



Norwegian University of  
Science and Technology

# Analysis of the Environmental Management in the Planning Phase for the Construction of an Electrical Railway

The Case for the Electrification of the Trønder  
and Meråker Lines by Jernbaneverket

**Helene Irgens Hov**

Safety, Health and Environment

Submission date: June 2016

Supervisor: John Eilif Hermansen, IØT

Co-supervisor: Cecilie Mørk Selsbak, Jernbaneverket  
Ingunn Dåvøy, Jernbaneverket

Norwegian University of Science and Technology  
Department of Industrial Economics and Technology Management



# Description of the study

The purpose of the study is to analyse the environmental management in the planning phase of the project “Electrification of the Trønder and Meråker line”, focusing on the inclusion and fulfilment of internal and external demands regarding environmental aspects. The study concerns where and how environmental considerations are included in the project planning, and includes demands placed upon external suppliers of goods, materials and services.

Main components:

1. Review of literature about the specific railway project, internal and external requirements, theory about project planning in construction including environmental decision-making, national transportation strategies, and acknowledged standards and best practices in environmental management.
2. Empirical analysis of compliance in project with internal and external demands, executed with a GAP analysis and interviews with decision makers.
3. Empirical analysis of effectiveness and degree of inclusion of environmental knowledge and concerns in project planning.
4. Identification of critical decision points and challenges, and making suggestions for optimization of the process of integration of environmental management.



# Preface

This master thesis was written as a part of the MSc degree in Health, Safety and Environment at the Department of Economy and Technology Management (IØT) at the Norwegian University of Science and Technology (NTNU) in Trondheim spring 2016. The master thesis was written in collaboration with Jernbaneverket, and the project Electrification of Trønder and Meråkerbanen is the case for the study. The case was at the time of the study in the planning phase, and changes might therefore be made after the completion of this study.

I would like to thank the supervisor for the thesis, associate professor John Eilif Hermansen at IØT for valuable advice for the thesis. A special thanks to Cecilie Mørk Selsbak, environmental advisor at the project Electrification of Trønder and Meråker lines, for crucial information and valuable insight into the project and organization throughout the semester. Further, I would like to thank the case project employees and Jernbaneverket for their time, opinions and information for this thesis, and for allowing an insight into an interesting organization and sector. Thanks are further given to Solfrid Foss at Difi, for valuable information from Difi.



# Abstract

## **Sammendrag (Norwegian)**

Hensikten med studiet er å analysere miljøledelsen i planleggingsfasen for case prosjektet Elektrifisering av Trønder og Meråkerbanen av Jernbaneverket. Dette inkluderer identifisering av erfaringer og utfordringer, samt potensielle tiltak for å forbedre miljøprestasjon. Caset er et pilot miljøprosjekt, som kan gi læring både i Jernbaneverket og i bygg og anleggsindustrien. Prosjektet er den del av en modernisering av jernbanen. I studiet legges det vekt på miljøaspekter knyttet til norske utslippsforpliktelser. Analysene ble utført gjennom intervjuer med ansatte på prosjektet, og Gap analyse av oppfyllelse av interne og eksterne krav. Ytterligere roller i Jernbaneverket ble videre intervjuet for å gi innsikt i generelle erfaringer og utfordringer i Jernbaneverket. Resultatene indikerer at prosjektet har høyere miljøambisjoner enn prosjekter vanligvis har i Jernbaneverket. Det er evaluert at det er sterke strukturer for miljøledelse generelt i Jernbaneverket. Videre er det funnet at mer omfattende informasjon er utviklet gjennom et miljøbudsjett, og at dette muliggjør utarbeiding av mer spesifikke miljøkrav i anskaffelser enn normen. Likevel er bruk av miljøbudsjett og regnskap relativt nytt i Jernbaneverket. Resultatene indikerer at det kan finnes en flaskehals for å sikre miljøytelse gjennom prosjektfasene, og at dette kan være manglende kunnskap og erfaring for hvordan en best bruker informasjon fra miljøbudsjettet videre, samt hvordan en setter, integrerer og følger opp ulike typer krav i anbud og kontrakter. Tiltak er foreslått for dette. Videre kan økt miljøkunnskap for ansatte på prosjektet fremme mindre forsinkelser og kostnadsøkninger i prosjektet.

## **Abstract (English)**

The purpose of the study is to analyse the environmental management in the planning phase of the case project Electrification of the Trønder and Meråker lines by Jernbaneverket. This includes identification of experiences and challenges, and potential measures for improving environmental performance. The case is an environmental pilot project in Jernbaneverket, which can provide learning both in Jernbaneverket and in the construction industry. The project is a part of the modernization of the railway net. Environmental aspects related to Norwegian greenhouse gas reduction targets are emphasized in the study. The analyses were performed through interviews with employees in the project, and Gap analyses for compliance to internal and external environmental demands. Additional roles in Jernbaneverket were further interviewed for providing insights to main experiences and challenges in Jernbaneverket. There are in general strong structures for environmental management in Jernbaneverket. The results provided indicates that the case project has higher environmental ambitions than projects usually have in Jernbaneverket. A comprehensive environmental budget provides extended information regarding impacts from the project, and this enables setting more specific environmental demands in procurements than the norm. Still, the use of an environmental budget and inventory is considered quite new in Jernbaneverket. The results indicate that a bottleneck for securing environmental performance through the project phases is lacking knowledge and experience for how to best use the information an environmental budget provides, and how to set, integrate, and follow up different types of demands in tenders and contracts. Measures are suggested for this. Further, increasing environmental knowledge has been found to possibly promote fewer delays and cost increases in the project





# Table of contents

Description of the study .....	i
Preface .....	iii
Abstract .....	v
Table of contents .....	vii
List of figures .....	ix
List of tables .....	x
Table of abbreviations .....	xi
Table of definitions .....	xii
1 Introduction .....	1
1.1 Background .....	1
1.2 Problem description and system boundaries .....	5
2 Methodology .....	9
2.1 Method for description of the case .....	9
2.2 Method for literature review for the construction of a theoretical framework .....	11
2.3 Method for interviews .....	12
2.4 Method for Gap analysis of external and internal environmental demands .....	14
3 Description of the case and Jernbaneverket .....	17
3.1 Jernbaneverket .....	17
3.1.1 Organisation .....	17
3.1.2 Operations .....	18
3.1.3 Overarching objectives .....	19
3.1.4 Phase structure and planning phases .....	20
3.1.5 Environmental management in Jernbaneverket .....	21
3.1.6 Contracts and procurement .....	25
3.2 The case: Electrification of the Trønder and Meråker lines .....	28
3.2.1 The purpose, organisation and suppliers for the project .....	29
3.2.2 Project phases and timeline, the case sections and technical concept .....	31
3.2.3 Environmental management for the project .....	35
3.2.4 Summary and evaluation .....	40
4 Theoretical framework .....	43
4.1 National strategies and plans for transport .....	43
4.1.1 The National Transport Plan 2014-2023 .....	43
4.1.2 The National Transport Plan 2018-2029 .....	44
4.1.3 Summary and evaluation .....	50
4.5 Legislation for environment and construction .....	51
4.5.1 The Constitution of Norway .....	51
4.5.2 The Planning and Building Act .....	51

4.5.3 The Public Procurement Act – Prop 51 L (2015-2016) .....	52
4.5.4 A new Regulation for Public Procurement in Norway .....	53
4.5.5 Current development in research on legislation and environment.....	55
4.5.6 Summary and evaluation.....	56
4.6 Standards and tools for EMS in construction.....	57
4.6.1 ISO 14001 Environmental management systems .....	57
4.6.2 Difi – Green procurements in construction.....	60
4.6.3 NS 3466: Environmental programme and follow-up system in the construction sector.....	64
4.6.4 Summary and evaluation.....	66
4.7 Environmental management and green procurement in construction.....	66
4.7.1 Studies on environmental management in construction.....	66
4.7.2 Studies on green procurement.....	71
4.7.3 Summary and evaluation.....	72
5 Empirical analyses .....	75
5.1 Interviews.....	75
5.1.1 Interview results.....	75
5.1.2 Summary and evaluation.....	83
5.2 GAP analysis for compliance with internal and external demands.....	84
5.2.1 Gap analysis for performance according to internal demands .....	84
5.2.2 Gap analysis for performance according to external demands .....	88
5.2.3 Summary and evaluation.....	89
6 Discussion.....	91
6.1 Empirical analyses .....	91
6.2 Research questions and findings .....	91
6.3 Evaluation of empirical analyses .....	100
7 Main findings and recommendations.....	103
7.1 Main findings .....	103
7.2 Recommendations.....	105
8 References.....	107
Appendix A: Connections for research questions, interview guide and literature themes.....	
Appendix B: Interview guide.....	
Appendix C: Interviewees.....	
Appendix E: Environmental SWOT analysis for the project.....	
Appendix F: Gap analysis – Compliance to internal demands .....	
Appendix G: Gap analysis – Compliance to the revised Public Procurement Act and Regulations .....	
Appendix H: Draft of demand specification for EPDs .....	
Appendix I: Draft of environmental award criteria for contractor.....	
Appendix J: Control plan for the project .....	
Appendix K: Difi -Suggestions for environmental demands construction projects.....	

## List of figures

Figure 1: System for the issue analysed – The electrification of the Trønder and Meråker lines.....	8
Figure 2: Model with data sources for the Gap analysis performed in the project. ....	15
Figure 3: Organization of Jernbaneverket (Svingheim, 2016b).....	18
Figure 4: Area map for the operations of Jernbaneverket, and overview of electrified lines (LINY et al., 2015). ....	19
Figure 5: The planning system of Jernbaneverket (Tuven, 2014) .....	21
Figure 6: General purchasing plan for Jernbaneverket (Jernbaneverket. 2015). ....	28
Figure 7: Sections in the Mid-Norway region that are covered by the project Electrification of the Trønder and Meråker lines: Trondheim – Steinkjer and Hell-Storlien (Jernbaneverket, 2014). ....	29
Figure 8: Project structure for the electrification of Trønder- and Meråker line (Jernbaneverket, 2015c). ....	30
Figure 9: Project plan and overarching project phases for the electrification of the Trønder and Meråker lines (Jernbaneverket, 2015c).....	32
Figure 10: Illustration of CL construction and elements (Jernbaneverket, 2015c) . ....	34
Figure 11:Norwegian climate gas emissions for 2014 (Avinor et al., 2016). ....	46
Figure 12: Percentage of emissions from transport for sectors not subject to quota (Avinor et al., 2016). ....	47
Figure 13: Connection between the ISO 14001 framework and PDCA (ISO, 2015). ....	58
Figure 14: NS 3466:The coherence between environmental politics, environmental programme, environmental follow-up plan and other documents (Standard Norge, 2009). ....	65
Figure 15: Normative steps in a general EIA (Glasson, 2005). ....	69

# List of tables

Table 1: Overview of documents with requirements used as «desired state», and data used for describing “current state” in the performance of the Gap analyses. ....	16
Table 2: Main performance areas for Jernbaneverket from 2014-2017 (Jernbaneverket, 2013b). ....	20
Table 3: Environmental policies of Jernbaneverket (Staurem and Dahl, 2014). ....	23
Table 4: : Internal environmental performance targets for 2017 for Jernbaneverket (Jernbaneverket, 2013a) . ....	23
Table 5: Objectives for the environmental communication plan of Jernbaneverket (Staurem and Kojedahl, 2016).....	25
Table 6: Documents included in contracts with contractors in Jernbaneverket (Jernbaneverket, 2016a). ....	26
Table 7: Functional and technical demands for the project (Jernbaneverket, 2015).....	34
Table 8: Main objectives for the project (Jernbaneverket, 2015c).....	35
Table 9: Positions and responsibilities for environmental management (Dahl, 2014). ....	36
Table 10: Environmental impact for the construction, operation, maintenance and disposal expected in the project (Garmann and Skjøstad, 2014).....	38
Table 11: Overarching environmental goals of Jernbaneverket, in accordance to NTP 2019-2023 (Samferdselsdepartementet, 2013).....	44
Table 12: Objectives and targets in the NTP 2018-2029. *XX percentage is under consideration. (Avinor et al., 2016).....	45
Table 13: Principles for priorities according to the climate strategy of the NTP. (Avinor et al., 2016). ....	48
Tabell 14: Main changes in the proposal of a new Public Procurement Act (Nærings- og fiskeridepartementet, 2015b). ....	53
Table 15: Considerations for a green procurement process, according to Difi (Difi, 2016a) .....	61
Table 16: Frequent procurements in public construction and affected environmental aspects (Difi, 2010). ....	63
Tabell 17: Stages of a products lifecycle according to NS 3466 (Standard Norge, 2009).....	65
Tabell 18 : Top 10 challenges faced by project managers for green construction (Hwang and Ng, 2013). ....	71

## Table of abbreviations

<b>Abbreviation</b>	<b>Name</b>	<b>Norwegian translation</b>
Difi	Directorate for Public Management and eGovernment	Direktoratet for forvaltning og IKT
EIA	Environmental Impact Assessment	Miljøkonsekvensanalyse/utredning
EMS	Environmental management system	Miljøstyringssystem
EPD	Environmental Product Declaration	Produkt miljødeklarasjoner
ISO	International Standardization Organization	Internasjonal organisasjon for standardisering
JBV	Jernbaneverket	Jernbaneverket
MOP	Environmental follow-up plan	Miljøoppfølgingsplan
NS	Norwegian Standard	Norsk Standard
NTP	National transport plan	Nasjonal transport plan
PCR	Product Category Rules	Produktkategori-regler
SHA	Safety, Health and Working environment	Sikkerhet, helse og arbeidsmiljø
SHA	Safety, health, working environment	Sikkerhet, helse, arbeidsmiljø
UNFCCC	United Nations Framework Convention on Climate Change	FNs klimakonvensjon

## Table of definitions

<b>Concept</b>	<b>Definition</b>
Absolute demand	Absolute demands are demands that disqualify bidders from a tender if they are not met (Jacobsen, 2016).
Award criteria	Criteria for choosing the most beneficial bid (Difi, 2015).
Continuous improvement	Reoccurring activity to enhance performance (ISO, 2015)
Environment	Natural surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, people, outer space and their interrelationships(ISO, 2015)
Environmental aspect	Element of an organization's activities or products or services that interacts or can interact with the environment (ISO/TC 268/WG3, 2015).
Environmental management system	Part of the management system used to manage environmental aspects, fulfil compliance obligations, and address risks and opportunities (ISO, 2015)
Environmental objective	Objective set by the organization consistent with its environmental policy (ISO, 2015)
Environmental performance	Performance related to the management of environmental aspects (ISO, 2015)
Environmental policy	Intentions and direction of an organization related to environmental performance, as formally expressed by its top management (ISO, 2015)
Green procurement	Green procurement is promotion of the production of products and services with a lower environmental impact (European Commission, 2008).
Indicator	Measurable representation of the condition or status of operations, management or conditions (ISO/TC 268/WG3, 2015)
Life cycle	Consecutive and interlinked stages of a product (or service) system from raw material acquisition or generation from natural resources to final treatment (ISO, 2015)
Measure	Action that is done to achieve an objective. The electrification project in itself is a large measure. Measures can be preventing, such as implementing an EMS system to handle environmental aspects.
Qualification requirement	Requirements for suppliers wanting to participate in the tender. If the firm does not fulfil the qualification requirements, they will be dismissed from the tender (Difi, 2015).
Requirement specification	Demands to the delivery/execution of the task. The demands provide the framework for the suppliers bid, and will be integrated in the contract done with the most beneficial bidder (Difi, 2015).
Sustainability	State of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs (ISO/TC 268/WG3, 2015)
Sustainable Development	Development that meets the environmental, social and economic needs of the present without compromising the ability of future generations to meet their own needs (ISO/TC 268/WG3, 2015).

# 1 Introduction

Electrification of the Trønder and Meråker lines is planned in Jernbaneverket (JBV), to modernize the stretches for the coming 30 years. The electrification is an environmental pilot project. The project is in the detailed planning phase, and decisions are made for how the environmental management system (EMS) will handle the objectives and risks for the project (Jernbaneverket, 2015c).

In the Paris Agreement made on the climate summit COP21 by the UNFCCC (UNFCCC, 2015a), Norway indicated cuts by 40 percent compared to the emission level for CO<sub>2</sub>-equivalents in 1990 (Klima- og miljødepartementet, 2015). The transport sector constitutes 31 percent of the total emissions in Norway (Avinor et al., 2016). A 50 percent reduction in CO<sub>2</sub> equivalents is planned in the sector according to the new National Transport Plan (2018-2029) (Avinor et al., 2016).

The pilot project can be a learning process, and can potentially increase the general and environmental performance of JBV. JBV can be a strong agent for environmental improvements in infrastructure and construction projects. As a governmental organization, it has special responsibility for their environmental aspects according to § 112 in the Constitution of Norway. (Justis og beredskapsdepartementet, 2014).

The Public Procurement Act has been revised by The Norwegian ministry of Trade, Industry and Fisheries, and a new simplified version with a larger emphasis on the life cycle of products and services is on hearing at the time of this study (Nærings- og fiskeridepartementet, 2015a). Green procurements is one of the objectives for JBV according to the NTP, and is especially relevant because of the environmental ambitions communicated for the project and the significant procurements that will be made of services from contractors and suppliers.

Analysis of the environmental management of the electrification project is performed in this case study, with emphasis on compliance to legislation, internal demands and best practices. Deviances, measures and issues for improvement are found. Greenhouse gas emissions are included in a larger degree than other environmental aspects, all though infrastructure construction can provide significant impact on environmental themes such as ecosystems and biodiversity.

The background for the study is presented in this section, before the problem is described, and research questions and system boundaries are explained.

## 1.1 Background

The electrification of the Trønder and Meråker lines is performed as a part of renewing the railway net in Trøndelag to a modern standard, and is a pilot environmental project in JBV. The electrification will cause a change from diesel to electricity, considered a cleaner energy source. The stretches are a part of a strategy for implementing ERTMS on the national stretches. A more flexible, effective and competitive transport function with lower transport costs is expected from the electrification. Shorter travel time can enhance the living and working market in the Trøndelag area. The project is performed in the South and Northern Trøndelag, and is planned in the period 2015-2023. (Jernbaneverket, 2015c) The

electrification project was in the detailed planning phase at the time of the study, and is tendered as a total enterprise (Selsbak, 2016b).

The electrification project is prioritized as a part of the transport policy, strategy and plans described in the Norwegian National Transport Plan (NTP) for the period 2014-2023 (Samferdselsdepartementet, 2013). Further, it is included in the NTP for 2018-2029. Central objectives in the NTP are integrated in existing objectives in in JBV. (Avinor et al., 2016).

The NTP (2018-2029) was developed in the aftermath of the Paris Agreement. The agreement was made under the international climate conference COP 21 by the UNFCCC in Paris October 2015 (UNFCCC, 2015a). The agreement was based on the findings of IPCC for the scientific acknowledged finding of correlation between greenhouse gas emissions and global warming, and further related consequences of this (IPCC, 2014). Norway is one of 196 nations that have indicated their commitments for reductions in CO<sub>2</sub> emissions. The commitment was to contribute to reducing the global temperature increase to no higher than 1,5<sup>o</sup>C in 2100 compared to 1850. The participant nations in the Paris Agreement will report on results every fifth year, and communicate new and stricter emission targets. (UNFCCC, 2015b). This is a contribution to a sustainable development, which Norway has further committed to by the UN Sustainable Development Goals (SDGs) in September 2015 (UN, 2015). The SDGs were adopted as a part of a mandate of the document “The future we want” from the Rio+20 meeting in Rio De Janeiro 2012, and replaced the previous UN Millennium Development Goals (UN, 2012).

Norway has committed to a 40 percent decrease in greenhouse gas emissions in comparison to the level in 1990, based on cooperation with the EU (Klima- og miljødepartementet, 2015). Norwegian climate policies and priorities developed from this are described in the national budget for 2016. Transport constitutes approximately 60 percent of emissions non-subject to quotas in Norway (Finansdepartementet, 2015), and 31 percent of the total emissions (Avinor et al., 2016). A large emission reduction will be done in this sector. (Finansdepartementet, 2015) In the climate strategy of the NTP (2018-2029), there is a target of halving the total emission level compared to 1990 (Avinor et al., 2016).

A railway reform is planned in the NTP (2018-2028), which will part the structure of Jernbaneverket. This will result in a railway directorate, which has the responsibility of strategic development of the train services, evaluating future transport needs, coordinating cohesiveness with other transportation modes, and tender person transport on the railway. A railway infrastructure company will manage, operate and maintain existing infrastructure, traffic control, and plan and construct new infrastructure. This will be done based on agreements with the railway directorate (Avinor et al., 2016). Construction activities will according to interviews for the electrification project function as previously, and this will not affect the environmental management in the projects (Nermoen, 2016).



Railway transport emissions constitute 0.05 tons CO<sub>2</sub>-equivalents of transport emissions not subject to quota in the EU regulation system. Emissions related to construction, operation and maintenance in the transport sector are not necessarily included in the emission statistics, all though they might still be significant. Reducing greenhouse gas emissions from construction, operation and maintenance of infrastructure is one of the strategies to solve the priorities in the NTP. This is planned amongst other measures through use of zero-emission machine operation, optimizing material usage, and cutting emissions through the whole of the infrastructures lifetime. (Avinor et al., 2016)

An emission free or climate neutral state in the transport sector is pursued through a strategy that includes electricity and hydrogen as energy sources in the NTP. Incentives for transitions to public transport from person vehicles are planned, and there is an objective to improve the net of public transport in regards of efficiency, reliability and functionality. The railway is considered a low-impact mode of transport compared to motor vehicles. In addition to shifting mode of person transportation, there is an aim to transfer transport of goods from road to railway, both internally and for import and export. As a central infrastructure, the railway has importance for development of business and society in Norway. (Avinor et al., 2016)

Changing energy source from diesel to electricity mix for the Electrification of the Trønder and Meråker line is expected to provide a decrease in yearly emissions by 12 300 tons CO<sub>2</sub> equivalents. Reductions in noise and particles from diesel engines will be a consequence from the electrification. The project is expected to be climate neutral after 2 years of operation. (Tillerbakk and Skjøstad, 2015) One could say that this makes the project successful as an environmental pilot project in itself. Still, the reduction in CO<sub>2</sub> equivalents could be described as “picking the low hanging fruit”, and that ambition levels should go further than this in an environmental project. All though the railway operation is of a minor significance for the annual emissions of Norway, public construction is a large contributor to total emissions, and has impact on other environmental aspects.

The concept environmental management includes all forms for environmental impact caused by the activities of JBV, all though there is emphasis on greenhouse gas emissions in this research project (Tillerbakk and Skjøstad, 2015). Infrastructure interferes with a wide range of different nature areas. Each project is of a different character and meet different challenges (Nermoen, 2016). The general structures and procedures for environmental management in JBV needs to be functional enough to work in very different and often complex projects.

JBV's environmental management system (EMS), is in accordance to ISO 14001 Environmental management systems, an increasingly used standard since its introduction in 1996 (Morrow and Rondinelli, 2002). The aim of the standard is to provide a framework for organizations to protect the environment in a systematic manner, assist to fulfil demands for compliance, and enhance the environmental performance of the organization (ISO, 2015). Common motivations for implementing EMSs such as ISO 1400, includes integrating Health, Safety and Environment with quality systems, ensuring proactive performance beyond compliance, motivating employees and finding cost reduction measures. Results from this can include improved material reuse, improved waste recycling and reduction of emissions. (Morrow and Rondinelli, 2002) For business performance, it can provide increased access to markets, reduce costs, provide improved compliance to regulations, improve customer trust and satisfaction, and improve involvement of employees (Ofori et al., 2002). Still, some argue that the use of ISO 14001 provides limited guidelines for the actual operational

planning of the environmental management (Eccleston and Smythe, 2002), and that organizational ambitions tend to focus on relative improvements in environmental performance (MacDonald, 2005). Identified challenges for implementing formal EMS includes lacking environmental knowledge for employees, increased costs and lack of use of the continual improvement concept as a learning organization (Ofori et al., 2002) (Ball, 2002). ISO 14001 was revised 2015, with an increased emphasis of identifying risks for and managing the lifecycle of processes, supply chains and products. (DNV GL, 2013)

An environmental budget is developed for the construction and finished electrified railway net. Tools such as lifecycle analysis can reveal central impact causing activities in the project, and help identify the most effective mitigation measures.(Garmann and Skjøstad, 2014) Other tools such as environmental impact assessments (EIA) provide a knowledge groundwork that enables mitigation of environmental risks in the planning phase. The development of environmental tools enables organizations to gain a stronger insight into the consequences of their activities. Some argue that simply using different environmental tools does not provide optimal performance, and that a stronger integration of the tools such as the EIA in the EMS will provide a stronger environmental management system. (Glasson, 2005) For JBV, optimal environmental performance could depend on the actual utilization of results from the EMS, environmental budget and environmental assessments, into the strategic operational planning of projects.

Environmental impacts from an organization's products, services and activities includes impacts related to its procurements, which therefore should be an integrated part of an EMS. Public organizations in the EU can comprise as much as 14 percent of the domestic product. Sectors such as public transport and construction comprise a large share of this. This makes environmental impacts from their procurements significant, and makes public authorities potentially strong agents for green procurement. (European Commission, 2016) Green procurement is promotion of the production of products and services with a lower environmental impact (European Commission, 2008).

The Public Procurement act governs procurements of products and services performed by public organizations such as JBV. There has been proposed changes to the existing Norwegian Public Procurement Act and connected regulation. The changes are based on changes in EU directives, and reports from units in Norway. There are made efforts to simplify the act. A stronger direction for including the lifecycle of products and services is further included. The environmental demands in the act are based on an all-party agreement for the development of a low-emission society in Norway, for strengthening the climate compromise, and for "the green shift". (Nærings- og fiskeridepartementet, 2015a) The green shift is an "*adjustment to a society where growth and development happens within the boundaries of nature*", where there is a transition towards products and services with less negative climate and environmental impact (Klima- og miljødepartementet, 2014). Public procurements is one of the policy instruments towards the green shift, and environmental demands is meant to contribute to the reduction of environmental impacts, and by setting them promote innovation to reach the climate targets (Nærings- og fiskeridepartementet, 2015a).

The electrification of the Trønder and Meråker line is performed as a total enterprise, where one contractor performs the construction of the project (Jernbaneverket, 2015c). In the study the case's performance in accordance to the new proposed Public Procurement Act is analysed, for providing insights for areas of improvement for construction procurements.

Environmental demands can be made at several stages when entering procurement contracts, such as with qualification requirements and award criteria. Environmental parameters are often taken into consideration, according to studies of the Swedish construction industry. Environmental evaluation criteria are less used, and do not weight in such a degree that they decide the outcome of evaluations. (Varnäs et al., 2009) For Norwegian municipalities, environmental demands were also found used in a small degree when evaluating suppliers (Michelsen and de Boer, 2009). The signalized high ambitions through the criteria can all though influence the bids from the contractors. Waste disposal, harmful substances and working environment are common criteria in Swedish construction industry, and the environmental management system of the contractor the most common. Self-inspection by the contractor, regular project meetings and revisions are common monitoring methods. (Varnäs et al., 2009) According to Uttam et al. (2012), integration of EIA and green procurement in construction projects is found to lead to improved environmental performance in construction projects. Coordinating EIA and green procurement might lead to strengthening of the link between project planning and implementation.

Difi has developed guidelines for setting environmental criteria in procurement of construction, but the implementation of this is dependent on the characteristics of the project. Setting demands to technology, materials or similar might restrict bids, because of lacking maturity of the market for the demands. Setting strict demands might also exclude bidders from the tender, and limit cooperation with suppliers for obtaining the best environmental results for the project. Still, all environmental information is recommended included in tender documentation to secure the consciousness of the contractors for the targets of the project (Difi, 2016a).

JBV have developed an environmental policy and routines for their projects, and by complying with ISO 14001 aims for continuous environmental improvement. In procurement and cooperation for the construction projects, however, JBV as a builder is dependent on the environmental performance of the contractors and suppliers. The contractors and suppliers has to adopt the environmental policies of the builder, and improve their EMS for the builder to achieve results from their EMS. (Ofori et al., 2002). For a successful integration of social and environmental concerns in construction, it has been recommended to include stakeholders such as contractors and suppliers an supplier at an early stage (Shen et al., 2010). Challenges for project managers in green projects is found to include difficulties in selecting subcontractors providing green construction services, uncertainty for green materials and equipment, and a lacking understanding of green specifications in contract details (Hwang and Ng, 2013).

## 1.2 Problem description and system boundaries

### **The relevance for the research project**

The electrification of the Trønder and Meråker lines is an environmental pilot project. Norway has set ambitious emission reduction targets in the The Paris Agreement. Development of the railway is central in the NTP, as part of a strategy for reductions in greenhouse gas emissions from the transport sector. Emissions and environmental impacts

from the construction of infrastructure are further targets for reductions in the transport industry. As a public organization, and one of the main actors in the development of the infrastructure construction sector, JBV has strong influence on the environmental development in the construction sector. Environmental management in the construction industry can be challenging, especially in complex projects, as described in chapter 1.1.

Greenhouse gas emission reductions from train operation will be achieved in the electrification project due to the change from diesel fuel to electricity. The integration of the environmental policy of JBV in the organization, routines, and environmental evaluations and how it is communicated to suppliers affect the environmental performance. Demands from legislation for construction and environment has increased over the last decade, and the compliance to these is part of the environmental performance. Standards such as ISO 14001 and NS 3466 are used to structure environmental management systems according to internal requirements from the environmental policy, and external demands from legislation and authorities.

Does Jernbaneverket aim for sustainability, or do they aim for relative improvement? The electrification project as an environmental pilot project signal high ambitions for their environmental management. The project has developed a comprehensive environmental budget for the project, and an environmental programme. Environmental management in line with ISO 14001 is used. As the project still is in the detailed planning phase, how the environmental information is integrated in decision making in the project can affect the result for the project. Environmental demands and how they are communicated and integrated in contracts with contractors and suppliers is a part of this. Through the environmental pilot project, JBV can be a pioneer in exploring solutions to environmental aspects that provide challenges in the construction industry. This could also lead to improved environmental management, and overall performance in JBV. In the study, new and coming developments in environmental legislation, standards and guidelines are analysed. As JBV's projects span over years to come, and JBV has decreed environmental responsibility, it is relevant for the organization to be proactive for the coming development.

### **Purpose and main content of the research project**

The purpose and main content of the research project is described in "Description", page i.

### **Problem description and research questions**

For the research issue, there are identified a set of research questions:

- Where and how are environmental considerations included in the project phases?
- What environmental information is developed, and how is it used in decision-making?
- How does the project and the organization solve the external and internal environmental demands?
- What challenges are identified for Jernbaneverket's work with environmental considerations in general?
- How are environmental criteria and demands communicated to suppliers, and how is the consistency with the environmental policy maintained?
- In what degree does Jernbaneverket follow the guidelines of the revised Public Procurement Act?

The research questions are used for developing an interview guide used in interviews in the study, and as a basis for the literature review conducted. Connections between research questions, interview questions and themes for the literature review is found in Appendix A.

The report from the study is written in English, all though main sources are in Norwegian. Translations are performed by the author, but in some cases, original text from documents is described in full in Norwegian in tables and figures.

### **Contribution from the study**

The study investigates the environmental management of a large actor in the construction sector by the investigation of a pilot project. Challenges and experiences for environmental management and green procurements in construction are identified, and contribute to the current research on this. Measures are identified for the project and organization, and could provide learning internally in Jernbaneverket, and externally in the sector.

### **System boundaries for the research project**

The study analyses the environmental management for the project, focusing on compliance to internal and external demands, and integration of environmental considerations in procurements. How this is solved through decision making and planning is within the issue.

The system for the issue analysed can be seen in figure 1. There are set system boundaries. International developments and demands are restricted to the Paris Agreement and the UN Sustainable Development Goals, and their influence the national transportation and climate policies. Matters such as biodiversity is a pressing issue for sustainable resource use boundaries of the planet, but is not treated due to the limited scope of the study. The scope for national targets includes Norway's commitments and policies for greenhouse gas reduction, and targets and strategies for transport in the Norwegian National Transport plan. The National Budget describes priorities for transport and greenhouse gas reductions.

The electrification project is investigated in the case study. JBV's overarching environmental policies, targets, routines and structures affect the execution of environmental management in the project, and is therefore within the scope. Data for other projects provides additional perspectives on general issues in JBV. The collaboration and information sharing with contractors is treated in the research, but the EMS of the contractor is not analysed, due to the early phase of the electrification project.

Standards and tools for EMS are analysed in the research project, focusing on "best practice" guidelines such as ISO 14001 Environmental management systems, NS 3466 Environmental programme and follow-up system in the construction sector and guidelines by the Agency for Public Management and eGovernment (Difi).

Software systems and data handling are not investigated for the EMS of the electrification project. Evaluation of matters such as ecological consequences of plans for the electrification projects is not within the scope of the study. Technology for electrification and railway construction is treated in a limited degree, but is important for the results of the project. Green technology and materials, and the market situations for these are not within the scope of the research project, all though it can be relevant for the environmental performance for the electrification project. The overarching structure and routines for project management in JBV can affect their performance, but is out of the scope of the research study.

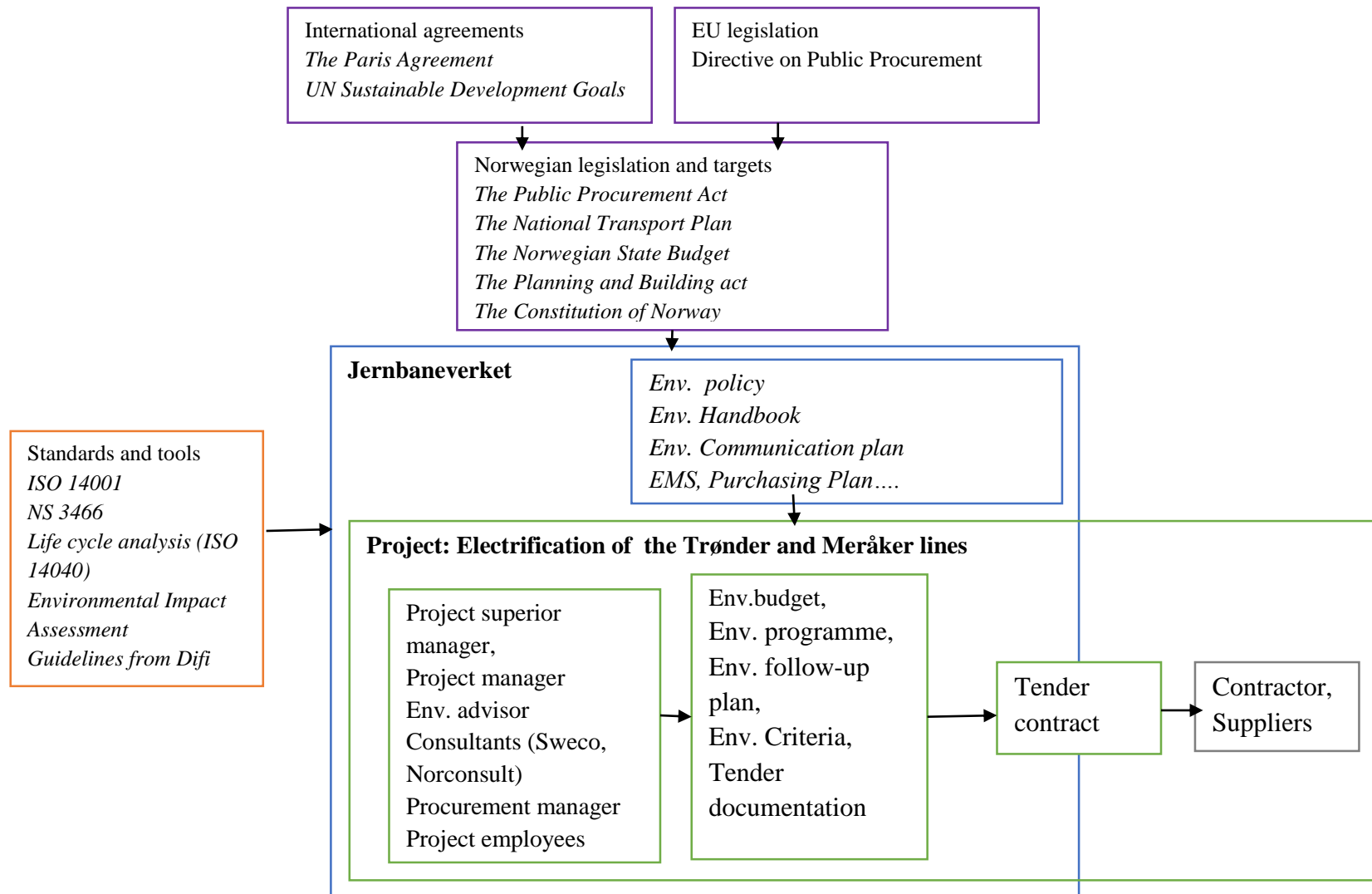


Figure 1: System for the issue analysed – The electrification of the Trønder and Meråker lines.

## 2 Methodology

This chapter explains methodology used in the study. To analyse and evaluate the research questions and the main statement, there is used a mixed method approach, in a type of methodological triangulation (Yin, 2014). The main part of the study is a single-case study, with qualitative analysis of case interviews, document analysis and literature review as a part of this. A Gap analysis for documents and verbal reports is used for the study.

There is first conducted a document review analysis for the case. Second, there is conducted a literature review and analysis, to provide a theoretical background for analysing the environmental management for the project. Further, there is conducted empirical qualitative analyses consisting of Gap-analyses for compliance to internal and external demands, with input from interview information, and an analysis of interviews for the project. The results from the combined data collection approaches and analyses are discussed. The discussion aims to evaluate the structure of the environmental management, identify challenges, and to identify areas and measures for improvement. Lastly, main findings and recommendations resulting from the study are described.

Using a mixed method approach can enable addressing more complex research questions, and further provide a stronger construct validity because findings are done by the use of multiple measures for the same phenomenon. Construct validity can be described as identifying the correct operational measures for the concept being studied. Another advantage of using a mixed method approach is that it can develop stronger converging lines of inquiry towards findings. Issues of construct validity can further be improved by having key informants review the draft case study report, as is done in the research project. (Yin, 2014)

In the study, multiple data are used. This includes research literature, organization specific documentation, interviews including oral reports, laws, standards and public guidelines, which constitute a triangulation of evidence in the study. This further enables a stronger construct validity, as case findings are likely to be more accurate if based on multiple different information sources, through a similar convergence. (Yin, 2014)

Reliability is high if the operations of a study can be repeated with the same results (Yin, 2014). The description of study methods used for data collection, and specific references to the data analysed, can ensure reliability for the project. Parts of the study such as interviews, might be difficult to repeat, as there is used a semi-structured interview method where the dialogue is made “in the moment”. This could further provide different results in a repeated study. Main findings are, all though, prone to be the same.

### 2.1 Method for description of the case

The single-case in the research study is the electrification project for the Trønder and Meråker lines in Jernbaneverket. (Yin, 2014)

A definition of a case study can be made as: *“The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result”* (Schramm, 1971).

Case studies can be used to understand complex social phenomena, and to enable obtaining a holistic and real-world perspective on issues such as managerial processes. The study aims to analyse how the environmental management function in the case, where guiding structures are developed at the administrative level of the organization. The operation of them in specific projects determines the results for the organization. (Yin, 2014) In the case, there is an analysis of the process in the "real-world".

Case studies are often chosen when research questions are in the form of "how?" and "why?", where there is a focus on contemporary events, and there is limited control over behavioural events. "How" implies actions in operational links over time, as is the case for the electrification project development, with decision-making through the various planning phases, leading to the end result and performance. (Yin, 2014)

A single-case method is used for the study, based on a rationale that the case is unusual in a sense that JBV has a distinctive role in the infrastructure development in Norway, and that the pilot project characteristics implies environmental practice above the normative environmental ambitions in the construction industry. The study design is an embedded single-case study, as the organization, the project, and members of the project are under investigation. Vulnerabilities of single-case studies include that the case might at a later stage turn out not to be the expected case. For the case in the study, some decisions are not finalized, as the project is in an early phase at the time of the study, and changes in plans might occur after the study. Single-case designs need careful investigation of the potential case, to minimize the chances of misrepresentation and to increase access for data collection. (Yin, 2014) For the scope of the research project as described in chapter 1.2, it is necessary to collect and analyse data to obtain a clear image of the project and JBV.

JBV has a distinct difference from other builders in its strong connection to national politics, and that it is the single builder organization for all railway nets in Norway. Still, it shares many similarities with other organizations acting as a builder, as the process of construction follows similar structures and phases. The collaboration with contractors and suppliers is further a common issue. Generalization of findings, and external validity can be relevant in processes that bear similar characteristics for builders. Aspects specific for JBV, that it is a public managed organization and handles the total of Norway's railway net, could make findings valid for other countries with similar structures, though the Norwegian specific complexity of legislation, national policies and targets could limit the external validity for this. For improved external validity, similar case studies of railway construction management in other countries could be aligned and analysed for similarities, and their respective context. Findings from this case study potentially have the strongest external validity for other projects in JBV.

As a public organization with expanded responsibilities for environmental aspects, JBV can function as a high ambition role model and a benchmark organization in the construction sector. (Andersen and Pettersen, 1995).



Internal validity can be described as seeking to establish a causal relationship, where certain conditions are believed to lead to other conditions. Internal validity is not very relevant to the case, as it is in nature more descriptive and exploratory. There are, although, issues with interpretations of data in the research study later than the actual unfolding of occurrences in the project, which could affect the results. (Yin, 2014)

Documents and information were retrieved from the environmental advisor for the project, and from the environmental advisor at the Department for planning and development. Additional information was collected on their formal webpage. Information was in addition obtained through verbal reports; specific information regarding the project obtained in the interviews of the study. The information collected is integrated in the section and analysed combined.

The qualitative text analysis of the documents was performed by examining characteristics, plans and strategies for JBV and the specific project. This is to obtain a detailed understanding of the case, and to provide a framework for addressing theory compared to the case, and findings for the case.

