Environmental Protection
For Siemens, environmental protection has two key aspects: First, we take sound product stewardship seriously and place great importance on product-based environmental protection; our products, systems and services are designed to achieve high standards in terms of environmental compatibility. Second, we take steps to ensure that company locations maximize resource efficiency and keep emissions as low as possible. To this end, we take a systematic approach to environmental management.

Environmental Policy
A commitment to act
Protection of the environment and conservation of resources are an aspect that we have integrated in our Business Conduct Guidelines on which all Siemens employees base their conduct. From this we derive our Siemens Environmental Policy, which describes what we mean by environmental protection. This in turn is the basis for our commitment to act proactively. Siemens’ Environmental Policy was approved in October 1998. With its focus on the fundamental principle of sustainable development, it continues to be relevant today.

For further information:
www.siemens.com/environmentalportfolio
www.siemens.com/green-mobility

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 (M). The total train length is 54.34 m with a maximum transport capacity of 678 passengers. The maximum speed is 80 km/h.

Complete mobility. Integrated solutions for efficient passenger and freight transport.

Safeguarding mobility is one of the big challenges in our society. To ensure our mobility in future, we need networked transportation and information systems. And we will only meet these mobility requirements through efficient coordination and perfect meshing of all modes of transportation. This is why Siemens – with its “Complete mobility” approach – is offering integrated transportation and logistics solutions for safe, cost-effective and environment-friendly passenger and freight services. For Siemens has the necessary competence to provide everything from infrastructure systems for railways and roadways to solutions for rolling stock, airport logistics and postal automation.

Key elements of “Complete mobility” are efficient solutions for rail-based transportation systems for cities and population centers and for connecting large cities and countries. Siemens operates all over the world. With most modern engineering and manufacturing sites for railway vehicles Siemens looks back on 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:
www.siemens.com/mobility
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.

Key environmental performance indicators

Material consumption over entire life-cycle

<table>
<thead>
<tr>
<th>Material classes</th>
<th>Unit</th>
<th>Material consumption</th>
<th>Recycling of materials</th>
<th>Absolute material consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron alloys</td>
<td>kg</td>
<td>121,425</td>
<td>-118,996</td>
<td>2,429</td>
</tr>
<tr>
<td>Nonferrous metals</td>
<td>kg</td>
<td>32,501</td>
<td>-31,851</td>
<td>650</td>
</tr>
<tr>
<td>Inorganic materials</td>
<td>kg</td>
<td>2,222</td>
<td>-638</td>
<td>1,584</td>
</tr>
<tr>
<td>Plastics</td>
<td>kg</td>
<td>41,565</td>
<td>-</td>
<td>41,565</td>
</tr>
<tr>
<td>Other materials</td>
<td>kg</td>
<td>7,590</td>
<td>-</td>
<td>7,590</td>
</tr>
<tr>
<td>Organic substances</td>
<td>kg</td>
<td>12,141</td>
<td>-</td>
<td>12,141</td>
</tr>
<tr>
<td>Electronics</td>
<td>kg</td>
<td>6,218</td>
<td>-</td>
<td>6,218</td>
</tr>
<tr>
<td>Total</td>
<td>kg</td>
<td>223,662</td>
<td>-151,485</td>
<td>72,177</td>
</tr>
</tbody>
</table>

Material composition of one train

The metro train has a tare weight of 94 t. The car body is designed as a lightweight aluminum-profile construction. The bogies mainly consist of high-alloy steel. All other train components mostly consist of plastics and electronic parts. In the figure of material composition the component weights of small parts are not considered.

Fire prevention

The metro train has been designed in accordance with DIN 5510 (preventive fire

Material consumption over entire life-cycle

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 provided by the suppliers.
protection in railway vehicles). For defined applications BS 6853 (code of practice for fire precautions in the design and construction of passenger carrying trains) has been used. The metro train is equipped with fire extinguishers and in addition with fire and temperature detection sensors to make sure that a fire can be detected as early as possible. For additional evacuation purposes an emergency evacuation door is installed at each train end.

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/tkm for use, which represents a standard load case with average utilization for summer and winter operation. In addition, the energy demand for the manufacturing, delivery and end of life 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 (LCA) study according to ISO 14040. For the metro operated in Oslo, the environmental impact of global warming is about 2 g CO₂-equivalent/tkm for use and maintenance and 2.6 g CO₂-equivalent/tkm 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) in a distance of 10 m from the track center line and the internal noise level in the passenger compartment is 64 dB(A), both measured at 80 km/h. The measuring method is according to external noise ISO 3095 and internal noise 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.
One of our product focuses is to minimize the environmental impacts from resource extraction through to the end of life of rolling stock. At every stage, we have developed trendsetting solutions in accordance with life-cycle thinking.

Description of the life-cycle stages

**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 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 the LCA study. A process management system for environment, health and safety is implemented worldwide within Siemens. It has been certified in accordance with ISO 14001 and OHSAS 18001. The complete metro train will be delivered in an appropriate manner 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 in Oslo for a period of 30 years is based on a kilometerage 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.
The development of this Environmental Product Declaration has been supported by Prof. Dr. Wolfgang Wimmer, ECODESIGN company, Vienna. The verification of the Life Cycle Assessment to calculate the global warming potential of the metro train has been carried out by Prof. Dr. Kun-Mo Lee, ECODESIGN company, Seoul.

Legal Disclaimer
This environmental product declaration is not a guarantee within the meaning of § 443 German Civil Code. It does not constitute a guarantee concerning the characteristics of a product, nor does it constitute a guarantee that the product will retain particular characteristics for a specified period.
Metro Oslo

Environmental Product Declaration according to ISO 14021

www.siemens.com/mobility