

# The Follo Line Project

METHOD DEVELOPMENT: TOWARDS A MORE SUSTAINABLE RAILWAY



**Method development:  
The Green Railway Infrastructure Project**

The Green Railway Infrastructure Project takes Norwegian rail design ahead of current design management and elevates the design and construction process towards new, eco-innovative solutions.

# Building for the future

The Norwegian National Rail Administration is the first organisation in Norway to formulate a green assessment governing the choices of materials and solutions in major railway projects.

As a pilot project the Follo Line has created a method of life cycle assessment of the master plan to detail the potential environmental impact of construction, operation, maintenance and disposal of the Follo Line's infrastructure from a life cycle perspective.

The project has developed a method for integrating environmental criteria in all design phases, and it will be applied by all design & construction departments in the Norwegian National Rail Administration. There has been developed a guideline for implementing environmental assessment (LCA)/criteria for railway design. The aim is to implement this guideline as a standard in Norway.

The Follo Line Project will be executed by the Norwegian National Rail Administration on behalf of the Ministry of Transport and Communication. The Follo Line is the largest transport project in Norway: a new, 22 km double track line between Oslo Central Station and the public transport centre of Ski.

The project comprises the following sub-projects: Approach to Oslo Central Station, tunnel, open section and the construction of a new station at Ski. The Follo Line will include Norway's longest railway tunnel (19,5 km), which is the first rail tunnel in Norway to be built with two separate tubes.

Construction works is scheduled to commence in 2014, but important preparations have already started. The project is due to be completed in the end of 2019.

## Sustainable design

The method developed, called The Green Railway Infrastructure Project, takes Norwegian rail design ahead of current design management and elevates the design and construction process towards new, eco-innovative solutions. The project will generate significant environmental benefits such as reduced environmental impact, eco-procurement, environmental reporting, sustainable design and in general increased awareness of environmental impacts in all life cycle phases.

Following the success of this project, the Norwegian National Rail Administration collaborates with the Swedish Transport Administration, to further develop the Product Category Rules (PCR) for Railway infrastructure from 2009. An overall objective in the PCR work is to develop equal guidelines for rail and road infrastructure.

The Follo Line – A Green Railway Infrastructure Project was, in October 2012, awarded as "Highly Commended" by the International Union of Railways (UIC) in the category "Energy and CO<sub>2</sub>". The price for development of standard method, application and LCA Guideline for Railway Infrastructure was awarded at the 12th Sustainability Conference organized by the International Union of Railways (UIC) and Ferrovie dello Stato Italiane.

**For further information, please visit:**

[www.jernbaneverket/follobanen](http://www.jernbaneverket/follobanen)



# Making constructions “greener”

The Green Railway Infrastructure Project aims to develop a Norwegian standard for implementing environmental assessment (LCA)/criteria of railway design.

## 1 The objective of the The Green Railway Infrastructure Project is:

To define a standard method for life cycle assessment for planning a more eco-efficient railway infrastructure.

## 2 The objective of the LCA of railway infrastructure

### Main objective

To plan projects with input factors – materials and energy – which after a comprehensive assessment of the environmental impacts, safety and quality, ensures the lowest possible environmental impacts throughout the entire project lifecycle. The project’s environmental impacts (including climate change, eutrophication, photochemical oxidant formation, acidification, particle matter formation, human toxicity and ozone depletion) are documented in a Life Cycle Assessment.

### Success criteria I

The Life Cycle Assessment of planned railway infrastructure projects help to identify, assess and communicate the potential for reduced environmental impacts from the projects input factors (materials and energy) and solutions in a life cycle perspective.

### Success criteria II

The Life Cycle Assessment provides a basis for ranking and prioritizing environmental interventions in all planning phases.

### Success criteria III

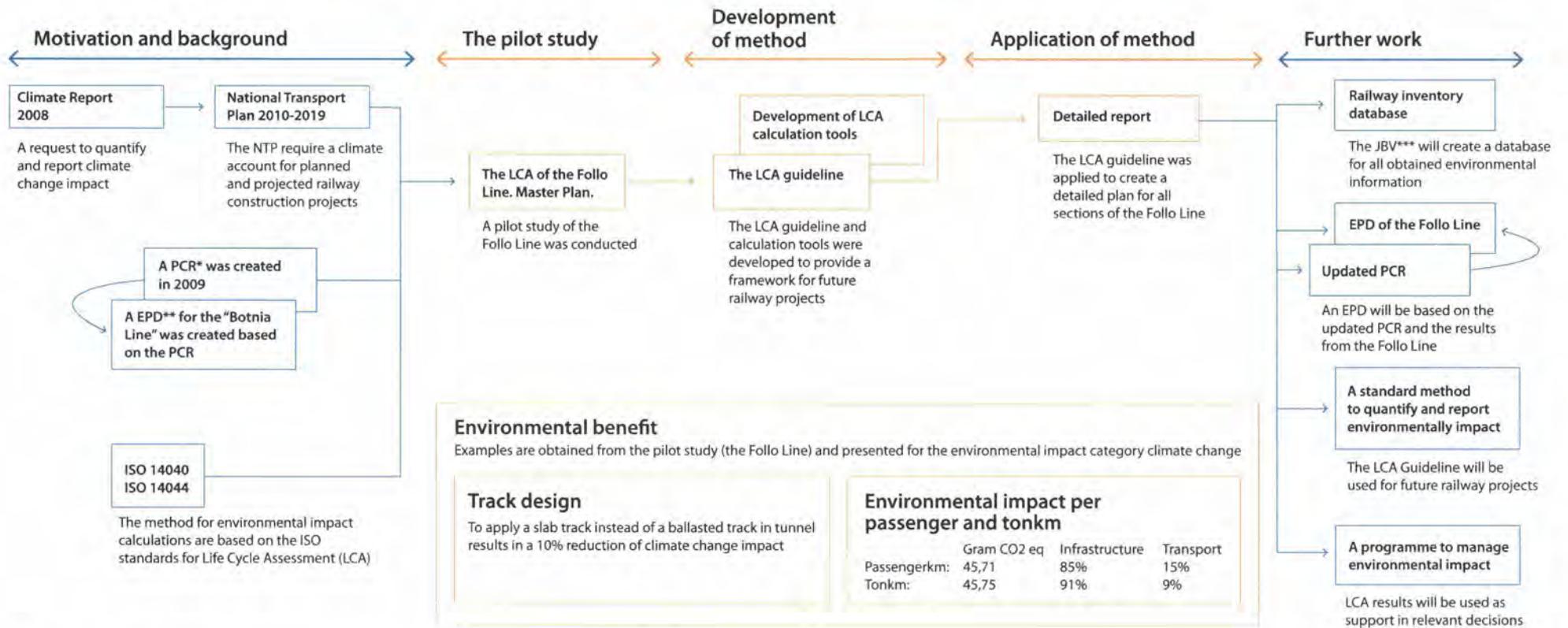
The Life Cycle Assessment should provide the basis for the projected life cycle climate impacts for the planned project, and the accounted life cycle climate impacts for the constructed project.