Strengths of using documentation as evidence includes obtaining stable data, and enabling review of data. Collecting the data is unobtrusive and does not interact the actions unfolding in the project. Further, it is specific, and can be broad in coverage of the issue investigated. Weaknesses include irretrievability for some documents. Many documents for JBV are available on their formal webpage, but multiple documents were made available by request. Due to the large sizes of these documents, and limited scope of this study, it has been decided not to include unpublished documents in full in appendices. This could weaken the reliability of the study, but the documents can be received by request to the author or JBV. The selection of documents can be a subject of bias selectivity, both by which documents the organization share, and by which documents the researcher uses. This can affect the image portrayed of the organization. Efforts were made in this study to provide a holistic presentation of JBV with multiple documentation of different themes. Access to documents can be a challenge, but in the project, this was not an issue. (Yin, 2014)

## 2.2 Method for literature review for the construction of a theoretical framework

A literature review was conducted in the study, to investigate core areas related to the scope. Existing knowledge and developments on the issue was investigated.

The literature review consists of separate parts based on the issues investigated. The methodology for the different parts are explained below, with headings from the theoretical framework.

### **Environmental management in construction**

A review of literature on environmental management in the construction industry, with a following qualitative text analysis was performed. Documents for the analysis was obtained through literature searches in literature databases. The literature search engine Oria, connected to the literature database of NTNU was used. The search words “Environmental management in construction”, “environmental management in construction projects”, “project management construction railway” and “public procurement environment

construction railway” was used. Some further suggested articles from the source databases for the articles resulting from the initial searches was found.

The combination of the search words were selected to identify literature concerning environmental management as a part of construction project management, and inclusion of public procurement in this. Literature was after this selected for documents containing information regarding the inclusion of environmental management in construction, the use of structured systems for environmental management, the inclusion of environmental considerations in project management, tools for environmental management, and public green procurement.

Findings from the literature review were sorted by themes related to the research questions of the study as illustrated in appendix A, before a qualitative text analysis was performed.

### **National strategies and plans**

The context for JBV’s operations was investigated through a text analysis for policy documents, concerning national strategies and plans for transport in Norway. The documents were collected through specific searches on the Norwegian governmental websites.

The documents were analysed for specific plans and strategies for transportation policies, greenhouse gas reductions, railway, and for the integration of railway policies in the general policy. Transportation data and plans for the Trondheim area were in addition analysed.

### **Legislation for environment and construction**

Laws relevant for the environmental work of JBV was found partly through information in documents in JBV. The new proposal for the Public Procurement Act was found through a specific web search on google.com. In the study, there are made limitations for laws and regulation to be investigated, due to the scope of the study. Emphasis was taken on analysing the existing and new Public Procurement Act and regulations, the Planning and Building Act, the Constitution and research concerning public authorities and compliance to environmental legislation.

### **Standards and tools for EMS in construction**

The search for standards and best practices for environmental management was conducted based on information from the interviews and documents analysed. The standard ISO 14001 is an example for this. Guidelines for public procurement in construction were found through a specific search on anskaffelser.no, after receiving information about this from one of the interviewees. Personal correspondence with Difi was further used to collect data.

## **2.3 Method for interviews**

There was performed interviews to gather empirical data in the form of information and evaluations for the study. The interview is considered one of the most important sources in case studies, as they can reveal perspectives on the case that documents not necessarily can describe (Yin, 2014). The interviews were performed by the researcher.

Semi-structured interviews were used. This is in accordance to common practice in case studies, where interviews resemble guided conversations rather than structured queries and allow flexibility (Yin, 2014). The length of the interviews ranged from 45 minutes to 60 minutes. They were performed as shorter case study interviews, a method which is likely to

follow protocol more closely than less structured interviews (Yin, 2014). There was used an interview guide rather than a case study protocol, which is presented in appendix B.

Semi-structured interviews, or qualitative interviews, has a purpose of generating extensive and rich data from participants in the study, and is especially suited to collect points of views. The interviewer steers the conversation, but the interviewee does most of the talking, and open answers are encouraged. Interviews are about what the interviewees say they do rather than what they do (Howitt, 2010), and this could affect reliability. In general, addressing reliability and validity for interviews is considered a complex issue (Howitt, 2010). Weaknesses of interviews can include poorly articulated questions providing bias and response bias (Yin, 2014), and practically in that they demand a great amount of time and resources (Howitt, 2010).

Interviewees with responsibilities and decision-making power regarding environmental aspects were identified and chosen for the project. The environmental advisor for the electrification project, and some of the interviewees suggested further objects for interview, and some of these suggestions were used. The sampling of interviewees therefore bears the characteristic of “snowball sampling” (Abbot and Jennifer, 2013). Information about interviewees, time, place and duration for the interviews is found in Appendix C.

Interviewees from the general JBV organization, and environmental advisors for two other projects were interviewed in addition to the interviewees from the case. This was to evaluate if the findings in the study are specific for the project or relevant for other projects as well. The main part of the interviewees were working on the case project.

Interview questions were developed from the research questions, as presented in Appendix A. Due to the unstructured interview method and different roles of the interviewees, the depth of discussion of different topics varied for the interviewees.

The interview locations for all but one was in meeting rooms at Jernbaneverket’s offices. Care was taken to perform the interviews in calm, uninterrupted spaces, to create an atmosphere for open conversation. One of the interviews were conducted by telephone, due to distance of the interviewee. This could provide a loss of non-verbal communication (Howitt, 2010).

The interviews were performed in Norwegian, as this is the native tongue for the interviewees, and promote a natural conversation. Effort was made to ask questions objectively, naively, and with avoidance of leading questions. Due to the themes decided by the interview guide, and the known objective of the study project for the interviewees, a threat for the internal validity is leading the interviews in a specific direction in the interviews. The conversational nature of the interview in addition poses the threat for the interviewee and interviewer for mutual and subtle influence. (Yin, 2014).

In the interviews, the interviewees shared reflections, opinions and specific information. Sharing information makes parts of the interviews function as “verbal reports” for the study, providing specific information regarding the project (Yin, 2014). Information from this was further used in the description of the case in chapter 3.2, and for the Gap analyses in chapter 5.2.

Sound recordings of the interviews were done for most of the interviewees, with the exception of the telephone interview conducted, and unstructured meetings with the environmental advisor for the electrification project. Sound recordings are important for qualitative interviews (Howitt, 2010), and was used because of the advantage of a more correct rendition of the interview. The interviewees were asked for permission to record. Recording was also used to create a better flow of the conversation, as the interviewer were not too distracted taking notes (Yin, 2014).

Transcriptions are not added to this report, but the interviews are recorded. The telephone interview was not recorded, but there was taken notes. In meetings with the environmental advisor, there was taken notes, with recording at some of the meetings.

Quality of data could be stronger with interviewee verification. This is not found to affect the quality of the data, as effort was made to verify information during the interviews. A verification of collected data in the study was further done by having key informants read through a draft report (Yin, 2014).

There are made criteria for evaluation of the quality of interviews by Kvale (1996), where some of these criteria are discussed in this section. The interview performance matched with several of the criteria. The interviewer's questions were shorter than the replies. Clarification questions for the interviewee's statement were asked during the interview, where this was found necessary. There was made an effort in not interrupting the interviewees when they were talking, but some disruptions were done when the subject was off topic of the themes in the interview guide. This was to not extend the time for the interview, and keep the subject to the study topics. (Kvale, 1997)

## 2.4 Method for Gap analysis of external and internal environmental demands

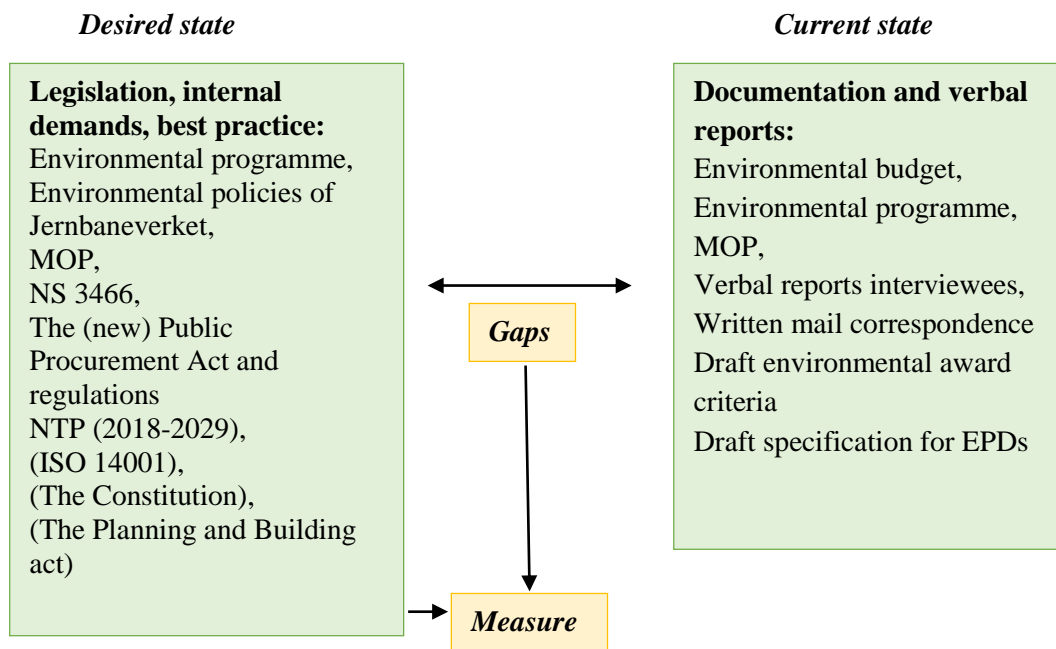
Gap analyses was used in the study to evaluate compliance to internal and external demands for environmental management in the project. The detailed Gap analyses is found in Appendix F and G. Further treatment of the Gap analysis is found in chapter 5.2, where findings are analysed and summarized.

A Gap analysis can be used as a process to determine where you are and where you want to be in regards to performance for a business process, activity or similar. It can be used to compare the desired state of performance with the current state of performance. A performance gap may exist between the two compared items. (Franklin, 2006) A gap can also be called a deviance or difference. The Gap analysis as a method bears resemblance to a benchmarking approach, where comparisons are drawn on performance between two units, often organizations, with an aim for learning and improvement (Andersen and Pettersen, 1995).

The motivation for the performed analysis, is to evaluate how or if environmental performance can be increased. JBV is relevant for a Gap analysis because it has a potential influencer position. The project is relevant because it might promote learning for other projects in JBV. JBV has set a policy for continuous improvement by working according to ISO 14001. In addition, according to the Constitution of Norway § 112, JBV as a governmental organization has special responsibility of doing measures to secure a sustainable development and use of resources.

In a Gap analysis, information on the desired and current operational results can be gathered. Desired results or performance can in the study be translated to compliance to demands or guidelines set by legislation, internal formulated demands and routines, and best practices in environmental management. Operational results or performance is in the study based on documentation and verbal reports describing measures that have been taken in the project. (Franklin, 2006) The Gap analysis process is illustrated in figure 2. In addition to identifying gaps, measures developed by the project are described. Where there are identified gaps, potential measures are found to achieve increased performance.

For the Planning and Building Act, the Constitution, and ISO 14001 there is not performed a direct Gap analysis, but compliance for these is discussed in chapter 6.



**Figure 2: Model with data sources for the Gap analysis performed in the project.**

The detailed Gap analysis is found in Appendix F and G. Further treatment of the Gap analysis is seen in chapter 5.2, where findings are further analysed and summarized.

As mentioned in chapter 2.2, boundaries have been set for the choice of legislation, internal demands and best practices used in the study. Emphasis is taken on proactive evaluation, in terms of compliance to demands and guidelines from newly updated and coming legislation and guidelines, such as the new proposed Public Procurement Act and regulations, the ISO 14001 revised in 2015, and the National Transport Plan 2018-2029. The motivation for this is to identify strategic areas important for improvement in the time ahead of this study.

Limitations exist for evaluating performance in the electrification project, as the project is still in the detailed planning phase. This makes performance according to the demands set for other phases, such as the construction phase, or finalised project, impossible to evaluate at the time of the study. The fact that the project is in the detailed planning phase, means that gaps identified are found according to the decisions and plans that have been made prior to and during the research study. Central environmental documents developed are described in chapter 3.2.

### Gap analysis for internal and external demands

Internal demands are in this study defined as objectives and demands the organization and project has set for itself, including measures which should be done according to this. Gap analyses were performed to evaluate how internal demands are ensured through the first phases of the project. These were performed stepwise as illustrated in table 1, and were analysed separately for deviances, and prescribed potential measures.

Results from the Gap analyses with demands from the environmental programme, the Public Procurement Act, and the Public Procurement Regulations as the desired state, were further used for Gap analysis with JBV's overarching environmental policies. The results from the other Gap analyses were used for a Gap analysis for performance in accordance to objectives set in the NTP. In the Gap analyses, the "current state" for the project was analysed, but in some of the analyses, overarching structures for JBV was commented where this was found relevant.

*Table 1: Overview of documents with requirements used as «desired state», and data used for describing "current state" in the performance of the Gap analyses.*

<b>"Desired state" as described in:</b>	<b>"Current state" :Data for project and Jernbaneverket</b>
Environmental programme	Verbal reports, interview results, MOP, draft for environmental award criteria, JBV web pages, and environmental budget.
The (new) Public Procurement Act	Verbal reports, interview results, MOP, draft for environmental award criteria, JBV web pages, environmental budget, and environmental programme.
The (new) Public Procurement Regulations	Verbal reports, interview results, MOP, draft for environmental award criteria, JBV web pages, environmental budget, and environmental programme.
Jernbaneverket's overarching policies	Results from Gap analyses for environmental programme and act and new regulations for Public Procurement.
NTP	Results from Gap Analyses

### Analysis of results from Gap analysis

A total analysis and summation was done for the separate Gap analyses, and for the gathered results. This provided results for environmental performance, improvement areas and measures for the project and JBV.

## 3 Description of the case and Jernbaneverket

The case Electrification of the Trønder and Meråker lines is analysed in this section through a document review, supplied with verbal report from the interviews. Characteristics, organization, operations, policies and objectives are described. This is done for the specific case, and the organization Jernbaneverket. The organization is relevant to investigate, since it sets the premises for the project. The case description serves as a theoretic background for the analyses conducted in the study.

### 3.1 Jernbaneverket

The general organization Jernbaneverket will in this section be analysed, as a context for the case project.

#### 3.1.1 Organisation

Jernbaneverket is an infrastructure agency, which function as an administrative body underlying the Norwegian Ministry of Transport. The ministry manages Jernbaneverket with instructions and annual award letters (Jernbaneverket, 2015b).

A railway reform is planned in the NTP (2018-2028), as described in chapter 4.1.2. Construction activities will according to the project superior manager for the electrification project function as previously, and this will not affect the environmental management in the projects (Nermoen, 2016).

The organisation of JBV is illustrated in figure 3. The project «Electrification of the Trønder and Meråker lines» is executed in the Mid-Norway section in the department of Infrastructure management.

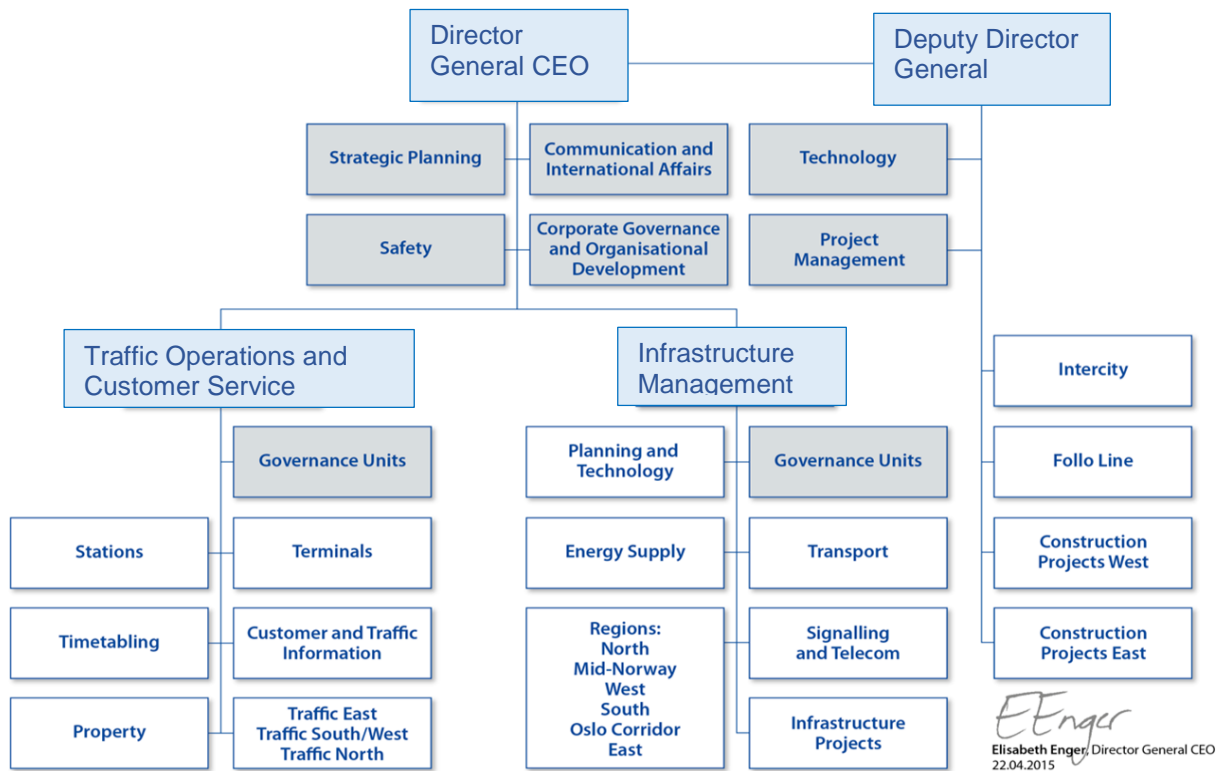


Figure 3: Organisation of Jernbaneverket (Svingheim, 2016b).

### 3.1.2 Operations

JBV owns railway tracks, platforms and waiting rooms, stations built after 1996, electric railway constructions, railway signalling plants, traffic control plants and telecommunication (Svingheim, 2016a).

The operations of JBV are determined by instructions from the Ministry of Transport. The operations are planning, construction and maintenance of the railway net, stations and terminals, making timetables, distributing track capacity between train companies, and managing and providing information regarding train traffic. (Samferdselsdepartementet, 2009) JBV operates at all functionally active railway stretches in Norway, as shown in figure 4, with electrified lines marked (LINY et al., 2015).



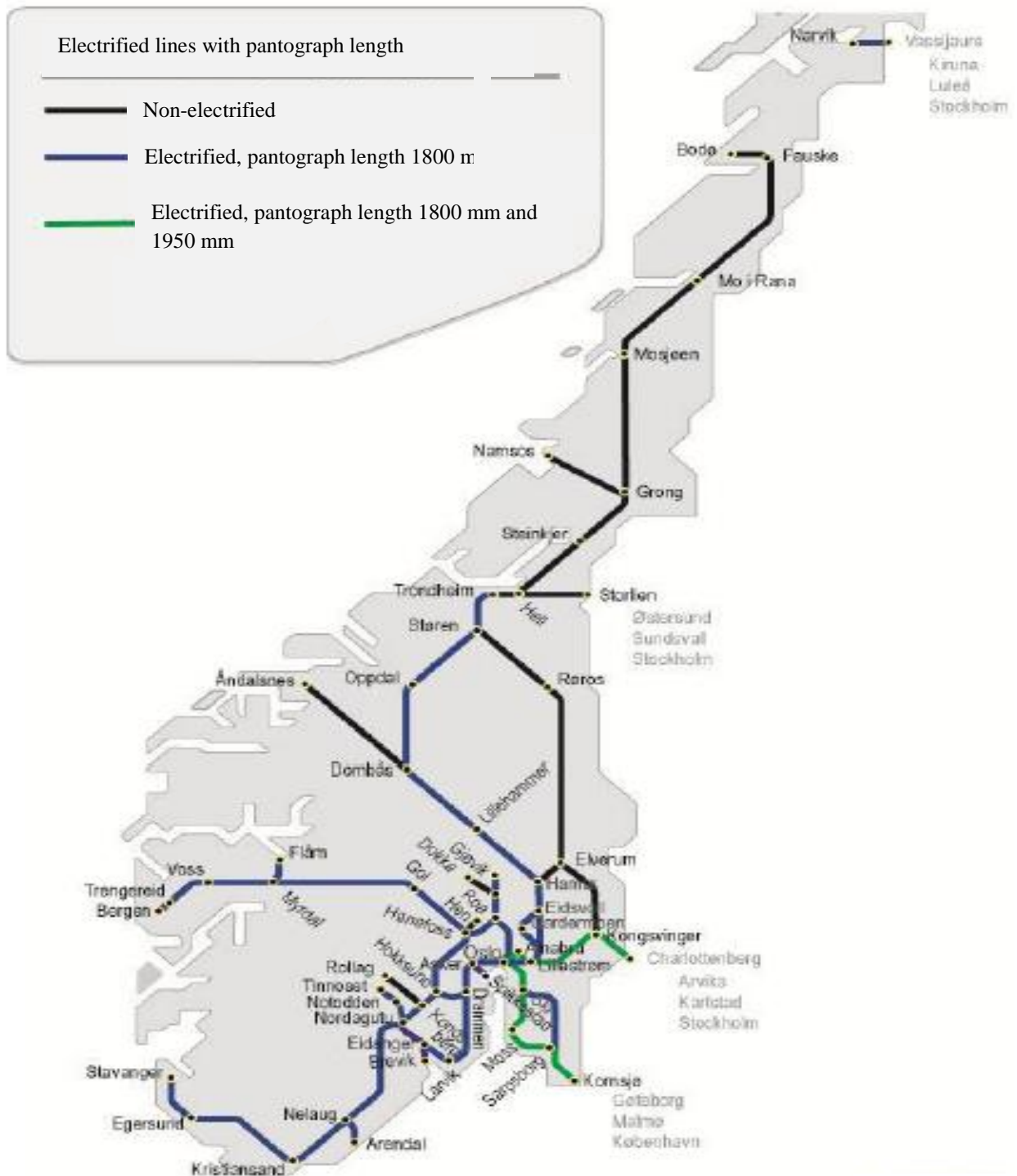


Figure 4: Area map for the operations of Jernbaneverket, and overview of electrified lines (LINY et al., 2015).

### 3.1.3 Overarching objectives

The Ministry of Transport sets overarching objectives, priorities and responsibilities for JBV. The current national plan for transport for Norway 2014-2023, states: “The political transport goal for the railway is to offer an effective, available, safe and environmentally friendly transport system that covers society’s need for transport, and that promotes regional development”. (Samferdselsdepartementet, 2013)

Action plans are made in a ten-year perspective, where financial priorities are set for environment as a part of this. The action plans are further developed into annual operating plans, with environmental action plans integrated (Dahl, 2014).

For the existing performance areas set for JBV from 2014-2017, there is placed emphasis on increasing effectiveness, timeliness of projects, increasing punctuality of train traffic and increasing customer satisfaction (Jernbaneverket, 2013b). The main performance areas for JBV from 2014-2017 are found in table 2, where numbering is performed by the researcher.

**Table 2: Main performance areas for Jernbaneverket from 2014-2017 (Jernbaneverket, 2013b).**

Nr.	Performance area
1	Designing the railway of the future
2	Planning and building new infrastructure
3	Operating and maintaining the infrastructure
4	Maintain and strengthen a high level in safety
5	Maintain and strengthen the environmental precedence
6	Satisfy the customer's and market's needs
7	Create the most simple and effective organization
8	Secure competence and capacity

### 3.1.4 Phase structure and planning phases

The document “Styring av utrednings-, plan- og byggeprosjekter i Jernbaneverket - UPB-prosessen” is a part of the management system for JBV, and describes actions that either shall or could be executed in construction projects for railway development in JBV (Tuven, 2014).

JBV separates between the terms project, project phase and planning phase. The project goes through several project phases or planning phases. Each project phase and planning phase in this constitute a separate project. There is made a decision point for each project or project phase. (Tuven, 2014)

Planning is defined by JBV as the fulfilment of the wanted measures, and the definition of how to get there. Investigation is defined as finding out where to go or what to do. The different planning and investigation phases for a larger measure has to go through the planning- and development phases in figure 5. The upper part of the figure show the link between decision points and the planning and investigation phases. “KS1” (quality assurance 1), “KS2” (quality assurance 2) and ST represent the specific points in time for the project where there are demands to external quality assurance. Arrows indicate the variation in where detailing of the technical groundwork functions as a foundation for the municipal sector plan or zoning plan, depending on if the project requires this. (Tuven, 2014)

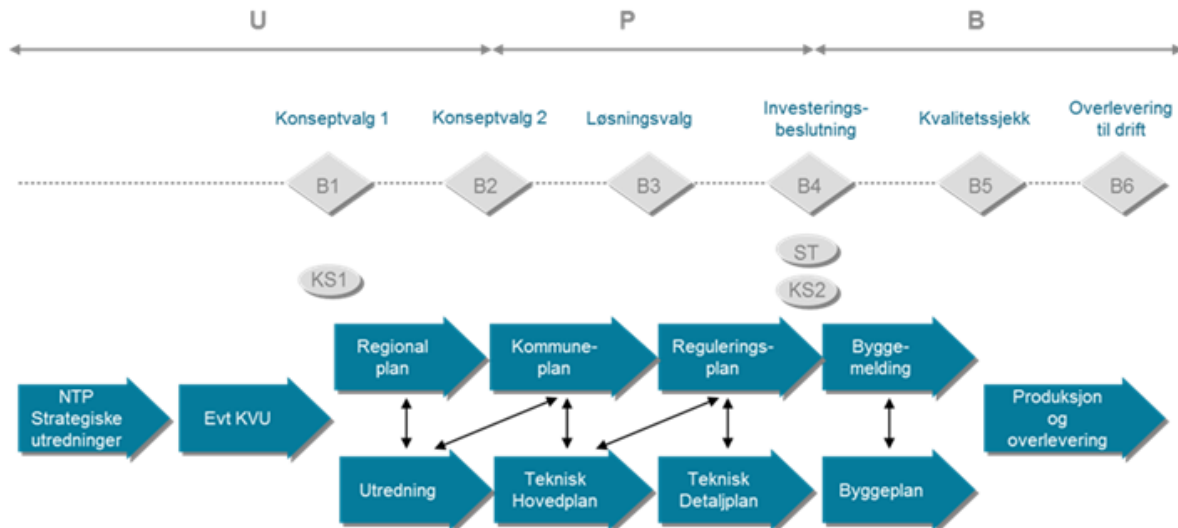


Figure 5: The planning system of Jernbaneverket (Tuven, 2014) .

There are three main elements in a new project. The first is the investigation phase, where the target is to develop an overarching strategic framework for further planning. Investigations can be of national, regional, sectional or thematic nature. (Tuven, 2014)

The second is the planning phase, where it is decided upon which phases that needs to comply with the Planning and Building Act. In the planning phase, it is also decided which phases connected to the technical groundwork that shall support the external process according to the act. In most cases, the technical groundwork at the level of the detail plan will support the zoning plan phase. (Tuven, 2014)

The third element is the construction phase, including projecting. In this phase, there is made a construction plan, and production and delivery is executed. (Tuven, 2014)

### 3.1.5 Environmental management in Jernbaneverket

#### Environmental aspects

Environmental aspects of JBV is construction, operation and maintenance of the railway system. Due to the differences in the organization's functions, the divisions in JBV has additional differing aspects. Energy is considered a part of the environmental concept. (Jernbaneverket, 2015b) Environmental aspects with a significant environmental impact, that are regulated by legislation and critical for reputation are considered essential (Dahl, 2014).

#### Environmental management system (EMS)

The EMS is made to answer to the internal and external demands placed upon JBV, such as the demands of the Internal Control Regulations. The EMS follows, but is not certified by, the standards ISO 14001:2004 Environmental management systems, and 50001:2011 Energy management systems. The environmental management system is a part of the main management system, which is organized according to principles in the ISO 9000 series. An annual report describes the environmental performance of JBV. (Jernbaneverket, 2015b)

There are documented instructions for the environmental management in JBV. All instructions relevant to the outer environment are collected in the internal database, under the section "Environmental Handbook", and is available for all employees. The environmental

management system contains descriptions of the organization and distribution of responsibilities. (Jernbaneverket, 2015b)

### **Organization of the environmental management**

The Infrastructure division's Management Staff, in the section Safety and Environment set common premises and routines. Environmental management is a line responsibility and each section as independent responsibilities for environment. (Jernbaneverket, 2015b).

The railway management has the main responsibility for the management system, and for setting environmental policies and targets. Project managers and unit managers have the responsibility of securing adequate environmental competence and compliance to environmental demands for their unit of management. (Jernbaneverket, 2015b).

### **Identified external demands by Jernbaneverket**

Laws and regulations identified by JBV as especially relevant to the environmental work of are:

- the Pollution Control Act
- the Product Control Act
- the Nature Diversity Act
- the Planning- and Building Act
- the Environmental Information Act
- the Cultural Heritage Act
- the Public Health Act (Chap. 3 concerning environment directed health care)
- the Public Procurement Act
- the Act relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service
- Outdoor Recreation Act (Jernbaneverket, 2015b)

The Planning and Building Act, and the Public Procurement act will be further treated in chapter 4.5.

### **Environmental policy**

Maintaining and strengthening the environmental precedence is the 5th of the main prioritized performance areas listed in table 2 (Staurem and Dahl, 2014). The environmental and energy policy of JBV builds on the safety politics, and elaborates the direction of the environmental work (Staurem and Dahl, 2014). An overview of environmental policies in JBV is presented in table 3.

**Table 3: Environmental policies of Jernbaneverket (Staurem and Dahl, 2014).**

1	JBV shall have a clear and communicated environmental organization, and shall set aside adequate resources for ensuring environment and energy efficiency-promoting tasks, secure the fulfillment of objectives, and execution of a good quality control.
2	JBV shall adhere to statutory environmental demands, and contribute actively to reduce and prevent environmental effects from own activities, and improve their energy efficiency.
3	JBV shall prioritize work to fulfill main- and step distributed targets for environment in the National Transport Plan, and contribute to develop these further with decreed sector responsibility.
4	JBV shall execute purchasing of environmental- and energy effective products, services and design to improve the environmental and energy performance.
5	JBV shall develop and use methods and tools that ensures environment and energy effective business processes.
6	JBV shall document and make visible the social significance of the railway, and environmental benefits.
7	JBV shall adhere to communicated values in the environmental work, including ensuring transparency regarding environmental concerns, engagement in public debate about transport and environment, and be a professional collaborator within environmental concerns.

### **Environmental objectives**

Environmental objectives in JBV is decided by the lap targets set in the NTP, which are described further in chapter 4.1.

The main environmental target states that JBV shall professionalize the environmental work and strengthen the railways environmental precedence including documentation of this. The objective is planned operationalized through environmental training for employees. Environmental objectives are further integrated into operational plans. Environmental internal control is described as a measure to reach objectives (Gry Dahl and Elin Staurem, 2014). The main performance targets for JBV in 2017 are described in table 4.

**Table 4: : Internal environmental performance targets for 2017 for Jernbaneverket (Jernbaneverket, 2013a).**

<b>Scope</b>	<b>Goal 2017</b>
Share of employees that received environmental training fitting for their working tasks	100%
Share of railway section with completed clean-up of pollution and waste	100%
Numbers of animal collisions shall be reduced	1400

### **Environmental risk assessments**

JBV describes their environmental management system in the instructions “Miljøstyring i JBV”. For compliance to the internal control regulations, environmental risk assessments shall be performed for all activities with negative environmental aspects. The environmental risk assessment is further used to establish operating plans for operations and maintenance, and to establish environmental follow-up plans (MOPs). (Dahl, 2014)

The environmental risk assessment shall provide information about the affected environmental resources and impacts. Environmental risk assessments are performed in

accordance to NS 5815:2006 and 5814:2008, with defined environmental risk acceptance criteria. The environmental advisor ensures quality for this. Routines exist for simple environmental risk assessments. (Dahl, 2014)

Environmental risk criteria are to comply with legislation at the least. They shall be in accordance to the ALARP (As Low As Reasonably Possible) principle. Unacceptable risks are handled continuously with preventive measures to reduce risks. (Dahl, 2014)

An environmental impact assessment is performed in the start phase of projects. Consequences that are not priced as noted in the NTP are calculated and reported. The units have independent responsibilities for identifying environmental and energy aspects, which shall be identified according to ISO 14001. Energy performance is measured in accordance to ISO 50001. (Dahl, 2014)

### **Integration of environmental information in the project phases**

The planning processes in JBV are in accordance to the Planning and Building Act. Environmental considerations shall be included in all planning phases, and continued in construction, operation and maintenance. (Dahl, 2014)

#### General considerations

Environmental consequences are evaluated according to instructions for official studies and reports, and demands for consequence analyses. The studies should, according to JBV, follow relevant environmental political targets, and it is referred to follow the former Constitution's § 110b. The paragraph stated that all citizens has the right to knowledge about the effects of planned interferences in nature. It is recommended in strategic studies to use the methods of the Public Roads Administration, to evaluate priced or non-priced environmental consequences. (Tuven, 2014).

#### Assessment of possible measures and the technical master plan

In the technical master plan there will be included an evaluation of environmental consequences, environmental targets and recommendations. (Tuven, 2014). These are summed up in an environmental programme (Dahl, 2014). An environmental budget can in addition be made with the use of "Tidligfaseverktøy klima". (Tuven, 2014).

#### Technical detail plan

In this plan, the environmental programme is continued in the form of an early environmental follow-up plan (MOP). This describes the physical and administrative measures that must be followed through in the construction phase. (Tuven, 2014).

#### Construction plan

In the construction plan phase, environmental risk evaluations include construction work. Environmental analyses, the environmental programme and MOP are updated as necessary. Environmental demands and measures are introduced in tenders and contracts. (Tuven, 2014).

#### Production and handover

The work processes in this phase consists of initiation and planning, execution, handover and completion, and final evaluation. The builder/project responsible in JBV is responsible for follow-up of contract with the contractor, including environmental demands. On-site inspections are performed based on a risk evaluation of which elements will have the largest

risk of poor quality or for large cost increases. The on-site inspections are carried out in addition to normal control sampling tests. (Tuven, 2014).

### Environmental communication

There is established an environmental communication plan for JBV with targets for communication, and structures for communication patterns, which can be seen in table 5. Project specific communication plans are developed further according to this. (Staurem and Kojedahl, 2016).

*Table 5: Objectives for the environmental communication plan of Jernbaneverket (Staurem and Kojedahl, 2016).*

Objective	Content
<b>Main objective</b>	JBV shall, through relevant channels with trustworthy and clear information, communicate the environmental advantages of the railway, and how environment is integrated in both long-term planning and daily operations.
<b>Part objective A</b>	<b>Target group/communication channel</b>
<i>Part objective A1</i>	<u>Target groups internally and externally:</u> Prioritized target groups shall experience relevant and clear communication regarding environment from JBV.
<i>Part objective A2</i>	<u>Communication channels:</u> Environmental communication shall be done through established and relevant communication channels, which are user friendly and adjusted to reach each target group.
<b>Part objective B</b>	<b>Message</b>
<i>Part objective B1</i>	<u>The railways environmental advantages and environmental aspects:</u> JBV shall communicate the environmental advantages of the railway, which include energy efficiency, low climate gas emission, no local air emissions, relative area efficiency and potentially diminished noise pollution. Normative environment shall ensure that information regarding general environmental advantages and aspects are made accessible so that the organization communicate with a single voice.
<i>Part objective B2</i>	<u>Environmental follow-up:</u> JBV shall clarify responsibility and roles regarding environmental follow-up for relevant recipients.

### 3.1.6 Contracts and procurement

#### Contracts

At the time of the study, there has not been established a contract with a contractor for the enterprise for the electrification of the Trønder and Meråker line. The contract used by JBV in with contractors is based on the standard NS 8405 Norwegian building and civil engineering contract (Standard Norge, 2008), but contains changes to the original standard content (Folden, 2016). This section describes main content in the standard contract (Jernbaneverket, 2016a).

The standard is used when a contractor will operationalize a construction on behalf of a builder. The foundation for the construction, such as drawings, descriptions and calculations, are delivered to the construction from the builder. The contract is not valid for subcontractors.

The contract includes the documents described in table 6, in prioritized direction. (Jernbaneverket, 2016a)

**Table 6: Documents included in contracts with contractors in Jernbaneverket (Jernbaneverket, 2016a).**

<b>A</b>	The agreement document if such a document is made.
<b>B</b>	Accounts or written material from negotiations performed after the bid is done, approved by both parties.
<b>C</b>	The bid from the contractor.
<b>D</b>	Written clarifications and accounts from inspections or conferences held before the bid was given.
<b>E</b>	The bidding or competition framework.
<b>F</b>	The standard NS 8405.

Regular construction meeting shall be held through the construction period according to the contract. The builder summons the meetings, and contractors can summon additional meetings if there is found reason for this. A kick-off meeting can be held before the start of construction to clarify and go through collaboration and decision-making routines. Distinct matters can be a reason for summoning additional meetings. (Jernbaneverket, 2016a)

All notices, claims, and answers to these must be documented. The contract describes financial safety and insurance demands for the contractor and the builder. The contractor has to fulfill the demands that are written in the contract. If there are breaches to this, the contractor shall communicate this to the builder as soon as possible. The contract specifies that both parties shall comply with laws, regulations and decisions for their contract commitments, and for conditions at the construction site. (Jernbaneverket, 2016a)

The contractor shall according to the contract hold good order for the construction site, and perform regular clean up after their work. The builder can lead controls for materials, execution and contract work. (Jernbaneverket, 2016a)

Before procurement of services from subcontractors, the contractor shall inform the builder about this. An established criteria in the contracts of JBV, is that the chain of contractor and subcontractor cannot exceed two, unless there is given documented agreement for this by the builder. If there is not agreed upon a different solution, the NS 8415 Norwegian subcontractor for the operation of building and construction works or NS 8416 Simplified Norwegian subcontractor contract for operation of building and construction works is used for contractor and subcontractor. (Jernbaneverket, 2016a)

The builder can at any time request the contractor to execute construction site management or progress control, if agreed upon in contract. The builder might also do this himself at the site. Day penalty can be set for deadlines in the contract. If other is not agreed upon, this is at 1 percent. The day penalty cannot be smaller than 1500 Norwegian kroners for delay over the end deadline, and cannot be smaller than 750 Norwegian kroners for part deadlines. The total day penalty responsibility of the contractor is set to 10 percent of the contract price. (Jernbaneverket, 2016a)

The parts have equal responsibility for giving notice of conditions that might damage people, property or the environment, which needs measures not settled in contracts. If damage on



environment, people or property is caused by the descriptions provided by the builder in the contract, the builder is responsible for this. (Jernbaneverket, 2016a)

The section regarding social responsibility describes that the contractor shall perform their work in accordance to basic demands for human rights, working rights and environment. The demands include the UN Declaration of Human Rights, UNs Child Convention, and the ILO convention no. 29, 87, 98, 100, 105, 111, 138 and 182. The contractor shall provide documentation for this, and there is a penalty for default at 1 percent. (Jernbaneverket, 2016a)

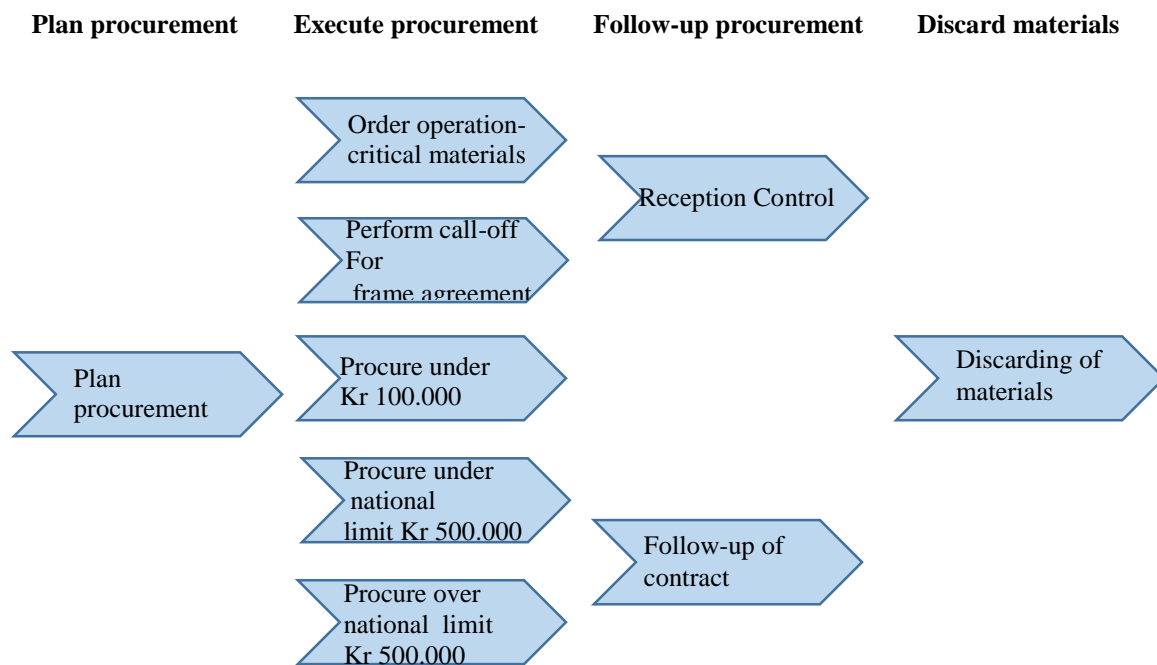
### **Green purchasing in Jernbaneverket**

Seventy percent of the budget of JBV is directed at sales of goods and services, therefore environmental considerations in the purchasing can affect the environmental impact by the activities of JBV. JBV has identified environmental rewards, and a promotion of environmentally friendly producers as advantages for including environmental aspects into the planning of purchases (Jernbaneverket, 2015a).

For the tender, environmental demands can be set at multiple stages of the procurement. The environmental demands are made to ensure that contractors follow the environmental policy of JBV, and the environmental decisions made for the project in the planning phase. This is in addition to specific legal environmental demands that the contractor must comply to, and can be specifications for how the work shall be performed (Nermoen, 2016). Qualification criteria are absolute demands that must be met by the contractor to be evaluated. Award criteria are criteria that might provide competition benefits for the contractor in the tender. (Andersen, 2016) Further, environmental demands might be included in standard parts of contracts, such as environmental competence as a part of competence demands, or environmental management system in accordance to ISO 14001 (Tytlandsvik, 2016). Control of this is done through revisions, inspections and reports from the contractor. Sanctions in the form of day penalties or price reductions, as with other deviances from contracts can be used for environmental deviances (Nermoen, 2016).

