Sydney Metro Northwest Rolling stock

ENVIRONMENTAL PRODUCT DECLARATION

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Date of validity: 17/12/2021
ALSTOM, AT THE FOREFRONT OF SUSTAINABLE MOBILITY

As a promoter of sustainable mobility, Alstom places environmental issues at the heart of its R&D strategy, constantly designing solutions and products which are less energy-consuming, quicker to install, cost effective to maintain, limited impact to external environment with higher lifespan and reduced carbon footprint.

For more than a decade, the company has systematically introduced eco-design in its engineering procedures. Various environmental dashboards have been implemented. They help us to quantify and improve the environmental impact of our solutions from development phase up to final use. Today, Alstom can rely on a team of eco-experts to ensure the environmental performance of its portfolio and is able to develop innovative infrastructure solutions tackling key environmental challenges.

**Sydney Metro Northwest Rolling stock**

It is Sydney’s first metro project providing world class commuting experience to passengers. These are driverless, fast, safe, and reliable trains. Ergonomically designed for easy access & passenger comfort with commendable acoustic performance .

We have deployed our eco design referential to ensure Eco friendly performance of the train throughout its life cycle.
Alstom, at the forefront of sustainable mobility

Alstom develops and offers range of systems, equipments and services for the rail sector. Mission is to support eco-friendly, safe and efficient transition towards global sustainable transport systems, also taking into account life cycle analysis, recycling of materials, maintenance and energy consumption. Alstom offers innovative solutions that respect the environment and meet the mobility needs according to a social responsible model. As a major player in ecological transport, sustainable development is at the heart of the Alstom’s strategy.

Alstom has an environmental management system fully in place, 100% of manufacturing sites and regional centers are certified according to ISO14001: Environmental Management Systems.

Ecodesign approach

More than 10 years ago, Alstom systematically introduced eco-design into its engineering procedures for that very purpose. It has given rise to environmental dashboards that focus on fundamental topics at the start of the development phase, the quantification of the environmental impact (life cycle assessments) and more ecological solutions. Today, experts (eco-designers, experts for acoustic and energy-saving materials) endeavor to ensure the environmental performance of each solution.

Ecodesign approach addresses the design and development of products using a life cycle perspective. It aims at continually improving the environmental performance of products through the management of their significant environmental aspects. In this context, life cycle assessment (LCA) is a relevant tool to identify and thus to allow the reduction of products’ environmental impacts.

Metro solutions

Sydney Metro Northwest Rolling stocks are built on Metropolis platform which is Alstom-made driverless system, proven over 15 years, that is built on the principle of ‘customization with modularity’.

It comes with range of energy conservation features like optimum weight management, high insulation properties, reduced solar heat transmission to Interiors, Variable climate control, LED lighting, ambitious recyclability target, Regenerative braking, Train Control and Monitoring System (TCMS) controlling the traction, braking and HVAC systems, etc.

See Alstom’s annual registration document for more information on Alstom Sustainable Development Strategy, including eco-design on www.alstom.com
Sydney Metro Northwest is Australia’s first fully-automated rail network and largest public transport project.

Sydney Northwest rolling stocks are based on Alstom’s Metropolis range of metro trains, relying on proven technologies from decades of experience. More than 17,000 Alstom metro cars are operated currently in the world by more than 50 customers. Sydney Metro Northwest, will open in the first half of 2019 with a train every four minutes in the peak. As the first stage, the 36 km Sydney Metro Northwest includes eight new stations and five upgraded stations.

**Fast journey.** The Metropolis train was designed to be an aerodynamically efficient car body. The Urbalis signaling system minimizes the time trains are stopped at stations and the time between each train.

**Enhanced travel experience.** Stations are equipped with platform screen doors for passenger safety. Each train is equipped with 38 surveillance cameras, emergency intercoms and provides real-time travel information as well as continuous mobile phone coverage.

**Accessibility.** All cars are designed respecting DSAPT requirements of Australia ensuring people with reduced mobility can move inside train with out difficulties. Accessibility is improved through three large double doors per carriage.

