TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

Environmental Product Declaration for

the railway track on the Bothnia Line

Title: Environmental Product Declaration for railway track on the Bothnia Line
Publication number: 2016:153
Date of publication: November 2014
Registration number: S-P-00200, UN CPC 53212
Publisher: The Swedish Transport Administration
Production cover: Grafisk form och event, the Swedish Transport Administration
Cover photo: Göran Fält
Printed by: Ineko
Distributor: The Swedish Transport Administration

EPD®

En EPD® (Environmental Product Declaration; miljövarudeklaration) är ett oberoende verifierat och registrerat dokument som ger transparent och jämförbar information om produkters miljöpåverkan i ett livscykelperspektiv.

Introduction

This environmental product declaration (EPD) describes, from a lifecycle perspective, the total environmental impact of railway track on the Bothnia Line. The EPD is entirely restricted to the track system; substructure (tunnels, bridges, track foundations) and power, signalling and telecom systems are not included.

Within the International EPD system based on ISO standard 14025, this EPD was drawn up in accordance with Product Category Rules (PCR) 2013:19 for Railways (see www.environdec.com for further information about the EPD system).

The aim of this EPD is that it should provide experts and scientists (in the constructions and infrastructure sectors) with objective and reliable information on the environmental impact of constructing, operating and maintaining railway track.
This EPD was developed by Trafikverket (the Swedish Transport Administration). It has been certified by Bureau Veritas Certification AB and the certification is valid for three years (after which it can be prolonged).

Botniabanan AB has been responsible for the financing, detailed planning and building of the Bothnia Line. After completion, ownership of the infrastructure has been transferred to Trafikverket. Trafikverket has an implemented management system in accordance with the Swedish government's regulation (SFS 2009:907) on environmental management in state agencies. One focus area for Trafikverket's environmental work is to reduce climate gas emissions from construction, operation and maintenance of infrastructure and Trafikverket has therefore developed a tool for carbon footprint calculations for infrastructure projects (*Klimatkalkyl*, available at www.trafikverket.se). Inventory data for this EPD has been included in Klimatkalkyl, and the results for Global Warming and Energy Resources in this EPD is comparable to results in Klimatkalkyl for corresponding infrastructure parts.

This EPD sets out the environmental performance of railway track on the Bothnia Line. The following EPDs are also available for other Bothnia Line systems:
- EPD for railway infrastructure on the Bothnia Line.
- EPD for railway tunnels on the Bothnia Line.
- EPD for railway track foundations on the Bothnia Line.
- EPD for railway bridges on the Bothnia Line.
- EPD for power, signalling and telecom systems on the Bothnia Line.

As this EPD is based on data relating to Bothnia Line infrastructure, the results might not be representative of other railway track systems. In order to decide if the results

can be representative for other railway track systems, the most important areas that should be checked to be comparable with the Bothnia Line are:

• Railway functionality (single or double track, type of traffic, axle load, etc.).

• Construction methods (e.g. ballasted or slab track).

• Origin of materials (mainly steel and concrete).

Comparison towards previous EPD

This EPD is an updated version of the original EPD from 2010. The reason for the update is that the PCR has been revised. In the revision, the declared unit was changed:

Old declared unit: *1 km railway (main line) over a calculation period of 60 years*
New declared unit: *1 km railway (main line) and year*

Inventory data for LCA-calculations have not been changed, but the change of declared unit gives results in other units compared to previous EPD. The declared environmental performance in this EPD is therefore not comparable to previous EPD since it is presented in other units.

Facts about the infrastructure of the Bothnia Line

The Bothnia Line is a new Swedish railway running from Nyland (north of Kramfors) to Umeå. It is routed via Örnsköldsvik and comprises 190 km of new single-track railway with 22 sidings (each 1 km long) and 7 travel centres/stations. The latter have good connections for pedestrians, cyclists, local and regional bus traffic and private vehicles. There is a large freight terminal in Umeå and a smaller container terminal in Örnsköldsvik.

