

## **TOOLS FOR ENVIRONMENTAL PLANNING IN INFRASTRUCTURE CONSTRUCTION**

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### **ABSTRACT**

LCA-based studies for transport infrastructure are gaining momentum, and this paper presents a brief overview of recent and ongoing work in Norway and Sweden with regard to status of framework, guidelines and tools. Both countries are still in an early phase of implementing this work into decision making processes, but the approaches in both countries are similar and recommend generic data for early screening of concepts and alternatives, while the more detailed planning stages call for common guidelines rather than common data.

### **INTRODUCTION**

Studies of environmental impacts from transport have traditionally focused mainly on the direct emissions from the combustion processes. In recent years, national transport authorities have given increased attention to environmental effects of the transport infrastructure itself, and the way it is being constructed, operated, maintained, and also planned.

This short paper will present some of the current and recent work on LCA-based evaluation of rail and road infrastructure in Norway and Sweden, and how different tools and databases are applied to inform decision makers at different stages of the planning and building process. The main focus will be on the Norwegian case and on rail infrastructure.

### **LCA FOR INFRASTRUCTURE ASSESSMENT**

A central element in the recent studies of infrastructure related emissions is the use of life cycle assessment (LCA) methodology. Examples include the Swedish Bothnia line (Strippel and Uppenberg 2010), the first Norwegian LCA-based environmental budget for a planned railway infrastructure (Korsmo and Bergsdal 2010), the Norwegian national high-speed railway assessment (Svånå (Ed.) 2011; Bergsdal, Pettersen et al. 2012), and a methodological framework for assessment of climate emissions and energy use in road infrastructure projects (Hammervold 2009). These studies have brought new knowledge to transport planners and decision makers by highlighting the role of infrastructure and identifying potential trade-offs.

Infrastructure is important for railways in particular since they are more complex and material intensive, and in particular in Norway with its challenging topography. The Norwegian high

speed rail assessment found that infrastructure accounted for two thirds of total emissions for a 60 year operation period (Bergsdal, Pettersen et al. 2012). The figure could be even higher with a less conservative assumption for the electricity production.

Recent studies in Norway were initiated following the government’s work with the National Transport Plan (NTP) which calls for development of tools and framework for estimating climate emissions from infrastructure projects in a life cycle perspective, and for development of environmental budgets. Norwegian transport administrations have since established joint guidelines for such assessments, and will continue this work in the coming years (Kjerkol H et al 2010). The Norwegian Public Roads Administration (NPRA) has implemented their own tool (Hammervold 2009), and the Norwegian National Rail Administration (NNRA) has developed detailed guidelines for implementation and organization of environmental assessments for each individual planning phase from early concept evaluation to documentation of final solution after construction (Jernbaneverket 2012).

The Swedish Transport Administration (Trafikverket) has initiated work on establishing routines and guidelines for life cycle assessment of transport infrastructure, and how this can be integrated into planning and construction of infrastructure (Öman, Andersson et al. 2012).

### LCA AS DECISION SUPPORT IN INFRASTRUCTURE PLANNING

Figure 1 shows the conceptual planning process for rail projects in Norway. In the early assessment stage, strategic decisions are taken regarding concept choices, alignment options and composition, design speed etc. Decisions at this stage rely on more generic and less specific data than later planning stages in order to provide some key information for decision makers. Later planning stages include more technical planning and is done in several stages with increasing level of data quality and detail. Decision support tools for this stage should be able to assess different technological solutions to optimize the performance of the chosen concept and alignment. In the construction stage, tools need to assist in the choice of materials and suppliers, and provide a basis for specific requirements during the construction.

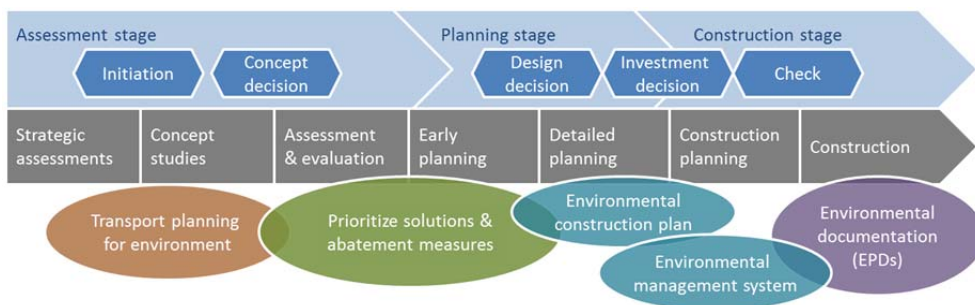


Figure 1. Overview of planning stages and environmental decision milestones and decision support for railway projects in Norway.

Figure 2 give an overview of the tools and structure that have been used in Norway and a proposed structure for the same in Sweden. The Norwegian work was initiated by governmental requirements, but the means and tools were not specified. The transport administrations have therefore started a process to establish joint guidelines, and tool developments have been the result of initiatives and work in single projects that have become pilot projects more by chance than by strategic choice. For rail infrastructure, the new Follo

line currently in planning has become the pilot for the NNRA’s environmental work, following the LCA-based environmental budget developed for the concept assessment stage of the project (Korsmo and Bergsdal 2010). Relevant tools and guidelines in Norway include:

- National Transport Plan - General guidelines and framework for climate emissions.
- High speed rail climate assessment and interactive calculator – Assessment report and interactive tool for high speed rail concepts in Norway and transition effects.
- SimaPro database – Generic database information based on Norwegian projects.
- SimaPro Follo pilot – Model, structure and organization of data for rail projects. Guidance document for LCA of rail infrastructure has been developed based on this.
- Environmental budget calculator – Interactive tool for result presentation, dissemination, simplified analysis of alternatives/assumptions, and benchmarking.