According to verbal reports from interviews, the purchasing follow standard routines for JBV, but as the projects vary in size and impacts, the specific implementation and practise of green purchasing can vary from project to project. When using environmental criteria, the weighting of them is decided in the individual projects (Andersen, 2016). Interview results for green procurement is further analysed in chapter 5.1.1.

The supplying process, as shown in figure 6 is the main structure for purchasing in JBV.



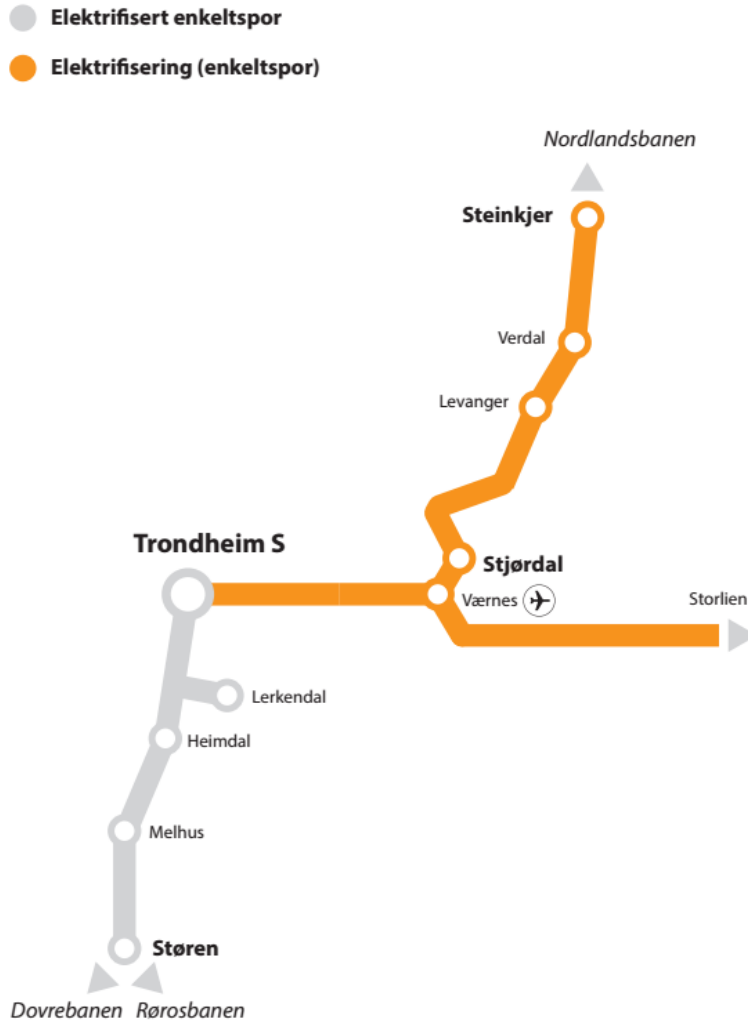
**Figure 6: General purchasing plan for Jernbaneverket (Jernbaneverket, 2015).**

The supply process structure directs decision-making during purchasing. When considering the need of product or service, a framework agreement for the area concerning the product or service in question is used if present. (Jernbaneverket, 2015a)

### 3.2 The case: Electrification of the Trønder and Meråker lines

This chapter describes the case project, based on data from documents and verbal reports. The description of the case provides information for further analyses.

The railway sections that will be electrified in the project “Electrification of the Trønder and Meråker line” are the sections Trondheim – Steinkjer, and Hell-Storlien, as shown in figure 7.



*Figure 7: Sections in the Mid-Norway region that are covered by the project Electrification of the Trønder and Meråker lines: Trondheim – Steinkjer and Hell-Storlien (Jernbaneverket, 2014).*

### 3.2.1 The purpose, organisation and suppliers for the project

#### **The purpose of the project**

The main purpose for the electrification of the Trønder and Meråker lines is to develop the railway sections to serve the society development in the coming 30 years (Jernbaneverket, 2015c).

Arguments for the electrification of the sections includes flexible production of transport services, increased effectiveness for the traffic operators and increased competitiveness of the railway against other transport solutions for people and goods. The electrification is expected to provide increased transport of persons and goods internally and externally for the Trøndelag area. Shorter travel times can provide a stronger integration of the living and working market, and provide increased productivity in business in the region. Lower transport costs and better access to qualified work force are also expected outcomes of the project. The sections can provide an alternative to the Dovre line, for goods transport between Trondheim to the southern part of Norway. The project is a part of a larger plan to improve transport infrastructure to, from and internally in Trøndelag. This connects to other

measures for the transport system in the region, including road, sea transport, rail- and tramway. (Jernbaneverket, 2015c)

Materials and equipment used for transport on the stretches are considered outdated, and there is a need for investments in new equipment that are adapted to the future infrastructure (Jernbaneverket, 2015c).

There are positive local and global effects resulting from the project. Less noise pollution and emissions of particles and GHGs compared to the operation of diesel trains is expected. (Jernbaneverket, 2015c)

The project will be tendered as a total enterprise, where JBV is the builder. JBV has arranged a dialogue conference, with the purpose of improving the contracting phase of project. (Nermoen, 2015)

### Organisation of the project

The project organization, as shown in figure 8, consists of JBV in cooperation with other enterprises and contractors. (Jernbaneverket, 2015c)

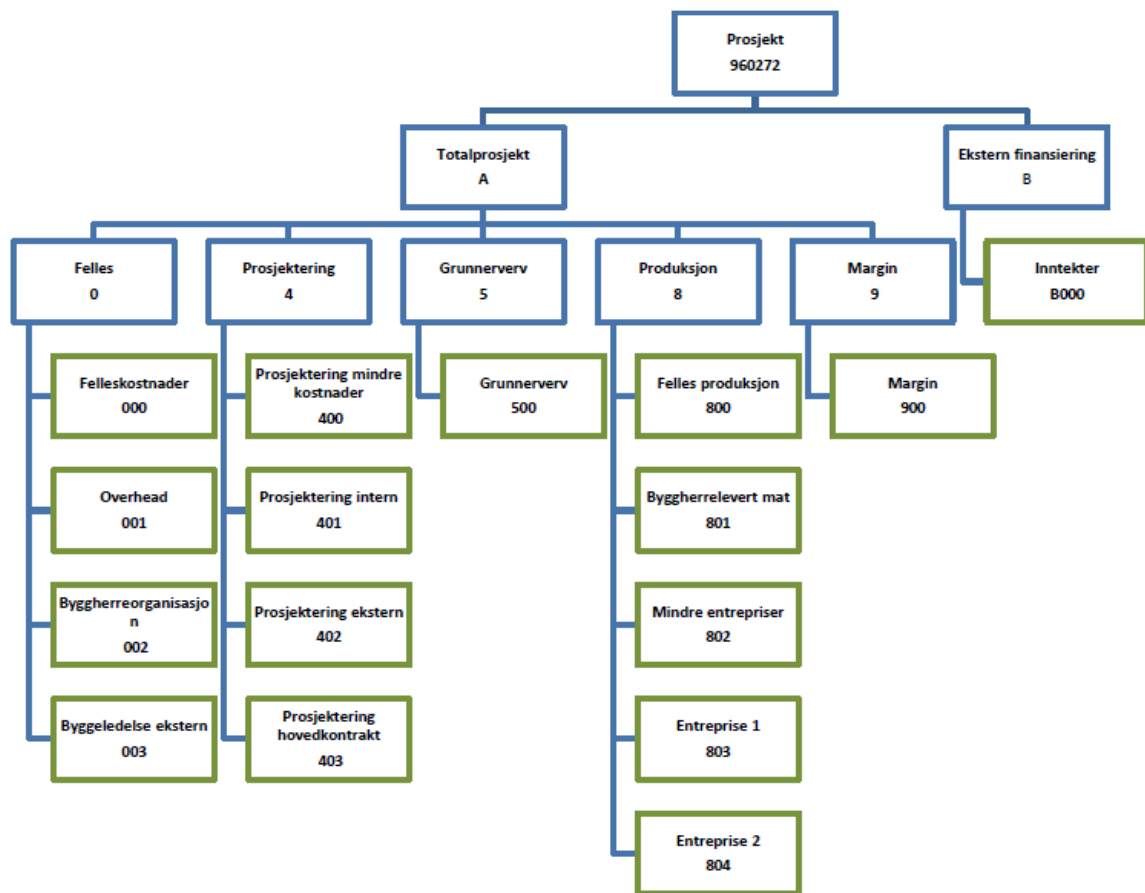


Figure 8: Project structure for the electrification of Trønder- and Meråker line (Jernbaneverket, 2015c).

### Consultant companies in the project

Norconsult, Cowi and Sweco are hired in the planning of the project, as described in chapter 3.2.3.

### 3.2.2 Project phases and timeline, the case sections and technical concept

At the time of the study, the project was in the detailed planning phase, with the contracting phase finished in 2015, as illustrated in figure 9. In 2016 there will be executed a quality assurance of steering documents and cost estimates (KS2) for the project. At the end of 2016, the approval of the detailed plan is expected, in addition to the fulfilment of the KS2 report. Mid 2016 a construction plan will be made, which is planned finished by autumn 2017. At the end of 2016, there will be a contraction phase for contractors. By the end of 2017 production will start, and continue to fulfilment of the project by the end of 2023. (Jernbaneverket, 2015c)

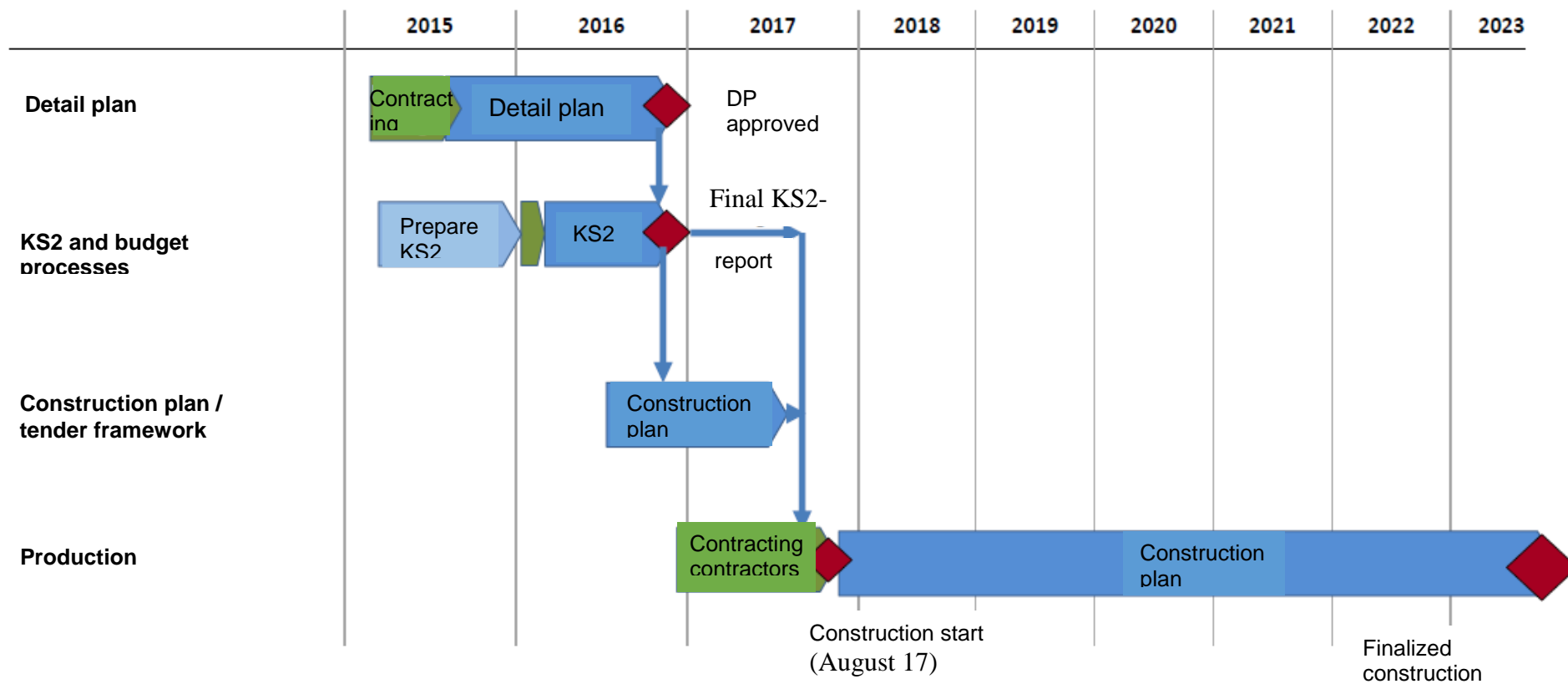


Figure 9: Project plan and overarching project phases for the electrification of the Trønder and Meråker lines (Jernbaneverket, 2015c)

### **The case sections**

A gathered construction of the two separate stretches is chosen to obtain scale advantages, and lower gathered costs than for two separate projects. Line electricity supply that will be established in the area of Stjørdal will cover the need for southern parts of the Trønder line, and the total need of the Meråker line. (Jernbaneverket, 2015c)

#### The Trønder line: Trondheim – Steinkjer

The railway section Trondheim-Steinkjer is upgraded because of expected population- and traffic growth in the Trøndelag region, and a demand for higher quality in frequency, punctuality, travel time and capacity. More than a million person travels per year are performed in the area Trondheim to Steinkjer. 70 percent of the travellers are commuters, and the railway section is considered a central infrastructure for the working and living market region surrounding the railway section. The travel time for the section is approximately 2 hours, which is planned reduced to 1 hour. A pending suggestion for development of the railway section is the establishment of an airport express train from Trondheim to Værnes airport. (Jernbaneverket, 2015c)

#### The Meråker line: Hell – Storlien

The section between Hell and Storlien is called the Meråker line. The section is characterized by goods transport, and JBV considers it an important strategic area for transportation of goods. The section functions as a central link between the Norwegian and Nordic railway net, but is one of the few sections not yet electrified in the railway net. This is a disadvantage for over-border traffic. (Jernbaneverket, 2015c)

### **Technical concept**

The technical concept of the project is treated in a limited degree, due to the scope of the research study. A summary of the considered most important information regarding this will be presented in this section to provide an outline of the project, but will not be treated in further analysis.

The concept for the project includes the establishment of a contact wire (CL) construction with autotransformers for electrical train operation on the Trønder and Meråker line, including the Stavne – Leangen line (Jernbaneverket, 2015c). A CL construction is illustrated in figure 10.

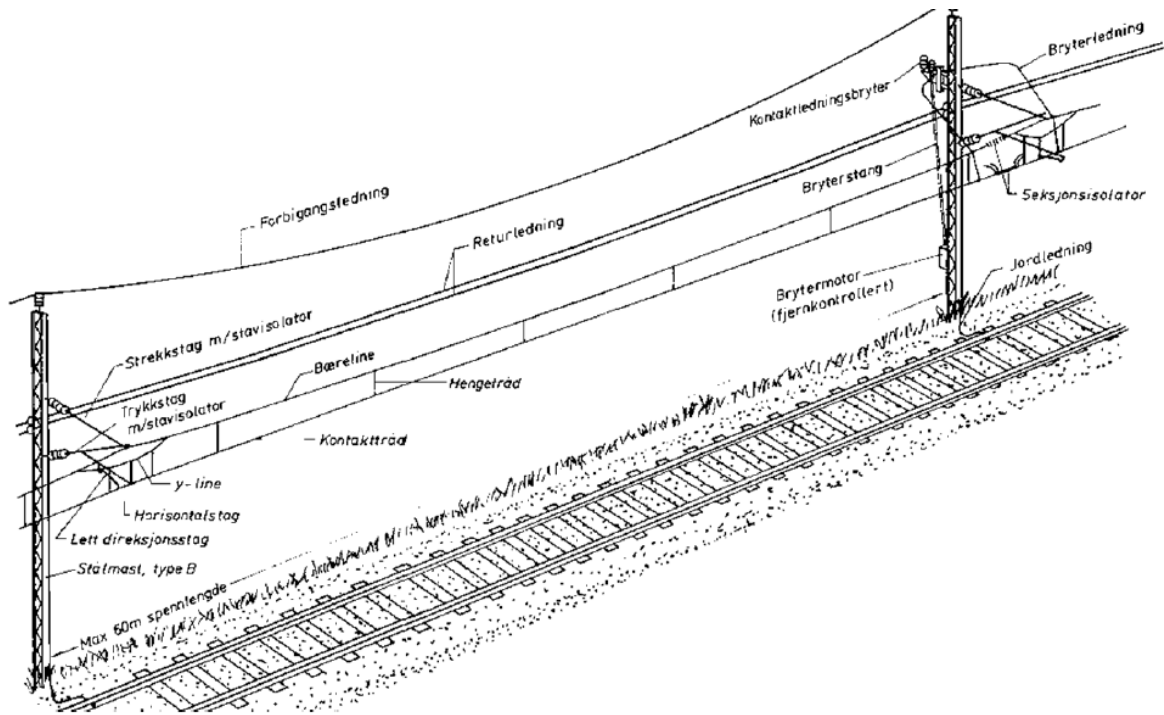


Figure 10: Illustration of CL construction and elements (Jernbaneverket, 2015c) .

Two converter stations on Eidum in Stjørdal and in Steinkjer will be established. There will be a rebuilding of direct current (DC) tracks for train detection to axle counters. (Jernbaneverket, 2015c) Functional and technical demands made for the project are presented in table 7.

Table 7: Functional and technical demands for the project (Jernbaneverket, 2015).

1	The contact line (CL) construction shall be dimensioned for expected train traffic in 2040.
2	The KL construction shall be dimensioned for a speed of 200 km/h. There will be existing track geometry, level crossings, and other technical systems in place deciding the allowed speed for different types of trains. The KL-construction shall not be speed limiting compared to the existing line.
3	A dispensation shall be applied for the demand for complete automatic train control (F-ATC) until European Rail Traffic Management System is established for the sections. Shall be done by 2023, according to existing plans.
4	All constructions shall be executed in accordance to existing technical regulations at the start of the detailed planning phase. Since the project will be electrifying an existing section, there will be appliance for dispensation from multiple demands that are only economically and practical to consider while building a new rail line.
5	There shall be used axle counters at establishment and renewal of train detection systems.

There are set some main targets for the project, as shown in table 3. The effect- and result-oriented goals will be developed further to quantifiable goals with measuring parameters and operational plan in the detailed planning phase. (Jernbaneverket, 2015c)



**Table 8: Main objectives for the project (Jernbaneverket, 2015c).**

<b>Social Policy Goals</b>	
<i>1</i>	Develop the transport services for the Trønder and Meråker lines, to make the train transportation more competitive against car transport.
<i>1 a)</i>	Increase share of transport for passenger traffic on the sections Trondheim – Stjørdal – Steinkjer and Trondheim – Sverige.
<i>1 b)</i>	Adjust for efficient and fast transport of goods on the railway.
<i>2</i>	Develop the infrastructure of the railway, so that negative environmental effects as a cause of train traffic are limited.
<b>Effect oriented goals</b>	
<i>Travellers</i>	Reduce travel time for person transport by trains in Trondheim – Steinkjer with 6-10 minutes and Trondheim – Storlien by 5-8 minutes.
<i>Traffic operators</i>	Be able to traffic the sections with longer and heavier freight trains.
	Increase the flexibility for the train operators.
<i>Environment</i>	Reduce the noise pollution from trains on the sections.
	Reduce GHG emissions from person and freight transport on the sections
	Reduce direct emissions of GHGs by 15 g CO <sub>2</sub> /sq.km and direct emissions contributing to acidification of water ways with 0,1 g/sq.km.
<b>Result oriented goals</b>	
<i>1</i>	Longer electrified line sections for person transport by train
<i>1 a)</i>	( <i>Dovre line</i> ) – Trondheim – Stjørdal – Steinkjer
<i>1 b)</i>	( <i>Dovre line</i> ) – Trondheim – Storlien – ( <i>Mittbanan</i> )
<i>2</i>	New electrified line stretch for freight transport traffic between the Trondheim region and foreign nations.
<i>2 a)</i>	( <i>Oslo</i> ) – Trondheim – Storlien – ( <i>Hallsberg – Oslo – Trondheim</i> )
<i>2 b)</i>	Trondheim – Storlien – ( <i>Northern-Sverige – Northern-Finland</i> )
<i>2 c)</i>	Trondheim – Storlien – ( <i>Mid and Southern Sweden – Europe</i> )
<i>3</i>	Line power supply with quality according to Technical regulations, TRV (nominal 15 kV 16,7 Hz)
<i>3 a)</i>	Sufficient voltage on the train’s current collector – Minimum 13.0 kV normally, minimum 12.0 kV in deviation situations.
<i>3 b)</i>	Converter stations converting voltage of 16.5 kV, with a supply capacity that meets the demands from train traffic in 2040.
<i>3 c)</i>	High supply security – Approximately continuous function for contact wire constructions and converter stations.

### 3.2.3 Environmental management for the project

#### **Environmental management system**

The EMS for the project is in accordance to ISO 14001. For the construction phase, there is planned use of the guidelines in Ceequal, which will be guided by consultants. (Selsbak, 2016b) As it is not established how this shall be done at the time of the study, Ceequal is not treated further in this report.

#### **Organisation of environmental management**

The organisation of environmental management for projects is described according to position in table 8. Directions for environmental management in JBV states that there shall at a minimum be an environmental advisor for each line area, and for each project under ordinary planning and project management regimes (Dahl, 2014). There is an environmental manager in a 100 percent position for the project (Nermoen, 2016).

Positions in projects and environmental responsibilities according to this is described in table 9. All managing positions, but also employees have environmental responsibilities (Dahl, 2014).

**Table 9: Positions and responsibilities for environmental management (Dahl, 2014).**

Stilling	Ansvar
Linjeleder	<p>Sikre risikostyring ift. miljø (risikovurdering, tiltak og beredskap) for egen enhet</p> <p>Sikre at virksomhetsplaner for egen enhet følger opp felles miljømål og strategier</p> <p>Følge opp virksomhetsplaner og rapportere måloppnåelse og nøkkeltall linjevei</p> <p>Fastsette roller, ansvar og myndighet for miljøarbeidet innenfor enhetens ansvarsområde</p> <p>Implementere gjeldende miljøkrav i enhetens arbeidsrutiner</p> <p>Sikre at miljøkrav er kjent i egen enhet og at de etterleves</p> <p>Sikre at medarbeidere, og især dem som har særskilt ansvar innen oppfølging av miljø, har tilstrekkelig opplæring og ressurser til å ivareta miljøkrav</p> <p>Sikre medarbeidernes medvirkning slik at samlet kunnskap og erfaring utnyttes</p> <p>Sikre at det gjennomføres tilstrekkelig internkontroll av operativ drift</p> <p>Innhente og kvalitetssikre nødvendig miljøstatistikk og miljøinformasjon for bruk i tertialrapporter, årsrapport, JBV's årlige miljørapport og transportplaner</p> <p>Sikre at interessenter og berørte parter får tilstrekkelig miljøinformasjon innenfor frist</p>
Miljørådgiver	<p>Bistå linje/prosjektleder i ivaretagelse av miljøhensyn og miljøkrav</p> <p>Bistå linje/prosjektleder i utøvelse av internkontroll i tråd med JBV's styringssystem</p> <p>Yte miljøfaglig rådgivning til linje/prosjektleder, herunder nødvendige analyser og utredninger</p> <p>Innhente, kvalitetssikre og rapportere påkrevet miljøstatistikk og miljøinformasjon</p> <p>Bistå i besvarelse av miljørelaterte henvendelser, utvikling av felles planer samt øvrige miljøfaglige leveranser for området/enheten</p>
Miljø-koordinator	<p>Divisjonene og store prosjekter skal utpeke én person som er ansvarlig for å koordinere miljøarbeidet i enheten og være kontaktpunkt mot retningsgivende Ytre miljø.</p> <p>Det anbefales at rollen som miljøkoordinator tillegges miljørådgiver, jfr. pkt. 2.2.5.</p>
Miljø-fag rådgiver	<p>Bistå i besvarelse av (interne og eksterne) miljøfaglige henvendelser</p> <p>Bistå i produksjon av informasjons- og opplæringsmateriell og gi opplæring</p> <p>Bistå innen analyser, utredninger og FoU</p> <p>Bistå i utvikling av statistikk og rapporteringer</p> <p>Etablere og drive fagrom og sikre samhandling</p> <p>Drifte og vedlikeholde felles metoder og verktøy</p> <p>Delta i faglige nettverk, fora og arbeidsgrupper på vegne av JBV</p>
Prosjekt-eier	<p>Angi miljømål og miljøkrav i prosjektbestillingen i tråd med overordnede føringer innen miljø</p> <p>Sikre at det i prosjektet avsettes tilstrekkelige ressurser til å etterleve miljøkravene</p> <p>Følge opp at miljøkravene etterleves i prosjektutførelsen</p> <p>Sikre at miljøkravene og miljøinformasjon fra prosjektet videreføres til driftsorganisasjonen</p>
Prosjekt-leder	<p>Sikre at gjeldende miljøkrav inkluderes i prosjektets styringssystem</p> <p>Avsette tilstrekkelige ressurser til å etterleve miljøkravene, herunder utpeke miljøleder/miljørådgiver</p> <p>Utføre miljøoppgaver i henhold til prosjektbestilling</p> <p>På selvstendig grunnlag sikre god internkontroll og etterlevelse av miljøregelverket</p>

<b>Medarbeider</b>	<p>Følge angitte instruksjoner innen miljø</p> <p>Medvirke til kontinuerlig forbedring og bistå i å finne praktiske miljøløsninger</p> <p>Bistå i å sikre god kvalitet i miljøstatistikk og miljøinformasjon</p> <p>Melde fra i Synergi ved miljøhendelser, brudd på krav, eller dersom det er behov for endringer i styrende dokumenter</p> <p>Varsle ledelsen iht. gjeldende varslingsrutiner ved alvorlige tilfeller av brudd på krav (miljøkriminalitet) eller andre kritikkverdige forhold.</p>
--------------------	--

### **Integration of environmental considerations in the project phases**

In this section, actions taken for planning the environmental management of the project is described based on documentation, and verbal reports from interviews conducted in the study.

Environmental information is developed and integrated at specific points in the project phases. In the investigation phase, an early environmental consequence analysis is performed, resulting in an environmental programme in collaboration with Norconsult. An environmental budget and SWOT analysis has been developed in collaboration with Norconsult in the investigation phase. An early environmental risk assessment is made in collaboration with Sweco in the detailed planning phase, resulting in a MOP for the construction phase. In the construction-planning phase, the environmental risk assessment and MOP will be further elaborated in interaction with the contractor. In the detailed planning phase and construction-planning phase, performance demands concerning the environment are integrated in the tender and contract with the supplier. A draft for environmental award criteria and a demand specification for environmental product declarations (EPDs) is developed in collaboration with Sweco based on the MOP, environmental budget and programme, and NTP. In the construction phase, the environmental risk evaluation is updated when deviances or relevant changes occur, and the contractors' environmental plans are followed up. (Selsbak, 2016b, Staurem, 2016)

### **Environmental budget for the project**

The environmental budget was made by Norconsult for the project, in accordance to ISO 14040: Environmental management – Lifecycle assessment – Principles and framework, and Product Category Rules (PCR) for railways. (Garmann and Skjøstad, 2014)

The purpose for establishing an environmental budget is to find environmental impacts and measures. It can be a tool for decision-making for environmental aspects. It provides an overview of the processes and their impact on the environment, identifying the processes with the highest contributions to total impacts. This provides information about at which processes one can expect the greatest effects of implementing preventive measures. The environmental budget can guide issues such as the selection of materials. (Garmann and Skjøstad, 2014)

The environmental budget consider both direct and indirect emissions. Direct emissions are included for construction and installation. Indirect emissions are calculated for background processes such as the processing of materials, production of energy, and transport. (Garmann and Skjøstad, 2014)

Table 10 provides an overview of the calculated environmental impact predicted for the construction, operation, maintenance and disposal expected in the project. According to the calculations CO<sub>2</sub>-emissions of 24 600 tons are emitted from the project. For the category climate, the GHG-emissions defined as domestic emissions were not calculated at the time the programme was developed. (Garmann and Skjøstad, 2014)

**Table 10: Environmental impact for the construction, operation, maintenance and disposal expected in the project (Garmann and Skjøstad, 2014).**

	Climate (CO <sub>2</sub> eq.)	Acidification (Kg SO <sub>2</sub> - eq.)	Ozone depletion (Kg CFC eq.)	Photochemical smog (kg Ethen eq.)	Eutrophication (Kg P eq.)	Particles (Kg PM10 eq.)
Total	24 600 tonns	147 tonns	1,6 kg	88 tonns	30 tonns	62 tonns
Per km and year	1 610 kg	9,6 kg	0,1 g	5,8 kg	1,9 kg	4,1 kg

For the project, results from calculations indicate a balance between yearly reductions and increases in emissions after two years, resulting in GHG neutrality for the project. For the rest of the lifetime of the railway, the train traffic on the electrified sections will result in large GHG emission reductions compared to other alternatives for transport on the sections. (Garmann and Skjøstad, 2014)

Both the construction phase and maintenance phase are considered important for the total impacts from the project. This is because many components will have to be changed multiple times during the constructions lifetime. The sections of the lines that contributes the most to impacts are the longest: Hell – Steinkjer, and Hell – Storlien. (Garmann and Skjøstad, 2014)

The larger part of the environmental impacts are stemming from the construction and maintenance of the electro-technical installation. This includes converter stations, autotransformer systems, and contact line constructions. (Garmann and Skjøstad, 2014)

Processing of copper and steel for transformers in converter stations and autotransformers, and steel for pylons in the contact line constructions, are identified as the processes contributing the most to total impacts. (Garmann and Skjøstad, 2014)

Identified possible measures for these processes include the optimization of placement and numbers of autotransformers, and possible implementations of transformers with a less percentage of copper. Other identified measures are to optimize the numbers of contact line pylons, consider use of pylons with a lower amount of steel, pylons of other materials, or pylons of recycled steel. (Garmann and Skjøstad, 2014)

Measures identified for predicted, but not calculated impacts from the project includes limitation of interference in nature, reductions in use of steel and concrete, the use of low carbon concrete and recycled steel. (Garmann and Skjøstad, 2014)

### **Environmental programme**

The environmental programme functions as a background document for detailed planning and projecting of infrastructure measures. It is formed after guidelines in the standard NS 3466:2009 Environmental programme and environmental follow-up plan for the outer environment for the building, construction and property sector. (Tillerbakk and Skjøstad, 2015) The areas concerned by the environmental programme, and the connected objectives can be seen in Appendix F. Environment shall be safeguarded in all planning phases in line with environmental demands, and at construction, operation and maintenance after the completion of the project, according to the programme (Garmann and Skjøstad, 2014)

Environmental aspects for the project are identified. The CL construction causes a need for profile expansions for some of the stretches. In the environmental programme, measures in the project needs to be done for 58 overpasses, 6 tunnels and 11 railway bridges. There is a high amount of vegetation at the sides of the railway tracks, which present an operational and safety risk for the construction. Trees in 17 meters distance from the railway tracks will be cut as a preventive measure for this risk. (Jernbaneverket, 2015c)

The foundation for the environmental programme is constructed by three central elements in JBV. One is their ambition to modernize existing line infrastructure with environment as a condition together with technique and economy, the second is JBV's overarching environmental policy. The last is governmental and municipal environmental policies given by laws, regulations, and authority demands relevant for the project. (Garmann and Skjøstad, 2014)

The environmental programme states that the electrification of the railway sections is a pioneer project for how environmental conditions can be integrated in the modernization of railway infrastructure in Norway. Committing environmental goals are made early in the planning process of the project. A large priority for the project is to obtain a clear environmental profile, and ensure communication with authorities, organizations and residents along the sections. (Garmann and Skjøstad, 2014)

### **Environmental SWOT-analysis for the project**

The SWOT analysis performed by Norconsult, Cowi and JBV has identified internal factors; Strengths and Weaknesses, and external factors; Opportunities and Threats for the project concept. These are considered relevant for the performance according to objectives in the project's construction and operation phase. (Norconsult, 2014)

SWOT analysis findings are found in Appendix E. Due to the broad scope of the SWOT analysis, only a selection of issues is analysed in this section.

For the construction phase, examples of identified strengths are clear environmental objectives and quantifying environmental impacts in the environmental budget. Weaknesses includes insecurities regarding if environmental objectives are strongly established internally in JBV, and that JBV is not able to follow the ambition to be an environmental pilot project. Identified opportunities includes the possibility of specifying environmental targets to contractors, and that JBV can demand documentation of environmental understanding in bids. Threats include unprecise environmental targets, which could make it difficult to manage contractors. Additional findings are that the Public Procurement Act is challenging, and existing challenges for selecting suiting award criteria for environment. (Norconsult, 2014)

For contracts, identified strengths include that environment is considered in the contract strategies. Weaknesses include lacking specific environmental demands for pricing in the contract framework, and that central public purchasing demands for environment are poorly established in the organization. Opportunities include performing a supplier seminar and possibility of demanding documentation for origin of materials. A threat identified is that the chosen contract strategy is not suiting for environmental considerations. (Norconsult, 2014)

### **Environmental follow-up plan (MOP)**

The environmental follow-up plan was under development during the research study, after guidelines in NS 3466. The MOP lists quality /result targets and measures for achieving this according to corresponding themes as in the environmental programme (Appendix F).

Measures from the MOP are further included in contracts with contractors (Selsbak, 2016b). The objectives and actions described in the MOP are used for the Gap analysis in Appendix E.

### **3.2.4 Summary and evaluation**

Documents and verbal reports were used in this section in a text analysis for the environmental management in the electrification project. In a case study, investigating the case through different sources of data provides a greater understanding of the case. To understand the function of the environmental management, it is considered important to understand both the organizational context and priorities for JBV and for the project.

Information for further analysis from this section mainly concerns environmental management for the project and JBV. Objectives and targets are interpreted as internal demands, and are identified from JBV's overarching environmental objectives, the environmental programme and MOP for the project. Findings from the SWOT are discussed further in chapter 6.

JBV is an administrative body under the Norwegian Ministry of Transport, which sets overarching objectives and policies for the organization. Environmental objectives in JBV are developed from the lap targets set in the NTP.

The environmental management system in JBV is in accordance to ISO 14001, and is a part of the main management system, which is organized according to principles in the ISO 9000 series. Documented instructions are made for the environmental management in JBV, and project managers and unit managers have the responsibility of securing adequate environmental competence and compliance to environmental demands for their unit of management.

The case project Electrification of the Trønder and Meråker lines is a part of a larger electrification strategy in JBV, with a project period from 2015-2023. The project is a pilot environmental project, and was in the detailed planning phase at the time of the study. Objectives for the electrifications are increasing effectiveness and timeliness of projects, punctuality of train traffic and customer satisfaction. The main purpose for the electrification of the Trønder and Meråker lines is to develop the railway sections to serve the society development in the coming 30 years. Construction will be done to establish a contact wire (CL) construction with autotransformers for electrical train operation.

The sections electrified includes the railway section from Trondheim to Steinkjer, and the railway section from Hell to Storlien. Environmental aspects for the project includes construction, maintenance, operation and disposal. Specific environmental aspects includes constructions for profile expansions of the sections, and procurements of materials and services. Main objectives for the case project include making train transportation more competitive against car transport, reducing noise pollution, and reducing greenhouse gas emissions from transport on the sections.

The project will be tendered as a total enterprise. A dialogue conference with potential contractors has been held in the detailed planning phase, with a purpose of increasing the quality of bids from contractors.

An environmental budget, an environmental programme, an environmental SWOT analysis, a MOP, a draft for environmental award criteria and a draft demand specification for the use of EPDs are developed. Environmental risk analyses, evaluations, and inclusion in decision-making is performed in the project in accordance to the planning strategies of JBV.

The main part of the environmental impacts of the project are stemming from the construction and maintenance of the electro-technical installation. Environmental strengths, weaknesses, opportunities and threats are identified through the SWOT analysis.

The contract used by JBV with contractors is based on the standard NS 8405 with modifications. Procurements follow standard routines for JBV, but as the projects vary in size and impacts, the specific implementation and practise of green purchasing can vary from project to project. Environmental demands can be set in the tender and contract, by qualification criteria, award criteria and requirements specification. Environmental demands are decided separately in each project. Control of compliance for the contractor can be done through revisions, inspections and reports from the contractor.





## 4 Theoretical framework

The theoretical framework is the result of the literature text analysis performed in the study. This chapter provides an analysis of national strategies and plans, legislation for environment and construction, standards and tools for EMS in construction, and a review of research findings for environmental management and green procurement in construction. The theoretical framework is further discussed in chapter 6.

### 4.1 National strategies and plans for transport

National policies and prioritizations for environment and transport sets strong guidelines for the environmental work in JBV. This section analyses the current and new national transport plans for relevance to JBV and the project.

#### 4.1.1 The National Transport Plan 2014-2023

The National Transport Plan describes the transport policy, objectives, principles and strategies for the transport in development in Norway for the coming years. The plan presents an overarching strategy for development of the national system for road-, railway-, air- and sea transport, and includes operations, maintenance and investments. It places guidelines and demands upon the strategies and operations of JBV. Central goals from the transport plan from 2014-2023 are integrated in existing objectives in JBV. At the time of the study, the transport plan is revised for the period 2018-2029, which will be described in chapter 4.1.2. (Samferdselsdepartementet, 2013)

The main objective for environment from the NTP for 2014-2023 states:

*“The transport policy shall contribute to limit GHG emissions, reduce environmentally damaging effects by transport, and contribute to fulfilment of national goals and Norway’s international commitments in the environmental field.”* (Samferdselsdepartementet, 2013)

There is made a periodic action plan for a ten-year period by JBV in accordance to the existing NTP. The measures described in this, are directional for the planning and operations by JBV. The post “Programme package for safety and environment” in the action programme, describes environmental measures for the time period described. (Jernbaneverket, 2014)

The Ministry of Transport, in the form of a yearly award letter to JBV, manages the yearly operations and priorities. This delivers concrete priorities and measures for the outer environment. (Jernbaneverket, 2014)

#### **Overarching environmental goals by NTP 2014-2023**

The main goal is operationalized through objectives parted in the steps described in table 11. (Gry Dahl and Elin Staurem, 2014):

**Table 11: Overarching environmental goals of Jernbaneverket, in accordance to NTP 2019-2023 (Samferdselsdepartementet, 2013).**

a)	Contribution to reduce GHG emissions according to the climate objectives of Norway, as they are accounted for in Meld St.21 Norwegian climate politics and in the climate agreement (Innst. 390 S (2011-2012), including contribution to the adaptation of Norway to a low emission society.
b)	Contribution to fulfil Norwegian targets for clean air and noise.
c)	Contribution to reduce the loss of nature diversity.
d)	Limit interference in cropland.

#### 4.1.2 The National Transport Plan 2018-2029

A foundation for a new Norwegian National Transport Plan (NTP) for 2018 to 2029 for Norway was presented 29. February 2016. The plan is a result of collaboration between Avinor, Jernbaneverket, Kystverket and Statens Vegvesen, after guidelines by the Ministry of Transport. (NTP, 2016) Objectives in the transport plan for environment will further be used as a theoretical background for the Gap analysis performed in chapter 5.2.

The objective of the national transport policy is to develop “*a transport system that is safe, value promoting and contributing to the low emission society*”. The transport policy aims to solve challenges evolving from a population and wealth increase.(Avinor et al., 2016)

Limiting greenhouse gas emissions from the transport system is central in the national climate policy, developed from the targets set by the Paris agreement. Contributing measures are increased use of low-emission technology, an increase in the use of low-emission energy fuel, and an increased investment in public transport, walking and bicycling in the city areas. Reducing greenhouse gas emissions from construction, operation and maintenance of infrastructure is one of the strategies to solve the priorities in the NTP. Achieving approximately zero-emission machine operation, and optimizing material usage and the projects emissions over their life cycle, is a long term objective for this (Avinor et al., 2016)

The development of the railway system is central in the plan, in collaboration with effective intersections with other modes of transport. Punctuality and reliability is planned increased, with better crossing opportunities in the national railway net. (Avinor et al., 2016)

The overarching priorities for the NTP includes better utilization of capacity, using incentives for zero- or low emission technology, and the use of alternate fuels. Co-ordinated area and transport planning, public transportation and bicycle express roads are priorities in larger city areas. This to aid reaching the target of zero growth for motor vehicle travels in cities, reducing climate gas emissions and better air quality. Further, there is a priority to create an effective, reliable and environmental low-impact transport system for transport of goods. The interactions between the modes of transport are planned strengthened, and the potential to transfer transport of goods from road transport to sea and railway is preferred utilized. Efforts for increased quality for international connections for person transport and transport of goods is further a prioritization. (Avinor et al., 2016)

In the work on the NTP, Jernbaneverket has prepared a long-term railway strategy for the period until 2050. Person transport in the larger city areas, goods transport, and a plan for the InterCity development are central in the strategy. Development of the railway is needed, and

will contribute to effective local train traffic, and long public transport sections in and between the city areas. (Avinor et al., 2016)

In the efforts for transferring goods from road to sea and railway, there is estimated that approximately 5-7 million tons of goods have a potential to be transferred. The measures for the transfer of the goods transport is estimated to be socio-economic profitable, and investments in the railway system constitutes the largest part of the investment. Maintenance, operation and renewing of the infrastructure is a priority for the transport agencies. There will also be an increased focus on preparing infrastructure for the effects of climate change. (Avinor et al., 2016)

From the main objective of the NTP, there are derived three main targets, with appurtenant secondary targets, as described in table 12 (Avinor et al., 2016).

**Table 12: Objectives and targets in the NTP 2018-2029. \*XX percentage is under consideration. (Avinor et al., 2016).**

OVERARCHING OBJECTIVES OF THE NTP: A transport system that is safe, promotes value creation and contributes to an adjustment to the low-emission society.		
MAIN TARGET ABILITY TO NAVIGATE Better ability to navigate for persons and goods in the whole country.	MAIN TARGET TRANSPORT SAFETY Reduce transport accidents in line with the zero-vision.	MAIN TARGET CLIMATE AND ENVIRONMENT Reduce climate gas emissions in accordance to an adjustment to the low emission society, and reduce other negative environmental consequences.
TARGET F1: The transport system shall be more robust and reliable.	TARGET S1: Numbers of killed and severely injured in the road traffic shall be reduced to 350, corresponding to a reduction of XX* percentage by 2030.	TARGET M1: Reduce climate gas emissions in line with the climate target of Norway.
TARGET F2: Shorter travelling times and sufficient capacity.	TARGET S2: Maintain and strengthen the high-risk level in railway transport, air travel and sea transport.	TARGET M2: Contribute to fulfill national targets for clean air and noise.
TARGET F3: Growth in person transport in city areas shall be solved by public transport, bicycling and walking.		
TARGET F4: Universally designed travelling chains.	TARGET S3: Avoid accidents with acute pollution.	TARGET M3: Limit the loss of nature diversity
TARGET F5: Transport costs for goods transport shall be reduce, the precedence of the different means of transport shall be exploited, and more goods shall be transferred from road to sea and railway.		

