



# **BRT for sustainable cities**

Persontrafik 2010-10-27

Peter Danielsson

Manager BRT

# What defines an efficient transport system?

## **Passengers**

- ✓ Affordable
- ✓ Frequent
- ✓ Short travel time
- ✓ Comfortable
- ✓ Secure

## **Authority**

- ✓ Moderate investment
- ✓ Reduces congestion
- ✓ Environmental friendly
- ✓ Supports city development
- ✓ Step-wise implementation

## **Operator**

- ✓ Low operating costs
- ✓ Efficient vehicle use
- ✓ Adapted to travel demand
- ✓ Reliable vehicle - uptime
- ✓ Systems productivity

*Stake holders'  
key interests*

# System Approach



## *Attractiveness*

- ✓ *Network*
- ✓ *Speed*
- ✓ *Frequency*

## *Environment*

- ✓ *Energy efficiency*
- ✓ *Emissions*
- ✓ *Modal integration*

## *Self finance capabilities*

- ✓ *Revenues*
- ✓ *Operational costs*

# BRT Elements



- High capacity buses
- Exclusive bus ways
- Level boarding

• Off-board ticketing

• Priority at intersections

• Passenger information

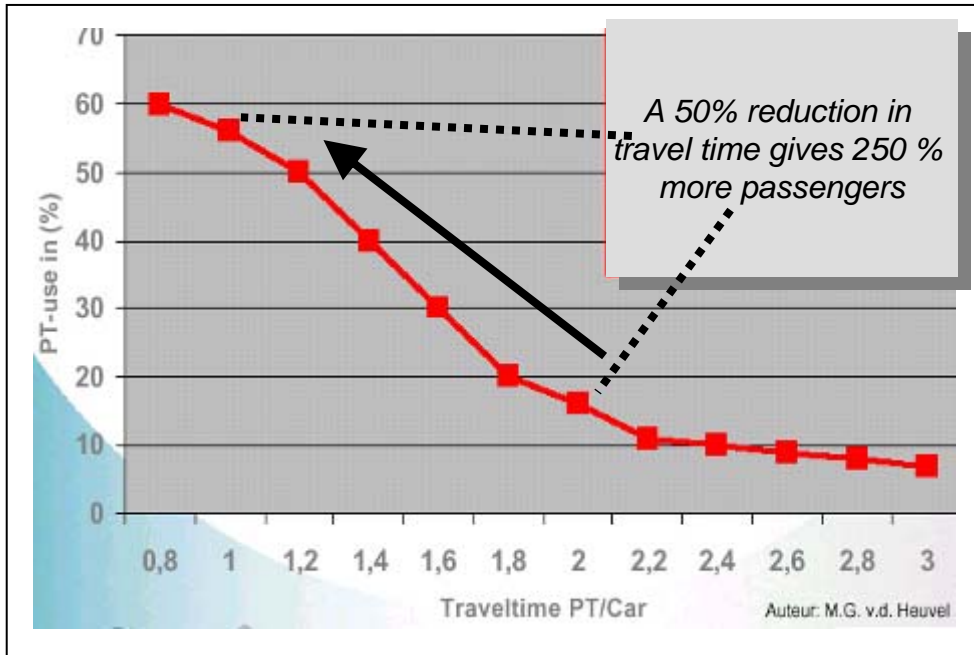
• Traffic control



**Volvo Buses**  
Peter Danielsson

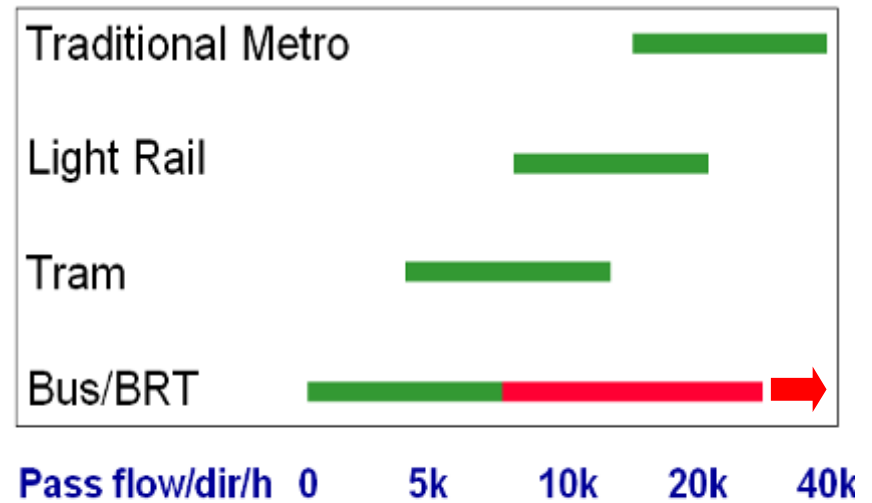


# BRT is competitive to LRT



*Relationship travel time & passenger acceptance*

## BRT competitive to Rail



— traditional  
— with BRT

*Relationship transport type & capacity*



# BRT – Minor Investment

For 1€billion you get:

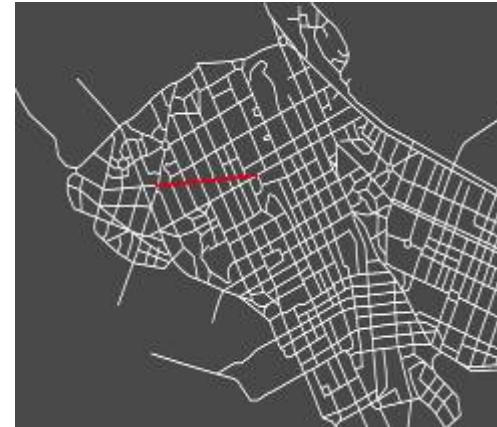
**400 km of BRT**



**50 km of LRT**



**10 km of Metro**



	BRT	LRT
Investment in infrastructure per km	1–5M€	10–30M€
Investment in vehicles per pass. capacity	2,000€	6,000€
Capacity (1,000 pass./h)	10–20	10–20
Average speed (km/h)	20–30	20–30
Relative investment per capacity	1	4-10
Completion of one line (year)	1–2	2–3
Operational costs	Low-medium	medium-high
Flexibility	high	low



