Life Cycle Assessment in railway industry

3-4 November 2011
### Agenda

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Eco-design Framework

Eco-Design

Integration of environmental parameters in design product to control and reduce its environmental impacts

To

Design products conform to customers expectations and reducing environmental impact on its life cycle as far as possible
Eco-design Framework: Main Steps

**Analysis**
- Environmental Analysis on Life Cycle / Life Cycle Assessment
- Customers & Market Expectations
- Improvement Ways / Prioritisation

**Planning - Improvement**
- Improvement Axis: Keys Aspects
- Collaborative and Internal Programmes
- New technologies / New products

**Check & Justify**
- Indicators/Performances Key Axis
- Life Cycle Assessment / Ecodeclarations
In agreement with Alstom's general EHS policy and the UITP charter on sustainable development signed in 2004, Alstom Transport undertakes to support the respect of the environment in the development of all its products and to be a leading player in the railway market in meeting the needs of sustainable mobility. This eco-design policy covers all product lines of Alstom Transport.

**OUR COMMITMENT FOR ENVIRONMENT-FRIENDLY PRODUCTS**

- **Promote** the manufacturing of its products in ISO 14001 certified sites, internally, at suppliers' and sub-contractors'.

- **Design and manufacture** all products with a view to controlling and reducing their impact on the environment all along their life cycle.

- **Reduce** our contribution to environmental impacts & **global warming**.

- **Inform** our customers of the application of this Eco-Design Policy.

- **Manage environmental aspects** in a pro-active way, cooperating with all stakeholders.

- Respect and anticipate all legal and regulatory requirements.

- *Jean-Louis RICAUD*  
  Chief Operating Officer
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Eco-design Metier

**ECO DESIGN ?**

**R&D - Engineering**
- Environmental Management: Frame & Tools
- Key aspects: Frame & Tools
- Key aspects: Clean Solutions

**Improvement Axis**
- Clean Materials
- Emissions Control
- Energy Efficiency - Savings
- EMF-EMC
- Noise & Vibration Reduction
- Landscape Integration

**Tenders & Projects**
- Methodologies
- Tools
- Instructions
- Technologies

**Performance Livrables**
- Rex
Eco-design Metier

- **Normative**
  - ISO 14001
  - ISO 14040 & ISO 14021-25

- **Tools**
  - Life Cycle Assessment : EIME®
  - Instructions :
    - 9 Operational Instructions
    - 1 Standard Specification : DTRF150650
    - 2 Design Review Checklists
  - Data management : in PDM PLM
  - Environmental Product Declaration

- **Priorities**
  - Policy and Framework Deployement
  - Life Cycle Assessment : improve use and easiness

- **Programmes**
  - Internal : Improvement & coupling PDM/PLM
  - Collaboratives :
    - LCA Model integration in design optimisation
    - UNIFE LCA TG (PCR 2009: 05 (495)-Label)
Agenda

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**Improvement Axis:**

**Clean Materials**

**Priorities**
- Materials “without” dangerous substances (SVHC) - REACH
- Renewable Materials – Biomaterials/ Long life duration & Recyclable
- Low Impactive & Sober regarding Energy, Raw material and water (LCA)

**Actions**
- Engineering Instructions and Check Lists
- REACH Project
- Referential on Recyclability & Valorisability
- Integration LCA in design choices

**Solutions**
- Halogen Free Solutions
- CrVI free solutions
- Water based Paints
- Green Floor
- Biodegradable Oils
- Light Materials & Assemblies
- Recyclability = 85 à 90 %
- Valorisability = 90 à 98 %
Annexe XVII

Candidates Substances:
(46 puis 300 puis ??)

Dangerous substances acc. directive 67/548/EEC or CLP Regulation n° 1272/2008

Substance of Very High Concern (SVHC)
CMR 1 ou 2, PBT / vPvB, equivalent concern
CMR 1&2 : 886; CMR 3 : 231

Restricted on the marketing and the use
Prohibited

Submitted Autorisation:
6 Annex XIV : 14

Autorisation, June 2008/Fev 2011/Fev 2013
Prohibited unless

Prohibited unless

Registration:
Information follow up

Other Substances: Pre-Registered (More than 70000)

PRIORITY 1 : REACH

Problematic Substances

Improvement Axis:
Clean Materials
A environment Friendly production

Impact management

• An efficient management system of impacts (EHS roadmap) at level group, with a reporting by indicators

