



Metro Oslo

Environmental Product Declaration
according to ISO 14021

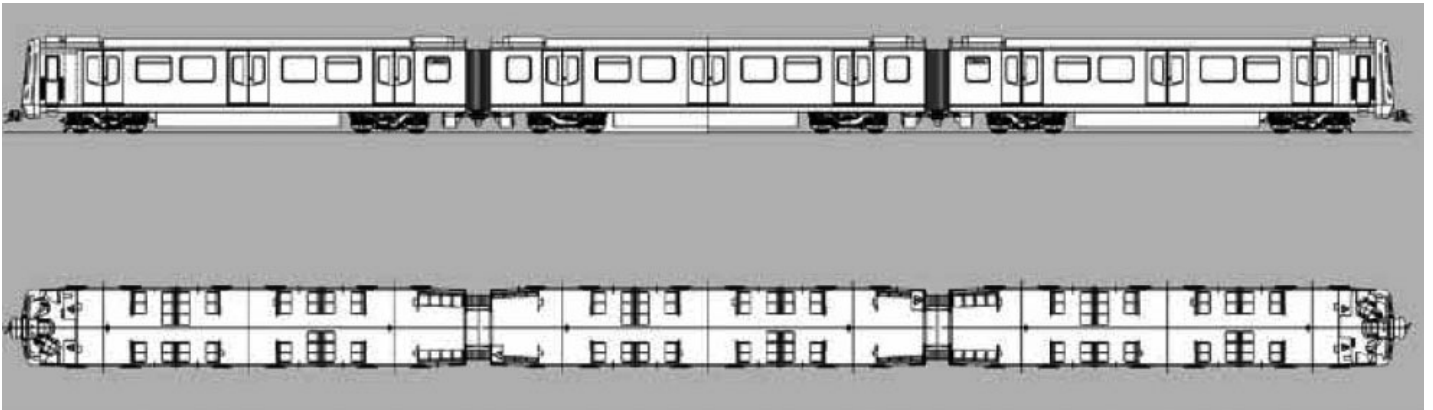
Transportation Systems

SIEMENS

Product Description

One train consists of three cars in the configuration MC1-M-MC2. The cars at the front and at the rear are motorized and equipped with a driver's cab (MC). The middle car is motorized without a

driver's cab (M). The total train length is 54 m with a maximum transport capacity of 678 passengers. The maximum speed is 70 kph.



Manufacturer

Siemens Transportation Systems is a major driving force behind new technologies to keep railway systems competitive. On the basis of our innovative strength, we offer leading edge and efficient products, systems and services for every aspect of rail technology. The volume of traffic is currently increasing beyond expectations. More than ever, innovative solutions are needed in order to ensure tomorrow's mobility - a future that is simply inconceivable without rail-based transportation. As one of the world's leading suppliers of products, systems and services for all rail requirements, Siemens Transportation Systems has proven to be a competent and reliable partner on all markets around the globe. In providing efficient, customized solutions, Siemens is contributing to greater efficiency and safety as well as to improved comfort and environmental compatibility in rail traffic.

Siemens Transportation Systems operates all over the world. Erlangen, Vienna and Graz are home to three of the most modern engineering and manufacturing sites for railway vehicles and look back over a long tradition in the railway business. Up to 450 vehicles and approximately 3,000 bogies per year can be delivered to customers all over the world.

For further information, see:
www.siemens.com/transportation

Design for Environment

Sustainability is the key to securing our company's future. Our commitment as a socially responsible company means that we have to meet the demands of commerce in an ecologically and socially sound manner. Demonstrated commitment to environmental protection and safety increases the competitive edge of both our operations and our customers and also lays the foundations for a successful future.

Siemens strives – through innovative products, systems and solutions - to improve the quality of life all over the world. These products and solutions are distinguished by high energy efficiency, helping to protect both environment and health, and contribute towards ensuring environmentally sustainable mobility. Our global system for managing environmental protection and safety issues ensures the continuous improvement of our environmental performance. We have set ourselves the target of designing, developing, manufacturing and marketing our products and services so as to protect the environment and human health to the highest possible extent, meeting or exceeding any applicable regulations, and to minimize the impact on our natural resources.