The line has 90 railway bridges (total length of 11 km) and 16 tunnels (25 km of main railway tunnels and16 km of service and access tunnels). Designed for combined passenger and heavy freight traffic, the Bothnia Line offers maximum speeds of 250 km/h for passenger trains and 120 km/h for freight trains with a maximim axle load of 25 tonnes. The groundbreaking for the project took place on 14 August 1999, and the railway is operational since autumn 2010.

Total track length (sidings included) is 209 km. The track was built using a long rail (420 m) system and is continuous welded (CWR). Sleepers are concrete with a c/c distance of 60 cm and class 1 macadam ballast. There are 125 points on the line, all with heating and snow brushes.

Technical Data Infrastructure

- Minimum radius of curvature: 3200 m
- Maximum gradient: 10 ‰
- Track gauge: 1435 mm
- Power-supply voltage: 15 kV, 16 2/3 Hz, AT-system
- Track: ballasted concrete sleepers, UIC 60 rail (continuous welded)
- Signalling system: ERTMS level 2
- Maximum axle load: 25 tonnes (30 ton on bridges)

Location of the Bothnia Line

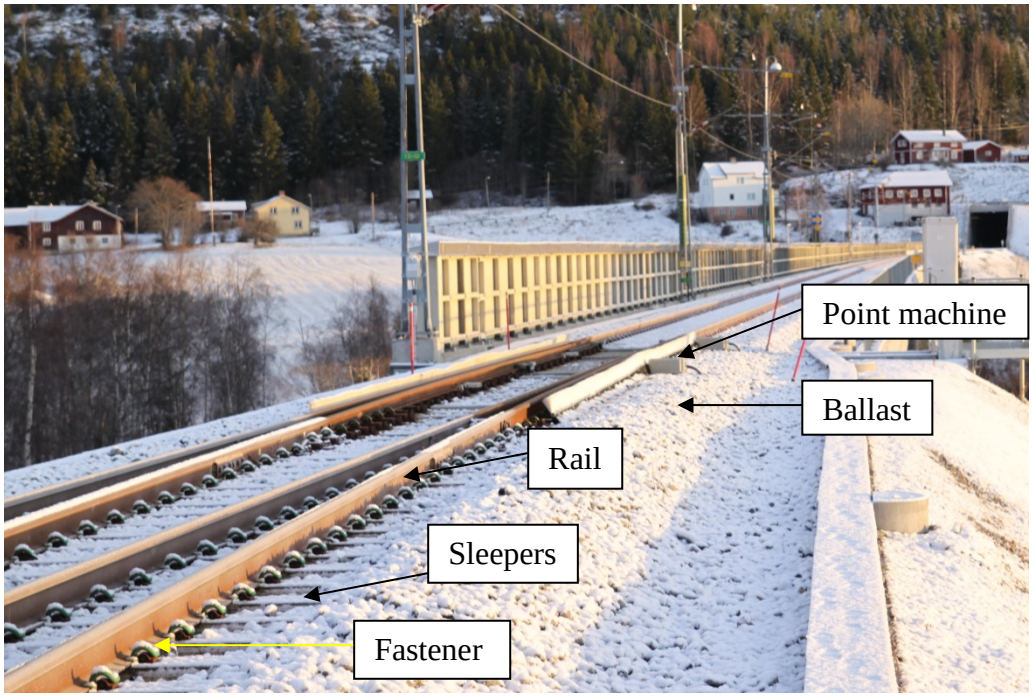
Environmental performance

Resource use and emissions

The environmental performance section of the declaration is based on a lifecycle assessment (LCA) carried out by WSP in 2014. The LCA was largely based on ecoinvent-data for materials and processes, and implemented in the software SimaPro. Inventory data was collected from the LCA for the Bothnia Line made by IVL Swedish Environmental Research Institute in 2009. An overview of system boundaries and included processes is given in the text, figures and tables below.

