The Tramway, aka LRT, aka VLT

An efficient, economic, sustainable mass transport resource

Comparison between BRT and tramway in Montpellier

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1. The tramway between BRT and metro

2. The case of Montpellier

3. The Tramway/BRT compared economic analysis
1. The tramway between BRT and metro

In the world’s major cities, mass transport comes down to a choice between metro (Mass Rapid Transit) and BRT (Bus Rapid Transit).

![New York's subway](image1)

![Bogota's TransMilenio](image2)

The tramway, whose revival dates from only the 1980s, appears as a mode of transport that is:

- **Touristy and historic** for the cities that have kept their old tramways (San Francisco, Rio de Janeiro, New Orleans, etc.)

- **Esthetic and costly** for the new tramways built generally in the rich countries
The modern tramway (or Light Rail, or VLT, or light metro) holds its place between the BRT and the metro

**The capacity of the vehicles** places the tram between buses and metros:

- articulated bus : 105 places (18m long) to 150 places (24m long)
- tramway : 200 places (30m long) to 350 places (45m long)
- metro : 300 to 1500 places, depending on the length of the trains.

**The total investment cost per kilometer** for a complete line also places the tram between BRT and metro:

- BRT with new infrastructure : €5 to 15 M/km
- tramway : €15 to 40 M/km
- metro : €80 to 200 M/km.

**The operating cost per kilometer traveled** within the same country places the tramway between bus and metro.
In the countries of the OECD, the passenger transported in a tramway often costs less than in a BRT over the lifetime of the system.

- The total investment cost (infrastructures and vehicle) is 2 to 3 times higher.

- But the operating savings permitted by the high capacity of the trains and the efficiency of the railway vehicles offset the extra cost of investment, over the entire depreciation term.

  If, of course, the customer base is there!

- The more the living standard of a country increases, the more the economic advantage of the BRT compared to the tramway decreases.
2. The case of Montpellier, an example of a successful choice in favor of the tramway

2.1 Montpellier's territory

2.2 The challenges of strong urban growth

2.3 Urban growth and development of public transport

2.4 The construction of a 55 km tramway network

2.5 The reasons for choosing the tramway
2.1 The territory of Montpellier Agglomération in its context

- 450 Km2
- 420,000 residents
- 31 towns, including the city of Montpellier (255,000 residents)
- Capital of the Languedoc-Roussillon region (2,550,000 residents)
2.2 The challenges of strong urban growth

Urban area according to the INSEE
- 92 towns
- 550,000 residents

+ 70% in 20 years in the 61 towns outside the metropolitan area

Montpellier Agglomération
- 31 towns
- 420,000 residents

+ 30% in 20 years
2.3 Urban growth and development of public transport

- Faced with the challenges of growth, Montpellier established an ambitious urban project and constructed a transport network virtually not existing in the 1960s.

- The network was organized around "bus priority areas" (name given to a local form of BRT).

- But "the priority areas" have quickly become saturated.

- And in 1995, Montpellier’s elected officials, under the leadership of Georges Frêche, decided on the construction of a network of tramway lines taking up the layouts of the "priority areas".
The bus priority areas heralded the tramway

Bus viaduct constructed downtown on top of the high-speed train tracks.
Montpellier Polygone

Viaduct of the bus priority area

Transformed into tramway line
2.4 The construction of a 55 km tramway network: 1997 - 2012

The urban project is based on dedicated transport: the tramway

**Line 1**: 15 km, commissioned in 2000, is the backbone of the future network on the major area of development.

**Line 2**: 20 km, commissioned at the end of 2006, located on the historical axis of the lines of communication.

**Line 3**: 21 km, is intended to reach the sea.
Line 1: 9 years after its commissioning, a complete success

- **Length**: 15.2 km and 28 stations.
- **Service frequency**: 3 minutes at peak hours, 5 minutes on average.
- **Average commercial speed**: 20 km/hour.
- **33 Alstom Citadis 401 tramways**
  - 40 meters long
  - 2.65 meters wide
  - 285 people (4 people/m2).
- **130,000** travelers per day.
- **30 million** travelers per year.
- **4 tramway parking areas: 2,200** spaces, including two structures:
  - 600 spaces,
  - 1,200 spaces.
- **Investment cost**: €407 M (in 2004 €)
Line 2: the tramway leaves the city