### The climate strategy of the NTP 2018-2029

The railway sector is not a part of the EU emission trading system, and have a target of reducing emissions by 30 percent according to the 2005 level. In accordance to the NTP, the richest countries might expect to reach a target of 40 percent reduction of emissions. (Avinor et al., 2016)

The emission percentage for transport compared to the total greenhouse gas emissions of Norway is 31 percent. For sectors not subject to quotas, the transport emissions constitutes 57 percent. Norway has set a committing target at 40 percent for the reduction of greenhouse gas emissions, compared to 1990. There is planned a dialogue with EU concerning a collaborative agreement for reducing emissions. (Avinor et al., 2016)

In the climate strategy, there is a target for halving the emission amount from transport, which per 1990 was at 14.4 million tonnes CO<sub>2</sub>-equivalents. Figure 11 illustrates the Norwegian greenhouse gas emissions for 2014 in tons, where transport emissions of CO<sub>2</sub>-emissions was at 15.4 tons. (Avinor et al., 2016)

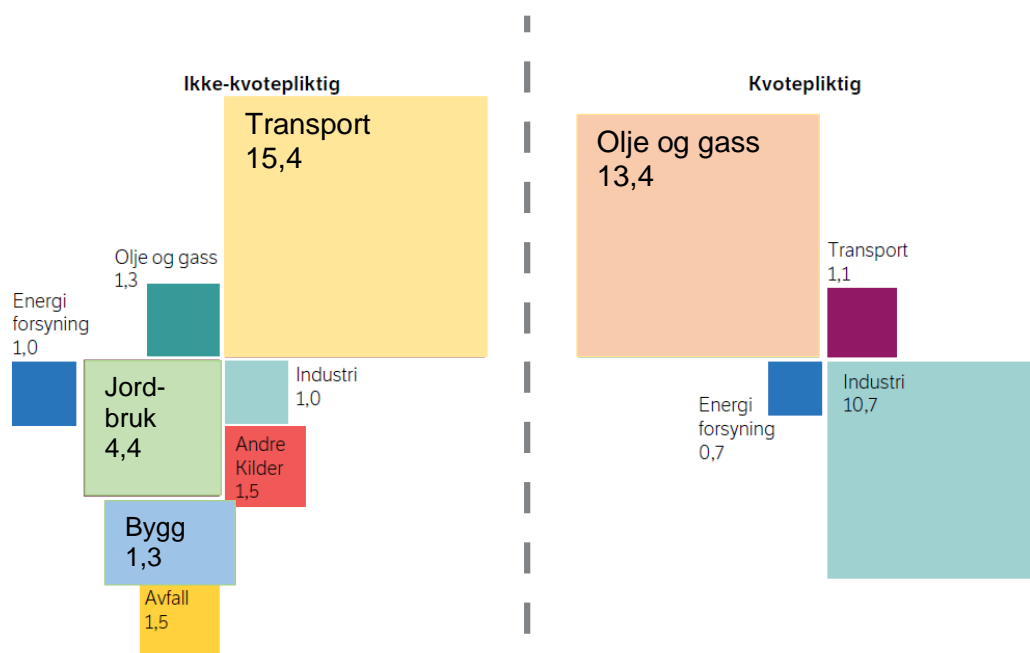
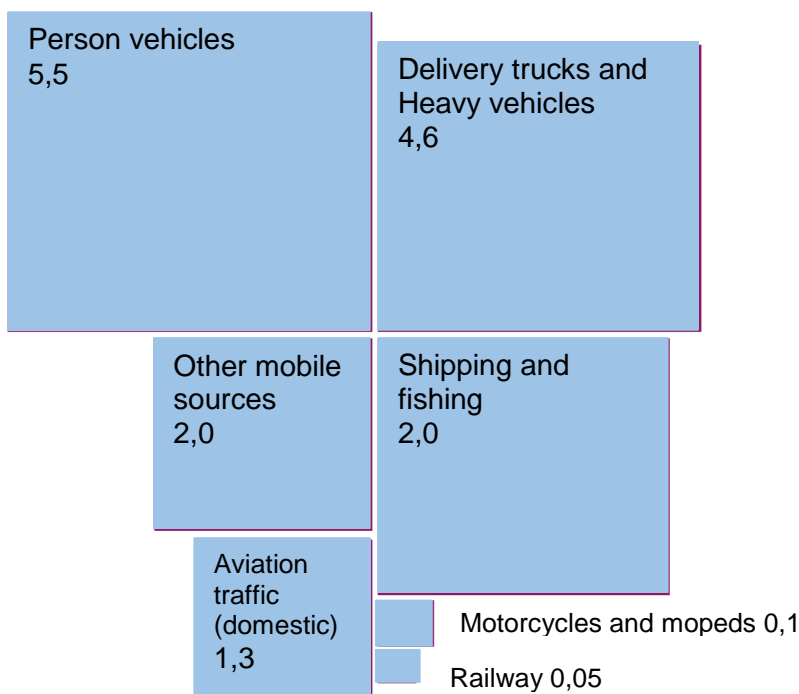


Figure 11: Norwegian climate gas emissions for 2014 (Avinor et al., 2016).

As seen in figure 12, the railway system constitute 0.05 tons CO<sub>2</sub>-equivalents of the total emissions in Norway. In addition to utilizing low-emission technology, and using less emitting fuels, there is a target for reducing transport needs, and facilitating quick and comfortable public transportation, bicycling and walking. In general, there is a focus to shift transport of goods and person transport as effectively as possible over from fossil fuel run transport. (Avinor et al., 2016)



**Figure 12: Percentage of emissions from transport for sectors not subject to quota (Avinor et al., 2016).**

Zero-emission technologies, alternate fuels and conscious material choices shall as far as possible be used for construction, operation and maintenance in the transport infrastructure sector. It is mentioned in the NTP that even though they affect the global climate, the emissions from these activities are not necessarily included in emission statistics from the transport sector. (Avinor et al., 2016)

The Environmental Directorate has performed analyses for measures that may reduce emissions by 50 percent in comparison to today’s value. The transport agencies suggests a target of transport being approximately emission free or climate neutral by 2050, where “zero-emission energy” is interpreted as electricity and hydrogen, and “climate neutral” is interpreted ad 100 percent bio fuel. To operationalize the strategy, there are planned economical time limited incentives and sanctions for promoting the use of zero-emission and climate neutral energy for transport. (Avinor et al., 2016)

A target for the railway is to be climate neutral or have zero emissions on stretches that at the time are not electrified. It is stated that electrification increases the railway efficiency and competitiveness. There is also a focus to increase the use of the capacity on sections where there’s potential for this. (Avinor et al., 2016)

There is a target for reducing emissions from construction of infrastructure by 40 percent by 2030. The target for operation and maintenance is at least 50 percent by 2030. There might be large emissions from the construction of infrastructure that is unaccounted for by the greenhouse gas inventory for the transport sector. In addition, environmental impacts are caused by damages on forest, emissions from diesel for engines, and emissions from production and transport of materials. Emissions from maintenance of infrastructure is connected with the decision-making in the planning and construction phase, and emissions for construction is best evaluated in a life cycle perspective according to the NTP. There is an estimation for a potential emission reduction of 50 000 to 100 000 tons per year. Measures

for achieving the reductions are using biofuels for machines, choosing low-impact and less material and by reducing interference in the terrain. Contracts are planned used as tools to reduce climate gas emissions, and enable reductions for other agencies and sectors. (Avinor et al., 2016)

The climate strategy in accordance to the principles in table 13 is planned to result in decline of projects that provide an increase in greenhouse gas emissions. The numeration is performed by the researcher in this study.(Avinor et al., 2016)

**Table 13: Principles for priorities according to the climate strategy of the NTP. (Avinor et al., 2016).**

1	Quick and comprehensive introduction of low- and zero emission technologies and sustainable fuels.
2	Exploit the potential for goods transfer from road to more climate friendly modes of transport.
3	Fulfill the zero growth target and expand it to multiple cities.
4	Do not build projects that increases the greenhouse gas emissions considerably.
5	Build projects that give a climate reward and positive socio-economic use.
6	The resulting assets shall be used to further efforts for public transport, walking and bicycling, and projects that provide emission reductions but have negative usefulness.

It is estimated the expansion of the railway will give a reduction of 37 000 tons CO<sub>2</sub>-equivalents per year, and cost approximately 43 billion Norwegian kroner. (Avinor et al., 2016)

The greenhouse gas calculations performed by the Norwegian Environment Agency show that measures for increasing the transport of goods by railway only need a year in operation to save 60 years' worth of emissions from construction and maintenance. 120 000 tons of CO<sub>2</sub>-equivalents are estimated reduced per year for the measures. (Avinor et al., 2016)

Emissions from the production of construction materials are regulated in the EU emissions trading system, and there is expected a significant decrease in emissions from this. (Avinor et al., 2016)

### **Environment**

Environmental impacts identifies in the NTP for transport are dismantling of agricultural land, pollution, noise and climate change. In the NTP, the transport agencies commit to making an effort to secure compliance to laws and regulations concerning the environment, and contribute to reaching national environmental targets. Irreversible nature damages, are the focus areas. (Avinor et al., 2016)

The transport agencies state that they shall secure thriving ecosystems, nature diversity, clean air, clean water, clear soil, flood control, climate regulation and the outdoors. They shall independently take control over their environmental impacts, measures and costs for this. Preventing, averting and compensating measures will be made by the agencies. (Avinor et al., 2016)

The NTP states that environmental considerations must be maintained throughout the project phases, especially the planning phase. There is a need, according to the NTP, for better

knowledge and method development for environmental measures. Surveillance of environmental conditions shall be an integrated part of projects, and contribute to increased knowledge about impacts. (Avinor et al., 2016)

Noise pollution from transport such as the railway is a challenge in many areas, and measures must be done to reduce this. Measures includes operating infrastructure near residences in a less noise polluting way. (Avinor et al., 2016)

For nature diversity, the Nature Diversity Act underlie the planning, construction and operation of transport sites. Safeguarding areas important for ecology is important, as mentioned in the Governments action plan for nature diversity “Green infrastructure”. Development of new tools to strengthen the knowledge and decision framework for nature diversity is needed, according to the transport agencies. Measures in prioritized direction include avoiding damaging operations, averting measures, restoration measures or ecological compensation. (Avinor et al., 2016)

The transport agencies shall reduce chemical pollution and impact on water quality by reducing physiological, biological and chemical influences. Environmental toxins shall be phased out. Lower impact chemicals shall always be considered. Water treatment plants shall be built in connection with construction and operation, and leaks from chemicals shall be counteracted. Cross-sectional collaboration between the transport agencies is evaluated for matters such as environmental management and common standards. (Avinor et al., 2016)

Preventing measures shall be done to reduce land pollution. Pollution episodes shall be handled in accordance to established routines, and land shall always be evaluated for potential existing pollution before the start of construction. Clean-up measures shall be done for transport of environmental toxins. (Avinor et al., 2016)

Cultural relics shall be safeguarded by development and use of methods for examinations, without intervention, and managed in accordance to listings. The agricultural landscape shall be maintained. (Avinor et al., 2016)

### **Suppliers and contracts**

An increase in the activity level of the contractor and advisor market is expected because of increased construction in the infrastructure sector. There is a challenge for some projects to maintain quality for the consultant services, which provide a challenge for costs and progress in planning and construction projects. (Avinor et al., 2016)

Further development of contracts with contractors is necessary according to the NTP, to promote an effective, secure and low environmental impact production in the construction market. Form of enterprise, size of contracts and parting of contracts needs to be evaluated. Developing and using the competence of suppliers is a focus area, which includes using turnkey contracts when applicable. JBV will use total enterprises in a larger degree than before. (Avinor et al., 2016)

There will be put a larger emphasis on other criteria than price for the settling of contracts. Quality will be emphasized, especially for large and complex projects. The transport agencies will continuously develop qualification and award criteria emphasizing other aspects than price. (Avinor et al., 2016)

### **The reform of the railway**

A new parting of the railway sector will result in a railway infrastructure enterprise and a railway directorate. The railway infrastructure enterprise will manage, run and maintain existing infrastructure, traffic control and plan and maintain a new infrastructure. This will be done based on agreements with the railway directorate, which will perform strategic development of the train service, elucidate future transport needs, co-ordinate train transport and other transport, and perform competitive tendering for person train transport. (Avinor et al., 2016)

### **Investments**

Safety and environment has the highest prioritization among investments in the program areas for JBV, and is set at 11.7 billion Norwegian kroner. Environmental challenges identified include noise pollution, existing pollution and outdated equipment. Clean up along the lines must be increased, and that there is a need for modernization of construction sites according to the current environmental demands. (Avinor et al., 2016)

### **The Trondheim area – Transport and the environment**

There is an increasing effort for developing transport infrastructure in Trondheim at the time of the research project. The measures are based on local political decisions, and the Storting's decision regarding the "Miljøpakke Trondheim", as a part on a city environmental agreement for 2016-2023. In the city environmental agreement, there is a target to achieve zero growth in passenger cars, reduce climate emissions, a decrease in traffic accidents, and a decrease in traffic noise. Efforts will include measures for bus infrastructure and development of the railway service (Avinor et al., 2016)

The railway is central for commuting from neighboring municipalities, transport internally in Trondheim, and for transport to the city airport Værnes. The electrification of the Trønder and Meråker line is central for this. (Avinor et al., 2016)

#### **4.1.3 Summary and evaluation**

The NTP describes the transport policy, objectives, principles and strategies for the transport development in Norway for the coming years. It places guidelines and demands upon the strategies and operations of JBV. Central goals from the transport plan from 2014-2023 are integrated in existing objectives in JBV.

The new NTP (2018-2029) includes strategies for emission reductions of 50 percent for the current level from transport. Approximately zero-emission machine operation through measures such as electrification, and optimizing material usage and the projects emissions over their life cycle, is a long-term objective. There are described measures for reducing environmental impact from transport in the NTP.

There is a target for reducing emissions from construction of infrastructure by 40 percent by 2030. The target for operation and maintenance is at least 50 percent by 2030. There might be large emissions from the construction of infrastructure that is unaccounted for by the greenhouse gas inventory for the transport sector. There is identified a need to further develop methods for environmental management, and for the use of contracts to promote increased environmental performance for the transport agencies.



## 4.5 Legislation for environment and construction

This section analyses legislation for environment and construction. It must be noted that a multitude of laws and regulations are relevant for environmental aspects of construction of infrastructure, as the ones mentioned in 3.1. The selected legislation is chosen based on relevance for the scope of the research study, and to provide a proactive approach to the further analyses for compliance.

### 4.5.1 The Constitution of Norway

In the chapter regarding Human rights in the Constitution of Norway, the § 112 treating rights regarding environment, was changed in 2014, with the addition of the last sentence. (Justis og beredskapsdepartementet, 2014) The paragraph states:

*«Anyone has the right to an environment that secures health and a nature where production capacity and diversity are conserved. The nature's resources shall be used based on a long-term and versatile consideration that conserves this right for the posterity.*

*The citizens has the right for knowledge regarding the condition of the nature environment and the effects of planned and implemented measures in nature, so that they can safeguard the right they have in accordance to the previous term.*

*The government's authorities shall implement measures that accomplish these principles.*”(Justis og beredskapsdepartementet, 2014)

The paragraph states that the governmental authorities, such as JBV, shall secure sustainable consumption and a health-promoting environment as a part of the human rights for the inhabitants of Norway. The section connects human rights with the safeguarding of environment.

### 4.5.2 The Planning and Building Act

The purpose of the law is to promote a sustainable development for individuals, society and future generations, according to § 1-1. The law is meant to coordinate efforts for nature conservation between public authorities, and promote consequence evaluations for environment and society. (Kommunal- og moderniseringsdepartementet, 2008)

According to § 3-1, plans shall take climate considerations through solutions for energy-supply and transport. Soil resources shall be considered, in addition to landscape qualities and protection of landscape and cultural environments. Plans shall further promote society safety through preventing risk for damage on health, environment and important infrastructure. Plans must contribute to international conventions and agreements for the themes in the act. (Kommunal- og moderniseringsdepartementet, 2008)

Paragraphs in the law describe planning in municipalities, counties and regions, and how this shall be done (Kommunal- og moderniseringsdepartementet, 2008). For JBV, the development of the railway sections is integrated in municipal plans.

There shall be performed impact assessments for plans with significant effects for environment and society, according to § 4-2. Risk and vulnerabilities for plans for

construction shall be identified and evaluated, according to § 4-3. (Kommunal- og moderniseringsdepartementet, 2008)

Under the theme technical demands, § 29-5, it is stated that measures shall be done in compliance to demands for safety, health, environment and sustainability. This is to secure lives and material values. (Kommunal- og moderniseringsdepartementet, 2008)

Waste shall be treated responsibly, and in accordance to waste specific regulations, according to § 29-8. (Kommunal- og moderniseringsdepartementet, 2008)

#### 4.5.3 The Public Procurement Act – Prop 51 L (2015-2016)

The ministry of Trade, Industry and Fisheries proposed a new version of the Public Procurement Act, the 22. January 2016. The law regulates the methods the governmental units shall use to execute purchasing of goods, services, construction and building. (Nærings- og fiskeridepartementet, 2015b)

The public procurement act has the purpose of promoting effective resource use in Norway. It is meant to ensure that the public works with integrity, and purchase in a beneficial way to the society, according to § 1. It applies when employers participate on contracts of goods, services or building and construction, according to § 2. The act is meant to provide a competitive market that facilitates innovation, and social and environmental performance for goods and services. (Nærings- og fiskeridepartementet, 2015b)

The background for the new proposal is three developments since the last act. The European Union has approved three new directives about public purchasing, which will be executed in the Norwegian court system. The proposal by the NOU 2014: “Enklere regler – bedre anskaffelser” for changes in the distinctively Norwegian part of the purchasing regulations has also contributed. A last reason is the proposal of the department considering changes in the rules for enforcement of the law. (Nærings- og fiskeridepartementet, 2015b)

The NOU 2014: «Enklere regler – bedre anskaffelser», proposed simplifications based on a perceived need to clarify the differences between targets and measures, and exclude non-acquisition related measures from the law. Prop 51 L is based on this. (Roll-Matthisen et al., 2014)

The underlying principles for the act, according to § 4, is for the employer to act in accordance to basic principles for competition, equal treatment, predictability, verifiability and proportionality. (Nærings- og fiskeridepartementet, 2015b)

In accordance to the Public Procurement act §5, governmental organizations shall try to reduce their environmental impact, and choose services with environmental benefits. Human rights are also emphasized in the Public Procurement Act. These measures are thought to provide improvement in climate and environmental challenges both nationally and internationally. Public purchasing is meant to be one of the measures for providing a shift to a low emission nation for Norway, in accordance to participation in international environmental agreements. Purposes include facilitating technology innovation providing cleaner and less environmentally damaging products and services. (Nærings- og fiskeridepartementet, 2015b)

The units adhering to the law are in a large degree responsible for independent identification and implementation of measures for environmental concerns and working environment in their purchasing routines. (Nærings- og fiskeridepartementet, 2015b)

Demands and criteria can be specified, according to § 5, to ensure that public contracts are followed through in a way that promotes environment, working and social conditions. The department can instruct employers through regulations to demand universal design in public contracts. (Nærings- og fiskeridepartementet, 2015b)

If an illegal direct purchase is done according to the Public Procurement Act § 12, a dispute settlement body will fine the employer with a violation charge. According to § 16, an employer may receive an imposition to fulfill Norwegian commitments by agreements with the European Economic Area (EEA), World Trade Organization (WTO) for public purchasing, or other international agreements Norway adhere to. (Nærings- og fiskeridepartementet, 2015b)

The main changes to the proposal can be seen in table 14.

**Tabell 14: Main changes in the proposal of a new Public Procurement Act (Nærings- og fiskeridepartementet, 2015b).**

1	New and shorter description of the purpose of the act
2	Expanding of the function area of the law to service license contracts.
3	A new and simpler decision about fundamental principles that only focus on the main principles.
5	A new decision to protect environment, basic human rights and other society considerations in public purchasing. The provision gives the department authority to set regulations about limitations in the number of linkages in the supply chain, and demands for universal design. It replaces the Public Procurement Act § 6, which instruct public employers to consider life cycle costs, universal design, and environmental consequences of the purchase.
6	A new instruction for employment of apprentices.
7	To reintroduce the competence of the Appeals Board for public purchasing (KOFA) to fine breach charge for illegal purchases.

#### 4.5.4 A new Regulation for Public Procurement in Norway

In addition to the suggestion for a new revised Public Procurement Act of January 2016, there was presented a suggestion for a new regulation for public procurement. The new regulation will supersede the current Regulation of 7.April 2006 no. 402. (Nærings- og fiskeridepartementet, 2015a)

The regulation is made to be simpler, allow rules that are more flexible and reduce administrative burdens for employers and suppliers. It is also made to allow a greater legal clarity, to facilitate for small and medium businesses, and to facilitate for the consideration of environment, social aspects, innovation and other social considerations. (Nærings- og fiskeridepartementet, 2015a)

#### **The EU Directive on Procurement**

A background for the revision of the regulation is the previous revision of the EU 2014 Directive on Procurement. The directive is a part of the Single Market Act, which is EU's action plan for the inner market. The directive is a measure to support objectives in the

Europe 2020 strategy concerning smart, sustainable and inclusive growth. (Nærings- og fiskeridepartementet, 2015a)

In the directive, there are new provisions concerning electronic communication, and the tender and bids shall be made available electronically. Documentation from suppliers, are simplified, and self-declarations can in a larger degree than before be used as documentation of compliance to demands. (Nærings- og fiskeridepartementet, 2015a)

Larger emphasis can be put on production processes when evaluating properties of procurements. An increased and clearer access to include life cycle costs in the allocation phase shall be enabled by the regulation. New reasons for declining suppliers include breaches on national and international rules concerning environment, basic human rights and working rights. There shall be offered free information and guidance for using the directive, and suppliers shall receive support for planning and executing procurements. (Nærings- og fiskeridepartementet, 2015a)

### **Themes in the new Regulation for Public Procurement**

According to the ministry, §3-8 in the existing Norwegian directive has led to employers not wanting to have contact with relevant suppliers in advance of the procurement. It states that the employer shall not seek or receive advice from someone with financial interests in the purchase, for preparation of specifications for a procurement. Changes in formulation are made to demonstrate which measures can be made to secure that the competition is not twisted. (Nærings- og fiskeridepartementet, 2015a)

A further change is that the employers shall develop tender documentation. This applies if the employer does not provide all information necessary for the preparation of request for participation by suppliers. The employer may provide overarching information for the tender, instead for a detailed list of information that is needed in the tender. Demands for qualifying documentation in § 17-5 is removed in the new directive. (Nærings- og fiskeridepartementet, 2015a)

The main rule that the employer always can choose to use the procurement procedures open or limited tender competition is continued from the existing Norwegian directive. Increased access to tendering and competitive dialogue shall allow the employer to freely choose between the two. In the new regulation, the innovation partnership directive is integrated as a new contract type. Shorter minimum deadlines shall be made possible, to provide larger flexibility to the supplier. (Nærings- og fiskeridepartementet, 2015a)

In the new Norwegian regulations, the requirement specifications can include demands for all phases of the life cycle of a product. Examples of this is production process, delivery or other phases. For labelling schemes, it is enabled to direct to third party certificated labelling schemes, which can concern environmental, social or other aspects. The use of labelling schemes is regulated for requirement specifications, award criteria, and contract terms. Demands for delivering other documentation than environmental labels are also regulated in the new regulations. In the new EU directive, the definition of life cycle costs includes societal costs such as increased environmental impact. (Nærings- og fiskeridepartementet, 2015a)

It is stated that required qualifications should be related to and proportional to the procured product or service. This is for avoid the suppliers having to meet unnecessary high demands,

which especially applies to small and medium sized companies. New guidelines are given in the EU directive to describe which documentation the employer can ask of the supplier. (Nærings- og fiskeridepartementet, 2015a)

Before the award of contract, the employer shall demand that the supplier provide supporting documents for control of the self-declaration. The supplier can ask for this information at any point in the process to support correct implementation of the procedure. (Nærings- og fiskeridepartementet, 2015a)

For award criteria, the concept “the most economically advantageous tender” is formulated in the new EU directive as a superior criterion for the award of contract. This can be identified by the award criteria price, lowest cost or best relationship between price and cost. For the evaluation of the best relationship between price and quality, the supplier can evaluate qualitative, environmental and social aspects of the offer. This can be done in addition to either price or cost. Innovative characteristics, universal design or fair trade are listed as examples of criteria that may be used. (Nærings- og fiskeridepartementet, 2015a)

As a new point in the regulation, employers have a duty to demand information from sub suppliers from the first link in the supplier chain, for building and construction work and services under the employers’ direct supervision. The employer can also voluntarily ask for this further down in the supply chain. This is meant to provide transparency and fight working crime. (Nærings- og fiskeridepartementet, 2015a)

In the new directive, there are stricter demands for documented communication, which shall as far as possible be done electronically. (Nærings- og fiskeridepartementet, 2015a)

A new contract type, innovation partnership, is meant to contribute to innovation. The innovation partnership involves the employer working together with other actors in the development of innovative products, services, or construction and building work. The employer then purchase the product. (Nærings- og fiskeridepartementet, 2015a)

New reasons for rejection based on conditions of suppliers include serious and repeated breaches on environmental, working and social conditions. (Nærings- og fiskeridepartementet, 2015a)

#### 4.5.5 Current development in research on legislation and environment

Current research has investigated the boundaries and use of legislation concerning environmental issues. There have been arguments regarding the existence of a gap between what environmental impacts organizations takes responsibility for, and the ones they are bound to by legislation.

Sjåfjell & Halvorssen (2016) has investigated the oil and gas extraction in the Arctic region with Norway as a case, and made the conclusion that this is contrary to the law. According to the fifth main report from the IPCC, keeping the global temperature increase under 1.5 °C cannot be reached with further exploitation of fossil fuels at the existing level. The study arguments that exploitation of oil and gas in the Arctic region conflict with the UNFCCC, general environmental principles, the Convention of the law of the sea, the Convention on Biological Diversity, international human rights, the EU treaties objectives on sustainable development. This, in addition to the international and EEA commitments and § 112 in the

Constitution of Norway, leads to the illegality of the exploitation plans, according to the study.

The environmental impact assessment performed for oil and gas exploitation in the arctic region is found unsatisfying, in that it does not discuss effects on climate change and human rights, or if the exploitation should be done at all. This this leads to the EIA breaching with the Constitution's § 112, according to the study. Arguments are made, that economic issues are prioritized in a large degree over environmental aspects.

Regarding the legal responsibility for the state in environmental measures, the study states that the constitutional proposals for the change in § 112 in 2014 clearly strengthen the duties of Norway in making measures for the environment. Further the article states: "*The debate regarding if the Constitution actually cause legal duties for the Norwegian state, and if it is applicable in specific cases, should therefore be discontinued.*"

#### 4.5.6 Summary and evaluation

The constitution § 112 sets a healthy environment and sustainable consumptions as human rights, and describes the authorities special responsibility for measures in accordance to this.

The Planning and Building act purpose is promotion of sustainable development. It is especially relevant to public planned measures such as the electrification project. Impact assessments should be done in the start phase of measures, and climate considerations should be made for energy and transport. Plans must contribute to international conventions and agreements for themes in the act.

The revised and simplified Public Procurement Act, has the purpose of promoting effective resource use, and applies when employers procure goods, services or building and construction. It is an instrument used for achieving a shift to a low emission nation for Norway, based in international environmental agreements. Governmental organizations shall try to reduce their environmental impact, and contribute to improvement in climate and environmental challenges nationally and internationally. Promoting green innovation in the supply chain is further an issue.

The new regulations for public procurement in Norway is based on the revised EU Directive on Procurement. The purchasing process shall be done electronically, according to the new regulation for public procurement. Innovation partnerships, is as a new contract form meant to contribute to innovation. Evaluation of production processes can in a larger degree be included in evaluating procurements, and there shall be clearer access to include life cycle costs in the allocation phase. Demands can by the new regulation be done for all lifecycle phases of a product.

Current research on legislation has investigated the public authorities' responsibility for performing environmental safeguarding measures. A study has been done on the exploitation of oil and gas in the Arctic region, and environmental impact assessments for this. It concludes with the finding that this breaches with a multitude of international agreements on environment and human rights, and further is a breach on the Constitution § 112. According to the study, there is a gap between the responsibilities the authorities work by, and the ones they actually have.

## 4.6 Standards and tools for EMS in construction

Standards and tools for EMS can be used to create structure, knowledge of impacts from an organisation, and prioritize focus areas and measures. This section will describe standards and tools that can be used to increase environmental performance of an organization.

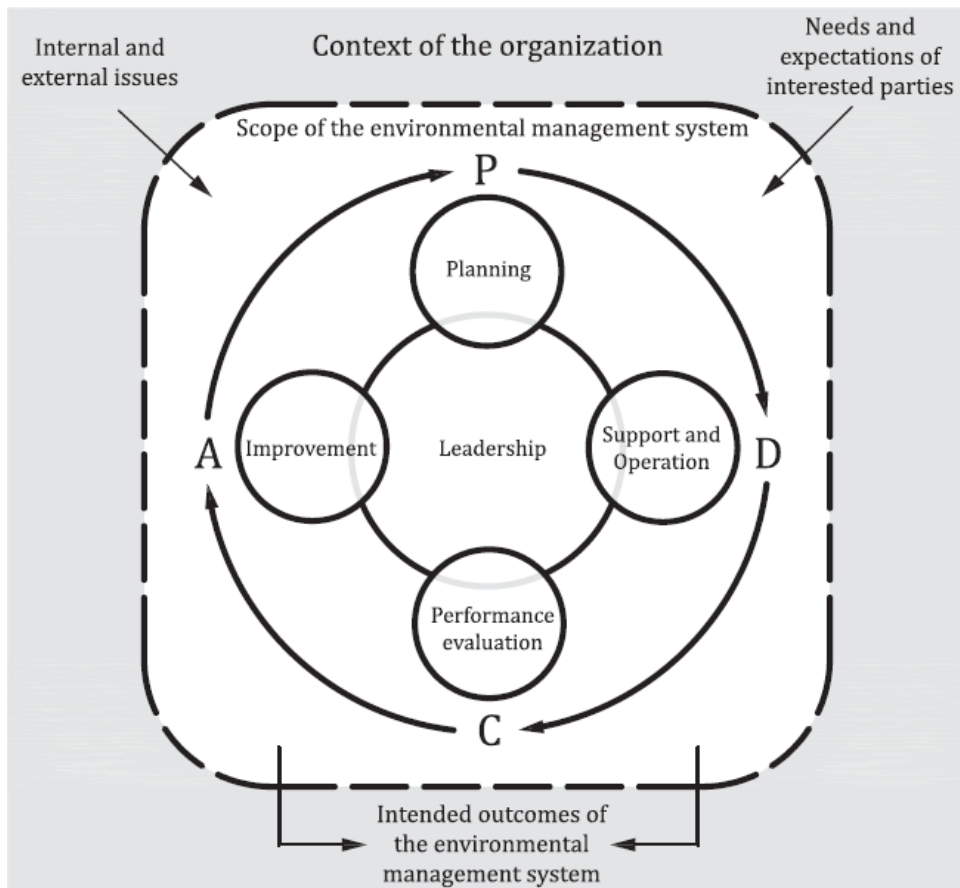
### 4.6.1 ISO 14001 Environmental management systems

The ISO standard 14001 is a part of the ISO 14000-series concerning the management of environment by organizations and companies. The standard has as purpose to provide organizations with a framework to protect the environment in a systematic manner, assist to fulfil demands for compliance, and enhance the environmental performance of the organization. (ISO, 2015)

The standard is based on the Plan-Do-Check-Act (PDCA) model, described in figure 13. The PDCA model is for an iterative process, where continuous see-through of the different phases is meant to lead to continuous improvement. (ISO, 2015)

The planning part of the PDCA consists of establishing environmental objectives and processes, to deliver results as described in the companies' environmental policy. The doing part of the PDCA is implementing the planned processes, while checking is monitoring and measuring the processes in accordance to the environmental policy, environmental objectives and criteria. Reporting results from processes is also a part of checking. Act consists of taking actions for continuous improvement. (ISO, 2015)

The standard was published in a revised version in September 2015, with changes in the content. The main changes in the standard is the increased life cycle focus for processes, supply chains and products. The scope of the value chains is extended to considering upstream and downstream processes for the products and services for the organization. Upstream processes include processes such as transport of materials, and deposit of waste is an example of a downstream activity. Aspects and risk from the value chain is in the 2015 version of ISO 14001 used as input to design and development. (DNV GL, 2013)



**Figure 13: Connection between the ISO 14001 framework and PDCA (ISO, 2015).**

Organizations can be certified for the standard by a third party certification body, all though organizations might also follow the guidelines without certification. In the standard, there are specified requirements for an EMS The standard is parted in themes, for which the main guidelines are described below. (ISO, 2015)

**Context of the organization**

External and internal issues that are relevant to the environmental management system shall be identified. Stakeholders, their needs and expectations shall be identified, and prioritized. This leads to the identification of compliance obligations. (ISO, 2015)

For the environmental management system, there is a need to establish system boundaries for the issues it covers. This is for developing the scope of the environmental management. There needs to be a mapping of roles and responsibilities in the organization, activities, services and products. (ISO, 2015)



## **Environmental management system**

To implement the environmental management system, the top management must express leadership and commitment. Taking the top responsibility for the system, and integrating the environmental management system into the business processes are some of the ways leaders can do this. (ISO, 2015)

An environmental policy must be established, implemented and maintained. This works as a framework for the development of environmental objectives and commitments. The environmental policy must be documented. (ISO, 2015)

## **Planning**

Processes to meet the requirements must be established, implemented and maintained according to the established environmental policy, identified requirements and scope. Identifying risks and opportunities is a part of planning. (ISO, 2015)

Environmental aspects are handled by determining for which processes, activities, products and services they can be controlled. This is done in a life cycle perspective. Established criteria shall be used to identify aspects with significant environmental effect. Compliance obligations shall be made available, and there shall be identified and routinized measures to fulfill them. (ISO, 2015)

Plans shall be made to address the areas previously described that needs measures to be handled, such as risks and opportunities. Environmental objectives shall be implemented at suiting levels and functions, and plans shall be made accordingly to fulfill them. (ISO, 2015)

## **Support**

Resources shall be made available to establish, implement, maintain and continuously improve the environmental management system. The competence and awareness level in the organization must sufficient to reach objectives. Processes shall be established for external and internal communication. For all processes, decisions, competence and similar, there shall be made updated documentation. (ISO, 2015)

## **Operation**

Operating criteria, and control for these, shall be established for the process. There shall be controls in place for ensuring that environmental demands are addressed in all lifecycle stages of the service or product. Environmental requirements for the procurement of products and services must be determined and communicated. (ISO, 2015)

Emergency preparedness and response shall be handled by implemented processes (ISO, 2015).

## **Performance evaluation**

It is central that the organization monitors, measures, analyses and evaluate the performance of the environmental management system, and evaluates compliance to internal and external demands. Audits shall be performed in planned intervals for the environmental management system, and performance shall be revised by management. (ISO, 2015)

## **Improvement**

As a part of the continuous improvement, the organization shall find areas for potential improvement, and implement measures to work towards these. (ISO, 2015)

#### 4.6.2 Difi – Green procurements in construction

The Directorate for administration and ICT has the purpose of developing and renewing the public sector (Difi, 2016b). The directorate manages the webpage “anskaffelser.no”, which provides guidelines for public procurement. Building and construction is one of the categories for which they provide guidelines.

##### **Including environmental considerations in the detailed project phase**

The detailed project planning creates the framework for the bidding from the contractors. Difi has made recommends actions that should be taken for the process in public procurements in construction projects (Difi, 2016a).

For the maintenance of all environmental concerns, all environmental conditions that participate in reaching the project objectives should be described in the tender. This should include the environmental conditions of the construction period. Recommended actions include describing specific details in the detail project, securing that all environmental demands are under price bearing posts, and planning of follow-up for the construction. Details or areas for the construction which will provide special environmental challenges should be detailed especially, and be followed up in the detail project (Difi, 2016a).

All demands for energy use, material properties, conditions at the construction site and similar should be given in the tender documentation. Environmental targets should be included in the general part of the description, and as an introduction to all disciplines tender and bid documentation, and in contracts. An environmental programme and environmental follow-up plan should be a part of the tender documentation, to secure the consciousness of the contractors for the targets of the project. (Difi, 2016a).

Follow-up of the construction site should be planned in the detailed project, according to Difi. Measurements and methods for analysis should be described in accordance to relevant standards. If there are no standards, one should provide a description of methods for measurements and reporting. (Difi, 2016a).

Possible methods for compliance to environmental demands are the collection of environmental documentation for construction materials, measurements of air quality, measurements of heat loss in constructions, inventory for handling of polluted matter, control of pre-separation for recycling, and controls of clean, dry buildings. (Difi, 2016a).

##### **Including environmental considerations in procurements – Difi guidelines**

The stepwise recommendations for ensuring inclusion of environmental consideration for procurement of products and services are described in table 15.

**Table 15: Considerations for a green procurement process, according to Difi (Difi, 2016a)**

<b>Considering needs</b>	
1.Think needs, not solutions	What is the problem that is planned solved by the procurement?
2.Involve users and specialists in the needs assessment.	Including stakeholders such as users, specialists and the organizations environmental coordinator. Plans should be made describing who should be involved, in what degree the persons should be involved, reasoning for involvement and the persons decision-making authority.
<b>Planning and organizing</b>	
1.Find environmental possibilities in the market	It is important to update on the new environmental solutions the market can offer, at every new procurement. Dialogue can be made with a representative selection of suppliers to map the market.
2.Think lifecycle costs	Evaluate the lifecycle costs of the product. Environmentally conscious choices might have a lower cost over its lifespan, even if it has a high purchase price. Life cycle costs should include purchasing price, installing costs, operation costs, maintenance costs, reparation costs, taxes, duties and licenses, and disposal costs. Persons with competence for the solutions should be included when calculating life cycle costs.
<b>Executing the competitive bidding</b>	
1.Control the maturity of the market.	The market situation for environmental technology should be evaluated, to ensure that environmental demands are in accordance to the market situation. If many suppliers meet the demands, they could be included in the requirement specification. If there are differences in the market, demands could be set as award criteria to award the best while promoting competition. Setting demands as contract demands prevent having to decline suppliers that cannot fulfill the demands now. Internet search can be used to find solution alternatives for products, services and suppliers, and to monitor the development of the market.
2.Evaluate setting environmental needs in the requirement specification.	Evaluate the environmental load connected to the various phases for the product. Difi has developed guidelines for demands for different products and services, or for setting own demands. Examples are maximum energy need, and max. emissions of CO <sub>2</sub> .
3.Consider environment as a required qualification.	Qualifications is competence necessary to fulfill the contract. Demands can be set for this. If no or few suppliers fulfill qualification demands, they should be considered as contract demands. Standard qualification demands should not be used. Examples of qualification demands: Necessary environmental competence and routines for handling of hazardous waste. Environmental demands can be relevant for construction in environmentally sensitive areas, where necessary competence is needed from the contractor. Documentation should be requested, and how it is prepared should be specified. One cannot demand a specific EMS or certification, but has to state the requested qualifications. It is not permitted to formulate that the supplier shall have “an EMS” or be eco-labelled.
4.Consider environment in award criteria	Award criteria results in a higher score in the offer assessment, and can function as a competition parameter. In a market with limited demand compliance for the suppliers, award criteria could be used to premiere the suppliers that does comply. In a mature market, absolute environmental demands could be used. When using environmental criteria, it is important to weight the criteria so that extra points give a competitive advantage against competitors. Setting both absolute demands, and using award criteria within the same environmental theme enables selection based on the best compliance to an environmental demand. The environmental requirements has to be clearly communicated. The weighting of the environmental criteria should be at least 30% to ensure enough incentives for the suppliers. Deciding what provides max. score for criteria should be determined.
5.Consider environment as contract terms.	Setting contract terms for environment, sets demands for the fulfillment of them in the contract period. Contract terms are not a part of the evaluation of bids. Deadlines for

	compliance should be set. Contract demands should be monitored integrated with the general contract monitoring.
6.Integrate environmental considerations in framework agreements.	Framework agreements include repeatedly purchased standard products and services. It usually lasts over years. More emphasis should be made for environmental demands, since they provide a stronger effect in framework agreements. If there are a set of products or services in framework agreements, demands could be set for the largest, or for the one with the highest environmental effect.
7.Evaluate the procurement process.	For improvement in green purchasing, evaluation should be made for the procurement process. Experiences such as feedback from suppliers, compliance to demands, answers to demands, interpretation from the formulation of demands, documentation and possible improvements should be evaluated.
<b>Follow-up of delivery and contract</b>	
1.Follow-up of environmental demands.	Monitoring of fulfillment of demands. Difi has templates for evaluation of contracts. For absolute demands and award criteria, non-compliance is a breach of contract. Documented claims has to be given for this, in accordance to agreements in the contract. Sanctions used could be price discount, day penalty, compensation or cancellation of contract. For contract demands, a system for follow-up has to be in place. These should be discussed in meetings for contract follow-up.
2.Remember training of the users.	For products and services where knowledge and familiarity for the users are an issue, training should be made.
<b>Evaluation and learning</b>	
3.Compile learning points from the procurement	Documented experience provides improvement possibilities for green procurement practices. Questions that may be asked: Was the environmental quality of the delivery was as promised? Does hindsight provide environmental characteristics that should be demanded? Had the supplier market developed, and environmental options changed?