**Configurations**

Sydney Metro Northwest fleet is composed of 22 trains configured as 6 car sets:

- 2 driving trailer cars (TC)
- 2 motor cars with pantograph (MP)
- 2 motor cars (MC)

Trailer cars are provided with driver desk and driver controls as a provision for operating the train manually if required. TCs also contain front detrainment doors for emergency evacuation, multi purpose area for extra space for standing, luggage, prams, etc.

MC and MP cars are fitted with traction motors on bogies to move the train. MP cars are fitted with pantograph which connects to overhead catenaries to feed the train with high voltage current.
DESCRIPTION OF THE PRODUCT

This environmental declaration covers the Sydney Metro Northwest Rolling stock developed by Alstom for the North West rail link’s project.

Train feature

**Front mask:**
Reduced weight by using lighter materials and components. For example multi-material body shell.

**Exterior signage:** Use of liveries to limit emissions of volatile organic components.

**Car body:**
Light weight, integrated welded structure of corrosion resistance austenitic stainless steel.

**Interior, windows and doors:**
Light weight interior panels and insulation with good heat resistance, Automatic door closing to limit heat transfer.

**Bogies and running gears:**
Efficient ride and comfort, Controls speed and safety, low noise gear drive.

**Comfort:**
Efficient air-conditioning and ventilation systems: adjustment of the air flow depending on the number of passengers present. Two HVAC units per car.

**Propulsion and electric equipment:**
Traction allows energy recovery during braking.

Seating capacity

<table>
<thead>
<tr>
<th></th>
<th>TC x 2</th>
<th>MC x 2</th>
<th>MP x 2</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated only</td>
<td>61</td>
<td>64</td>
<td>64</td>
<td>378</td>
</tr>
<tr>
<td>Seated and standing passengers (4 passengers/m²)</td>
<td>380</td>
<td>386</td>
<td>386</td>
<td>1152</td>
</tr>
</tbody>
</table>

**MAIN CHARACTERISTICS**

**Passenger service type:**
Urban

**Vehicle:**
Metro

**Power supply**
Electricity, catenary

**Wheel/Tyre type**
Wheel

**Voltage**
1.5kV DC

**Design speed:**
110km/h

**Lifetime:**
35 years
LIFE CYCLE DESCRIPTION

Environmental impacts of Sydney Metro Northwest Rolling stock has been characterized through the realization of a LCA in accordance with ISO 14040: 2006 Environmental management - Life cycle assessment - Principles and framework and PCR Rolling stock. EIME software and associated EIME database are used to perform this life cycle impact assessment. Version 2016 of the database has been used.

**Functional unit**
The functional unit is to transport 1 passenger over 1 km. Indian and Australian geographical context has been chosen in line with the North West rail link Project.

**Life cycle boundaries**
The whole life cycle of the rolling stock is considered, in other words, the LCA is a “cradle to grave” LCA that take into account all life cycle phases form the extraction of raw materials which compose the different equipment to the end of life waste management. Transports along the supply chain and to the operator site are included as well as all assembly activities (electricity, utilities and consumable). The operation of the rolling stock requires a certain amount of energy, both for commercial and pre-conditioning service. Maintenance step includes the materials used to operate the rolling stock and the spare parts in accordance with Project preventive maintenance plan. Finally, collection and treatment end of life materials have been considered. The Australian electricity grid mix has been used for the electricity consumption during operation.
LIFE CYCLE DESCRIPTION

Bill of materials

A total of 236,160 kg of materials are used for the manufacturing of the rolling stock. Additional 161,659 kg of materials are required to produce the spare parts used for the maintenance.

<table>
<thead>
<tr>
<th>Rolling stock : Share of mass by materials families (kg)</th>
<th>UPSTREAM</th>
<th>DOWNSTREAM (spare parts)</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>203,340</td>
<td>101,439</td>
<td>304,779</td>
</tr>
<tr>
<td>EEE (electric and electronic equipment)</td>
<td>8,278</td>
<td>9,224</td>
<td>17,503</td>
</tr>
<tr>
<td>Polymers - filled and unfilled</td>
<td>7,612</td>
<td>1,214</td>
<td>8,825</td>
</tr>
<tr>
<td>Glass</td>
<td>5,539</td>
<td>10</td>
<td>5,550</td>
</tr>
<tr>
<td>MONM (modified organic natural materials)</td>
<td>4,541</td>
<td>64</td>
<td>4,605</td>
</tr>
<tr>
<td>Elastomers</td>
<td>3,347</td>
<td>17,638</td>
<td>20,985</td>
</tr>
<tr>
<td>Other</td>
<td>3,224</td>
<td>29,810</td>
<td>33,034</td>
</tr>
<tr>
<td>Fluid</td>
<td>280</td>
<td>2,260</td>
<td>2,539</td>
</tr>
<tr>
<td>TOTAL</td>
<td>236,160</td>
<td>161,659</td>
<td>397,819</td>
</tr>
</tbody>
</table>