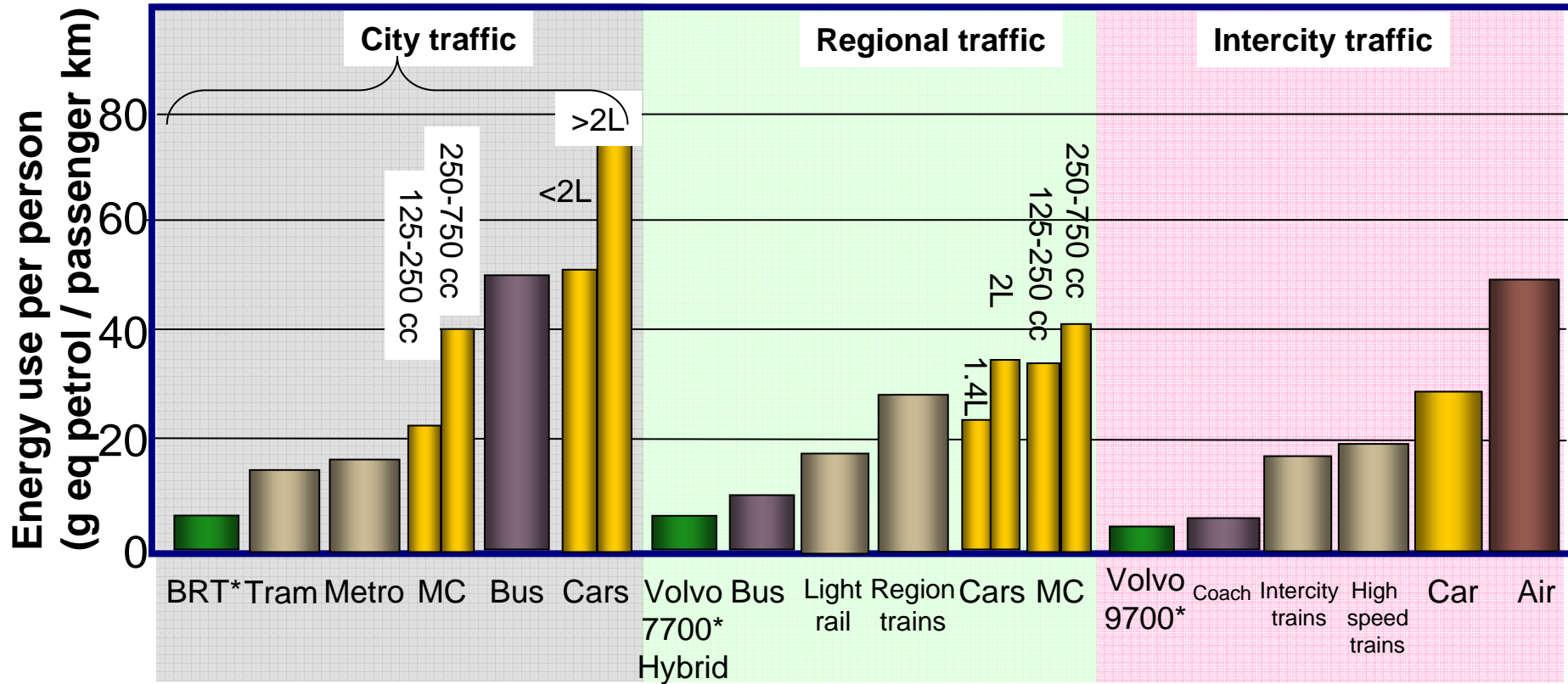
**Volvo Buses**

Peter Danielsson

7 Date



# Energy use, person transports French fleet study by ADEME



Source: ADEME, <http://www2.ademe.fr/servlet/getDoc?cid=96&m=3&id=51911&p1=00&p2=12&ref=17597>

\* Volvo data on BRT and hybrid performance related to respective traffic conditions



# Mexico City – Success of BRT

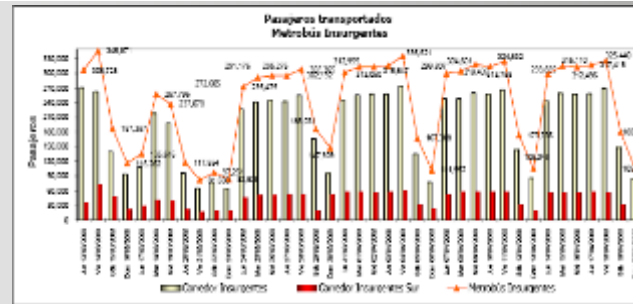
## BRT corridor Insurgentes

- 125 articulated buses
- Total 28 km
- 45 stations



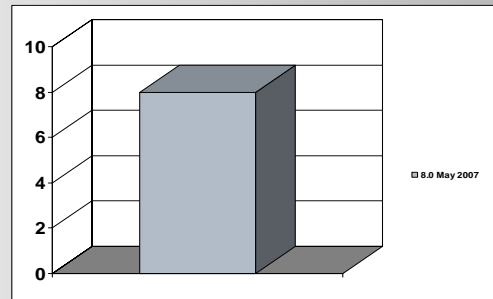
## Increased passenger demand

- Average 315,000 - all Insurgentes
- Headway < 1 min in peak hours
- 9,000 passenger/hour/direction
- Increasing capacity – BiArtic (25.2 m)