• Reduction of the energy intensity and CO2 emissions by 20% before 2015

• Waste recycling: 80% before 2015

• Water consumption reduction: 20% before 2015 in zones submitted to limitation

• ISO 14001 Certification of all productions sites before 2012

• VOC emissions reduction : 10% before 2015

• SF6 emissions reduction: 3 % per year

• Established by sectors of ecodesign policy

Group targets

• Tarbes renovation : 20 M€

• Construction of a plant in Chennai, India

Heavy Investments
Agenda

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Ecodesign on Rolling Stocks

• Use of adapted materials:
  - 89% recyclable
  - 93% valorisable

• Reduction Energy consumption:
  - Electrival: 2.67 Kwh/Km
  - Traction optimised – Reduction starting effort
  - HVAC: 33% of the time in half power
  - Air production: -14%
  - Lighting: -23%

• Low VCO emissions and particle brake

• Life Cycle Assessment
Comparative study on 2 Floor Covering solutions

- Fonctionnal Unit: Covers 1 m²
- Input:
  - Materials type and Qty
  - Life Duration
  - Distribution phase (Distance & Transport Mode)
## Ecodesign on Rolling Stocks

### Table: Ecodesign Indicators

| Indicateurs                        | Abréviation | Unité | $S=M+D+U$ | Fabrication | Distribution | Utilisation | $S=M+D+U$ | Fabrication | Distribution | Utilisation |
|-----------------------------------|-------------|-------|-----------|-------------|--------------|-------------|-----------|-------------|--------------|-------------|-------------|
| Raw Material Depletion            | RMD         | Y-1   | 1,11E-10  | 1,11E-10    | 2,16E-15     | 0           | 1,11E-10  | 1,11E-10    | 9,47E-16     | 0           |
| Energy Depletion                  | ED          | MJ    | 6,70E-04  | 6,56E-04    | 1,59E+03     | 0           | 5,20E+04  | 5,13E+04    | 6,86E+02     | 0           |
| Water Depletion                   | WD          | dm3   | 1,13E+04  | 1,11E+04    | 1,18E+02     | 0           | 7,51E+03  | 7,84E+03    | 6,59E+01     | 0           |
| Global Warming                    | GW          | g-CO2 | 2,94E+06  | 2,81E+06    | 1,27E+06     | 0           | 2,20E+06  | 2,14E+06    | 5,57E+04     | 0           |
| Ozone Depletion                   | OD          | g-CFC-11 | 4,86E-01  | 3,97E-01    | 8,80E-02     | 0           | 2,43E-01  | 2,04E-01    | 3,89E-02     | 0           |
| Air Toxicity                      | AT          | m3    | 7,55E+08  | 7,04E+08    | 5,00E+07     | 0           | 5,49E+08  | 5,26E+08    | 2,13E+07     | 0           |
| Photochemical Ozone Creation      | POC         | g-C2H4| 1,06E+03  | 1,09E+03    | 1,69E+02     | 0           | 1,32E+03  | 1,25E+03    | 7,40E+01     | 0           |
| Air Acidification                 | AA          | g-H+  | 5,74E+02  | 5,42E+02    | 3,26E+01     | 0           | 4,17E+02  | 4,03E+02    | 1,42E+01     | 0           |
| Water Toxicity                    | WT          | dm3   | 1,89E+06  | 1,68E+06    | 1,56E+04     | 0           | 9,40E+05  | 9,33E+05    | 6,86E+03     | 0           |
| Water Eutrophication              | WE          | g-P04 | 5,02E+02  | 5,00E+02    | 2,09E+00     | 0           | 2,79E+02  | 2,76E+02    | 9,14E+01     | 0           |
| Hazardous Waste Production        | HWP         | kg    | 3,23E+01  | 3,22E+01    | 4,67E-02     | 0           | 2,33E+01  | 2,33E+01    | 2,06E+02     | 0           |

### Diagrams:

- [Pie chart showing percentage distribution](image)
- [Spider web chart comparing indicators](image)
**Ecodesign on Rolling Stocks**

**Résultats : Transformateur**

**Interphase repartition for transfo**

- Recyclability rate: 32.66%
- No dangerous material

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<thead>
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<tr>
<td>RMD ($Y^{-1}$)</td>
<td>4.9593e-11</td>
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<tr>
<td>ED (MJ)</td>
<td>3.8156e7</td>
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<tr>
<td>WD ($dm^3$)</td>
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<td>GW ($g\sim CO_2$)</td>
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<td>OD ($g\sim CFC_{11}$)</td>
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<td>AT ($m^3$)</td>
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<tr>
<td>POC ($g\sim C_2H_4$)</td>
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<td>AA ($g\sim H^+$)</td>
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<td>WT ($dm^3$)</td>
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<td>WE ($g\sim PO_4$)</td>
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<tr>
<td>HWP (Kg)</td>
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