Hazardous substances

From many years, Alstom is proactively engaged in the reduction of hazardous substances use in order to:

- Avoid production and corresponding risks
- Avoid use inside Alstom and Alstom’s suppliers premises
- Avoid any release into the environment
- Avoid extra cost for end of life treatment
- Avoid emissions at the end of life (incineration, landfill, etc.)
- Allow recycling

In particular, Alstom’s standard for hazardous substances management considers European regulation (REACH) and railway sector principles through the RISL (Railway Industry Substances List).
Worldwide industrial organization

Design and engineering of Sydney Metro Northwest rolling stock started in 2015 at Bangalore, India in collaboration with various Alstom sites in France. Sydney Metro Northwest rolling stocks are entirely manufactured in India with supply of electrical assemblies from Coimbatore and final manufacturing, assembly and testing done at Sricity. Alstom’s internal suppliers are also involved in the design and manufacturing of major components.

- Design of main components
  - Bogies, Le Creusot
  - Signaling equipment, Villeurbanne,
  - Onboard informatics systems, Saint-Ouen
  - Traction, Charleroi
- Engineering: Bangalore
- Electrical assembly: Coimbatore
- Train assembly: Sricity

Energy consumption during operation

Energy consumption calculations are based on pre-defined use scenario for Sydney Metro Northwest project including the following parameters:

- Passenger loading: 1,536 passengers for peak hour services and 720 passengers for non-peak hour services
- Operation 365 days per year and 19 hours per day
- Energy recovery during braking

A recyclable solution

The main components of the rolling stock are metallic materials and electronic and electrical equipment which allow a high recyclability potential.
# Environmental Performance

## Use of resources (per pass.km)

<table>
<thead>
<tr>
<th>FLOW</th>
<th>UNIT</th>
<th>NON - RENEWABLE RESOURCES</th>
<th>RENEWABLE RESOURCES</th>
<th>SECONDARY RESOURCES</th>
<th>WATER USE (per pass.km)</th>
<th>WASTE (per pass.km)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material resources</strong></td>
<td>Kg</td>
<td>3.83E-04</td>
<td>8.37E-07</td>
<td>1.93E-04</td>
<td>5.77E-04</td>
<td></td>
</tr>
<tr>
<td>Dolomite</td>
<td>kg</td>
<td>2.33E-04</td>
<td>2.37E-07</td>
<td>7.83E-05</td>
<td>3.11E-04</td>
<td></td>
</tr>
<tr>
<td>Inert rock</td>
<td>kg</td>
<td>6.26E-05</td>
<td>3.38E-07</td>
<td>2.80E-05</td>
<td>9.09E-05</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>kg</td>
<td>2.93E-05</td>
<td>2.41E-08</td>
<td>1.35E-05</td>
<td>4.27E-05</td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>kg</td>
<td>4.00E-05</td>
<td>1.43E-10</td>
<td>8.08E-08</td>
<td>4.01E-05</td>
<td></td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>kg</td>
<td>8.86E-06</td>
<td>7.52E-08</td>
<td>1.59E-05</td>
<td>2.48E-05</td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>kg</td>
<td>1.26E-07</td>
<td>1.17E-07</td>
<td>2.45E-05</td>
<td>2.47E-05</td>
<td></td>
</tr>
<tr>
<td>Natural aggregate</td>
<td>kg</td>
<td>2.14E-07</td>
<td>1.18E-07</td>
<td>1.10E-05</td>
<td>1.13E-05</td>
<td></td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>kg</td>
<td>2.63E-06</td>
<td>1.04E-07</td>
<td>7.05E-06</td>
<td>9.79E-06</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>kg</td>
<td>6.56E-06</td>
<td>5.85E-08</td>
<td>1.48E-05</td>
<td>2.14E-05</td>
<td></td>
</tr>
<tr>
<td><strong>Energy resources</strong></td>
<td>MJ</td>
<td>9.31E-03</td>
<td>9.30E-04</td>
<td>1.81E-01</td>
<td>1.92E-01</td>
<td></td>
</tr>
<tr>
<td>Hard coal</td>
<td>MJ</td>
<td>1.04E-03</td>
<td>7.72E-04</td>
<td>1.65E-01</td>
<td>1.67E-01</td>
<td></td>
</tr>
<tr>
<td>Uranium</td>
<td>MJ</td>
<td>6.78E-03</td>
<td>2.55E-05</td>
<td>9.86E-03</td>
<td>1.67E-02</td>
<td></td>
</tr>
<tr>
<td>Crude oil</td>
<td>MJ</td>
<td>1.31E-03</td>
<td>1.17E-04</td>
<td>3.79E-03</td>
<td>5.22E-03</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>MJ</td>
<td>1.74E-04</td>
<td>1.53E-05</td>
<td>2.54E-03</td>
<td>2.73E-03</td>
<td></td>
</tr>
</tbody>
</table>