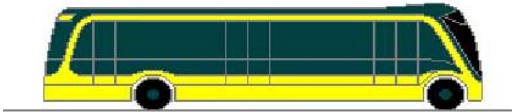




## Passenger satisfaction

- Overall satisfaction 8.0 (10)
  - Frequent & rapid
  - Safety & security



# How to transport 10.000 persons 1 km

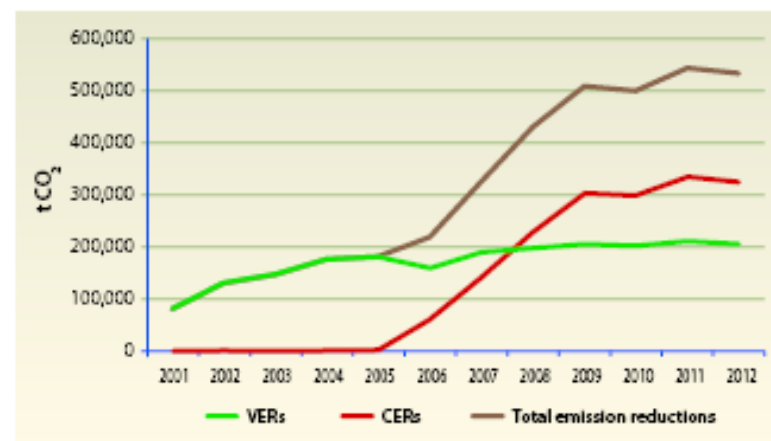
	Passengers (numbers)	Vehicles (numbers)	Space (m <sup>2</sup> )	Fuel (liters)
	5	2000	24000	200
	25	400	8800	120
	100	100	3400	50
	175	57	2850	35
	270	37	2370	26

# Clean Development Mechanism – CO2 reductions with BRT

- *Projects in developing countries can sell emission reductions to countries with reduction commitments (Annex I)*
- *UNFCCC is regulating the market*
- *Certified Emission Reductions (CER) calculated for projects*
- *Methodology developed for BRT projects (AM0031)*
- *Reductions of app. 500.000 Mt/year for Transmilenio (phase I and II)*
- *Carbon credits value estimated to \$ 30 M until 2012, and €130-350 M from 2012-2026*



*Projected baseline, project and leakage emissions of the CDM project TransMilenio.*  
Source: Grütter based on POD



# Environment opportunities



- Fuels with lower CO2 load like biogas and biodiesel
- Second generation bio fuels based on gasification offers large fuel potential
- Diesel electric propulsion with battery storage provides up to 30 % fuel savings today
- Plug-in hybrid buses mid term (can use renewable electricity)
- Battery buses longer term solution

# Characteristics of the Trunk Bus Line 16 in Gothenburg

1. Part of an easy informed system
2. 3 minute headway in peak hours (10 min off peak)
3. High accessibility in roads and junctions
4. Fewer stops
5. Boarding through all doors
6. Smart card ticketing
7. Highest standard of bus stops
8. Real time information on stops
9. Low floor Bi-articulated buses
10. Good environmental technology