Extraction and production of raw materials, transport of materials and manufacturing of products were included in the LCA calculations. The data in respect of infrastructure-related processes and quantities of materials was collected from the building of the Bothnia Line. As regards steel for rails, specific data for material production was used. For other materials, selected generic data was used according to the calculation rules in the PCR 2013:19. The electricity used in construction processes and for production of materials was calculated as the average electricity mix for the countries hosting the processes.

The LCA calculations are based on the technical life times of all included components and results in a yearly contribution to all impact categories. All construction, reinvestment, operation and maintenance processes are included in that. All results are presented in the declared unit per kilometre of track foundations (main line) and year. As a complement, the impact from the construction phase is presented separately per kilometre of railway track (main line).



All processes and elements needed to construct, operate and maintain the railway track system have been included in the LCA. However, note that substructure (tunnels, bridges, track foundations) and power, signalling and telecom systems are not included. The figure shows some of the most important structural elements.

Overview of processes and elements included in the LCA for railway track on the Bothnia Line.

Track construction	**Track operation**	**Track maintenance**
Rail	Switch heating	Reinvestments determined by lifetimes of components and constructions
Sleepers and fasteners	Operation of point machines	Rail grinding
Ballast	Illumination of railway depots	
Point machines		
Construction work		
Welding		
Rail grinding		

As, under the rules in PCR 2013:19, waste handling processes make a negligible contribution to environmental impact categories (<1 %), they were excluded from the LCA. For processes excluded by default, see PCR 2013:19.

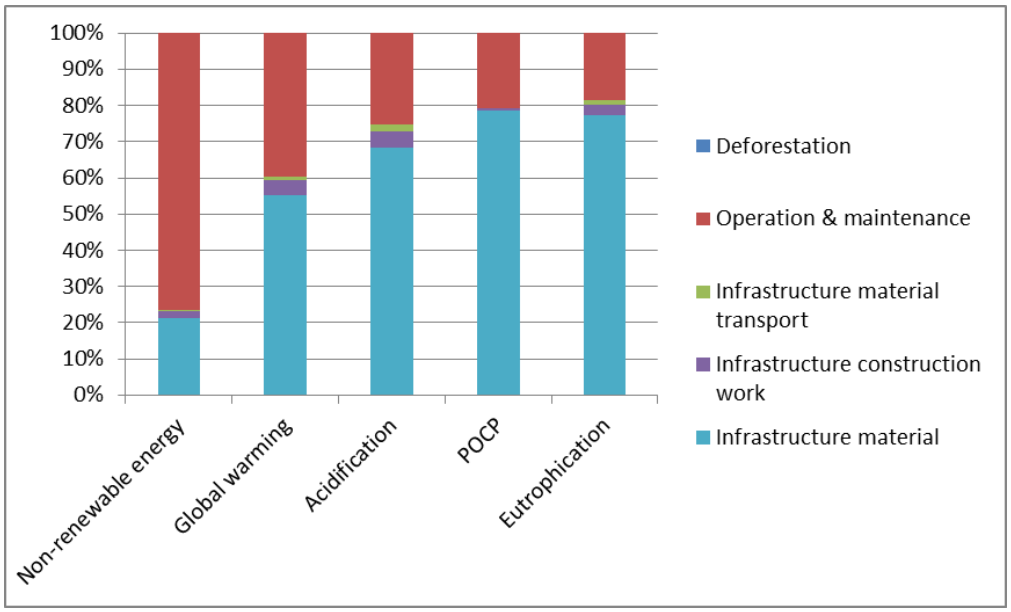
Annual environmental impact for 1 km railway track (main line) of the Bothnia Line. All construction, reinvestment, operation and maintenance activities are included for the track infrastructure. Impact from construction phase is presented separately per km (not annually). Note that substructure, power, signalling and telecom systems are not included.