- **Length**: 20 km and 33 stations with 2 single tracks of 4 km at the 2 ends.
- **Frequency**: 5 to 7 min on the double-track portion, 10 to 15 min on the single tracks.
- **Commercial speed**: 21 km/h.
- **24 Citadis 302, 30 meters** long and 2.65m wide.
- **57,000** travelers per day
- **14.5 million** travelers
- **8 tramway parking areas**: 1,285 spaces, 3 linking/transfer points with Line 1.
- **Investment cost**: €455 M (2004 €)
Future Line 3: to the sea and new neighbourhoods

- **Length**: 22 km and 32 stations.
- **Same hours and frequency as Line 2.**
- **Single tracks** in a fork on the southern part served at half frequency.
- **23 40-meter trains** 2.65 m long.
- **Frequency** planned:
  - 80,000 travelers per day
  - 20 million travelers per year
- **Decoration of trains**: Christian Lacroix.
- **Start of work**: March 2009.
- **Planned commissioning**: April 2012.
- **Investment cost**: €450 M (in 2008 euros).
2.5 The 4 reasons for choosing the tramway in Montpellier

- **A future without oil**
  "By 2050, the cities that managed to create a transport infrastructure network not running on oil will have a decisive advantage."
  *Georges Frêche, President of Montpellier Agglomération, on the launch day of work on Line 3 (April 2009)*

- **A controlled investment**
  Tramway line 1: an infrastructure four times less expensive than a metro and transporting as many travelers as a line of the Marseille metro, the large neighbor.

- **A more beautiful city**
  The construction of the tramway, surface transport, beautifies and renovates the roadways used, letting even those who will not use it share in the benefit of the investment.

- **A good quality/price ratio**
  The operating cost savings offset the investment cost and put the total cost per passenger transported on the same level as that of a bus passenger.
3. The Tramway/BRT compared economic analysis

3.1 Method of comparison

3.2 Close-up look at the compared analysis of tramway, bus, and BRT costs in the case of Montpellier

3.3 The main lessons from the comparison
3.1 Method of comparison

- The comparison of bus, BRT, tramway, or metro solutions is generally incomplete.

- In the feasibility studies of the projects, the comparison pertains to the investment costs of the different solutions as a priority.

And the operating cost is taken into account without direct relationship with the investment.

- In Montpellier, the transport operator Transdev, present for 30 years in the semi-public company TaM, is responsible for:
  - Steering the bus, tramway, infrastructure, and rolling stock investments
  - Organizing the construction of the tramway lines
  - And operating the entire bus/tramway network (including the exchange centers).

- The operator has all of the figures necessary for the comparison. The examination of the same data in the other networks of the Transdev Group shows that the results are valid in most of the European situations.
3.1 Method of comparison

- **Using the place/kilometer offered as a base unit for comparisons**
  - The kilometer traveled by a vehicle does not permit comparison because of differences in capacity
  - Capacity = seated places + standing places at 4 people per available m2.