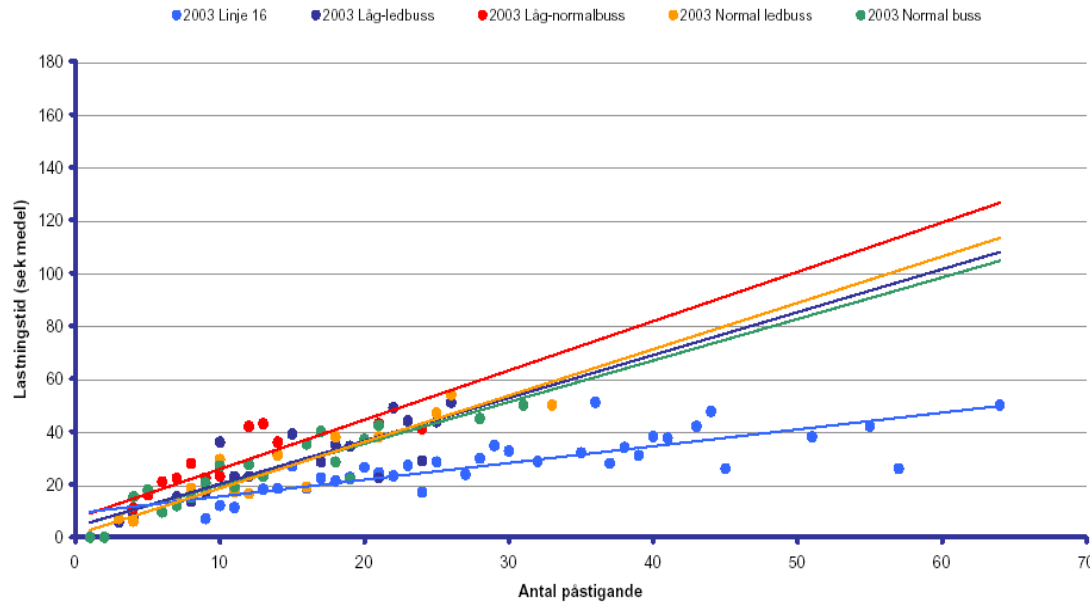


# Some key figures of trunk line 16

- 16 km line, 60 % dedicated
- € 1,2 M/km in infrastructure cost
- 11 Bi-articulated buses, € 5 M (165 pass. capacity)
- 24.000 passenger trips/day
- 21 km/h commercial speed
- Generates operating profit
- CO2 emissions app. 1.600 t/year
- Tram lines in Gothenburg 25.000-40.000 passenger trips/day
- Tram infrastructure € 15-20 M/km
- One tram car € 2,5 M Sek (182 pass.)
- Operating losses ~€ 3 M/year with tram line vs. trunk bus line



# BRT – Lower Boarding Time



- Low floor boarding at 1 door: 1.5-2 sec/pass
- BRT low floor boarding at 3 doors: 1 sec/pass
- BRT + smart card: 0,5-0,7 sec/pass
- BRT + pre ticketing at bus stop/terminal: 0,3-0,5 sec/pass



# Fuel saving in BRT operation

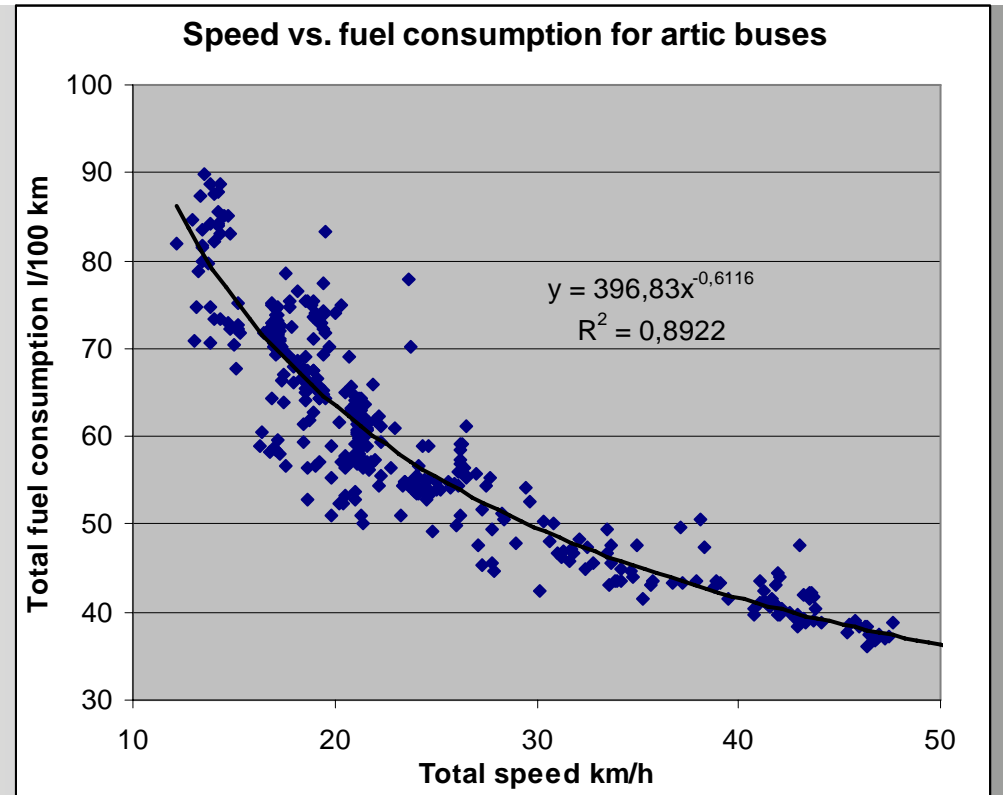
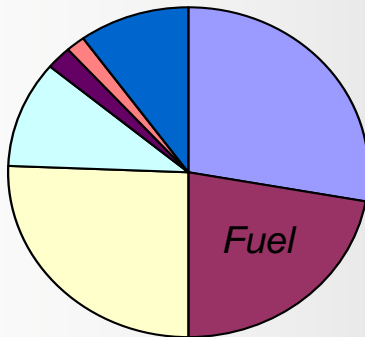
## Higher average speed in BRT