## Water use (per pass.km)

<table>
<thead>
<tr>
<th>FLOW PER FUNCTIONAL UNIT</th>
<th>UNIT</th>
<th>UPSTREAM</th>
<th>CORE</th>
<th>DOWNSTREAM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total water use in the life cycle</td>
<td>kg</td>
<td>5.99E-03</td>
<td>9.47E-05</td>
<td>2.01E-02</td>
<td>2.62E-02</td>
</tr>
<tr>
<td>Direct use in the core process</td>
<td>kg</td>
<td></td>
<td></td>
<td>2.97E-06</td>
<td></td>
</tr>
</tbody>
</table>

## Waste (per pass.km)

<table>
<thead>
<tr>
<th>FLOW PER FUNCTIONAL UNIT</th>
<th>UNIT</th>
<th>UPSTREAM</th>
<th>CORE</th>
<th>DOWNSTREAM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total waste</td>
<td>kg</td>
<td>7.76E-03</td>
<td>2.45E-05</td>
<td>1.03E-02</td>
<td>1.81E-02</td>
</tr>
</tbody>
</table>
ENVIRONMENTAL PERFORMANCE

Environmental impacts (per pass.km)

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>UNIT</th>
<th>UPSTREAM</th>
<th>CORE</th>
<th>DOWNSTREAM</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidification potential</td>
<td>AP</td>
<td>1.66E-06</td>
<td>6.39E-07</td>
<td>7.77E-05</td>
<td>8.00E-05</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>EP</td>
<td>1.37E-07</td>
<td>3.94E-08</td>
<td>3.42E-06</td>
<td>3.60E-06</td>
</tr>
<tr>
<td>Global warming potential</td>
<td>GWP</td>
<td>2.80E-04</td>
<td>6.47E-05</td>
<td>1.24E-02</td>
<td>1.28E-02</td>
</tr>
<tr>
<td>Emission of ozone-depleting gases</td>
<td>ODP</td>
<td>1.37E-10</td>
<td>1.40E-12</td>
<td>1.59E-10</td>
<td>2.98E-10</td>
</tr>
<tr>
<td>Photochemical oxidant creation</td>
<td>POC</td>
<td>9.87E-07</td>
<td>3.59E-07</td>
<td>3.43E-05</td>
<td>3.56E-05</td>
</tr>
</tbody>
</table>

Configurations

- Life cycle description information and environmental performance results published in this EPD corresponds to the Sydney Metro Northwest Rolling stock design configuration developed by Alstom to the specific use scenario.
- To know the performance associated to other possible configurations of the rolling stock please contact Alstom.
ENVIRONMENTAL PERFORMANCE

DEFINITIONS

Global warming potential
This indicator calculates the contribution to global warming of the planet by the emission of greenhouse gases. The result is expressed in kg equivalent CO₂.

Acidification potential
This indicator calculates the atmospheric acidification caused by the emission of gas with an acidifying effect. The result is expressed in kg equivalent SO₂.