### **Environmental indicators for the construction industry**

Difi has developed a set of environmental qualification requirements, specification requirements, award criteria and contract terms for procurement in the public construction industry. There are developed complete sentences that can be used directly into tender documentation. Difi states that setting stricter demands to enterprise construction will improve the environmental performance of the industry. It is recommended to hold meetings before the bidding deadline when setting strict demands, to secure qualified bidders. (Difi, 2015)

General environmental guidelines are developed for the two public procurements phases; the planning and contracting phase, and the contract phase. For the planning and contracting phase, there is a recommendation to set environmental competence as a qualification requirement in the tender rules. For the contract, it is recommended to make a requirement specification that will serve as a framework for the bid from the contractor. Further, it will be a part of the future contract containing specific environmental demands to the contractor's performance and construction. Connected sanctions or incentives should be described. For contract follow-up, there should made effort for a close follow-up of the contractor, where sanctions and incentives are used. (Difi, 2010)

Table 16 describes frequent procurements for public construction and their related environmental themes according to the environmental themes of NS 3466:2009. All environmental themes are relevant for construction of railways. (Difi, 2010)

**Table 16: Frequent procurements in public construction and affected environmental aspects (Difi, 2010).**

Environmental aspects	Typical supplier services (actuality)				
	Road construction	Railway construction	Thunnel and landslide support	Safety measures railway	Measures for traffic safety and environment
<b>Environmental management</b>	x	x	x	x	x
<b>Nature environment</b>					
Nature and close environment	x	x			
<b>Pollution</b>					
Emissions to air	x	x	x	x	x
Emissions to ground and water	x	x	x	x	x
Noise dust and vibrations	x	x	x	x	x
Lighting	x	x			
<b>Resource use</b>					
Energy efficiency work	x	x			
Material and product choices	x	x	x	x	x
Waste minimizing and handling	x	x	x	x	x

It is not allowed to set the same demand as both a qualification requirement and award criteria. The criteria proposed can be seen in appendix K. It is recommended that purchasers evaluate the demands that are relevant for the project. For the environmental qualification requirements suggestion, these are parted in two levels: a) basic and b) proactive. A) is requirements that all projects might use. B) is extended demands for projects with a higher ambition level. This parting is for adjustments according to ambition levels for the project. (Difi, 2010)

The demand specification is parted in two categories; 1) demands for performance of construction, and 2) demands for the construction product. (Difi, 2010)

### **Further descriptions of the Difi guidelines**

The guidelines and criteria developed in Difi is based on the corresponding developed for the EU. For further information, Difi refers to these, and demands and criteria developed for the construction sector in Sweden. According to Difi, Sweden has come further in guiding the Swedish construction industry based on the EU guidelines. These are transferrable to the Norwegian construction sector. The development of guidelines for construction procurements

in Norway is still in the developing phase. The new Public Procurement Act sets a stronger incentive to price the environmental impacts, to ensure follow-up in projects.

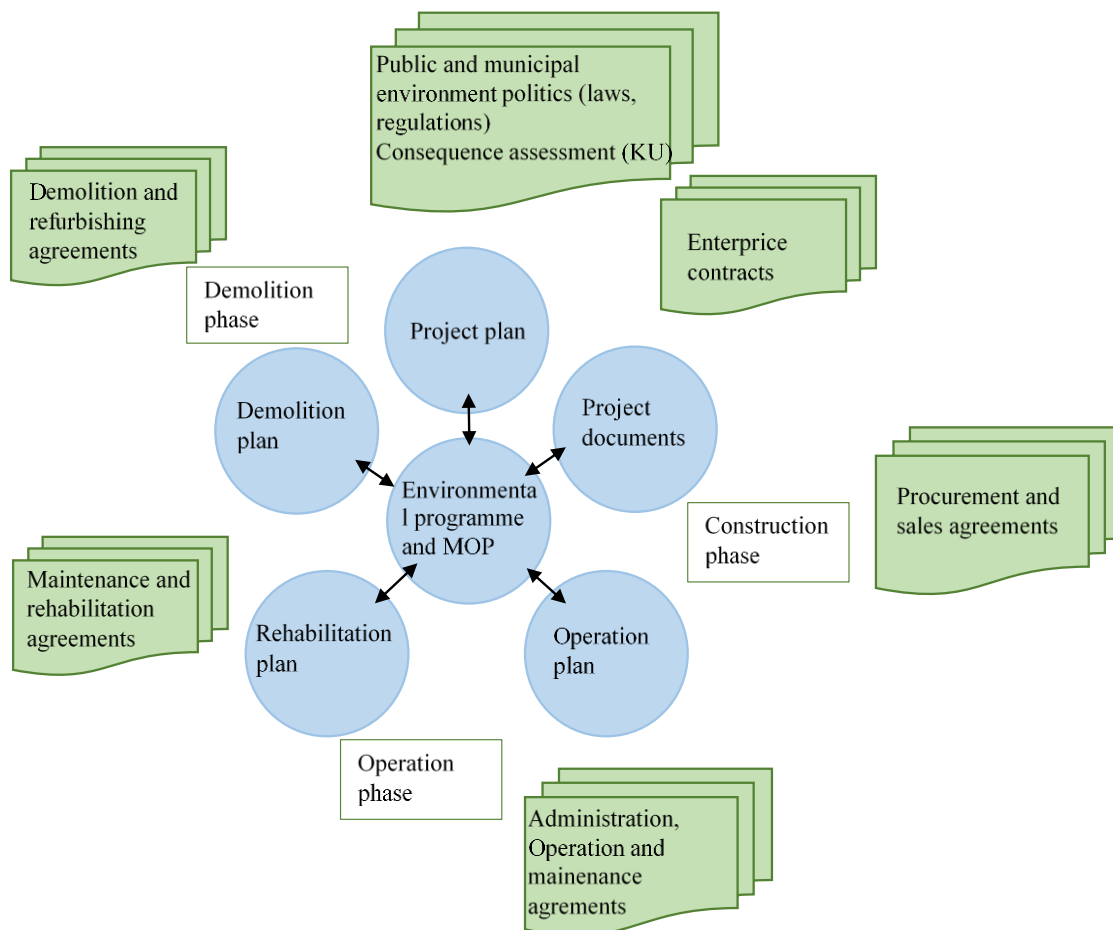
Challenges identified by Difi for public procurements includes a non-sufficient competence level for this in municipalities and governmental organizations. Further, the procurement functions and climate and energy department's in governmental organizations are distanced from one another, with separate plans and strategies. For Difi, there are two main tracks for their work. They work in the direction of integrating environmental and climate considerations in public procurements, and they work for integrating procurements as a part of the climate and environment politics. Difi is currently in user dialogues with actors in the construction sector. (Foss, 2016b)

#### 4.6.3 NS 3466: Environmental programme and follow-up system in the construction sector

In the case company there is a routine demand to establish an environmental programme for the project in accordance to the standard NS 3466 Environmental programme and follow-up system in the construction sector.

The standard provides a framework for establishing and using an environmental programme and environmental follow-up plans (MOP) through a construction projects lifetime. The environmental programme is established for a systematic follow-up of environmental considerations in projects of large and complex projects. The objective of the environmental programme is to set environmental targets for a project. A MOP is developed for the construction phase of the project. This is based on the identified elements in the environmental programme, and identified risks for the planned operations for the construction. The environmental programme and MOPs are also meant to provide easier environmental communication, and can be used to comply with hard laws, be a part of plans for the project, and be a part of enterprise contracts and operation contracts. (Standard Norge, 2009)

The coherence between environmental politics, environmental programme, environmental follow-up plan and other documents according to ISO 3466, can be seen in figure 14. (Standard Norge, 2009).



**Figure 14: NS 3466: The coherence between environmental politics, environmental programme, environmental follow-up plan and other documents (Standard Norge, 2009).**

The projects life cycle should include the phases described in table 17.

**Tabell 17: Stages of a products lifecycle according to NS 3466 (Standard Norge, 2009).**

1	Design phase (inclusive work on regulation plan)
2	Planning phase (planning on an overarching and detailed level)
3	Production phase
4	Operation and maintenance phase
5	Rehabilitation phase
6	Demolition, disposal and recycling phase

The environmental programme should be established as early as possible in the lifespan of the project. Revisions shall be done when new knowledge on environmental impacts arises, or there are changes in project or frame conditions. (Standard Norge, 2009)

The minimum requirements for the environmental programme includes a description of the project and an anchoring of the environmental programme in the project organization and systems for follow-up. There shall be done an evaluation of environmental themes, and relevance for the project. Project environmental targets shall be established, and alternative

measures and suggestions for further assessments shall be made. Processes shall be described for changing of the environmental targets. (Standard Norge, 2009)

#### 4.6.4 Summary and evaluation

ISO 14001 Environmental management systems has as purpose to provide organizations with a framework to protect the environment in a systematic manner, assist to fulfil demands for compliance, and enhance the environmental performance of the organization. The standard was revised in 2015, with an increased emphasis on life cycle impacts for processes, supply chains and products, both upstream and downstream of the activities. Jernbaneverket's works by, but are not certified for ISO 14001.

Difi develops guidelines for public procurement, and has a category for building and construction. Suggestions for qualification criteria and award criteria are developed in the form of basic and more ambitious demands. Follow-up measures are included. According to Difi, the guidelines for construction in Norway is in a developing phase, and there is user dialogue to evaluate which guidelines the sectors need. EU and Swedish developed demands and guidelines are suggested used directly in the Norwegian construction industry.

NS 3466 provides a framework for establishing and using environmental programmes and MOPs. The standard is based on systematic follow-up of environmental considerations, and guides setting targets for a project based on identified risks and demands.

### 4.7 Environmental management and green procurement in construction

For the evaluation of the environmental management in the project, it is relevant to investigate previous research on environmental management and green procurements. The main part of the studies investigated focuses on construction, but some of the findings are for general organizations. The findings are based on international research, and it must be noted that the development and context for the Norwegian industry might not make all findings applicable.

#### 4.7.1 Studies on environmental management in construction

##### **Motivations for environmental management and standard certification**

There has been an increase in the use of environmental management systems in the last decade. Many organizations and companies choose specific frameworks as set in standards for managing their environmental policy and work. Standards in widespread use for this is ISO 14001 and European Eco-Management and Audit Scheme (EMAS). (Morrow and Rondinelli, 2002)

The introduction of standardization of environmental management systems started with the British Standard 7750 in the 1990s. In 1993 EMAS was developed, and the ISO 14001 series in 1996. More than 30300 organizations were certified by ISO 14001 by 2002. (Morrow and Rondinelli, 2002)

Motivations for integration and certification of environmental management systems in organizations includes integrating environmental, health and safety management with total quality systems, securing and going beyond compliance, demands for improved



environmental performance, and finding cost reducing measures. A study by the German Federal Environmental Agency show that motivations for a selection of German companies are to improve environmental performance, improve the use of energy sources, motivate employees, increase legal certainty, improve the image of the company, and upgrade the environmental documentation of the company. (Morrow and Rondinelli, 2002)

Environmental performance for the contractors is of importance as the project Electrification of the Trønder and Meråker line is a total enterprise. The two most important motivations for environmental commitment and innovation for contractors has been found to be managerial concerns and government regulatory pressures in a Chinese study. An increased emphasis on environmental issues by managers influences the adoption of green construction practices for the contractor. On the other hand, project stakeholder pressures from community; environmental non-government organizations and employees, has not been found to have a significant effect for green construction practices for contractors. (Qi et al., 2010)

A survey of manufacturing facilities in Canada, Germany, Hungary and the United states, indicated that the adaptation of more comprehensive environmental management systems were driven by institutional pressures for improving external legitimacy, and the will to build on complementary resources and capabilities in the company. (Darnall et al., 2008)

### **Performance of organizations with environmental management systems**

Results from implementing standardized environmental management systems for surveyed German companies were integration of environmental and quality systems and increased environmental awareness for employees. Integrating ISO 14001 has proven to improve material reuse, waste recycling, reductions of emissions to air, conservation of energy and water, and a reduction in environmental and safety incidents for some companies. (Morrow and Rondinelli, 2002) Further, it is found to provide increased access to markets, reduced costs, improved compliance to regulations, better environmental performance, improved customer trust and satisfaction, improved image, improved involvement and education of employees. (Ofori et al., 2002)

Environmental management systems can be formal or informal, and adopt a standard for EMS or obtain certification by a standard. Analysis of a survey of North American managers gave results indicating that formal or certified environmental management systems lead to the reduction of costs, quality improvement, waste reduction, and lead time reduction. A formal or certified EMS was in the study found to improve the organizations performance in general, and increase the number of times environmental options of less impact were used. The Non-certificated organizations did not increase performance in the degree of companies with formal EMS or certification. (Melnik et al., 2003)

Both adoption of ISO 14001 and environmental report publication, can reduce impacts from natural resource use, solid waste generation and wasteful water. ISO 14001 is found the more effective of the two. It is argued that the focus on continual improvement in ISO 14001 and environmental report publication, secures a more long-term focus improved environmental performance, than simply complying with laws and regulations. (Arimura et al., 2008)

For a survey of manufacturing facilities in Canada, Germany, Hungary and the United states, there was found correlation between relying on resources and capabilities such as quality management, export orientation, R&D and employee commitment in developing their

environmental management systems, and a larger likelihood to improve overall business performance. (Darnall et al., 2008)

Studies have shown that the use of sustainable construction practice by contractors can contribute to improvement of their sustainability performance. Still, studies has indicated that there are no unique relationships between sustainability performance and business performance for the contractors surveyed, all though long term sustainability performance might lead to business competitiveness in the future. (Tan et al., 2011)

### **Challenges and limitations for standardized environmental management systems**

A limitation identified for the use of the ISO 14000 framework for environmental management systems, is that it provides limited guidelines for the actual planning of the environmental management, and limited descriptions for how operations should be done (Eccleston and Smythe, 2002).

An insufficient knowledge level for employees with responsibilities in relation to the environmental management system is an identified challenge for implementation of the ISO 14001, according to a research study performed for Singapore (Ofori et al., 2002).

MacDonald (2005) claims that the trend of implementing ISO 14001 is only a start towards sustainability in organizations. It is claimed that the emphasis for downstream activities of the actor undermines considering upstream activities, and by doing this, the organization does not really address the “core” of their potential environmental impact improvement. They rather focus on relative improvements or keeping up with the actions of their competitors. In other words, a continuous process towards sustainability is not actually in place. Understanding the sustainability concept is imperative. All though tools for the environmental work of organizations exist, such as ISO 14001, there is confusion as to how these best are used together and as a part of the EMS. (MacDonald, 2005)

ISO 14001 has been said to be an important step towards environmental management. It has also been criticized for being in a larger degree reactive to the global environmental destabilization, rather that restoring. It has been argued that adoption of 14001 will better steer the construction industry towards sustainability rather than label-based schemes. There are arguments for that a full use of ISO 14001 is only achieved if the organization tries to operate as a learning organization rather than using the standard as a mechanistic control system. (Ball, 2002)

Short-term costs for employing environmental consultants, training of employees and developing managing structures are identified as drawbacks of the adoption of ISO 14000. Disruptions to work flow, increased costs and delays are other identified limitations. All though the builder might operate continuous improvement, contractors and suppliers has to improve their EMS for the builder to actually obtain results from their EMS system. For contractors in Singapore, it was found that contractors are limited in their EMS from the expectation of direct cost-benefit from ISO 14000, and that financial incentives from clients and government was an important motivation for implementation. (Ofori et al., 2002)

### **Tools for improvement of environmental management systems**

There has been an increase in tools related to the environmental management of companies, which include standards, methods both for management and for analyses, proposed

indicators, specifications, and many more. The scope of this research project delimitates the tools presented for relevance to the case, leading to the focus on EIA and LCA in this section.

Environmental Impact Assessment (EIA)

Large infrastructure projects in Norway such as the electrification of the Trønder and Meråker lines are legally bound to perform an EIA, according to the Norwegian Planning and building Act. Many countries has implemented compulsory EIA as a part of large projects with interference in nature (Glasson, 2005).

EIA is a systematic process that investigates the environmental consequences of planned measures in advance, such as the construction of a railway. The purpose of the method is prevention of environmental impact, providing information for decision-making, providing direction for environmentally sensitive design and promoting sustainable development (Glasson, 2005). Normative steps for a general EIA are described in figure 15.

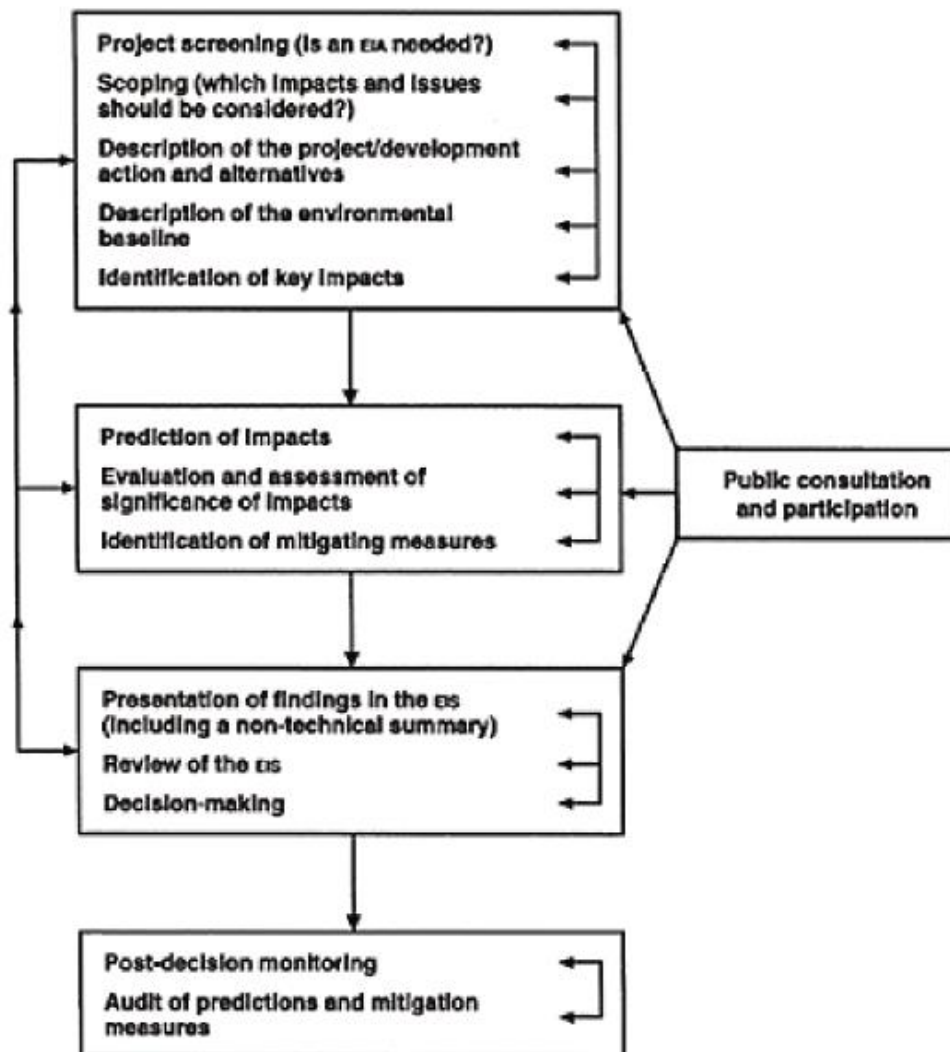


Figure 15: Normative steps in a general EIA (Glasson, 2005).

The steps are a part of a cyclical activity, with feedback and connections between each step. The steps provides an outline and will not be further detailed, since the operational performance of an EIA is out of the scope of this research project. Mitigation measures

might be found for the identified impacts. Environmental impact statements (EIS) are prepared from the EIA, providing estimates of the impact associated with the project. Impacts of a large character provides proactive information that enable changes or stop in existing plans for measures. (Glasson, 2005)

EIA has been proposed integrated into the environmental management system to solve the identified limitations of environmental management. It is argued that advantages for this are potential saving of costs and time, and that it will help ensure long-term performance and maintenance of environmental quality. (Eccleston and Smythe, 2002)

In a study of the integration of EIA and public procurement, there was found limitations for the follow-up of EIA in construction projects. Improving impact assessment practices was recommended to provide decision making of greater efficiency, and to provide an improvement in implementation processes (Uttam et al., 2012)

### Lifecycle analysis (LCA)

LCA is a knowledge-providing tool, concerning the impacts from planned processes and products, throughout all of their lifecycles. In the building sector, it has been in use since 1990. The four main steps of an analysis is defining the objective and scope, developing an inventory of data from impact causing activities, assessing the impact from these activities, and interpreting the results. (Ortiz et al., 2009)

There are developed multiple methodologies for LCA, and databases with country specific data for calculations of impacts. For the construction industry, LCA can be used in two ways. One is for the building material and component combinations (BMCC), and the other for the whole process of the construction (WPC). WPC can further be parted in three scenarios, where civil engineering constructions constitute one of them. LCA of BMCC and WPC has been found to be an innovative methodology for development towards sustainability in the construction sector. (Ortiz et al., 2009)

### **Green construction**

A study on construction project feasibility studies in mainland China concluded that economic factors were more considered than social and environmental aspects. Social and environmental factors were in some cases not given consideration in the feasibility study. According to the research, both economic, social and environmental performance attributes should be assessed in project feasibility studies, for improving conservation of principles of sustainable development. This should involve participation of project stakeholders, such as government, clients, engineering consultants, architects, contractors and suppliers. (Shen et al., 2010)

Hwang B.G. & Ng W.J. (2013) has identified challenges faced by project managers in green construction projects. Challenges for this include higher costs for the project, elevated risks for different forms of project delivery, and a long planning and approval process for new green technology and materials. The top ten challenges identified by the authors are described in table 18. It must be noted, that the analysis for the research was performed on a small sample set.

**Tabell 18 : Top 10 challenges faced by project managers for green construction (Hwang and Ng, 2013).**

1	Longer time required during pre-construction process.
2	Difficulties for selecting subcontractors providing green construction services.
3	Uncertainty for green materials and equipment.
4	High cost of green materials and equipment.
5	Increased amount of meetings and coordination with green consultants and engineers.
6	Higher frequency of alterations and variations in the design during the construction process.
7	Difficulty in comprehending green specifications in contract details.
8	Unforeseen circumstances in executing green projects.
9	Planning of non-traditional construction sequences.
10	Planning of different construction techniques.

#### 4.7.2 Studies on green procurement

##### **Green procurement**

Green Procurement is according to the Commission of the European Communities (CEC) “*a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured.*” (European Commission, 2008)

Public authorities are large consumers in Europe, and spend approximately 1.8 trillion euro annually, 14 percent of the EU domestic product. This creates a potentially large collective impact from European countries for sustainable production and consumption. In addition, it has the purpose of an incentive framework for industry development of green technology. Public sectors such as public transport and construction are found to have significant impact, because they comprise a large share of the national markets. (European Commission, 2016)

A study of the Swedish construction industry gave results indicating that environmental parameters are taken into consideration frequently in procurement of construction contracts, but that environmental evaluation criteria are less commonly used. Environmental evaluation criteria were less used because of risk of appeals that may cause delay of the project, and for simplification of the tender process. Fear of increased costs and limitations to the project were other reasons. Further, it was found that where criteria were applied, this did not in a large degree decide the outcome of the evaluation. Still the criteria were found to possibly affect the bids submitted and the environmental performance, based on the signaled high ambitions for the project. It was found that there was a stronger focus on requirements during construction for civil engineering projects. This was for issues such as type of machines, transport, and emissions. Public organizations set demands more frequently than private. (Varnäs et al., 2009)

The environmental criterion most commonly used in the survey of Swedish construction was the environmental management system of the contractor, which could be proof of the handling of environmental issues in construction for the contractor. Other common criteria concerned waste disposal, harmful substances and working environment. For setting the requirements and criteria, using expert advice was often used. Monitoring the requirements

was frequently done by self-inspection of the contractor, regular project meetings and revisions. (Varnäs et al., 2009)

A survey of green procurement practices for Norwegian municipalities and counties gave indications that the requirements in the Public Procurement Act were not fully implemented. Large municipalities with more resources has a stronger established green procurement than smaller municipalities. It was found that keeping a purchasing department and developing purchasing strategies are success criteria for green procurement, all though this in itself is not found sufficient. A limitation for the green procurement of the municipalities is that even if they include environmental demands in call for tenders, they do not always use the information when selecting suppliers. (Michelsen and de Boer, 2009)

According to Uttam et al. (2012), green procurement is of increasing interest at the procurement stage in large-scale infrastructure projects. It is argued that integration of the EIA and planning of green procurement will lead to more sustainable procurements and greater environmental performance for construction projects. According to Uttam et al., the link between project planning and implementation should be strengthened, and an increased coordination between EIA and green procurement will provide this. (Uttam et al., 2012) Green specifications incorporated into constructions contracts is further though to more sustainable construction (Lam et al., 2011).

According to Lam et al. (2010), optimal performance for the environmental management system in construction were found not be guaranteed by the system alone. Green specifications are in the study suggested incorporated into contracts to promote sustainable construction where environmental management systems are in place. (Lam et al., 2011)

Initiation of green procurement measures in the pre-decision phase has been recommended, since the influence of the EIA is found largest in this phase. According to the authors, it is important to consider proposing establishment of green procurement practices in the scoping, the study of alternative designs and the drafting of the environmental impact statement. (Uttam et al., 2012)

#### 4.7.3 Summary and evaluation

Motivations for implementing structured environmental management systems such as ISO 14001 includes increased legal compliance, securing energy efficiency, integrating HSE in total management systems and image. Results include increased performance, less waste production, reductions of emissions to air, energy conservation and cost reductions. Challenges identified is that it promotes limited guidelines for the actual planning, insufficient knowledge for employees, the possible focus on relative improvements, and that organizations working by the act not necessarily work as a learning organizations.

EIA and LCA can be used for early identification of environmental impacts and priorities in construction projects, and can provide information for decision-making.

In green construction, economic factors have been found to be considered in a larger degree than social and environmental aspects in feasibility studies. Challenges faced by project managers in green construction can include longer time during pre-construction processes, difficulties for selecting subcontractors providing green construction services, and uncertainty for green materials and equipment.

Procurements from public organizations is comprehensive. Public transport and construction sectors are found to have significant impact as large actors in the national markets. Findings from the Swedish construction industry indicates that environmental parameters are frequently included in construction procurements, but that environmental evaluation criteria are less used. Reasons for this included fears for delays and increased costs. When criteria were used, they did not necessarily decide the outcome, which has also been found for Norwegian municipalities. Integration of EIA and green procurements has been suggested to increase environmental performance, especially if considered in early phases. A common environmental criterion is the EMS of the contractor.





## 5 Empirical analyses

Gap analyses and interviews were performed in the study, to analyse data for the research issue. The results from the Gap analyses for internal demands by the project and JBV, and external demands from the revised Public Procurement Act and connected regulations will be presented in this section, in addition to interview results.

### 5.1 Interviews

Interviews were performed to investigate the research issue in the study. The interview guide in Appendix B is developed from the research questions. The cohesiveness between research questions, interview questions, and summary questions is described in appendix A.

Interviews were performed partly to request information, and partly to request evaluations. Where specific information was provided, some of this data is used for the description of the case and JBV in chapter 3.

The interview results are presented according to summary questions led from the research questions. The results in the interviews are presented in a summarized form of the main information in the interviews. The interview objects are referred to consecutively in the text.

#### 5.1.1 Interview results

##### **What project phases are there for the construction of the railway project, and where are environmental considerations included?**

The project phases are organized as explained in chapter 3.1.4 and 3.2.3, from verbal reports.

##### **What environmental information is developed for the project?**

The information developed according to phases is described in chapter 3.2.3.

The project is one of two environmental projects where an environmental budget is produced as a voluntary activity (Roheim, 2016). In addition to the environmental budget, an environmental inventory is under consideration for the construction phase of the project. The environmental inventory is thought to provide extended information about how the decisions made in the project affect the impact on the environment, and how the environmental budget corresponds to the actual impact of the project. It is also meant to provide information regarding which possibilities there are for including environmental considerations in decision-making for the project. There is, all though, uncertainty as to which impact causing activities should, and could, be included in the inventory. (Roheim, 2016).

##### **How is environmental information included in decision-making?**

Results from the environmental budget is used to develop measures in the environmental programme, MOP and drafts for environmental demands and criteria to contractors (Selsbak, 2016b).

The environmental responsibilities of employees for the case is relevant for how decision-making is done. The part-project managers have responsibilities concerning environment for their respective projects in JBV. All employees in projects has some responsibilities concerning the environment, but the project managers have the ultimate responsibility for the

environmental management the project. (Roheim, 2016, Bratsberg, 2016) The environmental advisor assists the project manager in this. The environmental advisor does not have formal decision-making power, but the advice they provide from the environmental evaluations they perform is strongly direction providing. (Staurem, 2016, Selsbak, 2016b) In general, the specialist staff, such as SHA and environmental advisors, are support functions for the project manager. (Bratsberg, 2016, Roheim, 2016)

The project manager direct suppliers in activities such as environmental management, transport and waste treatment. The decisions made concerning environment are further communicated to the contractor through contracts, but may be revised. Documentation for environmental matters included in decision-making are archived. (Roheim, 2016)

### **What challenges are there for including environmental information into the projects decision processes?**

The use of the tools environmental budget and inventory for providing environmental information in the project is relatively new in JBV, and provides challenges. There is a lack of experience for how to use and integrate this in projects in an optimal way. (Roheim, 2016) In the case, the most impact providing materials are identified, but there is a lack of knowledge for the availability of less-impact materials in the market. (Roheim, 2016, Selsbak, 2016b) Limitations for which materials are functional alternatives based on the technical nature of the project, and economic considerations, is further a challenge. The economic nature of the mode for working with railway projects can cause a down-prioritization of evaluating alternatives with less environmental impact. (Roheim, 2016)

In JBV, the complexity of the projects, and the unpredictability of environmental matters that arise in different projects are described as challenges. Each project is of a different nature. (Nermoen, 2016) The collaboration between units with different specializations can provide challenges for including information in decision-making processes. An example provided is for the collaboration with consulting engineers. The work processes are team based, but decisions can be made quite separately. In some of the specialty specific decision processes, there is perceived a lack of understanding of environmental concerns for the technical issues considered. There is not always an understanding of when an environmental advisor should be included in a decision process. (Bratsberg, 2016)

Lack of environmental knowledge for project leaders and managers is further considered a general challenge in JBV, such as for the general construction industry. This is a challenge, because a lack of making environmental considerations at an early stage can create problems at later stages in the projects. This can again cause time delays and cost increases. (Staurem, 2016)

### **How is compliance to internal and external environmental demands solved in the project?**

Compliance to internal and external demands shall be ensured by the environmental management system in the general organization of JBV. Governing documents and routines made by the Department for planning and development are normative for ensuring compliance to internal and external environmental demands in the project. (Staurem, 2016) Based on these, there is made a control plan with deadlines and responsibilities delegated to different roles in the project. The control plan can be seen in Appendix G, and provides an overview of tasks, execution and follow-up. Tools for complying with the environmental

management system are handbooks with guidelines, with guidelines for operationalizing the environmental management. (Selsbak, 2016b)

### **In what degree is public procurement integrated as a part of environmental management?**

JBV is considered a buying organization. Internally in the organization, there are only a few employees, while a large number of employees are hired through contracts for the project. This makes public procurement important for JBV, where environmental considerations is a part of the procurement process. (Folden, 2016)

The procurement function works according to the management control system of JBV. The control systems in JBV are considered as strong. The procurement strategy is a part of the contract strategy, where environmental considerations are included. A cross-disciplinary team creates separate procurement strategies for projects, where relevant functions in the project and organization are drawn into the development. Environmental considerations are in a larger degree developed internally in the projects, while the procurement functions more externally towards the contractor. (Folden, 2016)

SHA plans are developed for the projects, which include environmental risk assessments. Price bearing posts need to be included in this for the contractual matters of the project. If price bearing posts are not included, the results from the risk assessments functions as a requirement of due care to contractors. (Folden, 2016)

The inclusion of environmental considerations in the procurement function varies. Environmental considerations are included in a larger degree in projects where there is considered higher environmental risk. It differs between the projects if there are considered environmental risks or not. (Folden, 2016)

The inclusion of environmental demands in procurements is perceived as relatively new in JBV, as for the rest of the construction industry. JBV is still considered a leader in terms of environmental management for builders in the construction industry, but improvement is still considered necessary (Andersen, 2016) In general, the emphasis of inclusion of environmental matters in contracts in JBV is increasing (Folden, 2016).

Railway and road construction is not considered to have come as far as the building industry in setting demands for environment or energy use. The further development in the building industry can be partly caused by stricter regulations for buildings by the “Byggeteknisk forskrift” (TEK10). Still, consciousness in the construction industry is interpreted as increasing for this. There is currently more focus for the outer environment, but tracking of CO<sub>2</sub> emissions from the construction industry is considered to be equally relevant for the construction industry. The tracking of the CO<sub>2</sub> imprint in the electrification project is considered to provide a potential for learning in JBV, especially in the construction phase. All though projects are different, the construction processes are similar in that they can be demanding and have a high level of resource use. There is considered a possibility for improving these processes and their effectiveness, and creating routines for setting environmental demands. When the trains are running, the railway is considered as environment friendly, but the construction phase has potential for improvement. (Andersen, 2016)

### **How are environmental criteria and demands set and communicated to suppliers?**

How environmental demands are set is documented through the purchasing strategy. There is a use of standard demands in the technical regulations for matters such as quality, and frame agreements are in place for operational rolling stock. (Nermoen, 2016, Folden, 2016) The external advisors, and suppliers of services in the project will meet demands in addition to the contractor (Roheim, 2016).

The contractual part of procurements can be considered as two-parted. One part of the contractual part is implicit in legislation and technical regulations, to which the contractor must comply. Sorting of waste on the construction site is one of the demands included for this in the technical regulations (TEK10). The other part are demands set by JBV included in the contractual documents. The content of these vary between procurements. Demands for certifications is an example for this. (Andersen, 2016)

Demands that can be set for procurement includes qualification criteria, which the suppliers must satisfy to compete in the tender. Qualification criteria used are often well-trying alternatives with the same formulation. A typical environmental qualification criterion is environmental management system in accordance to ISO 14001. Using new less-trying qualification criteria is challenging. The challenge is based on knowing how to evaluate the criteria, where price is the simplest way of judging this. There has to be a clear way of evaluating the performance according to the criteria used. Matters where the criteria cannot be priced are in general challenging. (Folden, 2016) There will be qualification criteria for the environmental management by the contractor in the case. (Roheim, 2016)

Environmental award criteria enables awarding suppliers with points for best performance for a demand. (Andersen, 2016, Folden, 2016) The weighting of award criteria is dependent on the specific project. There is not a lot of experience with setting weighting in JBV. The weighting is normally set between 10 and 30 percent, and is evaluated for each procurement. There will always be variation between projects for achievement in setting environmental criteria. For award criteria, it is important to secure that the demands are not twisting the competition. They need to be formulated in an open manner, so that multiple actors still can compete in the tender. If there is insecurity for what can be accomplished, there needs to be defined measurable parameters for the criteria. (Andersen, 2016)

The demands needs to be distributed in accordance to which form they function best, as qualification criteria, award criteria or contract demands. Demands can in theory be set for any environmental issue, but there needs to be a consciousness for how the demands work and what results they provide. It is perceived as challenging to set good environmental demands in projects, and there needs to be set good parameters. There can be confusion for the difference for the qualification criteria and award criteria for public procurement in general. The understanding of the demands set, and how to fulfill them needs to be in place for the contractor. If demands are found unclear, contractors might demand a reevaluation of the bids. (Andersen, 2016)

Environmental demands can further be set in contracts. The contracts used by JBV are often based on the standard contract NS 8406 and 8405. The standard 8406 is for execution contracts, where the contractor performs what is specified in the contract. NS 8405 is for total enterprises, and are used for larger projects. The contract regulate the environmental matters in different degrees, based on appendices included in the contract. Standard appendices that are used for contract provisions are C1 and C2. C1 and C2 cannot be changed, are a part of

the contract, and contain environment specific information. As an example, C1 can contain demands for machines and how they are used, or clean-up of the construction site after construction. The appendix C3 contains assignment specific delivery conditions, and may be changed. Demands might be placed for all environmental matters in theory, but they need to be specified. (Andersen, 2016)

The environmental budget creates a precedence for setting demands in the electrification project, in comparison to other projects, according to the environmental advisor for the project. Tools such as this provide information to set demands. (Selsbak, 2016b) Environmental advisors are important for providing the occupational insight to set and formulate demands. The procurement responsible then sets the criteria into an evaluation model, which satisfies the demands according to the Public Procurement Act. (Andersen, 2016)

A draft for award criteria for the contractor is made by the case's environmental advisor and Sweco, as described in chapter 3.2.3, but is subject to change. Demands are drawn from the interim in NTP, concerning climate, clean air/dust, noise, and nature diversity. The draft is not directly correlated with the MOP for the construction phase. Demands set in the draft includes a greenhouse gas budget made by the contractor, where experiences from this is meant to be used in later projects. The environmental manager and Sweco has made a simple greenhouse gas calculator based on guidelines from the certification body "Miljøfyrtårn". In addition, the contractor must sketch the potential reduction in CO<sub>2</sub>-emissions, and measures, throughout the project time. This is meant to promote creativity in the environmental work of the contractor. This might trigger a bonus, and central areas for the reduction of greenhouse gas emissions could be rig areas, transport and logistics, and locally produced materials. Demands for clean air/dust includes solutions that damper dust pollution and handling of particles in general construction work, road transport and drilling. The demands are not further specified at this stage. A description of noise reducing measures by the contractor is demanded, in addition to information regarding the machines that will be used, and any planned procurements of less noise polluting machines. For nature diversity, the contractor shall describe the measures taken for reducing interference in nature or cultivated land. For the visual environment, measures for finding a rig solution that reduces visual interferences shall be described. (Selsbak, 2016b)

The draft of the criteria for a greenhouse gas inventory for the contractor can be done multiple ways. The inventory can differ greatly based on the method used for calculations, and what is included. (Selsbak, 2016b) There is not a lot of experience with setting this demand (Folden, 2016). All though award criteria such as this can be harder to evaluate, it is considered as positive to get knowledge of what the contractors can provide. The tool can provide increased efforts in the environmental work for contractors. The builders need to set demands to improve the environmental performance in the construction industry, according to the leader for Contract and strategies. The competition situation for the contractors is the reason for this. They compete on the best solutions according to the description for the project provided in the tender, and budget their resources according to this. Environmental demands for materials, as suggested in the draft of demand specification for EPDs have not traditionally been set in JBV. There is not a lot of experience for setting environmental criteria, or setting demands for EPDs for materials in JBV. When setting EPDs, there are not specific expectations in the project for how this should be done. (Andersen, 2016) There are developed product category rules (PCRs) for developing EPDs in the Follo line project. This

is experienced as challenging, and as it is too early in the project to evaluate results from this. (Tytlandsvik, 2016)

Guidelines from Difi are considered useful and relevant for a greener development for procurements in construction. Still, the suggestions for award criteria by Difi are found to have potential for further development. The national programme for supplier development and Bellona are mentioned as other identified resources for guidelines for green procurement in construction. (Selsbak, 2016b)

The areas for measures for the contractor shall be described in a system description. The contractor will be evaluated on the holistic best solution for this, as there might be a lack of reference points for setting specific environmental demands to suppliers. (Roheim, 2016) All environmental demands will further be a theme of discussion in the interaction phase with the contractor. Final demands are formalized in contract with consultants and the contractor. Due to the complexity of the project, some areas tend to be forgot in the contract. These are usually managed by the contract management at a later stage. (Selsbak, 2016b, Roheim, 2016) It is regular that not all matters that should have been included in the contracts are included. Demands For Change (KOE) can be demanded by the contractor for this, where environmental issues that were not priced in the contract appear. Settlements has to be done in these situations. A characteristic of a well-performed contract can be a limited, or no demands for change at the finalized project. (Folden, 2016)

### **How is the consistency with the environmental policy and environmental criteria maintained with suppliers?**

It is important to set demands to contractors that are possible to follow up. The contractors deliver documentation of their performance according to demands in reports. In addition, it is possible to run revisions on site based on environmental issues and safety. (Nermoen, 2016) For the best performance of this, it is important to perform this fairly, and with a given notice that enables the contractor organization to be prepared for it (Andersen, 2016).

It can be challenging to find functional sanction mechanisms for breach of demands by the supplier. There is a challenge to set the sanctions in a degree that makes them relevant as controlling mechanisms. For matters resulting in reduced progress, there is a norm to use day penalties as a sanction mechanism, but the cost for this can be quite low. (Nermoen, 2016)

There is a need to follow up contractors and suppliers throughout the whole project. There are no specific routines for the follow up of suppliers, and according to the project superior manager, it is a working progress. Possible measures for follow-up of suppliers include judgement sampling and control rounds. The project manager describes difficulties with planning follow-up of the use of a greenhouse gas inventory, as the project does not have sufficient specific reference points to set strict demands for this. Fines for breaching award criteria is a possible sanction mechanism. (Roheim, 2016)

According to the environmental advisor for the project, follow-up of compliance can be done as described in the draft for award criteria, all though this is still under consideration. The environmental advisor confirms difficulties with following up demands for an environmental budget and inventory, because there is no reference value in CO<sub>2</sub>-equivalents for emissions one can expect from the construction, and for the potential for emission reductions through measures. (Selsbak, 2016b)

The end greenhouse gas inventory, and monthly reports for areas such as diesel consumption, air travel or similar for the construction phase is suggested as control of the work performed by the supplier, in compliance to the award criteria. No complaints from third party stakeholders is a target concerning dust pollution in central areas. Dust measurements and sampling tests are evaluated as control measures for dust pollution, in addition to inspections for the use of correct specified equipment. Measurements and sampling tests are considered as control measures for noise as well. Inspections and evaluation of quality of reestablishment of the rig area are considered used for control of the contractors work with nature diversity and visual environment. (Selsbak, 2016b)

### **How is the performance for the project and Jernbaneverket in accordance to the new guidelines for the new Public Procurement Act?**

The existing and new Public Procurement Act are in a large part the responsibility of the sections for purchasing and contracts in JBV, and there is no strong connection between the environmental management and procurement function. Public procurement is not an integrated part of the environmental work performed by the SHA and environmental advisors in JBV. The law is considered to function in a nudging way towards greener purchasing. (Selsbak, 2016b)

The interviewees working with contracts show a parting in the perceived effect of the revised Public Procurement Act, in terms of stricter guidance for green procurements. According to one interviewee, JBV at the least needs to comply with the Public Procurement. JBV might perform stronger than the level of compliance. The content in the Public Procurement Act is by the interviewee considered as providing directions for procurements, and interpretation and judgement will affect how procurements are performed. The changes in the new Public Procurement Act are considered mainly simplifications, and there are not perceived stricter directions for green procurements in the act. (Andersen, 2016).