Fuel consumption in general city operation compared to BRT:

- City – 16 km/hr      73 lit/100km
- BRT – 21 km/hr      62 lit/100km

➔ **Difference of 15 % consumption**

Operational costs

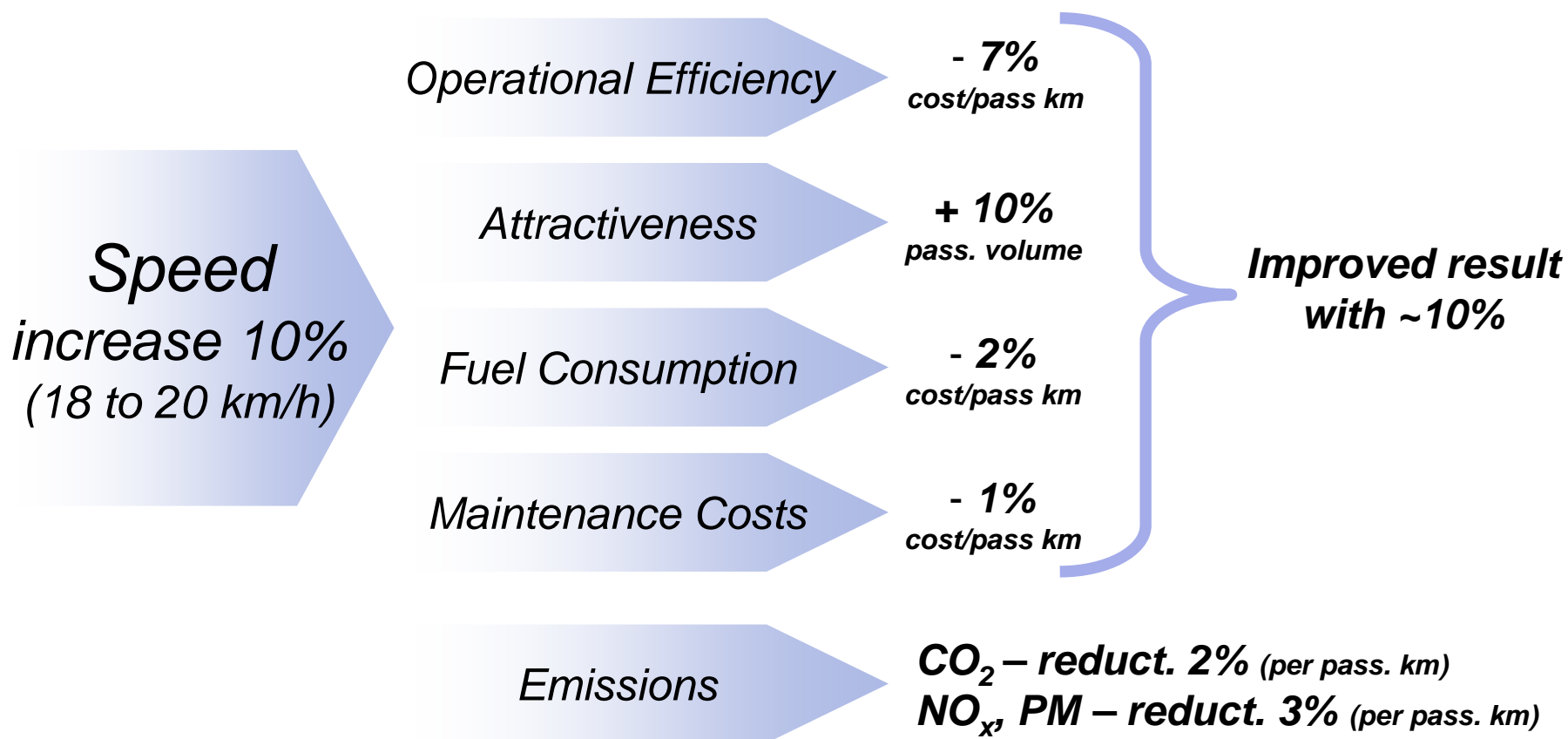


# Safety aspects

- Large reductions of accidents;
  - 50-80 % in several BRT systems in Latin America
- Dedicated bus lanes in Sweden;
  - 2.9 vehicle accidents/M vkm
  - 1.4 passenger accidents/M vkm
- Conventional mixed bus traffic
  - 7.2 vehicle accidents/M vkm
  - 4.2 passenger accidents/M vkm



# Speed – Impact on Productivity



# Low Floor – Volvo Concept Artic/Bi-Artic



**7500**



**7700**

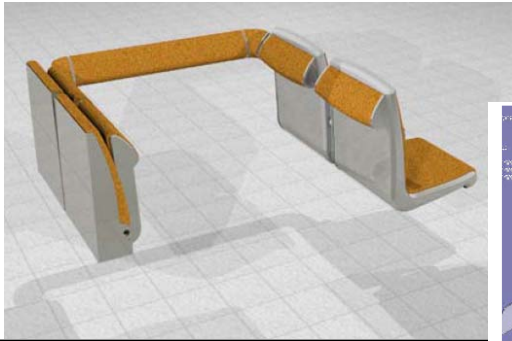