- **Comparing the total annual investment and operating costs**
  - annual investment cost = total cost over the average duration of depreciation (23 years for a tramway line) + annual financial expenses
  - operating cost = 2008 TaM cost accounting

- **Simulating a BRT (BHNS in France) in place of line 1 of the tramway**
  - Fully on reserved site like the tramway with the same commercial speed
  - Construction and equipment identical to the Nantes BRT (line 4), named Busway (registered trademark)
  - Investment cost per kilometer equal to the Nantes BRT (Transdev Group)

- **Keeping Montpellier's "ordinary" bus network as a reference.**

- **Simulating line 3 of Montpellier's tramway**
  Currently at the end of construction, all of the costs are known, and its operating cost comes from TaM’s 2008 data.
### 3.2 Close-up look at the compared analysis of tramway, bus, and BRT costs in the case of Montpellier

<table>
<thead>
<tr>
<th>YEAR 2008</th>
<th>TRAMWAY (actual figures)</th>
<th>TRAMWAY (actual figures)</th>
<th>URBAN BUSES (actual figures)</th>
<th>simulation BRT (like Nantes)</th>
<th>TRAMWAY (3-year forecast after implementation)</th>
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</thead>
<tbody>
<tr>
<td>LINE 1 15 km</td>
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<td>LINE 2 20 km</td>
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<td>12 Lines Same as L1 tram based on year 2008</td>
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<td>LINE 3 22 km</td>
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#### PHYSICAL DATA

- **Rolling Stock**
  - Line 1: 33 trains (285 places)
  - Line 2: 24 trains (210 places)
  - Urban Buses: 136 buses
  - 33 articulated NGV buses (105 places)
  - BRT: 23 trains (285 places)

- **Veh/km (in 1000)**
  - Line 1: 1,801
  - Line 2: 1,470
  - Urban Buses: 5,319
  - BRT: 1,800

- **Places offered (in 1000 PKO)**
  - Line 1: 501,100
  - Line 2: 308,700
  - Urban Buses: 425,800
  - BRT: 189,000

- **Transported travelers (in thousands)**
  - Line 1: 30,000
  - Line 2: 13,600
  - Urban Buses: 18,620
  - BRT: 11,300

#### INVESTMENT COST (in millions of 2004 euros)

- **Line 1**: €407
- **Line 2**: €455
- **Urban Buses**: €105
- **BRT**: €139
- **Line 3**: €450

#### 2008 ANNUAL COST COST per PKO (places/km offered)

- **Depreciation and financial expenses**
  - Line 1: €27.9 M
  - Line 2: €31.2 M
  - Urban Buses: €9.2 M
  - BRT: €9.5 M
  - Line 3: €30.8 M

- **Operating costs**
  - Line 1: €15.9 M
  - Line 2: €11.1 M
  - Urban Buses: €30.4 M
  - BRT: €14.3 M
  - Line 3: €13.4 M

- **2008 total**
  - Investment: 5.6 cents
  - Operating: 3.2 cents
  - Total: 8.8 cents

- **Cost per traveler transported**
  - Investment: €0.93
  - Operating: €0.53
  - Total: €1.46

<table>
<thead>
<tr>
<th><strong>COST per TRAVELER transported</strong></th>
<th>Investment</th>
<th>Operating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>€0.93</td>
<td>€0.29</td>
<td>€1.22</td>
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<tr>
<td>Line 2</td>
<td>€0.49</td>
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<td>Urban Buses</td>
<td>€0.84</td>
<td>€1.63</td>
<td>€2.47</td>
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<td>BRT</td>
<td>€1.40</td>
<td>€0.61</td>
<td>€2.01</td>
</tr>
<tr>
<td>Line 3</td>
<td>€1.19</td>
<td>€2.12</td>
<td>€3.31</td>
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3.3 The main lessons from the comparison

**The BRT** costs three times less in investment, but it is as expensive to operate as the tramway.  
*Brought back to the price per place offered, it is more expensive than the tramway* on lines 1 and 3 with 40-meter trains.

**The choice** between a BRT with a higher capacity and a modern high-capacity tramway is mainly related to the potential customer base.

Given the significance of the initial investment of a tramway line, *it is better to have large trains (40 m)*, with a low extra investment cost (2 to 3% of the total) and a low extra operating cost (around 5%).

Settling for a traditional bus network does not cost less per place offered. *In order to develop the use of public transport, it is better to invest in mass transport.*