Description of the Life-cycle Stages

One of our product focuses is to minimize the environmental impacts from resource extraction through to the ultimate disposal of rolling stock. At every stage,

we have developed trendsetting solutions in accordance with sustainable life-cycle thinking.

Materials



The data of this life-cycle stage is based on an internationally verified life-cycle assessment which involves the extraction of natural resources, transport to the processing sites and the production of raw materials. The metro train is designed as a lightweight construction with modular design components. All materials have been chosen with regard to minimizing environmental impact and to enhancing recycling ability.

Manufacturing / Delivery



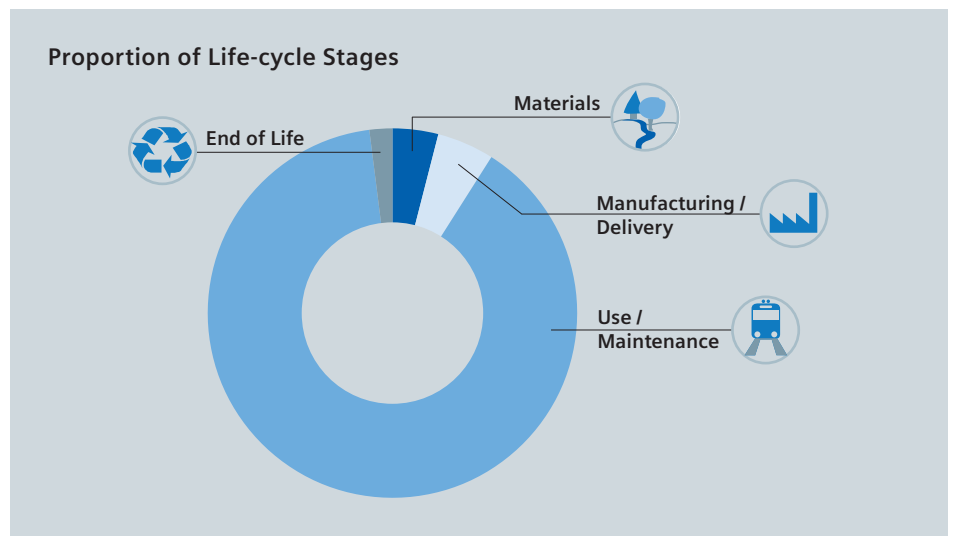
This stage covers the energy, materials and suppliers required for assembly and the production processes of a metro train at the factory site in Vienna. In addition, the packaging materials of supplier products, internal production transport and the recycling or disposal of resulting materials has been considered in this study.

A process management system for environment, health and safety is implemented worldwide within Siemens Transportation Systems.

It has been certified in accordance with ISO 14001 and OHSAS 18001.

The complete metro train will be delivered by rail freight from the manufacturing site to Oslo.

All information about inputs and outputs of the production sites is published in the Siemens Corporate Responsibility Report.



Use / Maintenance



Electricity consumption for operating the metro system in Oslo for a period of 30 years is based on a kilometreage of 120,000 km per year. It operates with high energy efficiency using regenerative braking which recovers up to 46 % of the energy consumed.

Each component of the metro train has a long lifetime and can be easily repaired and replaced.

The high proportion of recyclable materials of the spare parts is ascribed to the application of realizable materials and disassembly design.

End of life



The metro train can be easily disassembled and recycled. The "end of life" stage includes recycling, incineration and landfilling of the materials of the metro train. Transport to the recycling site and energy for the recycling processes are considered. Detailed information about the recycling behavior is contained in the Oslo metro disposal concept.

Key Environmental Performance Indicators

The intention of presenting key environmental performance indicators is to allow the comparison of products regarding their environmental performance.

The presented indicators are calculated and verified for the complete metro train and its operation.

Material Consumption

The material data of the metro train throughout its entire life-cycle process is based on data of the 2004/05 Siemens fiscal year. All necessary information of externally designed components has been given by the suppliers.

