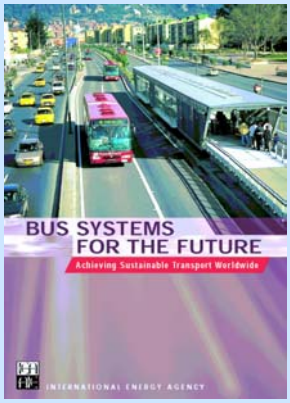
Bus Systems for the Future



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International Energy Agency
Paris

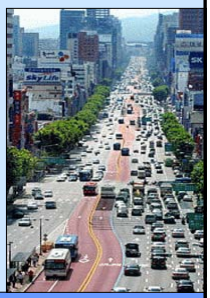
Presentation at Environment 2005 Conference, Abu Dhabi 31 January 2005

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



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

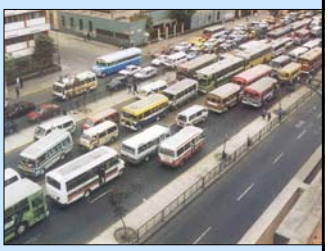
- Need competition - but at route level, not bus level
- Minimum standard for route service (frequency, bus stops)
- Variety of management approaches emerging - should consider what may work in different cities
- Drivers probably should be employed, on salary
- Setting fares is important but delicate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

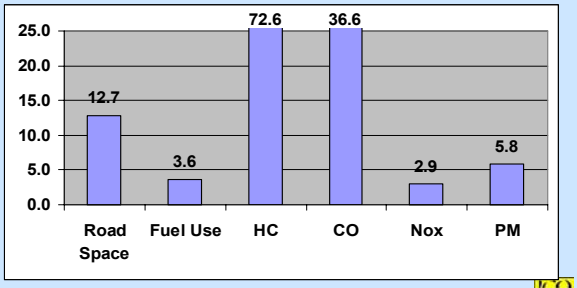


Lima, Peru

One bus can carry many car-equivalents of passengers…

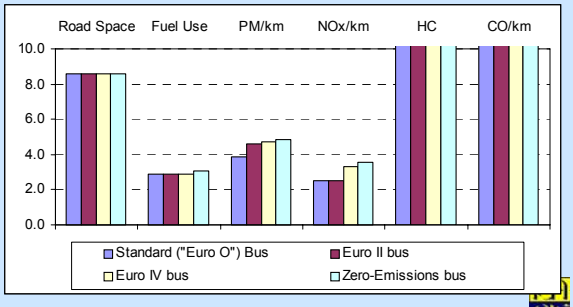
An IEA Scenario Analysis for Delhi: Impacts of adding a "conventional" diesel bus

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



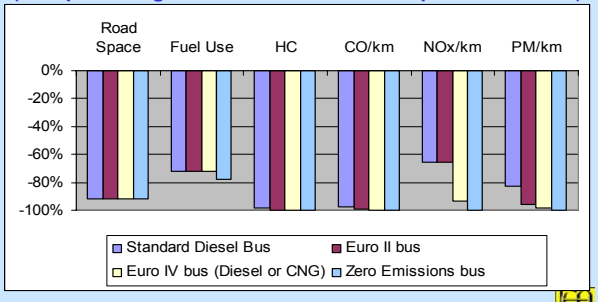
Impacts of adding a bus: comparison of four bus technology types

(as a multiple of one standard diesel bus)

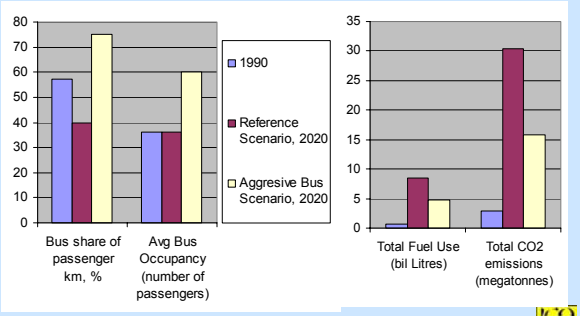


Impacts of adding a bus: comparison of four bus technology types

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



Oil Use and CO_2 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?