According to another interviewee, the changes in the procurement act is expected to result in stricter demands for considerations of environmental affects, and decrease the public discussion for if environmental demands are possible to set. Politicians have stated that environmental criteria should be weighted more than 30 percent. It is not necessarily considered as relevant to set 30 percent weighting for each project in JBV. The challenge for integrating environmental considerations in the procurement function is perceived as given, but the challenge is to answer this in a good way. The green procurement in JBV is expected to be developed over the coming years. Development will both be project specific and in the main organization, supported by environmental advisors. It is expected that experiences can easily be transferred to new projects. (Andersen, 2016)

The revised Public Procurement Act is expected to affect the procurement process in JBV, but it is not known in what way. There is ongoing evaluation of this. There are misinterpretations of the Public Procurement Act in the general use of this in public procurement, leading to very different practice in accordance to the act, according to an interviewee Guidelines for innovative procurements are used for the electrification project, where processes are made for improved communication with the market. (Andersen, 2016)

It is considered helpful to keep dialogue with the market of contractors before the tender is given, to improve performance in the project. This can also be used to learn what can be done regarding green procurements. Some builders only keep at a minimum effort, while other builders make an effort to investigate the market. It is considered valuable to keep

communication with the contractors to learn what can be done regarding green procurements. The dialogue conference held is a relatively new procedure in JBV, and is announced electronically. Dialogue conferences has not been a part of the procurement tools previously, and it is considered too soon to evaluate clear results. The procurement function is expecting improved general performance in projects from the conference. It amongst other outcomes can function as market research, providing information regarding how to set the right demands based on the possibilities in the market. (Andersen, 2016)

### **What challenges are identified for Jernbaneverket's work with environmental considerations in general?**

Time is a limited resource in the project, and this creates limitations for the environmental considerations for the project (Selsbak, 2016b). Some of the interviewees mentions follow-up and developing environmental indicators of satisfying quality as challenges in the environmental work. (Nermoen, 2016) Unpredictability in the operational environmental management based on the complexity of the projects is described as a general challenge. (Bratsberg, 2016) Further challenges are described corresponding to the themes of the research sections in this chapter.

### **What are possible optimization strategies?**

Better communication between actors in the complex projects is also described as a possible improvement in the operationalization of the environmental management, in addition to an increased level of general environmental knowledge for project managers and consulting engineers. (Bratsberg, 2016)

There is considered a possibility to research and find new solutions for issues such as materials and transport, which needs to be evaluated in a holistic life cycle perspective (Roheim, 2016).

Finding good parameters in form of key performance indicators (KPI), is described as an area of improvement for the project (Nermoen, 2016). The M-value that has been used in the Follo construction project in JBV is perceived as a possible measure for reducing unwanted environmental incidents. (Selsbak, 2016b) The M-value is an indicator for unwanted environmental incidents or accidents (Tytlandsvik, 2016).

Finding adequate sanction mechanisms is considered as beneficial when setting environmental demands. If the form of sanctions are economic, there must be a price for non-compliance to demands which provide adequate results for the environmental work of the suppliers. (Nermoen, 2016)

There is identified a need for simplifying the structure for the internal documents and guidelines for environment in the management system. There is an ongoing change process to make documentation more structured and simplified in general, to improve functionality. There is a need to develop processes to use experiences from the environmental proactive projects. (Staurem, 2016)

### **How is knowledge and experiences concerning environment shared in Jernbaneverket?**

The database Synergy can provide information regarding previous experiences about environmental cases, and how they were solved. There has though, not been sufficient amounts of data to adequately transfer experiences and data before now. All though there is a network of advisors in Jernbaneverket, there is no strong tradition to consult other advisors,



because matters that arise in the projects construction phase might need rapid response. (Bratsberg, 2016)

### 5.1.2 Summary and evaluation

The interviews performed provided information relevant to the research questions. The interview results provided both specific information for the project, and evaluations from the employees.

There was provided information for which project phases there are for the construction of the case project and where environmental considerations are included, which was used to describe the case in chapter 3.2. There are specific structures for integrating environment in decision-making processes in the projects of JBV, set by their planning strategies.

The project manager has the ultimate decision power for environment, but has supporting functions such as SHA-advisors and environmental advisor. Environmental advisors have strong influence in the advice they provide for environmental aspects.

There are challenges introduced for using an environmental budget and potentially an inventory for the project, as there is a lack of experience for this. The complexity and unpredictability for the projects in JBV can provide challenges for identifying environmental risks at an early stage. Further, a lacking inclusion of environmental considerations in technical matters can cause delays for projects at later stages. This can be caused by a lack of environmental knowledge for consultant engineers and project managers.

Compliance to internal and external demands are solved through the environmental management system, and through governing documents and routines. There is made a control plan for the project.

Public procurement is considered as important for JBV. There are procurement strategies in JBV and for the specific projects. Relevant functions are drawn into the planning of the procurement strategies for the projects. There is not traditionally a strong connection between the environmental management and procurement activities, and setting environmental demands is considered as relatively new in the organization and construction industry in general.

Some environmental demands are implicit in legislation for suppliers. Environmental demands can be set through qualification criteria, award criteria or implemented as a part of the contract. There are challenges for setting and evaluating demands, as this is relatively new in JBV. The project sets more specific environmental demands than the norm in JBV. This includes the environmental award criteria, and a demand for specifications for EPDs. A comprehensive environmental budget and SWOT analysis is normally not used for projects in JBV, and provide more information concerning environmental aspects than usually available in projects.

Follow-up of environmental demands has no routine structure, but can be done with documentation from the contractors, sample tests, and revisions on site. For deviations to demands, sanctions such as fines can be used.

## 5.2 GAP analysis for compliance with internal and external demands

Gap analyses was performed in the study to evaluate compliance to internal and external environmental demands, as described in chapter 2.3. A purpose of the Gap analysis was to find measures for improvement. The analyses will in this section be presented separately, where gaps and identified measures are further elaborated. A summation of results is provided. The results are further discussed in chapter 7.

### 5.2.1 Gap analysis for performance according to internal demands

The Gap analysis was performed for the environmental principles in the environmental programme for the project, overarching environmental objectives for the electrification of Trønder and Meråkerbanen, and targets according to themes in the environmental programme, as presented in Appendix F. The demands are presented in accordance to assigned number of the demand in the tables. There were identified 19 targets with potentials for improvement for the 86 gathered objectives and targets investigated in the internal demands for the project and JBV.

#### **Environmental principles in the environmental programme**

**1:** *«Environment shall be planned, performed and followed up in line with the Norwegian standard for environmental programme and environmental follow-up plan (MOP) for the exterior environment for the building, construction and real estate industry (NS 3466:2009)»*

The documents were analyzed for gaps in accordance to the standard. It must be noted that some elements are minimum demands, and other suggestions. The Gap analysis was performed for both, to analyze according to “best practice”.

A deviance is that it is not specified in the environmental programme that the project shall comply to ISO 14001, only that suppliers must do this. A cross reference to other management systems for the project is not clearly present either, which are both recommended by the standard. A measure found for this is that integration of environmental management in cross reference to other management system should be described in the environmental programme. The scope of the project’s environmental impacts could be more clearly defined. Energy sources for construction could be further treated in the programme, possibly with measures, as it is only noted that they cause greenhouse gas emissions.

NS 3466 describes that compensation measures can be provided, in case the prescribed measures are not adequate. The MOP will be further detailed by the contractor, which could be the reason for the gaps identified. In the MOP, there are only a few compensation measures, and there is a general lack of description of follow-up routines for the measures. Targets could further be quantified and given a deadline to enable follow-up. Another option for this is to specify that the contractor shall do this in their MOP.

**2:** *“To ensure that environment is a line responsibility, equal to technical subjects, economy, health and safety”* is considered to be a target that the case project could benefit from being conscious of, all though there is not identified a true gap for this in the project. Environmental responsibilities for the project are defined in the environmental programme. Results from the interview with environmental managers in other projects in later project phases indicate that integration of environmental considerations can be lacking across disciplines, especially between consulting engineers and environmental advisors. This, in addition to limited environmental knowledge for project managers, are identified as general challenges for integration of environmental considerations in projects. There is found a weakness for the

integration of environment in line management caused by lacking environmental knowledge for the case project by the SWOT analysis. Training in environmental knowledge is a measure that already is in place through the performance targets described in table 4. Environmental training was also a suggested improvement for environmental performance in JBV in interviews (Staurem, 2016).

#### Main environmental objectives for the electrification of the Trønder and Meråker lines

**18:** *“Use resources and materials with the least negative effect”*

To ensure the use of materials with the least negative environmental impact, the results from the environmental budget has been used in developing a draft for environmental award criteria and a draft of demands specifications for EPD's for materials. Environmental properties of products will be included in a holistic evaluation, where matters such as quality, endurance and economy has to be evaluated (Nermoen, 2016). A challenge for this is deciding how and which environmental demands or criteria to set, how strict they can be, and how they can be followed up. (Selsbak, 2016b). Guidance from Difi has been used, but there are perceived limitations for public guidelines for green procurement in the construction industry. Since interviews have provided information that green procurement is not strongly integrated in Jernbaneverket (Andersen, 2016), a measure for this could be to develop stronger green procurement processes. According to Difi, it is possible to evaluate the EU criteria developed, and investigate the work of the corresponding directorate to Difi in Sweden, which have come further in the development of guidelines for green purchasing processes (Foss, 2016b).

#### **Targets in the environmental programme by themes**

**27:** *“The measure shall be built with input – materials and energy – that after a holistic evaluation of environment, quality and safety gives the lowest possible negative environmental impacts trough the project's lifetime.”*

This is identified as an area of improvement. For the construction phase, the MOP states that the contractor should evaluate using recycled or less materials for specific components in the electrification. This does not set binding and clear directions for the contractor. The award criteria and demands for EPDs could compensate by establishing guidelines for how the contractor shall perform this, which could promote an improved environmental performance.

**36:** *“Contemporary measures shall be limited in time and space, and be done in the gentlest way possible.”*

The environmental programme states that contemporary measures shall be limited in time and space, which could be further specified in the MOP.

**40:** *“Contribute to a reduction in animal hits.”*

For the target concerning reductions in animal hits, this is only specified for birds in the MOP. The SWOT analysis results supports the finding of a lack of establishment of environmental targets for game. Other game and clearing of corridors could be mentioned.

**43:** *“Reduce consequences for game in the construction phase.”*

In the MOP, demands concerning nightly construction is not further treated, or when crossing opportunities and game fences shall be established. This could be a matter to develop in the MOP by the contractor.

**51:** *“The construction work shall not contribute to damage to cultural relics, cultural environment or cultural landscape. If valuable cultural relics and cultural environment are affected, these should be secured in the construction period.”*

For cultural relics, there is a demand that the contractor shall establish communication routines when finding cultural relics, which is not further treated in the MOP. The matter could be treated in the MOP of the contractor.

**55:** *“The population shall in the largest possible degree experience calmness and safeness in the construction period.”*

For the target concerning that the public shall experience calmness and safeness in the construction period, the measures identified in the environmental programme are not specifically treated in the MOP. These measures could be included in the MOP, or the new MOP from the contractor.

**67:** *“Dust issues as a consequence of construction work shall be minimized.”*

In the environmental programme, there is a demand that new, modern construction machines shall be used for avoiding air pollution. The use of new, modern construction machines is not specifically treated in the MOP, and could be treated further.

**68:** *“Emissions to air shall be reduced.”*

The demand for an action plan and emergency preparedness plan is not further treated in the MOP, and could be included in this MOP or secured in the MOP for the contractor. This is supported by results from the SWOT analysis.

**79:** *“Waste shall be handled as a resource and treated according to regulations. The waste shall be sorted and at least 70 percent of the waste shall be reused or recycled.”*

Measures for waste treatment in the environmental programme could be further treated in the MOP. This includes specification of the consideration of need for areas for waste treatment, and the specification to follow the environmental waste management system of JBV.

### **Overarching environmental policies of Jernbaneverket**

**2:** *“Jernbaneverket shall adhere to statutory environmental demands, and contribute actively to reduce and prevent environmental effects from own activities, and improve their energy efficiency.”*

There are found no identified deviations from statutory demands for the selected legislation. The Constitution § 112 could, all though, be included in relevant legislation for JBV in documents and on their webpage, as it is a governmental organization which has decreed responsibility in line with the last section of the paragraph.

JBV has solid structures for their environmental management, and the project works according to the routines for environmental management set. Environmental impacts are identified and evaluated, and measures for these are set. There are all though gaps for what is described in the environmental programme, and the demands that are set further in the MOP. An accomplice reason for this could be that the project and environmental documents are to be further developed in the interaction phase with the contractor.

According to interviews, challenges exist for early evaluations of certain measures in JBV. This can be partly caused by environmental aspects not being identified at an early stage for certain activities. Knowledge “silos” between different specialty units are mentioned as a

possible reason for this in the interviews, and for the cooperation between the project organization and consultant engineers. This might cause the need for active measures at a later stage, which might result in time delays or cost increase for the project. Measures for improving this could be securing environmental competence, and inclusion of evaluation of environmental impacts in all speciality subunits, and for consulting engineers.

Environmental impacts for the project is clearly identified by the environmental budget. This is not normally used for all projects, according to interviews. This could promote increased environmental performance for the project, if identified impacts are used for setting further directions after the planning phase of the project.

**3:** *“Jernbaneverket shall prioritize work to fulfil main- and step distributed targets for environment in the National Transport Plan, and contribute to develop these further with decreed sector responsibility.”*

JBV develops overarching objectives according to the NTP, and further work to integrate these in the project. The fulfilment of targets from the NTP, and an analysis of the performance of JBV in accordance to decreed sector responsibility is further treated in the section for Gap analysis of external demands.

**4:** *“Jernbaneverket shall execute purchasing of environmental- and energy effective products, services and design to improve the environmental and energy performance.”*

There is not a strong tradition for green procurement in JBV, based on interview results. There are challenges in setting environmental demands in terms of absolute demands and award criteria for the contractor. Uncertainties exist regarding how strict and precise criteria can be set and which criteria that can be set. There is no standard weighting system for award criteria. There are also uncertainties for the technology market for green materials and products and the contractors competence in this, and how setting absolute demands affects competition. This causes restraint on specific environmental demands for suppliers, and could decrease the potential environmental performance of JBV's project.

Creating systems for active learning from the use of environmental demands in the pilot projects in JBV could be a measure, especially since demands are based on a more comprehensive environmental budget than normal for projects. Setting a weighting of award criteria can ensure that the environmental award criteria has effect. Market research regarding available technology and materials could be performed, either by JBV itself, or in collaboration with contractors, construction unions, Difi or similar. Where there is a lack of technology/materials, there is a potential for making innovation partnerships and develop products where less-impact materials/products are lacking. The new public procurement act has simplified this arrangement in accordance to demands for competition.

**5:** *“Jernbaneverket shall develop and use methods and tools that ensures environment and energy effective business processes.”*

The environmental budget and environmental risk analyses performed in the project are effective tools for providing information for decision-making, and can ensure environment and energy effective business processes. The results are dependent on further use of environmental information made at the early stages of the projects. Securing green procurement is therefore relevant, through further developing the green procurement function in JBV.

### 5.2.2 Gap analysis for performance according to external demands

The Gap analysis for external demands was performed focusing on the revised Public Procurement Act, the revised Public Procurement Regulations, and for targets set by the NTP. This enabled an evaluation of green procurement in public procurement processes planned for the project, and structures for this in Jernbaneverket, based on relevant developments in the field.

#### **The Public Procurement Act and Public Procurement Regulations**

There were found no deviances to the Public Procurement Act and Public Procurement regulations.

#### **The NTP 2018-2029**

**M1:** *“Reduce greenhouse gas emissions in line with the climate target of Norway.”*

The electrification of the Trønder and Meråker lines, as the electrification of other non-electrified lines in JBV will promote greenhouse gas emission reduction for the operation phase of the railway (Garmann and Skjøstad, 2014), and therefore contribute to target M1.

Efforts can still be made to further reduce emissions from the construction phase, and potentially the maintenance phase. Emissions can be reduced by using less-impact materials, and by implementing measures for transport and machine operations in the construction phase, as described in the Gap analysis for performance according to internal demands.

Securing a connection between JBV’s policies and the contractor’s actions is necessary to promote this, as the contractor has freedom to act within their operations. Measures to promote this development in the project are by the environmental targets and measures set in the environmental programme and MOP, which will be further developed in the interaction phase with the contractor. The demands set in the tender and contract are central to obtain the desired results. The green procurement function can be improved in JBV for stronger compliance to target M1.

The shorter travelling times on the lines in the operation phase can in addition contribute to climate gas emissions based on transfer of transport from fossil fuel run vehicles for the sections. This is depending on several factors such as planning of routes, and preferences by travellers and transporters, and an evaluation out of the scope of this study.

**M2:** *“Contribute to fulfil national targets for clean air and noise.”*

The Gap analysis for internal demands identified the lack of description of new, modern machines for limiting emissions in the MOP. The drafted environmental demands for the tender could provide a stronger compliance to M1.

**M3:** *“Limit the loss of nature diversity.”*

There is not identified a clear gap for this. The planned profile expansions and logging of trees around the lines should be performed while evaluating this objective. There are set measures to secure nature diversity in the project, but it is not possible to evaluate the effects of these due to the scope of the study.

### 5.2.3 Summary and evaluation

#### **Internal demands**

The Gap analysis identified 19 gaps, or areas for potential improvement, out of 86 internal environmental objectives and targets. In general, JBV is considered to have solid structures for the inclusion of environmental considerations in projects on the overarching level.

The analysis both provided gaps for details in the environmental documents, and gaps for performance according to overarching objectives for the project and JBV. Potential measures were further described. Reoccurring gaps or gaps that are in correlation with results from the interviews are prioritized for further discussion based on relevance for the research issue.

Based on interview results concerning the general environmental knowledge of project managers and consultant engineers in JBV, securing environmental knowledge by training or by setting demands for environmental competence for consultant engineers can potentially improve the operation of these responsibilities. This could promote the identification of environmental aspects at early planning phases, and thereby promote the performance for the project in general, in terms of time and economy

When identifying relevant legislation for environmental aspects, JBV could include the Constitution § 112, to communicate the decreed environmental responsibility the governmental organization has according to this. This is further in line with the communicated ambitions for the environmental pilot projects.

The described target for use of less-impact materials and resources in the environmental programme and MOP does not set adequate incentives towards contractors for securing measures according to this. Therefore, the environmental demands drafted for environmental criteria, and for EPDs, as a part of the procurement demands are found to potentially strengthen the continuation of environmental objectives in JBV. Setting demands for this is promoted by the environmental budget, which provides valuable knowledge concerning the impacts of the project. Impacts from machines and their energy use is not considered to be treated sufficiently in the environmental programme and MOP for setting further directions for the contractor. The inclusion of award criteria for calculation of emissions, and measures for handling of particles and noise pollution from machines is considered an incentive that could promote increased environmental performance in the project.

As there are identified insecurities for how to best integrate environmental demands in the procurement of the construction by contractors, this is an area of improvement for JBV for increased compliance to internal demands. The organization is aware of this, and communicate a learning approach to the issue described. The electrification project goes further in setting demands than other projects in JBV. Systemizing and knowledge sharing from experiences from projects such as this in the general organization could strengthen the performance in environmental management in line with the continuous improvement principle implicated by their commitment to ISO 14001.

#### **External demands**

##### The Public Procurement Act and Public Procurement Regulations

There are identified no deviations for compliance to the revised Public Procurement Act and regulations. The act and regulations can be said to function in a “nudging” way. Based on the

emphasized responsibility for measures against environmental impacts placed on JBV by § 112, a high ambition level for the sections on green procurement, and evaluation of products and processes life cycles could be expected of JBV. A measure for securing performance higher than compliance can be done by further developing green procurement structures, and systemize learning from setting environmental demands as drafted for the case project.

#### NTP

The electrification of the line in itself provides reductions in emissions long-term. Efforts can still be made to further reduce emissions from the construction phase, as described for the summary and evaluation of internal demands. Shorter travelling routes can contribute to limiting greenhouse gas emissions by promoting a shift in transport mode from fuel run to rail for transport and passengers.



## 6 Discussion

The environmental management in the planning phase of the project Electrification of the Trønder and Meråker lines was analysed in the project based on the formulated research questions in chapter 1.2. In this chapter, results from the qualitative analyses are first discussed shortly. The results from chapter 3, 4 and 5 are discussed to provide answers to the research questions and issue of the study. An evaluation of the empirical analyses is provided in chapter 6.3.

### 6.1 Empirical analyses

The interview resulted in information and evaluations for the project from the 8 interviewees. Information from this was further used in the Gap analysis.

The Gap analysis identified 19 areas of potential improvement out of 86 internal objectives and targets where improvements for environmental performance could be done. It must be noted that the Gap analysis is performed in accordance to “best practice”, and that not all gaps are clear deviations, but rather areas for improvement. In general, Jernbaneverket is considered to have solid structures for the inclusion of environmental considerations in projects on the overarching level.

The analysis both provided gaps for details in the environmental documents, and gaps for performance according to overarching objectives for the project and JBV. The analysis of compliance to external demands was limited to the revised Public Procurement Act and regulations, and the NTP (2018-2029). Potential measures were further described. Reoccurring gaps, or gaps that are in correlation with results from the interviews is prioritized for further discussion based on relevance for the research issue.

As noted, there is emphasis on greenhouse gas emissions for the project. The analyses still concerned deviances for all environmental aspects included in the plans of Jernbaneverket according to their objectives.

### 6.2 Research questions and findings

#### **What environmental information is developed, and how is it used in decision-making?**

From the strategies and objectives in the NTP, and JBV’s specific environmental aspects, there has been developed a documented environmental policy and objectives for the organization, in line with the guidelines from ISO 14001. This is further used for the priorities set for the planning of the environmental management for the case project.

According to ISO 14001, identifying risks and opportunities is a part of the planning process. Identifying risks and vulnerabilities for construction projects is a legal demand for Jernbaneverket by The Planning and Building Act § 4 -3. JBV solves this by performing risk analyses, which is used for identifying focus areas and measures. The information developed is implemented in plans, in line with the recommendations in ISO 14001.

An environmental impact assessment has been performed before the start of the project. Impact assessments must be performed for plans with significant effects for environment and

society, according to The Planning and Building Act § 4-2. According to Eccleston and Smythe (2002) and Uttam et al. (2012), early environmental impact assessments can provide advantages such as savings of costs and time, improvement of long-term performance and environmental quality over time, and provide decision-making of greater efficiency. Securing follow-up of environmental impact assessments can provide this, but there are found limitations for this in construction projects. It is found important to consider environmental impacts at an early stage to conserve principles of sustainable development (Shen et al., 2010). Infrastructure development such as for the case study provide interferences with environment and society. Therefore, performing a comprehensive environmental impact assessment not only secures compliance, but the knowledge provided can provide increased environmental and general performance in the project if the results are further used in the planning of the project.

Further risk analyses and evaluations have been performed, where results and measures are documented through the environmental programme, to ensure compliance to internal and external demands. The environmental programme has been used for developing the MOP for the construction phase. There will be made a MOP by the contractor from this. The objectives and measures will be continuously developed in the next phases, as a part of the planning strategies of JBV. In general, there is a line for the development of environmental information based gradually more specific risk analyses as the activities in the project is described, according to results from the interviews.

Environmental aspects and impacts are determined by using established criteria, and the development of the environmental budget secures that this is done in a life cycle perspective, which complies with ISO 14001. Tools such as LCA have been found to be an innovative methodology to promote sustainability in the construction sector (Ortiz et al., 2009), and can promote the sustainability aspect in Jernbaneverket's operations by securing detailed information concerning environmental impacts. The SWOT analysis provides information on strengths, weaknesses, opportunities and threats and therefore is in line with the guidelines for ISO 14001. A strength identified in the SWOT is the enabling of setting concise, operationalized and measurable objectives from the environmental budget and inventory.

There is developed a draft for environmental criteria and a draft for a specification for EPDs for products for the tender, though these are susceptible to changes. Environmental demands will also be described in the contract with the chosen contractor. The inclusion of all environmental concerns in the project are important to include in the tender to reach the project objectives, in accordance to Difi. The high environmental ambition level makes the inclusion of demands in the contract especially relevant for the case project, to ensure that environmental objectives are reached. The procurement function's part in the environmental management is treated later in the discussion.

### **Where and how are environmental considerations included in the project phases?**

The NTP states that environmental considerations must be maintained throughout the project phases, especially the planning phase (Avinor et al., 2016). The decision-making in the phase of the case project is therefore relevant to investigate. According to ISO 14001, environmental objectives shall be implemented at suiting levels and functions, and plans shall be made to fulfil them. (ISO, 2015) A criticism of the ISO 14001 framework is that it provides limited guidelines for the planning of the environmental management (Eccleston and Smythe, 2002). To investigate the effectiveness of the environmental management

system, it is therefore relevant to investigate how the environmental information developed is used in the project's phases.

The project phases are organized as explained in chapter 3.1. Environmental information is developed and integrated at specific points in the project phases. An environmental impact assessment is performed in the investigation phase, resulting in an environmental programme. An early environmental risk assessment of the construction phase is made in the detailed planning phase, and is used for the MOP for the construction phase. In the construction-planning phase, the environmental risk assessment is further elaborated. In the detailed planning phase and construction-planning phase, performance demands concerning the environment are integrated in the tender and contract with the supplier. The environmental risk evaluation is updated when deviances or relevant changes occur in the construction phase. Contractors' environmental plans are followed up in the construction phase. Developed environmental demands are described in the tender and the contract phase. The environmental information integrated in decision making is archived, in accordance to the demand of ISO 14001 to make updated documentation for all processes, decisions, competence and similar. (ISO, 2015)

Results from the interviews further elaborate the findings for how environmental information is included. The project manager has the ultimate decision-making responsibility for the inclusion of environmental considerations, all though all employees in projects has designated environmental responsibilities. This is in compliance to ISO 14001. The environmental advisor has strong influence on the environmental considerations included in the project, and has a supporting function to the project manager in collaboration with other specialty functions.

Interview results provided evaluations that the environmental budget provides stronger insight into the impacts of the case project, and enables setting demands to contractors. Still, there is considered a challenge for how to best take use of the environmental budget, and a potential inventory for the construction, because there is a lack of knowledge for how to integrate this in an optimal way. Setting demands for less-impact materials or technology is a challenge, since there is a lack of information for what alternatives there are for this in the market, and for how they comply with the technical demands in the market. This supports the findings of Hwang and Ng (2013), where one of the most common challenges for project managers was uncertainty for green materials and equipment. Corresponding with the findings of Hwang and Ng (2013) is further the identified lack of information for what the market of contractors can provide for environmental demands. As it is considered important not to limit the competition in the market, this is a challenge. The challenges described constitute potential gaps in the Gap analysis for the overarching objectives, and targets by themes concerning materials and energy for the project, and for targets in the NTP.

### **How does the project and the organization solve the external and internal environmental demands?**

As a public actor, JBV has decreed responsibility for reducing environmental impacts from their activities, according to § 112. Therefore, it is relevant to expect performance beyond compliance to legislation for JBV. Research has provided findings that motivations, and results, for integration of structured environmental management systems includes securing and going beyond compliance (Morrow and Rondinelli, 2002, Ofori et al., 2002).

External demands are identified and described in the environmental programme and MOP for the project, which corresponds to the demand of making compliance obligations available by ISO 14001. Jernbaneverket could describe the Constitution § 112, to communicate the decreed environmental responsibility the governmental organization has according to this, especially because of the communicated ambitions for the environmental pilot projects.

Internal demands in the project are objectives led from the environmental policy and objectives in the general organization of JBV. This is in line with guidelines by ISO 14001. The project works in accordance to the EMS, and planning strategies of JBV for ensuring compliance. There are identified measures to cohere with legislation and internal demands in the environmental programme and MOP, as demanded by ISO 14001 and NS 3466.

There is made a control plan in the project, with deadlines and designated responsibilities, in accordance to ISO 14001s demand of establishing, implementing and maintaining processes to meet the environmental policy, identified requirements and scope (ISO, 2015).

### Gap analysis

For gaps identified in the Gap analyses, the scope of this discussion is for gaps between the current situation and desired situation that stand out as the areas with the largest potential for improvements. Some of the detail-level gaps are still presented as examples.

In the Gap analyses, there were found some deviances for compliance to internal demands. Based on the ambition level for the project, the Gap analyses were performed in accordance to best practice, to find areas for improvement. An example of a gap on a detailed level is that there is not prescribed compensation measures in the environmental programme and MOP. For more recommended measures on the detailed level, see chapter 5.2 and Appendix F.

Gaps identified for the environmental objectives for the case project include gaps concerning the use of resources and materials with the least negative effect, and an evaluation of inputs of materials and energy in a lifecycle approach. The gaps are not clear deviances, since the environmental budget has provided information regarding how impacts related to materials can be reduced. This is further treated in the MOP as well.

ISO 14001 states that there shall be controls in place to ensure that environmental demands are addresses in all life cycle stages of the service or product. For the construction phase, there are identified potential gaps to internal demands for ensuring that objectives for the energy use and use of machines in the environmental programme and MOP. There are described demands for measuring and trying to reduce emissions and noise from machines in the draft for award criteria, which could secure compliance to internal demands. The environmental budget and MOP in themselves does not provide strong incentives for the contractor to put effort into investigating the market for less-impact materials and products. The ability for the organization to promote integration of sufficient measures by contractors is an uncertainty. This is done through the phase, and challenges for this will be discussed in chapter 6.5.

The findings of gaps for the internal demands correspond to the findings of the Gap analysis for performance in accordance to the NTP lap objectives for environment. The electrification of the Trønder and Meråker lines produce long-term reductions, and the increased effectiveness might promote emission reductions from a shift of transport mode. Efforts can still be made through reductions in the construction phase.

### **What challenges are identified for Jernbaneverket's work with environmental considerations in general?**

The organization shall find areas for potential improvement, and measures towards this as a part of the continuous improvement, in accordance to ISO 14001. The case description and empirical analyses provided indications for general challenges in the environmental management of JBV. This could be relevant to consider in the planning of the project, and for improving the overall environmental performance in JBV.

The interview provided information about challenges for environmental considerations. The projects are complex, and each project is different. There are tight deadlines, and this creates limitations for environmental considerations for the projects, in line with the findings of the research of Hwang and Ng (2013), who identified challenges for project managers in construction projects. Providing functional environmental indicators that provide insight is further a challenge identified, as a part of the general challenge of follow-up of projects.

Optimally, environmental aspects are identified as early as possible, and measures are planned for this. A challenge is identified in the interview for JBV in general is for the collaboration between different specialty units, such as for consultant engineers and environmental advisors. This concerns a lack of identification of the environmental aspects of activities. This can cause that environmental considerations are not included in project planning at an early stage, and could lead to delays and cost increase later in projects. The SWOT supports this, by identifying a lack of communication between different organizational units for hearings in matters that might affect the project. A cause could be a non-optimal level of environmental knowledge, according to results from the interviews. The challenge identified comport with the findings of Ofori et.al (2002), where lacking knowledge levels for employees were found to be a challenge for implementing ISO 14001. The general environmental knowledge for project managers could further be improved. All though there are no identified gaps concerning environmental knowledge in the project, the interviews gave results indicating potential gaps for this for environmental principle 1 and 2 in the environmental programme in the general organization. A lack of environmental knowledge might limit the inclusion of environment as an equal line responsibility as described in principle 1. It is identified a weakness by the SWOT for lacking competence for the outer environment in the line management of the project.

ISO 14001 states that there needs to be a certain competence and awareness level present to secure the desired environmental performance. Therefore, securing environmental training should be continued as a main objective in JBV. Demands for environmental competence could be set when purchasing services from consultant engineers as a further measure, since challenges seem to be at the collaboration points in the project. It is a recommendation by Difi to set competence as a demand in procurement processes (Difi, 2010). Setting environmental demands for advisors is a principle for the project by environmental principle 2 (Appendix F). Increased involvement of environmental advisor functions is a suggested measure in the results from the interview. This could be done to identify environmental aspects, or even to exclude the need for measures for parts of the project if found relevant.

There is further a need to develop competence on optimal green procurement in the organization, as this is found to be a challenge in general in JBV.

The SWOT analysis identified the learning potential as a strength for the environmental pilot project. Still, a weakness included that JBV is not able to follow up the ambition of using the project as an environmental pilot project. Results from the interviews indicated that there is limited knowledge sharing between projects, and no specific structure for this. For continuous improvement, and to transfer experiences for projects such as the environmental pilot project, structures for knowledge sharing could be further developed.

The interviewees gave evaluations for how improvement in the general environmental management of JBV could be improved. This involves using the M-value for unwanted environmental incidents that has been used in the project Follobanen, and finding relevant KPIs for the environmental performance in the project. A simplification of the EMS of JBV is under development.

### **How are environmental criteria and demands set and communicated to suppliers, and how is the consistency with the environmental policy maintained?**

#### Setting environmental demands, and challenges for this

Environmental requirements for the procurement of products and services must be determined and communicated for compliance to ISO 14001. Environment is considered in the contract strategy, and this is considered a strength by the SWOT analysis. Still, the SWOT analysis found that the contract strategy was not sufficient for environmental considerations.

Setting environmental demands to suppliers is important to secure follow-up of environmental objectives for the project. The environmental performance of JBV is in this way dependent on the environmental performance of the contractor. As Ofori et al. (2002) has found, the contractor needs to have a sufficient level for their environmental management system for the builder to obtain results from theirs. According to the NTP, there is a need for further development of contracts with contractors, to promote low environmental impact production, security and effectiveness in in the construction market. In developing and using the competence of suppliers, turnkeys should be used where applicable, as is done for the case. (Avinor et al., 2016) A threat identified in the SWOT for the construction phase is that unprecise environmental targets makes it harder to manage the contractors, but the possibility of managing the suppliers is also considered an opportunity. This can be done by specifying environmental targets for contractors, according to the SWOT analysis, and demanding that the contractor documents environmental competence in their bid. In the organization, there is through the empirical analyses in this study identified gaps for securing adequate directions for the contractors through the environmental programme and MOP.

According to the NTP, contracts are planned used as tools to reduce climate gas emissions, and enable reductions for other agencies and sectors. (Avinor et al., 2016) The procurement function is a part of the management control system in JBV, and the procurement strategy is a part of the contract strategy, according to interview results. Separate procurement strategies for projects are made by cross-disciplinary teams. Price-bearing posts are considered useful when developing contracts. Demands that are set needs to comply with standard demands in technical regulations for matters such as quality, and frame agreements are used for many of the products used in JBV.

According to Difi, all environmental conditions that participate in reaching the project objectives should be described in the tender. Specific details should be described in the

detailed project, where all environmental demands should be under price-bearing posts, and there should planned follow-up in the construction phase. (Difi, 2010)

Some environmental demands for contractors are set in legislation, and is not integrated in contracts. Demands exceeding basic compliance to legislation can be set as qualification criteria, award criteria, specifications, or be included in the contract. In the project there is developed a draft of award criteria. Thus corresponds with Difi's guidelines for setting detailed and specific environmental demands, and the statement in the NTP that the transport agencies shall develop qualification and award criteria for other aspects than price. In addition, there is made a draft for a demand specification for EPDs for materials used by the contractor, which is in line with Difi's recommendations, and Lam et al. (2011). There will be used qualification criteria, but this is not set at the time of the study.

The inclusion of environmental considerations in procurement in JBV varies with the environmental risk identified. The interview results indicate that the integration of the procurement function in the environmental management is not optimal, and that there has not been a strong tradition for green procurements in JBV. The project has come further than other projects in terms of developing more detailed and comprehensive information for both direct and indirect impacts from the project. The challenge faced by the project at the time of the research study is how to use this information in an optimal way. How can one secure that identified measures such as the use of less-impact materials is actually performed by the contractor? All though environmental demands might in theory be set for anything, there needs to be consciousness for how the work in the contractual context, and which results they provide. How to use the different demand types is considered a challenge. Guidelines from Difi are used in the development of demands, but have been found insufficient. After the contracting phase, the demands are worked with in cooperation between JBV and the selected contractor. Matters might be forgotten to be included in contracts, and demands for change might be demanded by the contractor for this.

The limitations identified includes the possibility to evaluate the criteria. Quantitative evaluations such as price is the easiest to evaluate, according to the interviews. Environmental qualification criteria typically contain much used demands such as that the demand for an environmental management system for the contractor in accordance to ISO 14001, which is planned for the procurement of the construction enterprise. As environmental management systems in accordance to ISO 14001 is found to increase the environmental performance for organizations (Ofori et al., 2002, Melnyk et al., 2003, Arimura et al., 2008), this is a measure which can contribute to a sufficient quality of environmental management to ensure compliance with the environmental ambitions for the project. Less-tried demands are more difficult to set, because there needs to be a valid way to evaluate them.

According to Difi, there needs to be at least 30 percent weighting of environmental award criteria for the environmental matters to matter in the evaluation (Difi, 2010). There is no standard for setting the weighting of environmental criteria in JBV, and it is normally set between 10 to 30 percent. Establishing weighting of award criteria is considered an opportunity in the SWOT analysis. When considering award criteria, it was in the interviews described as important to secure that competition was not twisted by this. The formulation and comprehensiveness of the criteria by the contractors is considered important.

In the draft of environmental award criteria for the project, there is a criteria for the use of an environmental inventory for the project, where greenhouse gas emissions and reductions for

this is described. This has not been set before in JBV, and there are insecurities for how to best set this demand. Where there is insecurity for what can be accomplished, there needs to be defined measurable parameters for the criteria. For the described criteria, there is planned an evaluation of the total emissions budgeted by the contractor and awarding the lowest budgets. Hwang and Ng (2013) describes difficulties for selecting subcontractors as one of the most common challenges met by project managers for green construction, and the results from the case study supports this.

A bottleneck in the process of ensuring that environmental demands seems to be a lack of knowledge for what the market can provide according to the potential measures identified. When setting demands for materials and less-impact products such as machines, JBV lacks knowledge for how the market answers to this. This can be because the actual procurement of products such as materials or machines is performed by the contractor. If demands are set that cannot be met by the contractor market, this might excessively limit the competition for the tender. As the top priorities for the tender is to achieve the best technical solution for the best price, this limitation is not desirable. Using dialogue conferences could provide increased market knowledge, and is considered an opportunity in the SWOT analysis. If there is a lack of less-impact materials or technology in the market, innovative procurements as described by the Public Procurement Regulations and Difi could be done, promoting the green value creation for the industry. There could be established cooperation with research units, environmental organizations or other builders in the construction sector, which is recommended by Difi. The SWOT analysis supports these measures, and identifies establishment of alliances with research organizations, volunteer organizations and municipalities as opportunities.

A dialogue conference has been held for the case, a new procedure used in JBV. This is to gain knowledge of what the market has to offer, and to provide a better understanding for the project for the contractors. This has provided valuable input for the project, but has not provided specific information for how the contractors can answer environmental demands.

### **Follow-up of demands**

According to ISO 14001, the organization must monitor, analyse and evaluate the performance of the environmental management system, and evaluates compliance to internal and external demands. Audits shall be performed at planned intervals, and management shall revise performance. Difi states that for absolute demands and award criteria, non-compliance is a breach of contract. Sanctions suggested by Difi is price discount, day penalties, compensation or cancelling of contracts. There needs to be a follow-up system in place, which should be discussed in follow-up meetings. Opportunities identified in the SWOT for follow-up is the use of documentation for origin of materials and for environmental management for suppliers.

In the interviews, it is considered important to develop demands to suppliers that were possible to follow up. There is no standard way of follow-up. According to interview results, it can be performed by receiving documentation or reports from the contractors, by revisions on site, or judgement sampling. Results from the interviews indicate that setting the proper sanctioning mechanisms for deviances can be a challenge, which is supported by findings in the SWOT. This can be done with fines such as day penalties according to interview results, which corresponds to the guidelines of Difi.



It is described as challenging to develop follow-up of demands such as the environmental award criteria concerning the environmental budget and inventory for the contractor, because of lack of experience in using this. Reference values are not present. As non-compliance for award criteria is a breach of contract according to Difi, it is important to formulate the award criteria in a comprehensive way.

### **In what degree does Jernbaneverket follow the guidelines of the new Public Procurement Act?**

In the Gap analysis for compliance to external demands there are identified no deviations for compliance to the revised Public Procurement Act and regulations. The act and regulations can be said to function in a “nudging” way, but the promotion of setting environmental demands is not particularly strengthened from the current act. Compliance to the act and regulations can be done in multiple ways, and environmental ambition levels.

The interviews provided the information that green public procurement was considered relatively new in JBV. This is supported by an identified weakness in the SWOT, that environmental governmental procurement demands are not anchored in a sufficient degree in the organization of the case project. The interview results included a perception that this was the case for the construction industry in general, all though JBV was considered ahead in terms of environmental management. Environmental demands is included in increasingly degree in JBV. There is considered more focus for the outer environment than for greenhouse gas emissions. The pilot project is expected to provide learning for JBV, as the construction processes bears the same characteristics.

Based on the emphasized responsibility for measures against environmental impacts placed on Jernbaneverket by § 112, a high ambition level for the sections on green procurement, and evaluation of products and processes life cycles by the Procurement Act and regulations could be expected of Jernbaneverket. Research for the responsibility of public authorities for legislation has given results indicating that their decreed responsibility for safeguarding the environment does not always correspond to their operations. The governmental organizations are in a larger degree than private companies bound to contribute to the international commitments of Norway, given by the Constitution, and by the Building and Planning Act. The commitments given in the Paris Agreement provides ambitious emission reduction targets, where strong measures need be to be taken. This results in stronger environmental demands in Norway and a strategy for 50 percent reduction in emissions from transport, and 40 percent for construction of infrastructure. The electrification projects are important for cutting emissions, and providing a desirable alternative to fuel driven person and goods transport, but this could be described as “picking the low hanging fruit” in terms of working with emission reductions. Controlling the construction for the whole railway net of Norway means that Jernbaneverket has a unique role for setting environmental premises for suppliers, and thereby developing the market. This is important for the contribution to the “green shift”. Therefore, it is important that JBV acknowledge this responsibility, and develops structures for ensuring emission reductions in all phases in projects. A measure for securing performance higher than compliance can be done by setting environmental demands as drafted for the case project. There is all though, identified a threat in the SWOT analysis that the legal framework for public procurements is challenging to use for setting environmental award criteria.

The guidelines of Difi is found to be insufficient in the case project, which is a problem because this could limit the environmental ambitions for actors in public construction.

Guidelines from EU or Sweden, which are further developed than the guidelines from Difi could be used, as suggested by Difi. Learning from ambitious projects is mentioned by both Difi and the environmental advisor.