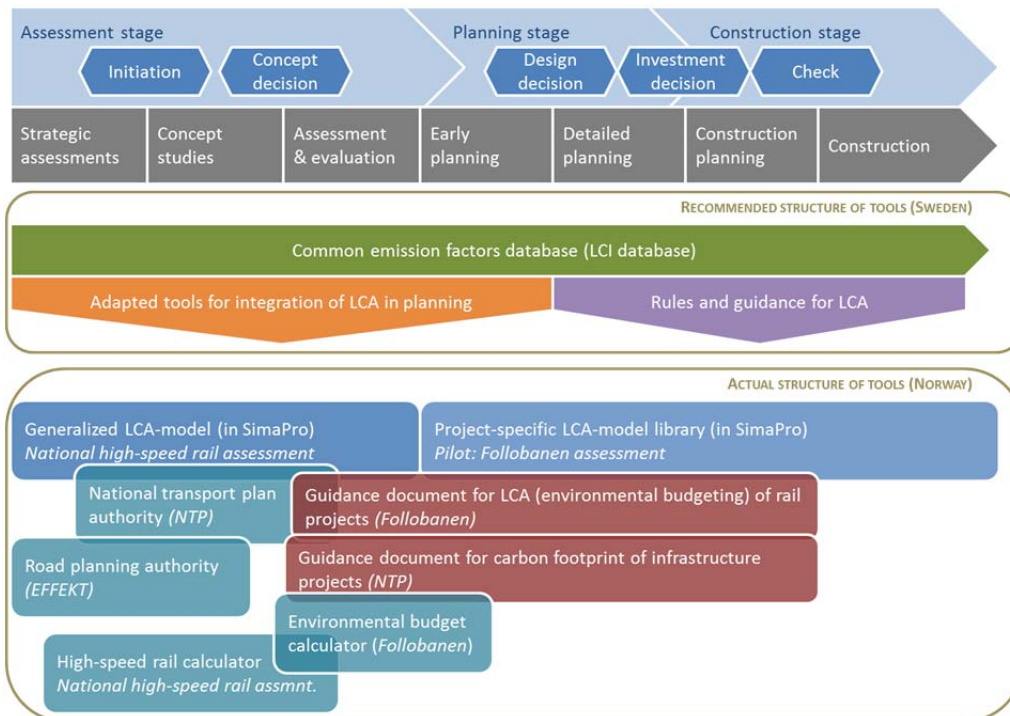


Figure 2. Overview of recommended tool structure (in Sweden) and actual observed structure in Norway of LCA-based environmental tools in planning for railway projects.

The tools developed so far are mainly related to the early assessment stages to evaluate alternative alignments and support concept choices, but are also being adapted to other and more specific questions about of technology, materials, suppliers etc. Further development is expected. A general feature for all the tools is that they rely on a database structure and information compiled and documented in the SimaPro software for LCA, thereby enhancing the flexibility for adapting tools to new planning stages and to compile, structure and transfer knowledge between projects and planning stages.

Comparing with the recommendations for Sweden, we see that the approaches are similar. The Swedish recommendations call for a common emission factors database as a basis for adapted tools for integrated planning in the earlier stages of the assessment and planning process (Öman, Andersson et al. 2012). This corresponds with the NTP guidance documents,

the Norwegian NPRA's EFFEKT model for climate assessment, and the NNRA's work with building a database based on completed LCA-projects. Both approaches use generic empirical data for early screening and evaluation. Information from new projects is supposed to be integrated in a common database which is continuously improved and updated. Generic data should describe material use and associated emissions intensities.

In the technical planning stages and final construction, the two approaches are also similar. The Swedish recommendations call for a common framework with rules and guidance, whereas the tool for assessment is free of choice. This is similar to the Norwegian approach where framework and guidance documents are developed and in use. Even if the applied tool has been the same so far, this is not a requirement in the guidelines.

Figure 2 shows no tools for completed projects and environmental accounts for Norway. The reason is simply that no project has yet been completed. The focus has so far been on the assessment and early planning stages, and these projects are not finished. However, guidelines are preparing for this and we can expect to see environmental accounts in the next years for some completed projects. The Swedish Bothnia Line was followed from environmental budget in the assessment and planning stage to an environmental account after completion, even extending to environmental product declarations (Stripple and Uppenberg 2010).

## CONCLUSIONS

National transport administrations in both Norway and Sweden have both initiated processes for establishing common and standardized sets of guidelines and framework for reporting and tools. Current developments are based largely on pilot projects and experiences from these are being implemented in the guidelines, and data is compiled and available for future projects and developments. The primary goal for the work is to support decision-making at various stages of the planning process. A challenge for the near future is to avoid the results becoming merely a documentation of a chosen solution, and rather integrate into the decision process at an early stage in order to provide relevant information before concepts and technical solutions are chosen. Both countries are currently working towards this end.

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