**B9S**

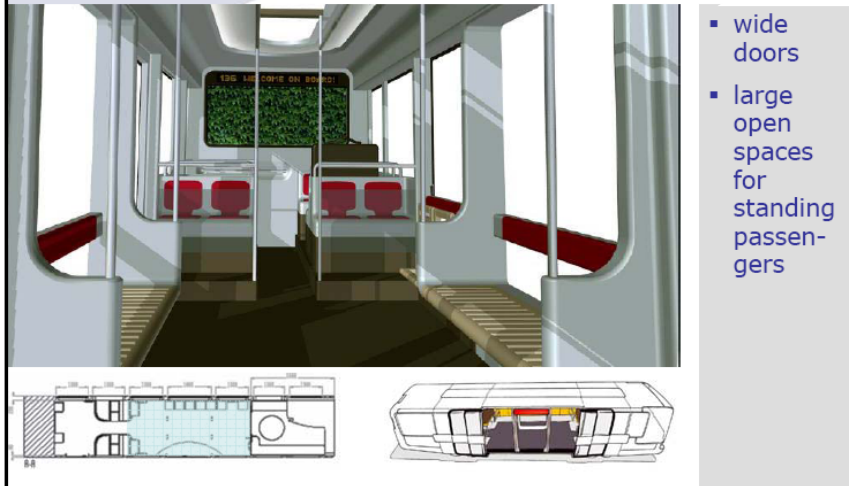
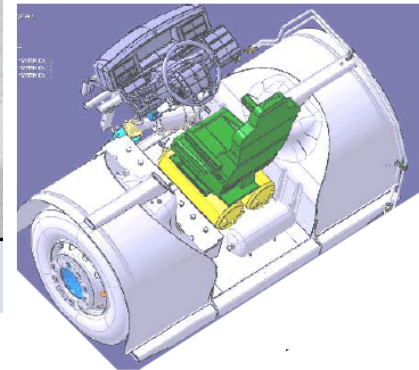


**B9L**

# “European Bus System of the Future”- EU project in 7th framework program



Example :  
Openings and interior  
fluidity



- wide doors
- large open spaces for standing passengers

- Industry wide project
- UITP Co-ordination
- WP 2.1/Volvo part:
  - Develop simulation tool of passenger flow and capacity
  - Flexible seating, extra wide doors, wider gangway (super single tyres), centre driver, bus design
  - Design and build demo bus
  - Field testing in Gothenburg 2011