Integrating environmental demands in the procurement of the construction by contractors is an area of improvement for JBV for increased performance according to both internal demands and to legislation. The electrification project goes further in setting demands than other projects in JBV. Systemizing and knowledge sharing from experiences from projects such as the case in the general organization could strengthen the performance in environmental management in line with the continuous improvement principle implicated by their commitment to ISO 14001. Still, it is important to set green demands that are weighted in a sufficient degree to create improvements, while allowing competition on best technical solutions.

### 6.3 Evaluation of empirical analyses

#### **Description of the case**

The single-case study is suiting for the study, as the project is distinctive in being an environmental pilot programme, in accordance to principles described by Yin (2014). Jernbaneverket is further in an especially strong influencer position in the Norwegian construction industry, as dominant for the construction of railway. The approach is found suiting, as the study investigates complex social phenomena, where the multiple data sources complement each other in providing answers to the research issue (Yin, 2014), and tries to illuminate a set of decisions (Schramm, 1971). This provides a holistic representation of the case (Yin, 2014).

The study of the planning phase of the case project provides a vulnerability in that changes in the period ahead of the study might affecting the findings of the study. Still, the system boundaries in the study is set to investigate the case in the planning phase at a fixed time interval, and findings are considered to be relevant for this phase, even with subsequent changes. Findings in the phase sets the groundwork for how the environmental management further develops, which could be investigated in new studies.

The mixed method qualitative approach provides an investigation of the research issue through different perspectives. As the research issue is of a complex system, with themes such as organization, management structures, knowledge sharing, and context by legislation and politics, the mixed method approach provides both descriptions, and evaluations from multiple data sources. This provides a strong construct validity, and converging lines of inquiry towards findings. The multiple data sources complement each other in triangulation, providing answers to the research issue. The use of interviewees from other projects provides alterations to the traditional single case study, but is chosen in the study for investigation of general issues in JBV. This complements findings from the case, and can create a stronger external validity for findings for the case in relation to other projects in JBV.

There are set boundaries for the scope of the study, where the environmental management structures, policies and routines are investigated specifically. To understand the case, it is important to understand the dynamics and structures in the main organization. Connections to other business processes such as procurement and project management is covered in the study, in addition to overarching structures. Efforts are taken to carefully investigate the case

for a correct representation. The detailed description of methods is considered to provide a strong reliability for the study.

### **Literature review**

The system boundaries set in the study limits the literature investigated in the study. The literature analysed is considered to provide complementing data to analyse the case. The selection of recent developments in environmental management, such as revised standards, planned transport policies, the revised Public Procurement Act and current research on legislation and public authorities makes the findings of the study relevant for current developments relevant for the case in the coming years, which is considered a strength for the study. As research on EMS in construction is done in different countries, all results might not be applicable to the findings of the case. Still, they are evaluated to provide general findings.

### **Interviews**

The interviews provided both rich data from descriptions and evaluation, and complements literature on the case. The semi-structured interviews provided a natural conversation, where themes for the study was integrated as a part of a conversation with interviewees. A challenge for reliability is that semi-structured interviews are created in the moment, but main findings are still expected to be found through repeated investigations. Performing more interviews could strengthen the findings of the study, but as the project administration is small, there are limitations for the numbers that can be performed for the case. Other general challenges for reliability and validity, and evaluations for this is described in chapter 2.3.

### **Gap analysis**

The Gap analysis provided findings of performance according to “best practice”. This provided findings of improvement possibilities for the case. The analyses were performed with multiple data sources for the current state of the case project, which strengthens findings. Still, the use of data sources for the general organization, and experiences from other projects in the analysis does not necessarily correctly represent the case. These are included to provide additional information concerning general experiences in the organization, which could be valuable to consider in the case project. This corresponds to the proactive approach in the study.



## 7 Main findings and recommendations

The study investigated the environmental management in the planning phase of the project Electrification of Trønder and Meråker lines, focusing on the inclusion and fulfilment of internal and external environmental demands. The effectiveness of the environmental management system and integration of green procurement was central. This was performed through qualitative empirical analyses through a literature review Gap analyses and interviews.

The study will be concluded with main findings described by the research questions, an evaluation of the effectiveness and inclusion of environmental knowledge, and an evaluation of critical decision points and challenges. Further, recommendations will be provided.

### 7.1 Main findings

#### **What environmental information is developed, and how is it used in decision-making?**

The NTP sets directions for the environmental strategies and policies for JBV. The NTP 2018-2029 has a comprehensive greenhouse gas emission reduction target of 50 percent for transport, and 40 percent for reductions from construction, which will set stricter demands to JBV. Jernbaneverket has an environmental policy, routines and planning phases, which sets the objectives for how and what environmental information shall be developed. In the case, there is developed an environmental programme, an environmental budget, a draft MOP, a draft for environmental award criteria and a draft for demand specifications for EPDs. The environmental risk evaluations provide measures that are planned in the project, and are included in contracts. The project manager has the final decision power. The environmental budget provides increased environmental impact information in comparison to other projects. The project's environmental management in general comply well for ISO 14001.

#### **Where and how are environmental considerations included in the project phases?**

Jernbaneverket has a structured planning system where environmental information is developed and integrated at specific points in the project phases. The environmental programme and MOP are developed from risk analyses. An environmental programme have been developed in the investigation phase. In the detailed planning phase, there is developed a MOP for the construction phase. In the construction-planning phase, the environmental risk assessment is further elaborated. Performance demands concerning the environment are integrated in the tender and contract with the supplier in the detailed planning phase and construction-planning phase. In the construction phase, environmental risk evaluations are updated when deviances or relevant changes occur. The environmental information integrated in decision-making is archived, in accordance to the demand of ISO 14001.

#### **How does the project and the organization solve the external and internal environmental demands?**

JBV has decreed responsibility for implementing measures to reduce environmental impacts according to the Constitution § 112. External demands are identified and described in the environmental programme and MOP. The internal and external demands are solved by identifications of measures to fulfil them, and integrating the demands and measures in the planning and contract strategy. ISO 14001 is a structure used to ensure compliance, and there is made a control plan to fulfil measures set in plans.

The Gap analysis gave results indicating that compliance to internal and external demands generally is strong for the project, but there are areas for improvement. The procurement function was found to have potential for better integration with the environmental management in the case. There were identified insecurities in how to best use demands in the tender and in contract, especially for the use of an environmental budget and inventory by the contractor, and for using less-impact materials. Environmental communication and competence could be strengthened in the project organization, and demands could be set that environmental considerations are included in all activities for suppliers and advisors.

### **What challenges are identified for Jernbaneverket's work with environmental considerations in general?**

The interviews performed provided information regarding general challenges for the environmental management in JBV. The different projects' complexity and challenges is an issue. Time sets limitations for environmental considerations in the project. Identifying environmental aspects at an early stage is important to avoid time delays and cost increases. There are challenges for this, where the environmental knowledge for project managers and consultant engineers could be a contributing factor to this, according to the interviews. Quality indicators for measuring environmental performance is further an issue, and the follow-up of environmental aspects in projects.

### **How are environmental criteria and demands set and communicated to suppliers, and how is the consistency with the environmental policy maintained?**

Environmental information developed in the planning phases are included in the contract with contractors, according to the interviews. In addition, one can use tools to set specific environmental demands to ensure integration of main priorities for projects. In general, in JBV, the evaluated risk level decides the demands set. The procurement strategy sets the frame for developing environmental demands in the tender, according to the results from the interviews. In the project, there are developed environmental award criteria and a demand specification for EPDs. Some demands will further be set in the contract, where there are standard and adjustable inclusions in different sections. There is not a lot of experience in setting demands such as the ones developed in the project, and public guidelines from Difi have proven to be limited. There are insecurities for how to best set demands, evaluate, and perform follow-up of them to achieve objectives, while still keeping competition in the market. There is identified a lack of knowledge concerning what the market can offer in terms of less-emitting materials and technology, which limits setting demands. Weighting of environmental criteria is decided separately for projects, and there is no weighting set yet for the case. For breaches of demands by the contractor, there can be set sanctions such as day penalties, but this is not yet decided for the project.

### **In what degree does Jernbaneverket follow the guidelines of the new Public Procurement Act?**

In the Gap analyses, there is found no deviances to the new Public Procurement Act or regulations. The act can be considered to promote green procurement, but not necessarily, if the purchaser has low ambitions for this. Results from the interviews indicate that green procurement is relatively new in JBV, but that JBV still is a leader in the construction industry. There has traditionally been more emphasis taken for the outer environment in environmental management.

As the case project has higher environmental ambitions than other projects in JBV, it is expected to provide learning for green procurements in JBV.

The constitution § 112 increases the need for JBV to go beyond compliance to the Public Procurement Act. There is identified a potential for developing stronger systems for green procurement in JBV, where learning from experiences in projects, and setting stronger organizational structures for this can be part of the solution.

### **Effectiveness and degree of inclusion of environmental knowledge**

The structure of the environmental management system is evaluated through the study to be comprehensive and effective. The draft of demands developed could increase the environmental performance for the project, as they are based on data for the impacts potentially caused by the project.

### **Critical decision points and challenges**

In the case project, the main challenges for including environmental knowledge and concerns in project planning seems to be where there is a lack of knowledge or experience. This could limit the integration of green public procurements in the environmental management, and thereby reduce the fulfilment of demands. There can further be a general challenge in the lack of identification of environmental aspects in the early phases for subject specific activities, due to insufficient involvement of environmental advisors and environmental competence for consultants and employees. The environmental budget provides comprehensive information regarding environmental impacts in comparison to other projects. A bottleneck could be the lack of experience in how to best integrate the results from this across the project to the construction phase, through establishing relevant demands in the tender and contract.

## **7.2 Recommendations**

The deviances from the Gap analyses should be considered to increase the performance for the project, for ensuring continuous improvement in compliance to ISO 14001. Where there are identified challenges in other projects, the case should be aware of these, and plan accordingly. Environmental competence and performance across projects in JBV can be increased by increasing knowledge sharing.

JBV has responsibilities for contributing to the emission reductions planned in the NTP. Emissions related to the construction phase, both direct and indirect, should be included in setting environmental demands for the contractor.

The case should evaluate the experiences and results for their green procurement, to contribute to learning in the organization in compliance to ISO 14001. Environmental training should be continued, as sufficient environmental knowledge has been found to be important through the interviews and previous research. This is further encouraged by ISO 14001.

According to Difi, the weighting of environmental criteria should be set at least at 30 percent to contribute in the scoring evaluation.

For ensuring procurement of low-emission technology and materials in the case, there could be performed market investigations, to reduce uncertainties for setting demands in the tender. Guidelines from the EU and Sweden for green procurement in construction could be used, according to Difi. Innovative procurements can be done to develop the market, which is simplified in the new Public Procurement Act and regulations. This could be done in collaboration with research centres, other green construction projects, volunteer organizations

and producers, based on findings from Difi, the SWOT and the revised Public Procurement Act and Regulations.

Setting high environmental ambitions and securing follow-through of these in objectives and procurements can promote a sustainable development in the industry, since JBV has a strong position in the construction of infrastructure in Norway.



## 8 References

### Published references

- ABBOT, M. L. & JENNIFER, M. 2013. Understanding and applying research design. New Jersey: Wiley.
- ANDERSEN, B. & PETTERSEN, P.-G. 1995. Benchmarking - En praktisk håndbok. Otta, Norway: TANO A.S.
- ARIMURA, T. H., HIBIKI, A. & KATAYAMA, H. 2008. Is a voluntary approach an effective environmental policy instrument?: A case for environmental management systems. *Journal of Environmental Economics and Management*, 55, 281-295.
- AVINOR, JERNBANEVERKET, KYSTVERKET & STATENS VEGVESEN 2016. Nasjonal transportplan 2018-2029. Norway.
- BALL, J. 2002. Can ISO 14000 and eco-labelling turn the construction industry green? *Building and Environment*, 37, 421-428.
- DAHL, G. 2014. Miljøstyring i Jernbaneverket. Norway: Jernbaneverket.
- DARNALL, N., HENRIQUES, I. & SADORSKY, P. 2008. Do environmental management systems improve business performance in an international setting? *Journal of International Management*, 14, 364-376.
- DIFI 2010. Anbefalte miljøkriterier for innkjøp av entreprisearbeid i tilknytning til offentlige anlegg Norway.
- DIFI. 2015. *Miljøkriterier - BAE* [Online]. Norway. Available: <http://www.anskaffelser.no/bygg-anlegg-og-eiendom-bae/temaer-bae/miljokriterier> [Accessed 14.05.2016 2016].
- DIFI. 2016a. *Miljø steg for steg* [Online]. Norway. Available: <http://www.anskaffelser.no/prosess/samfunnsansvar/miljo/miljo-steg-steg/vurdere-behov> [Accessed 14.05.2016 2016].
- DIFI. 2016b. *Om Difi* [Online]. Norway. Available: <https://www.difi.no/om-difi> [Accessed 31.05.2016].
- DNV GL 2013. Endringer i ISO-Standarder. Norway.
- ECCLESTON, C. H. & SMYTHE, R. B. 2002. Integrating Environmental Impact Assessment with Environmental Management Systems. *Environmental Quality Management*, 11, 1-13.
- EUROPEAN COMMISSION 2008. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Public procurement for a better environment
- EUROPEAN COMMISSION. 2016. *What is GPP* [Online]. Available: [http://ec.europa.eu/environment/gpp/what\\_en.htm](http://ec.europa.eu/environment/gpp/what_en.htm) [Accessed 15.05.2016].
- FRANKLIN, M. 2006. Performance Gap Analysis. United States of America: American Society for Training & Development.
- GARMANN, C. & SKJØSTAD, J. S. 2014. Elektrifisering Trønder- og Meråkerbanen Prosjekt 960272 Miljøbudsjett. Norway: Norconsult.
- GLASSON, J. 2005. Introduction to Environmental Impact Assessment. 3 ed.: Taylor and Francis.
- GRY DAHL & ELIN STAUREM. 2014. *Miljømål* [Online]. Norway. Available: <http://www.jernbaneverket.no/Jernbanen/Miljo/Miljoarbeid/Miljopolitikk-og-miljomal/> [Accessed 10.05.2016].

- HOWITT, D. 2010. *Introduction to Qualitative Methods in Psychology*, Harlow, England, Pearson Education Limited.
- HWANG, B.-G. & NG, W. J. 2013. Project management knowledge and skills for green construction: Overcoming challenges. *International Journal of Project Management*, 31, 272-284.
- IPCC 2014. Climate Change 2014, Synthesis Report, Summary for Policymakers.
- ISO 2015. Environmental management systems. Requirements with guidance for use.
- ISO/TC 268/WG3 2015. Sustainable development of communities - Vocabulary. 7, 8.
- JERNBANEVERKET 2013a. Innsatsområde 5.
- JERNBANEVERKET 2013b. Mål og innsatsområder.
- JERNBANEVERKET. 2014. *Overordnede føringer* [Online]. Available: <http://www.jernbaneverket.no/Jernbanen/Miljo/Miljoarbeid/Overordnede-foringer/> [Accessed 10.05. 2016].
- JERNBANEVERKET 2015a. Gjøre innkjøp i Jernbaneverket.
- JERNBANEVERKET. 2015b. *Miljøstyringssystem* [Online]. Available: <http://www.jernbaneverket.no/Jernbanen/Miljo/Miljoarbeid/Miljostyring/> [Accessed 10.05.2016 2016].
- JERNBANEVERKET. 2016b. *Elektrifisering Trønder- og Meråkerbanen* [Online]. Available: <http://www.jernbaneverket.no/Prosjekter/prosjekter/Tronderbanen/>. [Accessed 03.06.2016 2016].
- JUSTIS OG BEREDSKAPSDEPARTEMENTET 2014. Kongeriket Norges Grunnlov. 22.04.2016 ed.
- KLIMA- OG MILJØDEPARTEMENTET 2014. Grønt skifte – klima- og miljøvennlig omstilling.
- KOMMUNAL- OG MODERNISERINGSDEPARTEMENTET 2008. Plan og bygningsloven. 62.
- KVALE, S. 1997. *Det kvalitative forskningsintervju*, Oslo, Norway, Gyldendahl.
- LAM, P. T. I., CHAN, E. H. W., CHAU, C. K., POON, C. S. & CHUN, K. P. 2011. Environmental management system vs green specifications: How do they complement each other in the construction industry? *Journal of Environmental Management*, 92, 788-795.
- LINY, HMM, NICTOR & MORANN 2015. Strategi for driftsform på ikke -elektrifiserte baner. Norway: Jernbaneverket.
- MACDONALD, J. P. 2005. Strategic sustainable development1 using the ISO 14001 Standard. *Journal of Cleaner Production*, 13, 631-643.
- MELNYK, S. A., SROUFE, R. P. & CALANTONE, R. 2003. Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, 21, 329-351.
- MICHELSSEN, O. & DE BOER, L. 2009. Green procurement in Norway; a survey of practices at the municipal and county level. *Journal of Environmental Management*, 91, 160-167.
- MORROW, D. & RONDINELLI, D. 2002. Adopting Corporate Environmental Management Systems:: Motivations and Results of ISO 14001 and EMAS Certification. *European Management Journal*, 20, 159-171.
- NORCONSULT 2014. Ytre miljø, SWOT-analyse av konseptløsning - Elektrifisering av Trønderbanen og Meråkerbanen. Norway.
- NTP. 2016. *Plangrunnlag* [Online]. Available: <http://www.ntp.dep.no/Nasjonale+transportplaner/2018-2029/Plangrunnlag> [Accessed 04.05 2016].

- NÆRINGS- OG FISKERIDEPARTEMENTET 2015a. Ny forskrift om offentlige anskaffelser. Norway.
- NÆRINGS- OG FISKERIDEPARTEMENTET 2015b. Prop. 51 L (2015-2016) Lov om offentlige anskaffelser. Norway.
- OFORI, G., GANG, G. & BRIFFETT, C. 2002. Implementing environmental management systems in construction: lessons from quality systems. *Building and Environment*, 37, 1397-1407.
- ORTIZ, O., CASTELLS, F. & SONNEMANN, G. 2009. Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials*, 23, 28-39.
- QI, G. Y., SHEN, L. Y., ZENG, S. X. & JORGE, O. J. 2010. The drivers for contractors' green innovation: an industry perspective. *Journal of Cleaner Production*, 18, 1358-1365.
- ROLL-MATTHISEN, I., STRØMNES, D., FRØYLAND, L. J., FREDRIKSEN, H. R., BREKKE, K. R., VIGANDER, K., BREILAND, M., AMDAL, G., GJØNNES, A. D., LIESSEN, H., SKJÆRPE, B. S., ERIKSRUD, C., MELSON, C. P., W-SKUMNES, A. & SENHAJI, A. 2014. Enklere regler - Bedre anskaffelser. 16.
- SAMFERDSELSDEPARTEMENTET 2009. Instruks for jernbaneverket. Norway.
- SAMFERDSELSDEPARTEMENTET 2013. Nasjonal transportplan 2014-2023. Norway.
- SCHRAMM, W. 1971. Notes on Case Studies of Instructional Media Projects. Stanford University, California Institute for Communication Research.
- SHEN, L.-Y., TAM, V. W. Y., TAM, L. & JI, Y.-B. 2010. Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice. *Journal of Cleaner Production*, 18, 254-259.
- STANDARD NORGE 2008. Norsk bygge- og anleggskontrakt.
- STANDARD NORGE 2009. NS 3466 Miljøprogram og miljøoppfølgingsplan for ytre miljø for bygge-, anleggs- og eiendomsnæringen.
- STAUREM, E. & DAHL, G. 2014. *Miljøpolitikk* [Online]. Available: <http://www.jernbaneverket.no/Jernbanen/Miljo/Miljoarbeid/Miljopolitikk/> [Accessed 15.03 2016].
- STAUREM, E. & KOJEDAHN, I. L. 2016. Kommunikasjonsplan for miljøkommunikasjon i Jernbaneverket. Norway.
- SVINGHEIM, N. 2016a. *Om Jernbaneverket* [Online]. Available: [http://www.jernbaneverket.no/Om-oss/Om\\_jernbaneverket/](http://www.jernbaneverket.no/Om-oss/Om_jernbaneverket/) [Accessed 09.05. 2016].
- SVINGHEIM, N. 2016b. *Organisasjon* [Online]. Available: [http://www.jernbaneverket.no/Om-oss/Om\\_jernbaneverket/Organisasjonskart/](http://www.jernbaneverket.no/Om-oss/Om_jernbaneverket/Organisasjonskart/) [Accessed 09.05. 2016].
- TAN, Y., SHEN, L. & YAO, H. 2011. Sustainable construction practice and contractors' competitiveness: A preliminary study. *Habitat International*, 35, 225-230.
- TILLERBAKK, I. & SKJØSTAD, J. S. 2015. Elektrifisering Trønder og Meråkerbanen Prosjekt 960272 - Miljøprogram. Norway: Norconsult.
- UN 2012. The future we want. Rio De Janeiro.
- UN 2015. Transforming our world: The 2030 agenda for sustainable development.
- UNFCCC 2015a. Adoption of the Paris Agreement. Paris.
- UNFCCC 2015b. Synthesis report on the aggregate effect of intended nationally determined contributions.

UTTAM, K., FAITH-ELL, C. & BALFORS, B. 2012. EIA and green procurement: Opportunities for strengthening their coordination. *Environmental Impact Assessment Review*, 33, 73-79.

VARNÄS, A., BALFORS, B. & FAITH-ELL, C. 2009. Environmental consideration in procurement of construction contracts: current practice, problems and opportunities in green procurement in the Swedish construction industry. *Journal of Cleaner Production*, 17, 1214-1222.

YIN, R. K. 2014. *Case Study Research - Design and Methods*, Thousand Oaks, California, SAGE.

### **Unpublished references**

ANDERSEN, T. 24.05. 2016. *RE: Interview*. Type to HOV, H. I.

BRATSBERG, A.-L. 2016. Interview. *In: HOV, H. I. (ed.)*.

BYGD, J. 2016. Kontrollplan IPE.

FOLDEN, P. O. 2016. Interview. *In: HOV, H. I. (ed.)*.

FOSS, S. 31.05.2016 2016a. *RE: E-mail*. Type to HOV, H. I.

FOSS, S. 2016b. Interview. *In: HOV, H. I. (ed.)*.

JACOBSEN, A. C. 26.05.2016 2016. *RE: Spørsmål angående detaljprosjekt*. Type to HOV, H. I.

JERNBANEVERKET 2015c. Prosjektstyringsdokument for Elektrifisering av Trønderbanen og Meråkerbanen. Jernbaneverket.

JERNBANEVERKET 2016a. C1 - Almennelige kontraktsbestemmelser Utførelsesentreprise basert på NS 8405.

NERMOEN, B. 2016. Interview. *In: HOV, H. I. (ed.)*.

ROHEIM, B. L. 2016. Interview. *In: HOV, H. I. (ed.)*.

SELSBAK, C. M. 2016a. *RE: E-mail*. Type to HOV, H. I.

SELSBAK, C. M. 24.05. 2016b. *RE: Interview*. Type to HOV, H. I.

SELSBAK, C. M. 2016c. Miljøoppfølgingsplan for anleggsfasen. Jernbaneverket Sweco.

SELSBAK, C. M. 2016d. Skisse tildelingskriterier Ytre Miljø.

TUVEN, R. 2014. Styring av utrednings-, plan- og byggeprosjekter i Jernbaneverket.

TYTLANDSVIK, S. 2016. Interview. *In: HOV, H. I. (ed.)*.

STAUREM, E. 2016. Interview. *In: HOV, H. I. (ed.)*.

## Appendix A: Connections for research questions, interview guide and literature themes

Research questions	Summary questions interview	Interview guide questions	Literature themes
Where and how are environmental considerations included in the project phases?	What project phases are there for the construction of the railway project, and where are environmental considerations included?	Where are you on the project now? What has been done on the project?	Performance of organizations with environmental management systems Documents Jernbaneverket
What environmental information is developed, and how is it used in decision-making?	What environmental information is developed?	What environmental information is developed?  What responsibilities do you have for environment?  In what degree do you find your tasks clearly communicated and how concise do you experience the problems that are solved?	Tools for improvement of environmental management systems The NTP Documents Jernbaneverket
	How is environmental information included in decision-making?	What environmental decisions are made? How is it to implement environmental considerations in the project?	Documents Jernbaneverket Green procurement
	What challenges are there for including environmental information into the projects decision processes?	Are there any challenges for integrating environmental considerations in project phases?	Challenges and limitations for standardized environmental management systems Green construction
How does the project and the organization solve the external and internal environmental demands?	How is compliance to internal and external environmental demands solved in the project?	How do you comply with external and internal demands for environment?  Examples?	Motivations for environmental management and standard certification, Performance of organizations with environmental management systems,

			Challenges and limitations for standardized environmental management systems The Public Procurement Act, The Planning and Building Act, The Constitution, ISO 14001, NS 3466, Current developments in research on legislation and environment, Documents Jernbaneverket
- What challenges are identified for Jernbaneverket's work with environmental considerations in general?	What challenges are identified for Jernbaneverket's work with environmental considerations in general?	How do you consider the electrification project as an environmental pilot project?	Green construction Difi
	What are possible optimization strategies?	Do you have any suggestions for improvements in the environmental management of Jernbaneverket?	Difi,
	How is knowledge and experiences concerning environment shared in Jernbaneverket?	Who do you communicate with regarding environmental cases?  Considered quality of communication and results?  Do you know of any other projects with special emphasis on environment in Jernbaneverket?  Are experiences from these used?	ISO 14001, SWOT
In what degree do Jernbaneverket follow the guidelines of the Public Procurement Act?	How is the performance for the project and Jernbaneverket in accordance to the new guidelines for the new Public Procurement Act?	Do Jernbaneverket work with public procurement?	Documents Jernbaneverket The Public Procurement Act and regulations, Green procurement, Difi, SWOT

<p>How are environmental criteria and demands communicated to suppliers, and how is the consistency with the environmental policy maintained?</p>	<p>How are environmental criteria set and demands communicated to suppliers?</p>	<p>What weighting is done for environmental demands at tendering?</p> <p>What criteria are used for environmental considerations at procurement?</p> <p>What environmental criteria are set for materials and products?</p> <p>How were the criteria set?</p> <p>What challenges are there for including environmental criteria?</p> <p>Do you use a standard or guide for green procurements?</p>	<p>Documents Jernbaneverket The Public Procurement Act and regulations, Green procurement, Difi, SWOT</p>
	<p>How is the consistency with the environmental policy and environmental criteria maintained with suppliers?</p>	<p>How are demands communicated to suppliers?</p> <p>Are there any challenges for this?</p> <p>How are demands followed up?</p> <p>Do you have any experiences with this?</p>	<p>Documents Jernbaneverket The Public Procurement Act and regulations, Green procurement, Difi, SWOT</p>
	<p>In what degree is public procurement integrated as a part of environmental management?</p>	<p>Is your position related to procurement?</p> <p>How does Jernbaneverket work with public procurements?</p> <p>Do you have any suggestions for improvements?</p>	<p>Documents Jernbaneverket The Public Procurement Act and regulations, Green procurement, Difi, SWOT IO 14001</p>

## Appendix B: Interview guide

The purpose of the interviews in the research study was to investigate the research issue. Interview questions or themes were developed from the research questions as described in Appendix A:

The interview was conducted in Norwegian, and the Norwegian questions are presented in this guide.

The sections describes themes or questions covered in the semi-structured interviews. Most of the interviews were recorded. There was taken notes for all interviews.

### Introduksjon:

- Tid for intervjuet
- Bakgrunn for intervjuet
- Tema for intervjuet
- Hvordan det vil brukes
- Eventuelle spørsmål
- Spørsmål om intervjuobjekt ønsker å se over transkript fra intervjuet.

### Generell info:

- Navn
- Alder
- Tid i Jernbaneverket
- Kan du fortelle kort om din rolle i Jernbaneverket
- Prosjekt du jobber på/ har jobbet på?

### Miljøstyring /prosjektfaser:

- Hvor er dere på prosjektet nå?
- Hva har dere gjort?
  - Kort generelt
  - Spesifikt innen miljø
- Hvilke miljørelaterte avgjørelser er tatt?
- Hvilke ansvarsoppgaver har du knyttet til miljø? (*Organisering*)
  - I hvilken grad oppfatter du at dine oppgaver/ditt ansvar er tydelig kommunisert og hvor konkret opplever du det du skal løse?
- Hvem kommuniserer du med i forhold til miljø?
  - Oppfattet kommunikasjon?
  - Resultater av kommunikasjon?
- Hvordan synes du det er å innlemme hensyn til miljø generelt i prosjektet?
- Hvilken miljøinformasjon lages?
- Hvordan svarer dere på eksterne og interne krav knyttet til miljø?
  - Eksempler?
- Hva tenker du om Trønder/Meråkerbanen som "pilotprosjekter" innen miljø?
- Vet du om andre prosjekter med ekstra fokus på miljø i JBV?
  - Erfaringer fra dette som brukes?
  - Sammenlignet med dem, Trønder og Meråkerbanen?
- Utfordringer ved innlemming av miljøhensyn i prosjektfaser
- Har du noen tanker om mulige forbedringer innen miljøarbeidet til JBV?
- Er din rolle tilknyttet innkjøp på noen måte?



Innkjøp (for de med rolle tilknyttet det):

- Jobbes det etter offentlige innkjøp i JBV?
- Hvordan jobber JBV med offentlige innkjøp?
- Hvilken vektning gis miljø ved anbud/konkurransesetting av innkjøp?
- Hvilke kriterier settes for miljø (og sosiale hensyn) ved innkjøp?
- Hvilke kriterier settes for å ivareta miljø ved innkjøp av
  - Materialer og produkter
- Hvordan ble disse kriteriene satt?
- Hvilke utfordringer er det for å inkludere miljø som et kriterier ved innkjøp?
- Bruker dere noen standard eller veileder for bærekraftige innkjøp?
  - Hvordan?
- Hvordan kommuniseres krav til leverandører
- Hvordan følges dette opp
- Erfaringer med dette?
- Utfordringer?
- Forslag til forbedringer?

## Appendix C: Interviewees

No.	Project	Position	Name	Education	Main responsibilities	Date	Durance
1	Electrification of Trønder and Meråkerbanen	Project superior manager	Brede Nermoen	Civil engineer mining	Execution of project, organizing, follow-up and finalization as planned on time and costs.	30.03.16	Approx. 60 min
2	Electrification of Trønder and Meråkerbanen	Project manager contact line and AT	Bente Langeland Roheim	Civil construction engineer	Responsible for project on contact line and AT. Ultimate decision maker for environmental considerations.	31.03.16	Approx. 60 min
3	Electrification of Trønder and Meråkerbanen	Environmental advisor	Cecilie Mørk Selsbak	Biologist	100% position as environmental advisor. Manages environmental aspects for the project.	Multiple dates	Multiple meetings
4	Hell-Værnes	SHA advisor	Anne-Lise Bratsberg	Chemical engineer	Responsible for SHA and environment for the project	31.03.16	Approx. 60 min
5	Departement for planning and development	Environmental advisor	Elin Staurem	MSc. Industrial Ecology	Responsible for overarching environmental management and structure.	06.04.16	Approx. 60 min
6	Infrastructure projects	Leader contract and strategies	Thomas Andersen	Civil construction engineer	Contracts, procurement, experienced with project management.	24.05.16	Approx. 60 min
7	Administrative support Mid region	Senior advisor	Per Odd Folden	-	Works with contract development with contractors, advisory, procurements. Employed for 50 projects. Involved in the case project.	10.05.16	Approx. 60 min
8	Follobanen	Environmental advisor	Sigrun Tytlandsvik	MSc Nature management	Environmental coordinator for the Follo line, environmental manager for the sub-project Ski.	27.05.16	Approx. 60 min

## Appendix E: Environmental SWOT analysis for the project

(Norconsult, 2014)

### Tema: Grensesnitt prosjekt, organisasjon og samfunn

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"> <li>• JBV har visjoner om miljø.</li> <li>• Miljømål er lansert som begrunnelse for prosjektet.</li> <li>• JBV ønsker at prosjektet skal være et pilotprosjekt på miljø, noe som gir prosjektet tyngde internt i organisasjonen.</li> <li>• Prosjektets pilotrolle kan utnyttes til å utvikle miljøstyringssystemet (prosjekt og JBV).</li> </ul>	<ul style="list-style-type: none"> <li>• Organisasjonen er ikke "vant til" å etablere og forholde seg til miljømål (personavhengig, varierer fra prosjekt til prosjekt).</li> <li>• Utskifting av ressurser i prosjektet som følge av innføring av ny organisasjonsmodell i JBV (medfører endret plassering/organisering av prosjektet internt i JBV's organisasjon).</li> <li>• Mangelfull kommunikasjon mellom ulike organisatoriske enheter i JBV omkring høringsuttalelser i saker som kan berøre prosjektet.</li> <li>• JBV evner ikke å følge opp ambisjonen om at prosjektet er et pilotprosjekt på miljø.</li> </ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"> <li>• Følge opp dialog med inviterte offentlige myndigheter og interessenter.</li> <li>• Involvering av kommunene kan bidra til kompetanseheving, raskere saksbehandling og samstemming av miljømål.</li> <li>• Prosjektet kan avdekke forhold som er viktige å rapportere inn til Fylkesmennene.</li> <li>• JBV kan søke allianser utenfor jernbanemiljøet (forskningsmiljøer og/eller frivillige organisasjoner, f.eks. Transnova).</li> <li>• Kartlegge muligheter for å knytte studiemiljøet i Trondheim til prosjektet (f.eks. master-/ bacheloroppgaver osv.).</li> </ul>	<ul style="list-style-type: none"> <li>• Samfunnet oppfatter miljøgevinstene som diskutabile (for lite ambisiøse).</li> <li>• Samfunnet aksepterer ikke miljøgevinstene som tunge nok til å forsvare investeringen.</li> <li>• Budsjetteringsprosessene er en trussel ift. kontinuitet i organisasjonen (fare for utskifting av miljøressurser).</li> <li>• Budsjetteringsprosessene er en trussel ift. økt ressursbruk eller forsinkelser som følge av stopp i prosjektet.</li> <li>• Tiltaket er politisk styrt (budsjetter, fremdrift, kompetanse, tekniske løsninger osv.).</li> <li>• Manglende mulighet til å korrigere prosjektets mandat.</li> <li>• Regelverket for offentlige anskaffelser utfordrende ift. og velge gode tildelingskriterier for ytre miljø.</li> <li>• "Konkurranse" med prosjekt nytt dobbeltspor Trondheim-Stjørdal.</li> <li>• Manglende koordinering av eksternt kommunikasjon med prosjektet nytt dobbeltspor Trondheim-Stjørdal.</li> </ul>

(Norconsult, 2014)

## Tema: Miljømål i driftsfasen

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• JBV har visjoner om miljø.</li><li>• JBV ønsker at prosjektet skal være et pilotprosjekt på miljø, noe som gir prosjektet tyngde internt i organisasjonen.</li><li>• Prosjektet har tydelige miljømål.</li><li>• Det er gjort et godt arbeid ift. å identifisere natur- og miljøressurser i prosjektet.</li><li>• Det er planlagt gjennomført fareidentifikasjon i tidlig fase med fokus på planleggings-, utførelses- og driftsfasen.</li><li>• Prosjektet har et godt miljøprogram.</li><li>• Miljøbudsjett og -regnskap legger til rette for å etablere konkrete, operasjonaliserte og målbare målsetninger i en senere fase, og det er i tillegg fokus på målbarhet i prosjektet.</li><li>• Valg av AT-system muliggjør utnyttelse av returstrøm.</li></ul>	<ul style="list-style-type: none"><li>• Det er uklart om prosjektets miljømål er tilstrekkelig forankret internt i JBV.</li><li>• Miljømålene i prosjektet er ikke operasjonaliserte.</li><li>• Det er ikke etablert tiltak og beredskap mot akutt forurensning.</li><li>• JBV har ikke etablert miljømål for vilt.</li><li>• JBV evner ikke å følge opp ambisjonen om at prosjektet er et pilotprosjekt på miljø.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• Involvering av kommunene kan bidra til kompetanseheving, raskere saksbehandling og samstemming av miljømål.</li><li>• Prosjektet kan avdekke forhold som er viktige å rapportere inn til Fylkesmennene.</li><li>• JBV kan stille krav om at det i driftsfasen skal følge med grøntsertifikat på strøm.</li><li>• JBV kan søke allianser utenfor jernbanemiljøet (forskningsmiljøer og/eller frivillige organisasjoner, f.eks. Transnova).</li><li>• Kartlegge muligheter for å knytte studiemiljøet i Trondheim til prosjektet (f.eks. master-/ bacheloroppgaver osv.).</li></ul>	<ul style="list-style-type: none"><li>• Samfunnet oppfatter miljøgevinstene som diskutabile (for lite ambisiøse).</li><li>• Samfunnet aksepterer ikke miljøgevinstene som tunge nok til å forsvare investeringen.</li><li>• Berørte kommuner mangler miljøkompetanse/-ressurser for å håndtere lovpålagte oppgaver.</li></ul>

(Norconsult, 2014)

### Tema: Miljømål i utførelsesfasen (se også punkter under driftsfase)

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• JBV har visjoner om miljø.</li><li>• JBV ønsker at prosjektet skal være et pilotprosjekt på miljø, noe som gir prosjektet tyngde internt i organisasjonen.</li><li>• Prosjektet har tydelige miljømål.</li><li>• Det er gjort et godt arbeid ift. å identifisere natur- og miljøressurser i prosjektet.</li><li>• Det er planlagt gjennomført fareidentifikasjon i tidlig fase med fokus på planleggings-, utførelses- og driftsfase.</li><li>• Det er etablert et godt miljøprogram for prosjektet.</li><li>• Miljøbudsjett og -regnskap legger til rette for å etablere konkrete, operasjonaliserte og målbare målsetninger i en senere fase, og det er i tillegg fokus på målbarhet i prosjektet.</li></ul>	<ul style="list-style-type: none"><li>• Det er uklart om prosjektets miljømål er tilstrekkelig forankret internt i JBV.</li><li>• Miljømålene i prosjektet er ikke operasjonaliserte.</li><li>• Det er ikke etablert tiltak og beredskap mot akutt forurensning.</li><li>• Manglende vilje i JBV til å investere i den oppfølgingen som kreves (det koster å etablere og følge opp systemer).</li><li>• JBV evner ikke å følge opp ambisjonen om at prosjektet er et pilotprosjekt på miljø.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• JBV kan styre leverandørene.</li><li>• Involvering av kommunene kan bidra til kompetanseheving (spesielt ift. utførelsesfasen og forurenset grunn/masser), raskere saksbehandling og samstemming av miljømål.</li><li>• Prosjektet kan avdekke forhold som er viktige å rapportere inn til Fylkesmennene.</li><li>• Miljømålene for prosjektet kan spisses ift. beskrivelsene, spesielt til entreprenørene.</li><li>• JBV kan kreve at entreprenøren skal dokumentere miljøforståelse i sitt tilbud.</li></ul>	<ul style="list-style-type: none"><li>• Upresise miljømål gjør det vanskelig å styre entreprenørene.</li><li>• Regelverket for offentlige anskaffelser utfordrende ift. og velge gode tildelingskriterier for ytre miljø.</li></ul>

(Norconsult, 2014)

## Tema: Organisering

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>Miljømål er lansert som begrunnelse for prosjektet.</li><li>Stort fokus på ytre miljø i prosjektet gir mulighet for en styrket organisasjon.</li><li>Prosjektets miljøfokus bidrar til å øke kompetansen på ytre miljø i prosjektorganisasjonen.</li><li>Fokus på miljømål i prosjektet gir mulighet for å trekke inn miljøkompetanse i toppledelsen.</li><li>JBV har fokus på riktig bemanning/ressursinnsats på miljø i prosjektets faser.</li><li>Det er tidlig fokus på å etablere styringssystem for kvalitet, SHA og ytre miljø for prosjektet.</li><li>Prosjektets pilotrolle kan utnyttes til å utvikle miljøstyringssystemet (prosjekt og JBV).</li><li>Det er etablert et system for avvikshåndtering på ytre miljø.</li></ul>	<ul style="list-style-type: none"><li>Organisasjonen er ikke "vant til" å etablere og forholde seg til miljømål (men personavhengig, varierer fra prosjekt til prosjekt).</li><li>Manglende evne til å følge opp miljømål i driftsfasen.</li><li>Mangel på miljøkompetanse i oppfølgingsarbeidet (må styrkes i detaljprosjekteringen og i utførelsesfasen).</li><li>Mangelfull kompetanse på ytre miljø i linjeledelsen i prosjektet.</li><li>Mangel på ressurser for å overføre miljøkompetanse til entreprenøren.</li><li>Bytte av personell underveis i prosjektet.</li><li>Utskifting av ressurser i prosjektet som følge av innføring av ny organisasjonsmodell i JBV (medfører endret plassering/organisering av prosjektet internt i JBV's organisasjon).</li><li>Mangelfull kommunikasjon mellom ulike organisatoriske enheter i JBV omkring høringsuttalelser i saker som kan berøre prosjektet</li><li>Alle virksomheter skal ha IK-system. På noen steder vil det bli grensesnitt/overlapp mellom IK-system tilhørende ordinær virksomhet og anleggsvirksomhet. Det vil være behov for å definere hvem som skal ivareta oppgaven som hovedbedrift i like situasjoner.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>Organisasjonens styrke på miljø kan kommuniseres til omverdenen.</li><li>JBV kan gi miljørådgiverne i prosjektet myndighet til å stoppe arbeid i anleggsfasen dersom dette er i konflikt med prosjektets miljømål.</li></ul>	<ul style="list-style-type: none"><li>Manglende vilje hos JBV til å investere i den oppfølgingen som kreves (det koster å etablere og følge opp systemer).</li><li>Manglende tilgang på ressurser og organisering av disse.</li><li>Organiseringen av prosjektet er ikke hensiktsmessig for å få gjennomført det høye ambisjonsnivået på ytre miljø (manglende myndighet til å sette mål og håndheve dem).</li><li>Budsjetteringsprosessene er en trussel ift. kontinuitet i organisasjonen (fare for utskifting av miljøressurser).</li><li>Budsjetteringsprosessene er en trussel ift. økt ressursbruk eller forsinkelser som følge av stopp i prosjektet.</li><li>Tiltaket er politisk styrt (budsjetter, fremdrift, kompetanse, tekniske løsninger osv.).</li><li>Manglende mulighet til å korrigere prosjektets mandat.</li><li>"Konkurranse" med prosjekt nytt dobbeltspor Trondheim-Stjørdal.</li></ul>