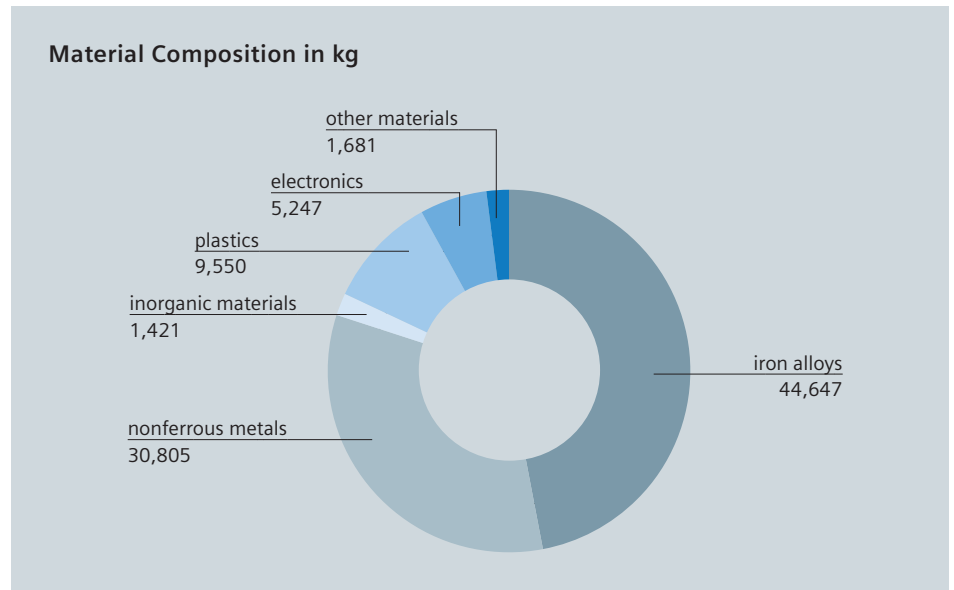
Material Classes	Unit	Material Consumption	Recycling of Materials	Absolute Material Consumption
iron alloys	kg	121,425	-118,996	2,429
nonferrous metals	kg	32,501	-31,851	650
inorganic materials	kg	2,222	-638	1,584
plastics	kg	41,565	0	41,565
other materials	kg	7,590	0	7,590
organic substances	kg	12,141	0	12,141
electronics	kg	6,218	0	6,218
TOTAL	kg	223,662	-151,485	72,177

Material Composition

The metro train has a total weight of 100 tonnes. The car body is designed as a lightweight aluminium-profile construction. The bogies mainly consist of high-alloy steel. All other train components mostly consist of plastics and electronic parts.

Fire prevention

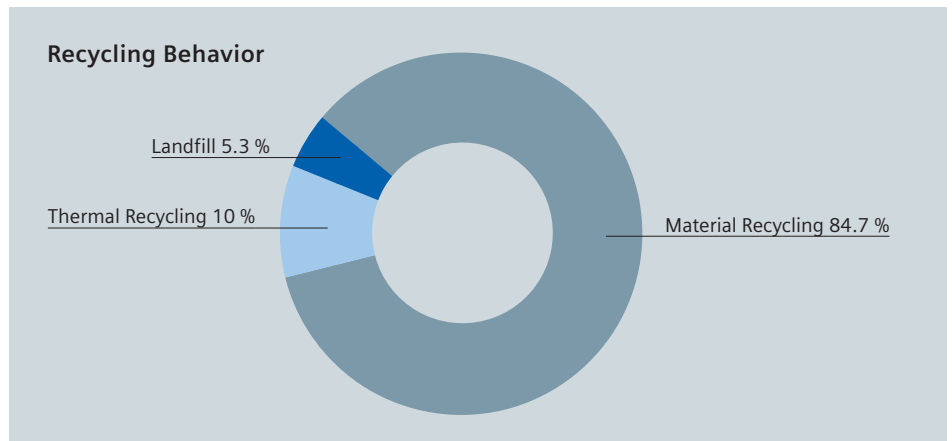
The metro train has been designed in accordance with the highest international standards, in line with DIN 5510 (preventive fire protection in railway vehicles) and BS 6853 (code of practice for fire precautions in the design and construction of passenger carrying trains). The metro train is equipped with fire extinguishers and fire and temperature sensors to make sure that a fire can be detected as early as possible.