# Future vehicle concept?

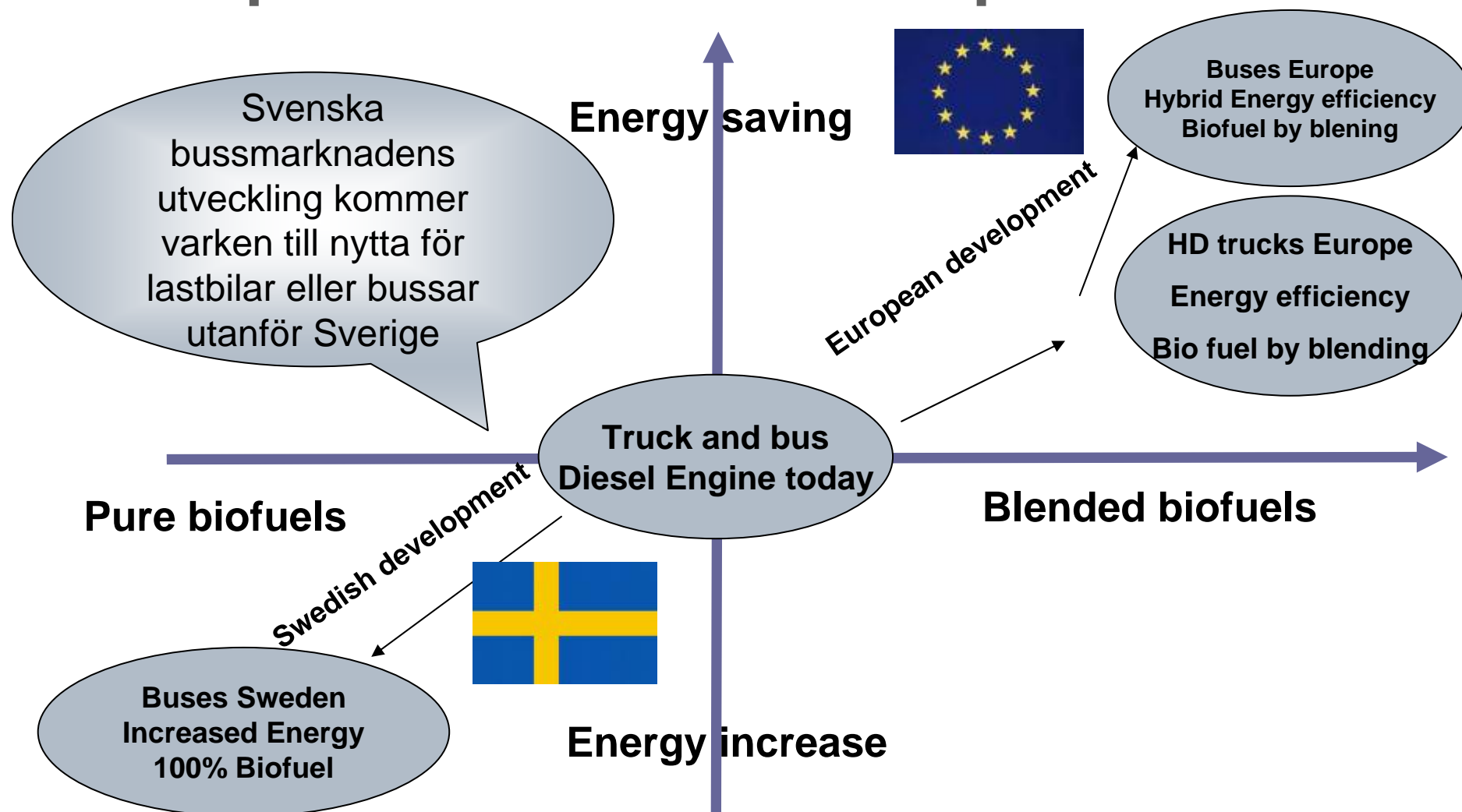


# Summary

- BRT is a well proven form of efficient high capacity bus transit
- BRT offers in principal the same user features as rail bound city transit
- With BRT the investments in infrastructure is one order of magnitude lower than a comparable tram/light rail solution
- Most BRT lines operates without subsidies
- Environment benefits can be substantial
- Short implementation time and synergies with existing PT network possible
- User preferences gives high ratings
- Several opportunities in Swedish cities
- Best value for the investment



# Developmentlines of HD transports



# Emission Standards – Volvo products