Eutrophication potential
This indicator calculates the eutrophication of water caused by the emission of specific substances (discharge of phosphoric, nitrogenous and organic matter). The result is expressed in kg equivalent phosphate.

Photochemical oxidant creation potential
The potential for creating tropospheric ozone is caused by the discharge of specific gases which have an oxidizing action under the effect of solar radiation. This indicator calculates the potential for the creation of photochemical ozone from the emission of about a hundred substances. The result is expressed in kg equivalent ethylene.

Emission of ozone-depleting gases
This indicator calculates the contribution made by the discharge of specific gases responsible for ozone layer depletion. The result is expressed in kg equivalent CFC-11.

Additional information

Noise and vibration
Design and innovative technical solutions are implemented in order to reduce the noise impact as much as possible due to the nuisance caused to the environment, the harmony of people living near the stations serviced and passengers by sound and electromagnetic waves. The table below shows the values measured outside the operating train.

<table>
<thead>
<tr>
<th>MEASUREMENT CONDITIONS</th>
<th>MEASURED LEVELS (LpA/8max)</th>
<th>ACCEPTANCE LEVELS (LpA/8max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary 0km/h</td>
<td>75,7 dBA</td>
<td>85 dBA</td>
</tr>
<tr>
<td>at 1m from the equipment surface and data height of 1,2m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass by speed 100km/h</td>
<td>88,9 dBA*</td>
<td>89 dBA</td>
</tr>
<tr>
<td>at 1m from the equipment surface and data height of 1,2m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
* Expected measure

Correspondence with PCR modules

EPD
UPSTREAM

- Extraction and production of raw materials
- Production of auxiliary materials
- Transportation from tier 1 suppliers

CORE

- Vehicle assembly: energy consumption
- Vehicle assembly: water consumption
- Vehicle assembly: waste generation
- Vehicle assembly: other auxiliaries (welding)

DOWNSTREAM

- Energy consumption for operation
- Spare parts (production, transport and disposal)
- Materials for operation (lubricant, etc.)
- Emissions
- EOL materials collection, treatment and disposal

LIFE CYCLE PHASES
**Programme Related Information and Verification**

**Product category rules (PCR):**
Rolling stock, PCR 2009:05, version 2.12

**PCR review was conducted by:**
The Technical Committee of the International EPD® System. Chair: Massimo Marino
Contact via info@environdec.com

**EPD®s within the same product category but from different programmes may not be comparable.**

**Independent verification of the declaration and data, according to ISO 14025:2006:**

- [x] EPD Process Certification (internal)
- [x] EPD Verification (external)

**Third party verifier:**
Damien PRUNEL, LCA & Ecodesign consultant
BUREAU VERITAS LCIE
LCA and ecodesign services
170 rue de Chatagnon - ZI Centr‘alp - 38430 Moirans - FRANCE
damien.prunel@fr.bureauveritas.com

**Accredited by:**
Recognized individual verifier, approved by the International EPD System.

**Programme:**
The International EPD® System
EPD International AB
Box 210 60
SE-100 31 Stockholm
Sweden
[www.environdec.com](http://www.environdec.com)

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**Product group classification:**
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**Reference year for data:**
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Global

**EPD owner:**
ALSTOM
48, rue Albert Dhalenne
93482 Saint-Ouen, Cedex France

**LCA author:**
Fanny LEBAILLY
fanny.lebailly@alstomgroup.com

**Programme operator:**
EPD International AB
[info@environdec.com](mailto:info@environdec.com)
Pour changer le titre du document sur tous les pieds de page :

Menu Affichage

> Masque des diapositives

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<thead>
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</table>

France, Europe, Middle East & Africa
Alstom
48, rue Albert Dhalenne
93482 Saint-OUen Cedex - France
Telephone: +33 1 57 06 90 00

Latin America
Alstom
Virgilio Wey Street, 150
Água Branca
05036-050 São Paulo/SP - Brazil
Telephone: +55 11 3617-8000

Asia Pacific
Alstom
No.66/02, Embassy Prime,
B Wing 3rd floor,
C V Raman Nagar,
Bangalore - 560 093
Karnataka - India
Telephone: +91 80 4641 2400

North America
Alstom
641 Lexington Avenue - 28th floor
New York, NY 10022 - USA
Telephone: +1 212 692 5320

www.alstom.com