		Declared unit per km and year			
Impact category	**Unit**	**Construction & reinvestment**	**Operation & Maintenance**	**Total**	**Construction per km**
Use of resources					
Non-renewable materials	kg	77 176	907	78 083	3 857 246
Renewable materials	kg	0,080	0,017	0,10	4,0
Non-renewable energy	MJ	104 539	337 539	442 078	5 196 502
Renewable energy	MJ	5 574	90 395	95 968	276 858
Secondary materials	kg	12 856	0	12 856	641 807
Secondary energy	MJ	6 555	191 145	197 700	327 755
Water, total	kg	46 498	890 690	937 188	2 308 776
Water, direct	kg	0	0	0	0
Land use	m2	217	346	563	10 770
Potential environmental impacts					
Global warming	kg CO_2-eq.	7 347	4 840	12 187	365 380
Acidification	kg SO_2-eq.	44	15	59	2 177
POCP (Photochemical oxidant formation)	kg C_2H_4-eq.	2,8	0,73	3,5	139
Eutrophication	kg PO_4^{3-}-eq.	18	4,1	22	890
Waste and outflows					
Output of materials for recycling	kg	12 856	0	12 856	0
Waste, hazardous	kg	0,38	0,15	0,53	19
Waste, excess soil	kg	0	0	0	0
Waste, other	kg	1 975	661	2 636	98 087

Specification of resources making the largest contributions to the different resource use categories

Resource use category	**%**
Non-renewable materials	
Gravel	93%
Iron	3%
Calcite	3%
Other	1%
Renewable materials	
Wood	100%
Non-renewable energy	
Fossil	34%
Nuclear	66%
Renewable energy	
Hydropower	98%
Biomass	1%
Wind, solar, geothermal	1%

Dominance analysis



Emission impact categories and the relative contributions (in %) made by the process groups relevant to the Bothnia Line's railway track. The process groups include all activities during the lifetime of the infrastructure. For example, "Infrastructure material" covers all materials used during construction, maintenance and reinvestment.

Upstream processes

Infrastructure material = Emissions from raw material acquisition and production of materials such as steel, concrete, etc.
Infrastructure material transport = Emissions from vehicles (e.g. trucks and trains) used for transporting infrastructure material (e.g. sleepers and rails) from suppliers to the construction site.

Core processes

Infrastructure construction work = Emissions from machines (trucks, locomotives, etc.) used in constructing the infrastructure.
Deforestation = Net emissions of CO2 resulting from forest land being permanently changed to railway land. Not applicable for railway track.

Downstream processes

Operation & maintenance = Emissions from production of electricity used for operation of the infrastructure (e.g. switch heating) and from use of fuels for maintenance work (e.g. rail grinding).

Additional environmental information

The impact that the building and operation of the Bothnia Line has on land use, biodiversity and environmental risk-related issues has been analysed and is described in the EPD for railway infrastructure. However, it is not possible or relevant to relate the results of the impact analyses to the individual infrastructure elements. Consequently, this EPD contains no such details.

Recycling declaration

The main infrastructure elements that are relevant as regards waste management and recycling are track, power, signalling and telecom equipment. Within Trafikverket, there is currently no general national strategy for recycling materials that are replaced during maintenance. Such materials often become the property of the contractor. Trafikverket's environmental strategy contains the following prioritised goals for the future:

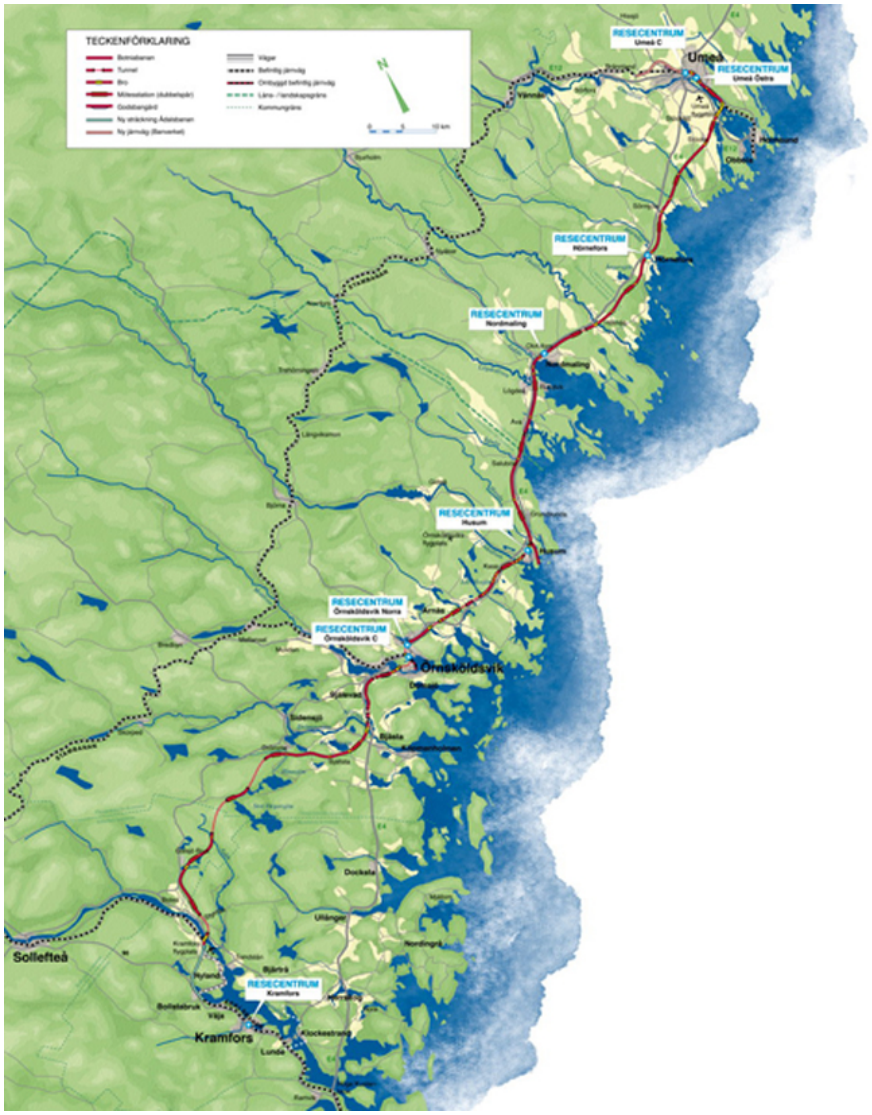
- Development, from an environmental perspective, of long-term reutilisation plans for strategic materials.
- Development of environmentally sound and effective management procedures for prioritised categories of waste.

Management of materials and substances

Throughout the construction of the Bothnia Line, all contractors have, as regards any chemical products and potentially environmental harmful materials they use, been required to obtain the approval of Trafikverket's Chemicals Board. Another requirement has been that PVCs and certain other materials (a number of specified harmful substances included therein) must not be used before the contractor has made an environmental risk assessment and Botniabanan AB has agreed with the use. If the use of any of these substances could not be avoided, the location of the components containing the substances has been documented by the contractor.

The satisfaction of these requirements has been checked in audits of all major contractors.

Hazardous waste generated in all contracts for the building of the Bothnia Line has been collected in environmental stations supplied by Botniabanan AB and managed by companies accredited for management of hazardous waste.



Route and travel centres/stations on the Bothnia Line (tunnels and bridges also shown)

EPDs from different programmes may not be comparable

See www.trafikverket.se for more information on the EPD and background material

PCR review was conducted by the Technical Committee (TC) of the International EPD Consortium (IEC). **See www.environdec.com for more information and contact for IEC.**
Independent verification of the declaration and data, according to ISO 14025: □ **Internal** X **external**
Third party verifier: **Bureau Veritas Certification AB** Fabriksgatan 13 SE-412 50 Göteborg SWEDEN *Accredited by: Swedac*

THE SWEDISH TRANSPORT ADMINISTRATION. PUBLICATION NUMBER: 2016:153. REVISED MAY 2017. PRODUCTION COVER: GRAFISK FORM, THE SWEDISH TRANSPORT ADMINISTRATION. COVERPHOTO: TRAFIKVERKET. PRINTED BY: INEKO.

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