Key Environmental Performance Indicators

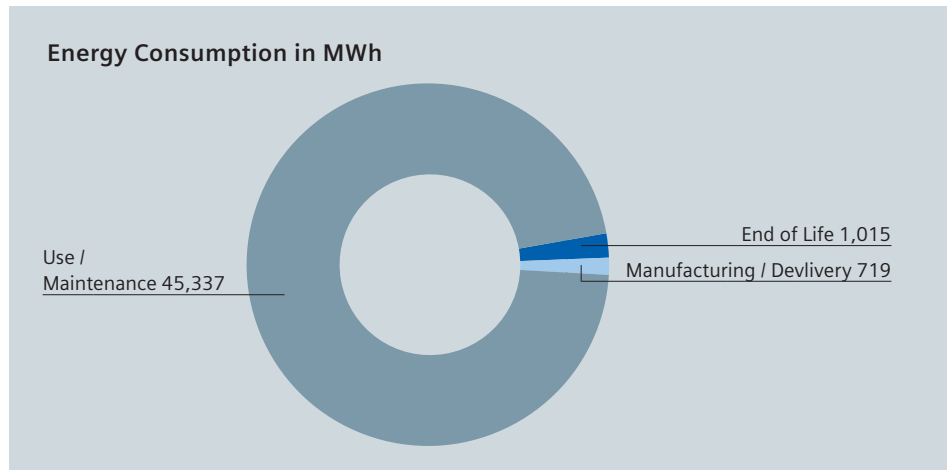
Recycling Behavior

A program for recycling and disposal has been drawn up showing a total recycling rate of 94.7 % for the metro train resulting from an 84.7 % material recycling rate and 10 % thermal recycling rate. The dismantling procedures of the metro components are described in the maintenance and repair manual.



Energy Consumption

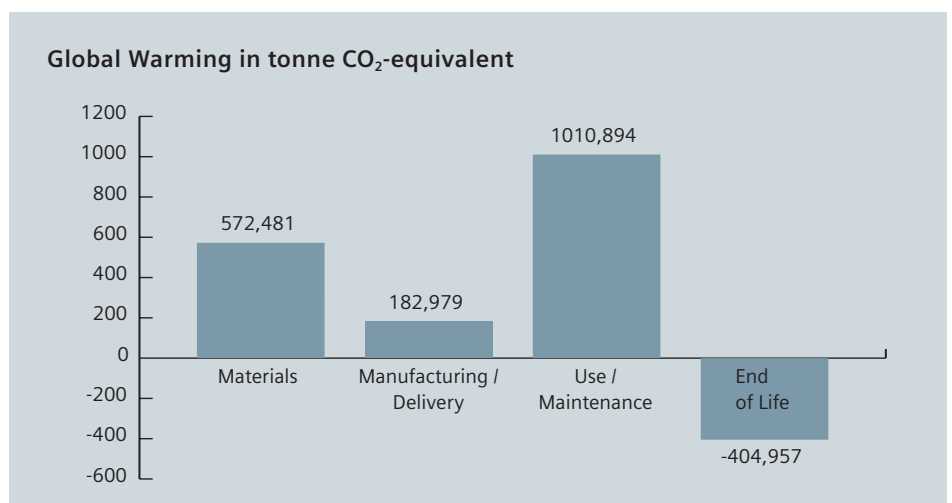
Energy consumption during product use has been calculated at a rate of 0.09 kWh/km-tonne for use, which represents a standard load case with average utilisation for summer and winter operation. In addition, the energy demand for the manufacturing, delivery and recycling processes of the metro train is shown.



Global Warming Potential

Global warming potential refers to the rise in global temperature caused by so-called "greenhouse gases" such as CO₂ or methane. The presented global warming results have been achieved from a life-cycle assessment study according to ISO 14040.

For the metro operated in Oslo, the environmental impact of global warming is about 2 g CO₂-equivalent / km-tonne for use and maintenance and 2.6 g CO₂-equivalent / km-tonne over the entire life-cycle. These low values result from the high energy efficiency of the metro train and Norway's energy mix with its large proportion of renewable energy.



Noise and Vibration

The external noise level created by a passing train is 76 dB(A) and the internal noise level is 64 dB(A), both measured at 70 kph. The measuring method is

according to ISO 3381. The external and internal noise and vibration emission levels have been minimized with a view to the perception of passengers and people living near the line.

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Legal Disclaimer

This environmental product declaration does not constitute a guarantee of the composition of a product, neither does it guarantee that the product will retain a particular composition for a particular period.

