Living Lab: Clean public transport deployment

Electric and hybrid buses for public transport

Sergio Fernández Balaguer
EMT: Madrid Public Transport Company

- Created in 1947
- 100% owned by Madrid City Council
- 24/7 service
- EMT operates and manages the whole urban bus network in Madrid city
- EMT also provides the service of other public mobility services:
  - ✓ Since January 2014, parkings and tow trucks in Madrid city
  - ✓ Since October 2016, the public e-bike sharing system, BiciMAD
  - ✓ Since January 2018, the cable car system
ECCENTRIC IN A NUTSHELL

KEY FIGURES IN CIVITAS ECCENTRIC

MADRID
- 5 Partner Cities

MUNICH
- 50 Mobility Measures

RUSE
- 6 Thematic Areas

STOCKHOLM
- 20 Observer Cities

TURKU
- €19.3m Total budget

COORDINATION:

Inclusive urban planning
Mobility as a Service
Safe walking and cycling
Clean public transport
Clean vehicles
Clean freight logistics

COORDINATION:

MADRID
Main goals of Madrid measure

• To increase the efficiency and environmental performance of the public transport bus fleet in Madrid;

• To provide a more attractive offer of public transport to compete with private car use;

• To help developing guidelines and recommendations for selecting major fleet renewal to be undertaken in the upcoming years.
Measure outputs

- 9 hybrid buses were added to the EMT fleet;
- Monitoring the performance of these new buses under real conditions while operating on EMT route 140, a tangential bus line close to the living lab;
- Assessing and comparing the different technologies (standard buses versus new ones);
- Developing recommendations for future fleet renewal, based on the operation of this type of vehicles and technology.
### Indicators

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Data units</th>
<th>Frequency B – I – A</th>
<th>Method DC-E-S-C</th>
<th>Observed group</th>
<th>Area of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bus service</td>
<td>km</td>
<td>B - I - A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>2</td>
<td>Satisfaction</td>
<td>Score (1-5)</td>
<td>I – A</td>
<td>Survey</td>
<td>Users of new buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>3</td>
<td>Emissions CO2</td>
<td>tons</td>
<td>B – I – A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>4</td>
<td>Emissions NOx</td>
<td>tons</td>
<td>B – I – A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>5</td>
<td>Emissions PM</td>
<td>tons</td>
<td>B – I – A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>6</td>
<td>Energy efficiency</td>
<td>MJ/km</td>
<td>B – I – A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>7</td>
<td>Operating costs</td>
<td>EUR/km</td>
<td>B – I - A</td>
<td>Data collection</td>
<td>New buses</td>
<td>Line 140</td>
</tr>
<tr>
<td>8</td>
<td>Investment costs</td>
<td>EUR</td>
<td>B</td>
<td>Data collection</td>
<td>New buses</td>
<td></td>
</tr>
</tbody>
</table>

**Frequency:** B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period
• High level of satisfaction (4.2 score over 5, compared to a 3 score to the old buses)

• 69% in favour to dedicate municipal funding fleet renewal (a score of 4.5 over 5).

• CO2 emissions and energy consumption reduced by 21%;
• NOx emissions reduced by 73%;
• PM emissions reduced by 39%;

• Investment costs 39% higher compared to Euro IV diesel
• However, operating costs reduced by almost half (51.4% reduction), from €66.67/100 km to €34.30/100 km.
## Objectives and targets

<table>
<thead>
<tr>
<th>No.</th>
<th>Objective and target</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy consumption (and emissions) reduced by 30%</td>
<td>Substantially achieved (at least 50%)</td>
<td>Energy consumption and CO2 emission reduction above 20% on L140. They could have been higher if the hybrid buses had provided more km on this route, instead of diesel buses.</td>
</tr>
<tr>
<td>2</td>
<td>Noise reduction, due to the use of alternative technologies</td>
<td>Achieved in full</td>
<td>33.8% of the L140 passengers considered that the new buses were less noisy than the previous ones. This was the difference noticed by a higher number of respondents, followed by “more comfort” (32%)</td>
</tr>
<tr>
<td>3</td>
<td>Contribution to the air quality plan objectives</td>
<td>Exceeded</td>
<td>NOx and emission reductions were higher than initially expected (72.7% and 38.9%), contributing substantially the objectives of Madrid’s Air Quality Plan and new “Madrid 360” strategy</td>
</tr>
</tbody>
</table>
Lessons learned and upscaling in Madrid

- Hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO2 emission and fuel savings of more than 20%, reduction in NOx and PM emissions, and significant customers’ satisfaction;
- Noise reduction is the most valued improvement by users;
- Hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.
- The measure has contributed to establish the EMT fleet renewal plan during these years. The plan’s objective is to have a 100% fleet with low or zero emissions vehicles.
- Evolution in market and local city strategies during the project life makes full electrification the trend to follow in the upcoming years
Thank you!

Sergio Fernández Balaguer

Contact Details
EMPRESA MUNICIPAL DE TRANSPORTES DE MADRID S.A.

sergio.fernandez@emtmadrid.es

More info about Eccentric Madrid:
https://www.madrid.es/portales/munimadrid/es/Inicio/Medio-ambiente/CIVITAS-ECCENTRIC/?vgnextfmt=default&vgnextchannel=c7d8b53ed819f510VgnVCM1000001d4a900aRCRD&vgnextoid=c7d8b53ed819f510VgnVCM1000001d4a900aRCRD

http://www.civitas.eu