## 3 The Objective of the LCA Guideline for the Railway Infrastructure

- To create an efficient work process
- To develop a standard LCA method/practice for future projects, applies to both railway and highway
- To secure that LCA of different railway infrastructure projects can be compared
- To secure that LCA of different infrastructure projects (rail, road) and solutions can be compared
- To secure that experience and best environmental practice can be transferred from project to project

# Development of method, application and the LCA Guideline for Railway Infrastructure

The Green Railway Infrastructure Project was initiated by the Norwegian National Rail Administration as part of the strategy for a more eco-efficient railway. The objective of the Green Railway Infrastructure Project is to obtain an environmental focus in relevant decisions taken both in the Pre-Study, the Master Plan, the Detailed Master Plan and in the Construction Plan. Further, to develop a framework for calculating and reporting environmental impact for planned and future railway projects.



\* PCR: Product Category Rules

\*\* EPD: Environmental Product Declaration

\*\*\* the JBV: Jernbanelverket; Norwegian National Rail Administration

# Development of method and the LCA Guideline for Railway Infrastructure

Result: an eco-efficient railway



## The LCA Guideline - for Railway Infrastructure

### Method

Environmental impacts are calculated based Life Cycle Assessment (LCA).

### Impact categories

- Climate Change
- Human Toxicity
- Ozone Depletion
- Acidification
- Eutrophication
- Particle Matter Formation
- Photochemical Oxidant Formation

### Main objective

“The project will be planned with input factors - materials and energy – which after a comprehensive assessment of the environmental impacts, safety and quality, ensures the lowest possible environmental impacts throughout the entire project lifecycle”.

# The Follo Line – a pilot study

The figure illustrates the environmental impact on climate change\*

in terms of CO2 equivalents, calculated by applying the Life cycle Assessment (LCA) method. The pilot study is calculated for an estimated service life of 60 years.

## 1. Railway

### The Follo Line

Impact on climate change (CO2 eq.)

Result for passenger and freight transportation:

Pkm: 45,7 gCO2 eq.  
Tkm: 45,8 gCO2 eq.

Infrastructure 87%

Energy and operation of rolling stock 13%

Construction of infrastructure has a relative higher environmental impact than the rolling stock.

## 2. Life cycle phase

Waste management 6%

Maintenance 34%

Production 60%

The production phase of the infrastructure constitute the comparatively highest environmental impact.

## 3. Corridor section

Open section 4%

Tunnel 78%

Culvert 18%

The tunnel represents the relative highest impact on climate change.

## 4. Component

Railway engineering 12%

Tunnel component 88%

The tunnel component represents the highest impact on climate change.

## 5. Materials

Injection cement 24%

Steel 25%

Concrete 23%

Other 28%

In the pilot study, concrete, injection cement and steel represent the highest impact on climate change and thus, the highest reduction potential.

\* The pilot study include impact assessment of the five impact categories: Ozone Depletion, Acidification, Eutrophication, Photochemical Oxidant Formation and Climate Change. The LCA Guidelines also include Human Toxicity and Particle Matter Formation.

## About The Follo Line Project

- 22 km of new double track line between Norway's capital Oslo and the public transport centre of Ski
- Construction phase scheduled to commence in 2014
- Designed for 250 km/h
- 19.5 km tunnel
- Two separate twin bore tunnels with cross-passages every 500 metres
- The project facilitates a potential high-speed line to the continent
- 1.1 million residents in the Oslo region
- 150,000 passengers daily
- 30% increase in population and jobs anticipated by 2025
- Great potential for increased freight traffic

Norwegian National Rail Administration  
The Follo Line Project  
P.O. Box, Sentrum, N-0103 Oslo  
Telephone (+47) 05280  
follobanen@jbn.no  
Design: REDINK  
Photo: Norwegian National Rail Administration  
/ Hilde Lillejord (page 1) / Øystein Grue (page 3)  
November 2012

