Low Fulton
International Energy Agency
Paris

Presentation at
Environment 2005
Conference,
Abu Dhabi
31 January 2005

www.iea.org



Two years since our book...

- What's been happening?
- BRT systems are now being constructed in dozens of cities around the world
- Prominent examples include:
 - Curitiba, Brazil
 - Bogota, Colombia
 - Quito, Ecuador
 - Delhi, India
 - Jakarta, Indonesia
 - Beijing, China
 - Seoul, Korea



Seoul, South Korea

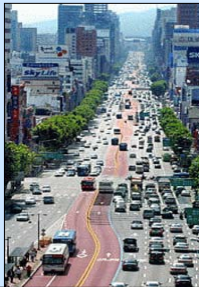


Before...



Using BRT to free up public space,
provide an alternative to private vehicle
usage, and reduce emissions

(courtesy Lloyd Wright)



What is Bus Rapid Transit?

- Taking bus transit systems to a new level...
 - Exclusive right of way lanes
 - Rapid boarding and alighting
 - Free transfers between lines
 - Pre-board fare collection and fare verification
 - Enclosed stations that are safe and comfortable
 - Clear route maps, signage, and real-time information displays
 - Modal integration at stations and terminals
 - Clean vehicle technologies
 - Excellence in marketing and customer service



Complementarity Measures: Bogota as an Example

- Nearly 300 kilometres of new, high-quality cycle ways
- Reclamation of public space by improving sidewalks and plazas
- “Ciclovía” Sundays in which 120 kilometres of roadways are closed to motorised traffic
- World’s largest annual car-free day during a week day, covering the entire city
- World’s longest pedestrian corridor, with a length of 17 kilometres
- Elimination of most on-street parking.



An important aspect: Reforming licensing and regulation

- Need competition - but at route level, not bus level
- Minimum standard for route service (frequency, bus stops)
- Variety of management approaches emerging - should consider what may work in different cities
- Drivers probably should be employed, on salary
- Setting fares is important but delicate process
- Rationalize paratransit services to become feeder services to major bus routes

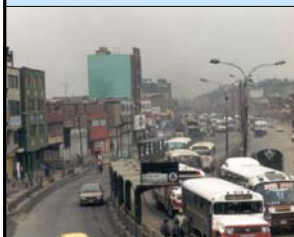


BRT “Lite” Problems

- Poor location of bus routes
- Bus “headways” too long
- Neglecting fast boarding, alighting approaches
- Inadequate infrastructure to ensure flow, speeds
- Allowing too many vehicle types into busways
- Lack of system integration (e.g. creating feeder services)
- Poor licensing, regulatory approach



Busway-only solutions



Bogotá before TransMilenio



Lima, Peru



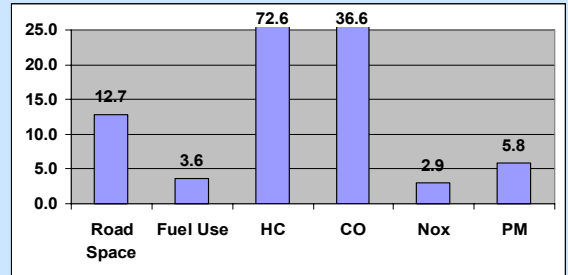


One bus can carry many car-equivalents of passengers...



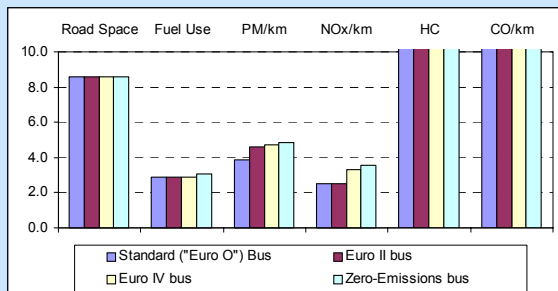
An IEA Scenario Analysis for Delhi: Impacts of adding a "conventional" diesel bus

(reductions as a multiple of one "standard" diesel bus)



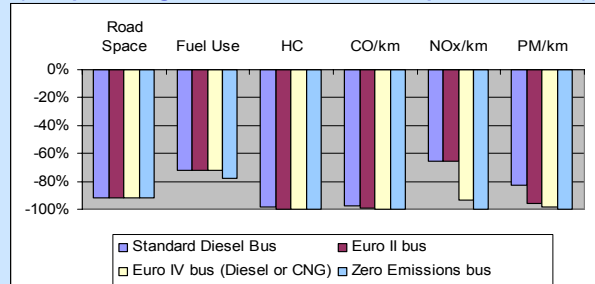
Impacts of adding a bus: comparison of four bus technology types

(as a multiple of one standard diesel bus)

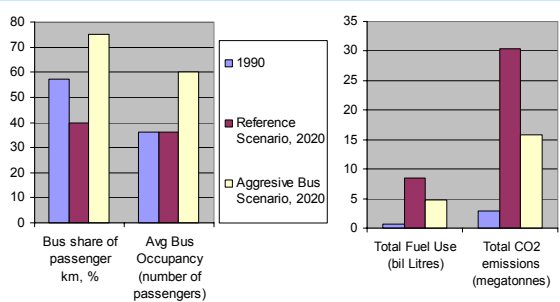


Impacts of adding a bus: comparison of four bus technology types

(as a pct change relative to total from displaced vehicles)



Oil Use and CO₂ Emissions: Two Future Visions



Source: IEA, based on Bose and Sperling, 2001



What about costs?

- Very difficult to estimate the net cost effectiveness of BRT, since:
 - Need to account for avoided costs of other travel modes
 - Need to account for impacts on consumer welfare (“hedonic” aspects)
 - Need to account for secondary economic impacts (e.g. land use, urban economy)



Busway Development Costs are Low

\$ Millions per kilometer of Infrastructure

	Low	High
At grade busways	1	8
Elevated busways	10	15
Light Rail	10	30
Metros	30	180

Source: Menckhoff, 2002

Bogota's 32 km Transmilenio System cost \$250 million, including \$80 million for 470 new articulated buses



How can we pay for technology improvements? Indicative bus economics

	South Asia Current	South Asia Improved	OECD Current
Fare (\$ / boarding)	\$0.10	\$0.10	\$1.00
Average number of riders	40	60	25
Average boardings / km	10	15	5
Average speed km / hr	8	16	16
Distance km / day	150	300	300
Daily revenues per bus	\$150	\$450	\$1,500
Annual revenues per bus	\$54 000	\$162 000	\$540 000



But some simple estimates... First, bus technology/fuel switching

Tech/fuel	WTW GHG reduction	Incremental cost per vehicle (including infrastructure)	Operating Costs	Fuel Costs	Estimated cost per tonne CO2
CNG	10%	\$30k	equal	equal	\$696
CNG	30%	\$30k	equal	equal	\$232
CNG	30%	\$30k	equal	25% lower	\$37
CNG	30%	\$20k	equal	25% lower	\$0
Fuel Cell	30%	\$1000k	equal	50% higher	\$6,667
Fuel Cell	30%	\$300k	equal	50% higher	\$2,000
Fuel Cell	90%	\$100k	equal	50% higher	\$160

These scenarios assume fuel costs counted over 750k km of bus travel



Conclusions

- BRT can:
 - Provide high-quality, relatively low cost mass transit
 - Retain or increase transit mode shares
 - Reduce roadway requirements for private vehicles
 - Provide substantial revenues to help pay for technology and other improvements
- But we need to study this more carefully:
 - How can high performance be achieved?
 - Mode switching behaviour studies are needed
 - Cost-benefit from BRT development
 - Can BRT be successfully transferred to other regions?

