1. Activities of the company
2. Objectives and scope
3. Environmental performance & Footprint
4. Environmental Assessment
5. Conclusion and next steps
Activities of the company

The largest range of the market: from tramway to very high-speed train...

DISTANCE

The largest range of the market: from tramway to very high-speed train...

SPEED

Alstom creates smarter mobility by designing and maintaining railway solutions that run smoothly and efficiently.
Activities of the company: Villeurbanne site

Development center for systems and products

More than 40 programs in development

Embedded products

- On-board IT (TDMS)
- Passengers information
- Driver monitor
- TrainTracker
- Auxiliary converter controller

Trackside products

- Automatic Train Control
- On-board IT (TDMS)
- Trackside
- Encoder (LEU)
- Eurobalise
- Radar
- Wheel sensor
- Accelerometer
- 2003 calculator
- Driver monitor
- Wheel sensor
- Trackside
- Encoder (LEU)
Context

- Ecodesign activities are quite mature at product level
- Ecodesign is part of the environmental system since 2014
- Significant aspects are well known at product level

Ecodesign setting according to 14006

- Lack on knowledge on:
  - Environmental footprint of complete signalling solution
  - Significant aspects on complete solution
Objectives and scope

- **Objectives:**
  - Caracterize environmental footprint of a complete signalling solution
  - Define significant environmental aspects at solution level

- **Scope:**

  Embedded products and trackside products for a metro line
A few words about Urbalis Fluence

Fluence concept:

**Along the rails**: electronic product ensuring security, traceability, maintenance and communication + cables

**Embedded**: intelligence of the train, high frequency of the trains

New way of managing the trains:

Trackside to on board comm => train centric comm
Allowing:
- Less electronic equipment (-20%)
- Automatic driving with higher performance (30% energy saving)
- Metro fleet with better frequency
Material balance

<table>
<thead>
<tr>
<th>Material Balance (≥5%)</th>
<th>Value (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene</td>
<td>23600</td>
</tr>
<tr>
<td>Copper</td>
<td>95500</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>3590</td>
</tr>
<tr>
<td>Steel</td>
<td>3050</td>
</tr>
<tr>
<td>Others (EEE/other plastics/other metals)</td>
<td>8006</td>
</tr>
</tbody>
</table>

---

Material balance chart showing the distribution of materials with percentages and values.
Tools and indicators

INDICATORS

- Acidification of soil and water (A)
- Depletion of abiotic resources - elements (ADPe)
- Depletion of abiotic resources - fossil fuel (ADPf)
- Air pollution (AP)
- Eutrophication (EP)
- Global warming (GWP)
- Ozone depletion (ODP)
- Photochemical ozone production (POCP)
- Water pollution (WP)
Life cycle analysis

- **Fonctional unit:**
  - 1 * trackside
  - 16,439 trains (average of functioning trains during the year)
  - 1 * cables set on trackside
  - 13 km track
  - mission profile of a french line for energy consumption and number of products
  - Lifetime: 20 years

- **Details for mission profile:**

<table>
<thead>
<tr>
<th></th>
<th>Power (W)</th>
<th>Hours</th>
<th>days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active normal service day on board</td>
<td>11890</td>
<td>19.75</td>
<td>342</td>
</tr>
<tr>
<td>Active continuous day on board</td>
<td>11890</td>
<td>24.00</td>
<td>3</td>
</tr>
<tr>
<td>Non active on board</td>
<td>1065.35</td>
<td>24.00</td>
<td>20</td>
</tr>
<tr>
<td>Active 24/24 trackside</td>
<td>20850</td>
<td>24.00</td>
<td>365</td>
</tr>
</tbody>
</table>
Life cycle hypothesis for the modelling:

- **Manufacturing:**
  - LCA with an adapted level of details
  - Use of models (board models instead of detailed component modelling)
  - Primary transportation taken into account (upstream distrib)
  - Packaging non taken into account (negligible)

- **Downstream Transportation:**
  - 850 km for products (From Tarbes and Villeurbanne)
  - 450 km for cables (From Autun and Nanterre)

- **Installation** not taken into account

- **Use:**
  - According to the Fluence mission profile and the products’ energy consumption
  - Scrap and maintenance non taken into account

- **End-of-life**
  - According to the EIME good processes (transportation, preprocessing, recyclability, landfill and incineration), including transportation to the recycling sites
Environmental performance and footprint

Significant life stages (based on average percentages, all impacts included)

<table>
<thead>
<tr>
<th>Life cycle phase</th>
<th>Impact driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials</td>
<td>Material use</td>
</tr>
<tr>
<td>Use</td>
<td>Energy consumption</td>
</tr>
<tr>
<td>End-of-life</td>
<td>Cables wastes</td>
</tr>
</tbody>
</table>

Manufacturing: 60%

End-of-life: 8%

Distribution: <1%

Use: 30%

Installation: 0%
Environmental performance and footprint

Impact repartition according to life cycle phases (for the complete solution):

INDICATORS
- Acidification of soil and water (A)
- Depletion of abiotic resources – elements (ADPe)
- Depletion of abiotic resources - fossil fuel (ADPf)
- Air pollution (AP)
- Eutrophication (EP)
- Global warming (GWP)
- Ozone depletion (ODP)
- Photochemical ozone production (POCP)
- Water pollution (WP)
Environmental performance and footprint

Results without cables: Repartition of impacts according to life cycle phases

Manufacturing phase divided with board contribution (grey) and trackside (pink)
Fluence initial footprint (in black) and footprint with a potential decrease in cable weight by 50% (in blue). It reduces the global weight by 45% and allows a reduction on impacts by **30.5% in average**.

Fluence initial footprint (in black) and footprint with a potential decrease in energy consumption on trackside products by 50% (in blue).

It reduces the global energy consumption by 35% and allows a discount of **10.5% of the impacts**.
Environmental assessment

A quotation method set up by Alstom to determine significant environmental aspects:

- Cables manufacturing
- Metallic racks
- ...
- Manufacturing
- Energy consumption
- End-of-life

Impact: LCA and others

Root causes

Generic aspects

Improvement tracks

Priorities

Quotation

- Customer’s requirements
- Marketing
- Standards
- ....
# Environmental assessment

## Main results

<table>
<thead>
<tr>
<th>LCA Step</th>
<th>Impact/aspect</th>
<th>Details</th>
</tr>
</thead>
</table>
| **Trackside cables manufacturing:** | - Impact on:                                        | - **ressources**  
- Water  
- Air | **Energy consumed by 2003, converter, and vital module with:** | - Impact on:                                        | - **Ozone**  
- Water  
- Primary energy | **Cable wastes** | - Impact on:                                        | - Water | **Transportation to recycling sites** | - Impact on:                                        | - Water |
| **Mechanic materials on products:** | - Impact on:                                        | - Air  
- Fossil resources  
- Ozone depletion  
- Dangerous waste | **rare and precious materials on electronic boards:** | - Impact on:                                        | - Raw materials | **Products transportation on assembly site:** | - Impact on:                                        | - Air  
- Eutrophication |
Conclusion and main messages

FLUENCE = 134 Tons with 89% of cables

Significant phases:
Energy less predominant than materials
Manufacturing footprint on EEE mainly for trackside products
Transportation significant for:
- Upstream component supplying
- Cable transportation to recycling center

Main improvement levers:
Material saving: cable volume reduction, miniaturization of EEE
Energy saving: main consumer: trackside products

Next step: identify new products and improvement tracks and improve the solution (GOLDEN RULES)