(Norconsult, 2014)

## Tema: Kontraktstrategi

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• Miljø er ivaretatt i prosjektets kontraktstrategi.</li><li>• Miljø er ivaretatt i JBV's etiske regelverk.</li></ul>	<ul style="list-style-type: none"><li>• Det er vanskeligere for byggherre å styre totalentreprise enn tradisjonelle entrepriser.</li><li>• Det opereres ofte med rundsum for prising av miljøtiltak.</li><li>• Det mangler konkrete miljøkrav som kan prises i konkurransegrunnlaget.</li><li>• Det kan oppstå målkonflikter i prosjektet (f.eks. bruk av kortreiste materialer vs. økonomi).</li><li>• Sentrale statlige innkjøpskrav på ytre miljø (DIFI) er for dårlig forankret i innkjøpsorganisasjonen.</li><li>• JBV mangler sanksjonsmuligheter overfor leverandørene ved brudd på miljøkrav i prosjektet.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• JBV kan gjennomføre leverandørseminar (blant annet som grunnlag for å velge entrepriseform).</li><li>• JBV kan kreve at entreprenøren oppgir hvor materialer kommer fra.</li><li>• JBV kan stille krav om at leverandør skal dokumentere miljøstyring.</li><li>• JBV kan innarbeide poster for prising av miljøtiltak og miljøkonsekvenser i kontraktene.</li><li>• JBV kan legge føringer om at alle produkter skal ha en miljøvaredeklarasjon.</li><li>• JBV kan vurdere vektning av tildelingskriterier på miljø kontra pris (f.eks. miljøforståelse)</li><li>• JBV kan stille språkkrav til entreprenøren (språkferdigheter, opplæring osv.).</li><li>• JBV kan vurdere om prosjektet skal anskaffe fundamenteringstog.</li></ul>	<ul style="list-style-type: none"><li>• Valgt kontraktstrategi er ikke optimal ut fra miljøhensyn.</li></ul>

(Norconsult, 2014)

## Tema: Fremdrift

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• Det er klar bevissthet hos miljøansvarlige i prosjektet i tidligfase om sammenhengen mellom fremdrift og miljøkonsekvenser.</li></ul>	<ul style="list-style-type: none"><li>• For lite tid til planleggingsaktivitet i prosjektledelsen i tidlig detaljplanfasen.</li><li>• For lite tid til å innarbeide spesifikke miljøkrav til entreprenør i prisbærende poster i konkurransegrunnlaget.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• Sette av nok til til planleggingsaktivitet i prosjektledelsen i tidlig detaljplanfase.</li><li>• Nok tid til å følge opp at spesifikke miljøkrav til leverandører innarbeides som prisbærende poster i konkurransegrunnlag (realistisk framdriftsplan).</li></ul>	<ul style="list-style-type: none"><li>• KS2-arbeidet er kritisk pga. uforutsigbarhet.</li><li>• Fremdriften i utførelsesfasen tillater ikke at entreprenøren kan tilpasse gjennomføringen av de ulike arbeidsoperasjonene ift. og minimere miljøkonsekvenser.</li><li>• Tiltaket er politisk styrt (budsjetter, fremdrift, kompetanse, tekniske løsninger osv.).</li></ul>

## Tema: Miljøprogram

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• Det er etablert et miljøprogram og miljøkart for prosjektet.</li><li>• Prosjektet har god oversikt over nåværende kunnskapsstatus.</li></ul>	<ul style="list-style-type: none"><li>• Det er ikke foretatt inventering av biologisk mangfold i felt.</li><li>• Miljømålene i miljøprogrammet er ikke operasjonaliserte.</li><li>• Miljøprogrammet har lite fokus på vannresipient.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• Prosjekterende og utførende kan bruke miljøkartene aktivt i sitt arbeid og melde inn behov for oppdateringer av eksisterende databaser til Fylkesmennene.</li><li>• JBV kan gjennomføre seminar med prosjekterende og utførende for å gjennomgå miljøprogrammet.</li></ul>	<ul style="list-style-type: none"><li>• Mangelfull eller feil kartlegging som ligger til grunn for miljøprogrammet kan føre til feil i valg av løsninger.</li><li>• JBV har ikke etablert miljømål for vilt.</li></ul>



(Norconsult, 2014)

## Tema: Anleggsgjennomføring

	<b>Styrker</b>	<b>Svakheter</b>
<b>Interne</b>	<ul style="list-style-type: none"><li>• Det er etablert miljøprogram, miljøkart og miljøbudsjett for prosjektet.</li><li>• Prosjektet skal utarbeide et miljøoppfølgingsprogram for anleggsgjennomføringen.</li><li>• Prosjektet vil gjennomføre egen risikovurdering i forkant av anleggsgjennomføringen.</li><li>• Det skal etableres et miljøregnskap for prosjektet.</li></ul>	<ul style="list-style-type: none"><li>• Prosjektet har for lite kunnskap om hva anleggsgjennomføringen vil medføre av miljøkonsekvenser.</li></ul>
	<b>Muligheter</b>	<b>Trusler</b>
<b>Eksterne</b>	<ul style="list-style-type: none"><li>• JBV kan gjennomføre seminar med entreprenører for å gjennomgå MOP for anleggsgjennomføringen.</li><li>• JBV kan gjennomføre tidlig varsling av prosjektet til leverandørene.</li><li>• Det er mulig å planlegge og koordinere aktiviteter slik at disse kan gjennomføres på tidspunkt hvor naturen er minst sårbar ift. påvirkning.</li><li>• Prosjektet kan ivareta miljøhensyn i planlegging av rigg, infrastruktur, transport og entreprenørarbeid på lokalitet.</li></ul>	<ul style="list-style-type: none"><li>• Utførelsesfasen er den mest utfordrende fasen i prosjektet ift. å ivareta ytre miljø.</li><li>• Økonomiske hensyn kan bli prioritert fremfor miljøkrav i utførelsesfasen.</li></ul>

(Norconsult, 2014)

### Tema: Byggherrestyrte arkitektoniske, tekniske valg

	Styrker	Svakheter
Interne	<ul style="list-style-type: none"><li>• Prosjektet fokuserer på muligheten for å ivareta miljøhensyn, arkitektoniske hensyn samt skape identitet.</li></ul>	<ul style="list-style-type: none"><li>• JBV er ikke oppdatert på metodevalg (kan ivaretas ved å åpne for å gi tilbud på alternative løsninger).</li><li>• JBV tar et økt ansvar ved å beskrive konkrete metodevalg.</li><li>• Byggherrestyrte valg kan hindre kreativitet hos tilbyderne.</li></ul>
	Muligheter	Trusler
Eksterne	<ul style="list-style-type: none"><li>• JBV kan stille krav om konkrete metodevalg i utførelsen.</li><li>• Det kan gjennomføres leverandørseminar/dialog med tilbydere for å optimalisere beskrivelsen.</li><li>• JBV kan stille krav om bruk av miljøvennlige produkter.</li></ul>	<ul style="list-style-type: none"><li>• JBV unytter ikke muligheten for å styre leverandører og entreprenører for å oppnå ønsket miljøprofil.</li></ul>

## Appendix F: Gap analysis – Compliance to internal demands

Gap analysis of environmental principles for the project and environmental objectives for the electrification project (Tillerbakk and Skjøstad, 2015, Selsbak, 2016c).

Demand	Answer in project	Gap	Measures
<b>Miljøprinsipper</b>			
<p><b>1:</b> Miljø skal planlegges, gjennomføres og følges opp i tråd med Norsk standard for miljøprogram og miljøoppfølgingsplan (MOP) for ytre miljø for bygg-, anleggs-, og eiendomsnæringen (NS 3466:2009)</p>	<p><b>MOP:</b> The MOP is for the construction phase. The document is a draft under writing by Sweco in collaboration with environmental advisor for the project. The MOP will be implemented in contracts with contractor, and there shall be further made a MOP by the contractor. Changes might be done in the document after the time of the research study.</p>	<p>4.2: There is not specified an assumed lifetime, start- and end time for the phase. There are not specified phases for the construction.</p> <p>4.6: In total, only a few compensation measures are described.</p> <p>4.7: There are not specified measures for how follow-up of targets should be done or measured; all though there are set quantified targets for some demands. An example is using at least 90% recycled steel for reinforcement products. Per now, there are not made descriptions for reports for evaluations of goal achievement, for how these shall be performed.</p>	<p>Describe lifetime, start- and end time for the construction phase. Describe compensation measures, routines for follow-up, quantify and time for targets, describe how reports for evaluations of goal achievement shall be done, or specify that this must be done in the MOP of the contractor.</p>
	<p><b>Environmental programme:</b> Norconsult has developed an environmental programme in collaboration with Jernbaneverket in 2014.</p>	<p>"3.3: There is no specification that the project uses an EMS in accordance to ISO 14001, but it is specified that suppliers should have an EMS according to this. It is not specified if the document is legally binding, or guidelines, all though it is noted that it shall be developed further in MOPs. There is no cross-reference to other systems for protecting environment, and no clear reference to the internal control regulations other than for waste handling, and listing in relevant legislation. There is no reference to the Building Regulations. Standards and legislation are listed in the document.</p> <p>3.4:</p>	<p>Description of environmental management system in the project, and connection to other management systems for the project. Delimitations could be specified clearer. Energy source use for construction work and transport should be</p>

		<p>There are not described specific delimitations for the project's environmental impact in terms of local, regional, national or global impacts. Environmental impacts are all though described in terms of e.g. climate change and noise for neighbours to the project.</p> <p>3.4.3: For the construction phase, the use of energy sources for construction work, or transport for this is not further treated than stating that it involves greenhouse gas emissions.</p> <p>3.5: As there for some environmental targets is referred to further development in the MOP for measures, it is not clear if they are quantifiable or have deadlines. For targets with measures, there are no specific deadlines set, but since the programme is for a complex project, it is relevant to set these at a later stage.</p>	<p>treated further in the MOP. Measures should be further specified in the MOP.</p>
<p><b>2:</b> Å ivareta at miljø er et linjeansvar, sidestilt med teknikk, økonomi, helse og sikkerhet.</p>	<p>Roles are defined for environmental responsibilities in the environmental budget.</p>	<p>No clear gap identified in project.</p>	<p>Environmental training of project managers and consulting engineers.</p>
<p><b>3:</b> Miljøkrav skal identifiseres i plan- og prosjekteringsfasen.</p>	<p>Environmental internal and external demands are described in the environmental programme.</p>	<p>No gap.</p>	<p>No measures.</p>
<p><b>4:</b> Det skal settes miljøkrav ved kontrahering av entreprenører og rådgivere.</p>	<p>There is not selected a contractor at the time of the research study. Demands will be set through contracts with entrepreneurs and suppliers. There is made a draft of environmental award criteria, and a demand specification for EPDs for the contractor.</p>	<p>No gap.</p>	<p>No measure.</p>
<p><b>5:</b> Prosjektet og entreprenør(-er) skal ha en miljøansvarlig i prosjektet.</p>	<p>The project has a 100% environmental advisor.</p>	<p>No gap</p>	<p>No measures.</p>

<p><b>6:</b> Miljøpremisser og oppnådde resultater skal være tilgjengelige for berørte myndigheter og allmennheten, også som dokumentasjon for oppfølging og kontroll.</p>	<p>Environmental programme and environmental budget is available through Jernbaneverket's official web pages.</p>	<p>Not known if other environmental documents for the project will be published.</p>	<p>No measures needed at this stage.</p>
<p><b>7:</b> Alle entreprenører og leverandører skal ha et system for internkontroll som blant annet dokumenterer hvordan miljøkrav blir ivaretatt, i henhold til ISO 14001 eller tilsvarende.</p>	<p>Demands are put on suppliers in the contracting-phase. No contractor are assigned at the current stage. Sweco and Norconsult as consultation suppliers has a system for internal control that documents consideration of environmental demands in accordance to ISO 14001 and ISO 9001.</p>	<p>No gap</p>	<p>No measures needed.</p>
<p><b>8:</b> Gjennomføre jevnlig miljørevisjoner og rapporterte på miljøstatus i henhold til fastsatte mål og krav.</p>	<p>Construction has not started. Environmental revisions will be performed by Jernbaneverket according to the MOP.</p>	<p>No gap</p>	<p>No measures needed.</p>
<p><b>9:</b> Ved gjennomføring av risikovurderinger av (ytre) miljø, skal Jernbaneverkets akseptkriterier for Ytre miljø-plan brukes.</p>	<p>A simple risk evaluation has been performed for the MOP in accordance to «Enkel risikovurdering" (jf. STY 603169) the 7. March 2016, due to the early phase of the project. More detailed risk analyses will be performed in the interaction phase with the contractor. (Selsbak, 2016a)</p>	<p>No gap</p>	<p>No measures needed.</p>

<b>10:</b> Prosjektet skal ha en tydelig miljøprofil, og sørge for kommunikasjon om løpende aktiviteter for å styrke og opprettholde bevisstheten rundt elektrifisering som miljøprosjekt.	Environmental information regarding the project is available on Jernbaneverket s webpages (Jernbaneverket, 2016b).	No gap	No measures needed.
<b>11:</b> All ny kartlegging av miljødata i prosjektet skal rapporteres til riktig fagmyndighet.	Not investigated due to the scope of the project.	No gap known.	No measure known.
<b>Overordnede miljømål for elektrifisering av Trønder og Meråkerbanen.</b>			
<u>Togtrafikken på ferdig elektrifisert Trønderbane og Meråkerbane</u>			
<b>12:</b> Større andel av togtrafikken kan bruke fornybare energikilder	Electrification as a measure.	No deviance.	No measure.
<b>13:</b> Redusere energiforbruket i togframføringen med 40-75%	Electrification as a measure.	No deviance.	No measure.
<b>14:</b> Redusere klimagassutslippene (CO2) fra togtrafikken med 25-30%	Electrification as a measure.	No deviance.	No measure.
<b>15:</b> Redusere direkte utslipp til luft av gasser (SO2, NOX, CO, HC) og partikler lokalt og regionalt	Electrification as a measure.	No deviance.	No measure.

<b>16:</b> Redusere støy fra togtrafikk siden elektriske tog støyer mindre enn dieseltog ved lave hastigheter	Electrification as a measure.	No deviance.	No measure.
<b>Elektrifiseringsarbeidene på banestrekningene:</b>			
<b>17:</b> Bruke råstoff og materialer som gir minst negativ miljøpåvirkning	The environmental budget identifies production of materials as the processes with the largest impact on greenhouse gas emissions. A draft of environmental award criteria (Appendix I) and specification for EPD's are made (Appendix H), , and will be further investigated in the interaction phase with the contractor (Selsbak, 2016a). (Selsbak, 2016b)	There is uncertainty regarding the best way to set demands for this in contracts, and how this should be followed up for best results. Difi has been consulted, which have guidelines for this, (4.6 Standards and tools for EMS in construction, Appendix K).	Considering EU guidelines could be performed or researching solutions for similar projects in Finland or Sweden. Sweden has established units for environmental criteria for construction (Foss, 2016a).
<b>18:</b> Unngå vesentlige negative konsekvenser for miljøinteresser langs banestrekningene	Considered through the MOP with measures for this.	No deviance.	No measure.
<b>19:</b> Unngå miljøfarlige utslipp til luft, vann og jord	Planned through measures in the environmental programme and MOP.	No deviance	No measure.
<b>20:</b> Oppfylle krav og retningslinjer til anleggsstøy	Treated in the MOP: "Guidelines for the treatment of noise in area planning (T-1442/2012) shall be followed"	No deviance known.	No measure.
<b>21:</b> Unngå bruk og deponering av miljøfarlige stoffer	Is evaluated and measures are described in the MOP.	No deviance known.	No measure.

**Targets by themes in the environmental programme** (Tillerbakk and Skjøstad, 2015, Selsbak, 2016c).

No.	Project target	Project demands/measures	Answer	Deviance	Measure
<b>Climate</b>					
<u>Targets</u>					
23	Adjust the line infrastructure so that GHG emissions from train traffic can be reduced by 25-30%.	Electrification of the line.	Planned through change from diesel to electric current.	No deviance.	No measure.
24	Adjust so that more of the train traffic can use renewable energy sources.	Electrification of the line.	Planned through change from diesel to electric current.	No deviance.	No measure.
25	Reduce the energy consumption of the train operation by 40 -75%.	Electrification of the line.	Not known.	No deviance.	No measure.
26	Design and dimension the electrified line sections so that they can tolerate the future climate impact.	Not known.	Not known.	No deviance.	No measure.
<b>Material and energy usage</b>					
<u>Targets for finished electrified lines</u>					
27	The measure shall be built with input – materials and energy – that after a holistic evaluation of environment, quality and safety gives the lowest possible negative environmental impacts trough the project’s lifetime.	Miljøpåvirkning av valgte materialer og energi, skal beregnes, dokumenteres og rapporteres i et livsløpsbasert Miljøbudsjett i hht Jernbaneverkets metodeverktøy og rutiner. Valg av innsatsfaktorer skal gjøres ut fra anbefalinger i miljøbudsjett. Miljøbudsjettet skal benyttes som grunnlag for miljøkrav ved anskaffelsen.	Results from the environmental budget are used in the MOP for establishing demands for evaluation of material selection for the contractor. It is not specified in the MOP that an environmental budget	No deviance.	No measure.



			shall be used. The draft for environmental demands (Appendix I) specifies in award criteria that the contractor shall make an environmental budget and inventory for the construction phase, and show how they can reduce emissions. The draft for specification demands (Appendix H), show possible specification demands for EPDs for the project.		
28	Adjust so that more of the train traffic can use renewable energy sources.	Not described.	Executed through the electrification of the line.	No deviance.	No measure.
29	Reduce the environmental usage in the train operation by 40-75%.	Not described.	Executed through the electrification of the line.	No deviance.	No measure.
<u>Targets for construction phase</u>					
30	The measure shall be built with input – materials and energy – that after a holistic evaluation of environment, quality and safety gives the lowest possible negative environmental impacts trough the project’s lifetime.	Føre miljøregnskap underveis i anleggsperioden for å synliggjøre faktisk miljøpåvirkning. Miljøregnskapet skal bidra til at valg som tas også er begrunnet med miljømessige hensyn. Materialer med lavest mulig livssyklus-kostnad og høy gjenbruksverdi bør velges. Innarbeide krav til materialvalg og energibruk i leverandørkontrakter.	See target for finished electrified lines.	See target for finished electrified lines.	See target for finished electrified lines.

<b>Landscape and the visual environment</b>					
<u>Targets for finished electrified lines</u>					
31	There shall be established a good visual environment along the railway tracks, with holistic architecture, scenery adaptation and a tidy railway net.	Det skal utvikles en helhetlig arkitekturstrategi for strekningene, som virkemiddel for å skape gode, attraktive og stedstilpassede omgivelser langs jernbanen.	The matter is further documented through the MOP.	No deviance.	No measure.
32	Equipment and installations shall be adapted to the scenery, and placed in a way so that it in the least degree possible appear unsightly.	Det skal utarbeides en overordnet formingsveileder for landskap for strekningene.	The matter is further documented through the MOP.	No deviance.	No measure.
<u>Targets for the construction phase</u>					
33	Vegetation within temporary construction areas, that are especially important as scenery elements, or constitute important structures of nature, shall be conserved.	Tiltak utarbeides i miljøoppfølgingsplan. Marksikringsplan utarbeides med krav til sikring av eksisterende vegetasjon.	The matter is further documented through the MOP.	No deviance.	No measure.
34	Areas affected by the measure shall be restored and repaired so that it constitutes a part of the natural scenery.	Tiltak utarbeides i miljøoppfølgingsplan.	The matter is further documented through the MOP.	No deviance.	No measure.
35	The construction areas shall be tidy.	Krav til etablering av riggplaner, med helhetlig utforming av riggområder.	The matter is further documented through the MOP.	No deviance.	No measure.
36	Contemporary measures shall be limited in time and space, and be done in the most gentle way possible.	Tiltak utarbeides i miljøoppfølgingsplan. Krav til revegetering etter inngrep.	Time and space not specified in MOP.	Time and space not specified in MOP, so that demand is clearly	Specify in the MOP.

				communicated for the execution of the project.	
37	Areas near the construction works shall be secured in the construction period.	Kartlegge behov for områder som skal sikres, og vurdere nødvendig inngjerding, skilting og sikring.	The matter is further documented through the MOP.	No deviance.	No measure.
<b>Nature diversity</b>					
<u>Targets for finished electrified lines</u>					
38	Avoid interventions in important nature areas and maintain important ecological functions and vulnerable species.	Measures are followed up in the MOP. Available theme data is used as a starting point. Theme data shall be quality ensured by responsible authorities. Need for further registration of and measures for nature diversity has to be clarified as early as possible.	Areas and possibly affected species are identified and mapped in the MOP.	No deviance.	No measure.
39	Spreading of alien, damaging species shall be avoided.	No measure described.	Areas and possibly relevant species are identified and mapped in the MOP.	No deviance.	It could be specified in the environmental programme that the matter will be further treated in the MOP.
40	Contribute to a reduction in animal hits.	Measures are followed up in the MOP. Mapping of wildlife corridors. Plan for clearing of wildlife corridors in the operation phase.	Relevant areas are identified for bird hits in the MOP.	Other game and clearing of corridors is not mentioned in the MOP, as it is made for the construction phase, all though the demands could be relevant to plan for the	The demands could be specified in the MOP.

				construction phase.	
41	Minimize consequences for birds.	Evaluate all consequences for birds according to the measure.	Relevant areas are identified for bird hits in the MOP.	No deviance.	No measure.
42	Water quality in adjoining recipients shall not be impaired permanently.	Available theme data is used as a starting point. The data shall be quality ensured by responsible authorities. Need for mapping and surveillance of environmental condition in watercourses shall be clarified in the MOP.	The matter is further documented through the MOP.	No deviance.	Specify demands water quality for in MOP.
<b>Targets for the construction phase</b>					
43	Reduce consequences for game in the construction phase.	Avoid nightly construction. Establish crossing opportunities as early as possible in the construction phase. Establish game fences as late as possible in the construction period.	Game fences and existing fences are considered in the MOP.	There is no specification of nightly construction in the MOP, or when crossing opportunities and game fences should be established.	Specify demands for nightly construction, crossing opportunities and game fences in MOP.
44	Vulnerable areas and important ecological functions at the construction sites shall be secured against damage.	Map vulnerable areas before the execution of construction. Measures are made in the MOP.	Areas and possibly affected species are identified and mapped in the MOP.	No deviance.	No measure.
45	Water quality in adjoining recipients shall not be impaired permanently.	No measure described.	The matter is further documented through the MOP.	No deviance.	It could be specified in the environmental programme that the matter will be further treated in the MOP.
<b>Nature resources</b>					

<u>Targets for finished electrified lines</u>					
46	Interference in areas with cultivated land and forest shall be minimized.	All entry points shall be reestablished at the finished construction. Ensure entry points to farms near the construction site to prevent conflict with construction traffic.	Considered in the MOP.	No deviance.	No measure.
47	Affected waterways shall not have an impaired condition after the completion of the construction.	The water flow of important waterways with business interests shall not be negatively affected.	Groundwater wells are considered in the MOP.	No deviance.	No measure.
<u>Targets for construction phase</u>					
48	Topsoil shall be stored responsibly, without risk of spreading plant diseases and weed/blacklisted species. The quality of the topsoil shall not be deteriorated during temporary storage.	No measure described.	Considered through the MOP.	No deviance.	It could be specified in the environmental programme that the matter will be further treated in the MOP.
49	Disease organisms shall not be spread.	Demand for routines for cleaning of machines and equipment are set in the MOP.	Considered through the MOP.	No deviance.	No measure.
<b>Culture relics and culture environment</b>					
<u>Targets for finished electrified lines</u>					
50	The measure shall not cause damage for valuable monuments, cultural environment and cultural landscape.  Where measures are necessary, the current situation shall be documented. The cultural values shall be recreated if possible.	Cultural relics in the railway shall be developed and preserved in accordance to "Landverneplan for jernbanen og Verneplan for jernbanebygninger"	Considered through the MOP.	No deviance.	No measure.

<u>Targets for construction phase</u>					
51	<p>The construction work shall not contribute to damage to cultural relics, cultural environment or cultural landscape.</p> <p>If valuable cultural relics and cultural environment are affected, these should be secured in the construction period.</p>	<p>Where interference is necessary, the current situation shall be documented. If possible, the cultural relics shall be recreated.</p> <p>At detailed planning, there has to be taken consideration to the findings that are registered on the environmental map</p>	Considered through the MOP.	No deviance.	No measure.
52	Not known automatically protected cultural relics that are detected in the construction period shall be secured and the builder and authorities shall be given notice immediately.	Entreprenører skal utarbeide varslingsrutiner for uventede funn av automatisk fredete kulturminner.	Not specifically mentioned in the MOP.	The demand is not further specified for the contractor in the MOP.	Specify in MOP.
<b>Nærmiljø og friluftsliv /Community and the outdoors</b>					
<u>Prosjekt mål for ferdig anlegg</u>					
53	Arealer og anlegg som brukes av barn og unge skal sikres mot forurensning, støy, trafikkfare og annen helsefare	Holde områdene ryddig og i god stand.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
54	Sikre allmenhetens rett til ferdsel, opphold mv. i naturen, slik at muligheten til å utøve friluftsliv som en helsefremmende, trivselskapende og miljøvennlig fritidsaktivitet bevares og fremmes	Nye ferdselsårer skal etableres dersom eksisterende går tapt.	Considered through the MOP.	No deviance.	No measure.

Prosjektmål for anleggsfase					
55	Befolkningen skal i størst mulig grad oppleve ro og trygghet i anleggsperioden	Loggføre alle henvendelser og klager i tilknytning til anleggsvirksomheten som kommer til Jernbaneverket og sørge for rask behandling. Kommunene oversender alle henvendelser til Jernbaneverket slik at det foreligger oversikt over hvordan anleggsarbeidet oppleves. Forebygge utrygghet gjennom kommunikasjonsplan. I kontraktene med entreprenørene vektlegges det at alle som arbeider på anlegget, skal vise personer med spørsmål høflig og vennlig videre til byggeleder eller kommunikasjonssansvarlig.	Not specifically treated in MOP, but it is referred to guidelines for noise in construction in the MOP.	Demands need to be specified in the MOP.	Could set more specific demands from the environmental programme in the MOP.
56	Søvn og hvile skal ikke forstyrres unødvendig	Arbeidstider skal være avtalt, og skal overholdes. Ref. T1442 og avtale med lokal kommunelege	Considered through the MOP.	No deviance.	No measure.
57	Mulighetene til å drive friluftsliv og rekreasjon utenfor anleggsområder skal begrenses minst mulig	Anleggstrafikk skal ikke avskjære gang- eller sykkelruter, uten at nye trygge krysningspunkter etableres. God framkommelighet for fotgjengere og trafikanter skal ivaretas	Considered through the MOP.	No deviance.	No measure.
58	Alle berørte skal gis informasjon om anleggsvirksomheten	Skilting, gjerder og informasjon skal alltid være oppdatert	Establishment of a communication plan, and updates for signs and information is mentioned in the MOP.	No deviance.	No measure.

<b>Ground conditions and mass stability</b>					
<b>Prosjektmål for ferdig anlegg</b>					
59	Anlegget skal ikke medføre økt fare for ras eller utglidning av spor.	Alle arbeider i løsmasser skal utføres med sikte på å forebygge utrasing. Setningsskader skal forebygges. Iverksette nødvendige tiltak for å sikre grunnforhold i anleggs- og driftsfase. Grunnforhold og massestabilitet kartlegges og vurderes langs eksisterende banestrekning, og ved etablering av ny bygningsmasse. Iverksette nødvendige geotekniske tiltak ved etablering av omformerstasjoner.	Considered through the MOP.	No deviance.	No measure.
<b>Prosjektmål for anleggsfase</b>					
	Ingen bygning eller infrastruktur skal få varige skader på grunn av setninger eller ras som følge av anleggsvirksomheten	Alle arbeider i løsmasser skal utføres med sikte på å forebygge utrasing. Setningsskader skal forebygges. Kartlegging av tilstand før igangsetting av anleggsvirksomhet Følge opp tiltak fra grunnundersøkelser som er foretatt i forbindelse med omformerstasjonene.	Considered through the MOP.	No deviance.	No measure.
<b>Emissions to air, water and ground</b>					
<b>Prosjektmål for ferdig anlegg</b>					
60	Redusere direkte utslipp til luft av gasser (SO <sub>2</sub> , NO <sub>X</sub> , CO, HC) og partikler lokalt og regionalt	Ved ferdig anlegg utarbeides krav til togoperatører om andel elektrisk togdrift på strekningene. Ingen direkte utslipp til luft av gasser (SO <sub>2</sub> , NO <sub>X</sub> , CO, HC) og partikler verken lokalt og regionalt fra elektrisk togtrafikk på strekningene. Behov for vedlikeholdsveier til ferdig anlegg må kartlegges.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.



61	Tiltaket skal ikke medføre utslipp til lokale resipienter som medfører skade på biologisk mangfold.	Tiltak utarbeides i miljøoppfølgingsplan.	Considered through the MOP.	No deviance.	No measure.
62	Bruk av ugrasmiddel skal begrenses.	Krav til bruk av ugressmiddel innarbeides og følges opp i henhold til vedlikeholdsplan for vegetasjon for banestrekningene.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
63	Det skal ikke være kilder til forurensning til jord i grøfter og sidearealer	Kartlegge og fjerne kjente og ukjente lokaliteter med forurenset masse	Considered through the MOP.	No deviance.	No measure.
64	Forbudte stoffer skal ikke benyttes ved anlegget	Det skal foreligge dokumentasjon over stoffer som brukes i omformerstasjonene	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
65	Berørte vassdrag skal ikke ha forringet miljøtilstand etter at anlegget er ferdig	Tilgjengelige temadata brukes som utgangspunkt. Temadata skal kvalitetssikres av ansvarlige myndigheter. Behov for kartlegging og overvåking av miljøtilstand i vassdrag skal avklares i miljøoppfølgingsplan. Avklare behov for overvåking av grunnvannstand og vannstand i kilder, bekker og vassdrag langs traseen, særlig i sårbare områder	Considered through the MOP.	No deviance.	No measure.
<b>Prosjekt mål for anleggsfase</b>					
66	Tiltaket skal ikke medføre forurensning som kan være til skade eller ulempe for miljøet eller ha negative konsekvenser for helse. Anleggsvirksomheten skal ikke føre til forurensning av grunnen	Midlertidige anleggsområder kartlegges med tanke på avrenning og stabilitetsforhold. Disponering skal skje i hht gjeldende reguleringsplaner. Tiltak utarbeides i miljøoppfølgingsplan. Kartlegge forurensning langs eksisterende spor og lage tiltaksplaner der dette er påkrevd av den enkelte	Considered through the MOP.	No deviance.	No measure.

		kommune.Eksisterende veger skal holdes fri for tilsøling fra anlegget.			
67	Støvplager som følge av anleggsvirksomhet skal minimeres	Nye, moderne anleggsmaskiner brukes ved realisering av tiltaket for å redusere luftforurensning Vasking av kjøretøy for å redusere støvutslipp ved massetransport	Idling, and dust reducing measures are considered through the MOP, but not new modern construction machines.	New, modern construction machines are not considered through the MOP.	Consider new, modern construction machines if this has not been done, through the MOP.
68	Utslipp til luft skal reduseres	Krav om å unngå tomgangskjøring. Etablere tiltaksplaner og beredskapsplan	Idling is treated in the MOP.	Action plan and emergency preparedness plan is not considered in the MOP.	Consider plans for measures and emergency preparedness plan in the MOP.
<b>Støy og vibrasjoner</b>					
<b>Prosjekt mål for ferdig anlegg</b>					
69	Redusert støy fra togtrafikk som følge av elektrifisering	Tiltaksplaner følges opp i detaljplanleggingen. Kartlegging av fremtidig støysituasjon	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
70	Trafikk på de elektrifiserte banestrekningene skal ikke føre til støy eller strukturlyd over grenseverdiene i Miljøverndepartementets Retningslinje for behandling av støy i arealplanleggingen (T-1442)	Tiltaksplaner følges opp i detaljplanleggingen.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
71	Ivareta stille og lite støypåvirkede natur- og friluftsområder	Tiltaksplaner følges opp i detaljplanleggingen.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.

Prosjektmål for anleggsfase					
72	Oppfylle krav og retningslinjer til anleggsstøy	Kartlegging med oppfølgende tiltak	Not finished in the MOP.	No known deviance.	No measure.
73	Forsvarlige oppførte bygninger, anlegg og ledningsanlegg skal ikke påføres varige skader på grunn av vibrasjoner fra anleggsarbeidene	Kartlegging med oppfølgende tiltak	Not finished in the MOP.	No known deviance.	No measure.
74	Anleggsfasen bør ikke gi støy, strukturlyd og vibrasjoner over grenseverdier i bebygde områder uten at kommunelegen og befolkningen er informert og tiltak vurdert og tilbudt beboerne	Kartlegging med oppfølgende tiltak	Not finished in the MOP.	No known deviance.	No measure.
Elektromagnetisme					
Prosjektmål for ferdig anlegg					
75	Følge krav til jernbanetekniske installasjoner i produktstandard EN 50121. Følge grenseverdier for elektromagnetisme i Jernbaneverkets Teknisk regelverk, kapittel Felles elektro	Krav til vurdering av eksponering av elektromagnetiske felt for befolkningen. Banestrømforsyningsanlegg og koblingsanlegg og transformatorer i kontaktledningsnett bør tilfredsstillende krav til emisjon og immunitet i henhold til [EN 50121-5]	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
Prosjektmål for anleggsfase					
76	Ikke relevant i anleggsfase	Ikke relevant i anleggsfase	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.

Waste management					
Prosjektmål for ferdig anlegg					
77	Anlegget skal ha minimal avfallsproduksjon og være rent og ryddig.	Krav til utarbeidelse av avfallsplaner.	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
78	Avfall skal håndteres som en ressurs og behandles forskriftsmessig. Avfallet skal kildesorteres og minst 70% av avfallet skal gå til gjenbruk eller gjenvinning	Krav til utarbeidelse av avfallsplaner. Kartlegge potensielt farlig avfall	Not specified in MOP, which is for the construction phase.	No deviance.	No measure.
Prosjektmål for anleggsfase					
79	Avfall skal håndteres som en ressurs og behandles forskriftsmessig. Avfallet skal kildesorteres og minst 70% av avfallet skal gå til gjenbruk eller gjenvinning	Krav til miljøsaneringsbeskrivelse for bygg og anlegg som skal rives. Krav til utarbeidelse av avfallsplaner. Krav til entreprenører om avfallshåndtering i anleggsperioden fastsettes i kontrakt. Rapporteres for hvert prosjekt og hver entreprise Kartlegge behov for arealer til avfallshåndtering. Følge Jernbaneverkets miljøstyringssystem for avfall.	Most demands are considered through the MOP.	Consideration of need for areas for waste treatment, and the specification to follow the environmental management system is not considered in the MOP.	Specifying in the MOP the consideration for need for areas for waste treatment, and the specification to follow the environmental management system.

**Overarching environmental objectives for Jernbaneverket (Staurem and Dahl, 2014)**

No.	Overarching policies	Answer in project	Gap	Measure.
1	Jernbaneverket shall have a clear and communicated environmental organization, and shall set aside adequate resources for ensuring environment and energy efficiency-promoting tasks, secure the fulfilment of objectives, and execution of a good quality control.	Jernbaneverket clearly communicates the environmental organisation. The scope of the study is not sufficient to evaluate use of resources.	No deviance identified.	No measure identified.
2	Jernbaneverket shall adhere to statutory environmental demands, and contribute actively to reduce and prevent environmental effects from own activities, and improve their energy efficiency.	No identified deviations to statutory demands. There are solid structures for environmental risk assessments. Environmental considerations are performed based on a comprehensive environmental budget, risk assessments and evaluations. Overarching environmental targets for the project are set, which are further specified in the environmental programme, MOP and through environmental criteria and demands that are planned set in the contract for the enterprise.	The Constitution § 112. is not mentioned. There are found gaps between the environmental management system and the MOP. Challenges for early evaluations of some environmental aspects for Jernbaneverket: - knowledge "silos" between different speciality units (e.g. consulting engineers and environmental managers). Environmental budget provides increased detail-level for the project in comparison to other projects.	Securing environmental competence. Inclusion of evaluation of environmental impacts in all speciality subunits.
3	Jernbaneverket shall prioritize work to fulfil main- and step distributed targets for environment in the National Transport Plan, and contribute to develop these further with decreed sector responsibility.	Jernbaneverket develops overarching objectives based on the NTP. Deviances mentioned in Gap analysis of project performance in according to NTP describes gaps and measures for improving performance in accordance to the target.	See Gap analysis of project performance in according to NTP	See Gap analysis of project performance in according to NTP

4	Jernbaneverket shall execute purchasing of environmental- and energy effective products, services and design to improve the environmental and energy performance.	Jernbaneverket will establish environmental demands for their contract with the selected contractor. The environmental programme, MOP, and award criteria, qualification demands and demand specifications for EPDs will be used to promote green purchasing.	There is not a strong tradition for emphasis on green procurement in Jernbaneverket. Challenges in setting environmental demands in terms of absolute demands and award criteria for the contractor.	Creating systems for active learning in Jernbaneverket. Market research regarding available technology and materials. Innovation partnerships.
5	Jernbaneverket shall develop and use methods and tools that ensures environment and energy effective business processes.	The environmental budget provides scientifically relevant information about the environmental impact of the planned project. This is further used for the environmental programme, MOP and award criteria.	The environmental precedence obtained through environmental impact assessment, risk analyses and plans could be weakened by the procurement function by the reasons explained in objective 1.	Tools for green procurement could be further developed.
6	Jernbaneverket shall document and make visible the social significance of the railway, and environmental benefits.	Benefits from the electrification project are documented and promoted through their webpage and in media.	No deviance identified.	No measure.
7	Jernbaneverket shall adhere to communicated values in the environmental work, including ensuring transparency regarding environmental concerns, engagement in public debate about transport and environment, and be a professional collaborator within environmental concerns.	Documents and information concerning the project and Jernbaneverket is easily accessible through Jernbaneverket's webpages, or by request.	No clear deviance identified based on the information obtained in the study.	Collaborations for improving green procurement routines could be performed.

## Appendix G: Gap analysis – Compliance to the revised Public Procurement Act and Regulations

(Nærings- og fiskeridepartementet, 2015b, Nærings- og fiskeridepartementet, 2015a)

Paragraph	Demand	Answer in project	Deviance	Measure.
The revised Public Procurement Act				
§ 2 Virkeområde	Loven gjelder når oppdragsgivere som nevnt i annet ledd inngår vare-, tjeneste- eller bygge- og anleggskontrakter, herunder konsesjonskontrakter, eller gjennomfører plan- og designkonkurranser, med en anslått verdi som er lik eller overstiger 100 000 kroner ekskl. mva. Loven gjelder for følgende oppdragsgivere: a) statlige myndigheter	The law is applying for Jernbaneverket's operations.	No deviance.	No measures.
§ 5 Miljø, menneskerettigheter og andre samfunnshensyn	Statlige, fylkeskommunale og kommunale myndigheter og offentligrettslige organer skal innrette sin anskaffelsespraksis slik at den bidrar til å redusere skadelig miljøpåvirkning og fremme klimavennlige løsninger der dette er relevant. Disse oppdragsgiverne skal også ha egnede rutiner for å fremme respekt for grunnleggende menneskerettigheter ved offentlige anskaffelser der det er en risiko for brudd på slike rettigheter. Departementet kan gi forskrift om det nærmere innholdet av bestemmelsen. Oppdragsgiveren kan stille egnede krav og kriterier knyttet til ulike trinn i anskaffelsesprosessen, slik at offentlige kontrakter gjennomføres på en måte som fremmer hensyn til miljø, arbeidsforhold og sosiale forhold, forutsatt at kravene og kriteriene har tilknytning til leveransen. Departementet kan i forskrift pålegge statlige, fylkeskommunale og kommunale myndigheter og offentligrettslige organer å stille krav om	A contractor takes measures for consideration of environment in the planned procurement of the construction of the total enterprise. Objectives are implemented in an environmental programme and MOP for the project, where targets and demands for this is a part of the contract. Some environmental demands are planned set as qualification criteria, such as for the environmental management system for the contractor and environmental competence. There is made a draft for environmental award criteria.	No deviances.	No measures.

	begrensninger i antallet ledd i leverandørkjeden ved utførelsen av offentlige kontrakter i bransjer med særlige utfordringer knyttet til arbeidslivskriminalitet. Departementet kan i forskrift pålegge oppdragsgivere å stille krav om universell utforming i offentlige kontrakter.			
<u>The revised Public Procurement Regulations</u>				
<b>Kapittel 1. Virkeområde</b>				
§ 1-1. Virkeområde	(1) Denne forskriften gjelder når oppdragsgivere som nevnt i § 1-2 inngår kontrakter om varer, tjenester eller bygge- og anleggsarbeider eller gjennomfører plan og designkonkurranser.	Jernbaneverket is planning to enter a contract with a selected contractor for the KL/AT enterprise. .	No deviance	No measure.
§ 1-2. Oppdragsgivere som er omfattet av forskriften	(1) Denne forskriften gjelder for a) statlige myndigheter, b) fylkeskommunale og kommunale myndigheter og c) offentligrettslige organer. (2) Et offentligrettslig organ er et organ som a) er opprettet for å tjene allmennhetens behov og ikke er av industriell eller forretningsmessig karakter, b) er et selvstendig rettssubjekt og c) har tilknytning til det offentlige ved at 1. organet hovedsakelig er finansiert av offentlige myndigheter eller andre offentligrettslige organer, 2. organets forvaltning er underlagt slike myndigheters eller organers ledelsesmessige kontroll eller 3. organet har et administrasjons-, ledelses- eller kontrollorgan der over halvparten av medlemmene er oppnevnt av slike myndigheter eller organer.	Jernbaneverket is a public organization, and therefore has to adhere to the regulation. The Public Procurement Act is identified as relevant in the environmental programme.	No deviance	No measure.



<b>Kapittel 4. Anvendelsesområde for de ulike delene i forskriften</b>				
§ 4-1. Anvendelsesområde	<p>(1) Reglene i del I gjelder for alle anskaffelser som er omfattet av denne forskriften.</p> <p>(2) Reglene i del II gjelder for</p> <p>a) kontrakter med en anslått verdi på minst 500 000 kroner ekskl. mva., men som ikke overstiger EØS-terskelverdiene i § 4-2, og b) kontrakter om særlige tjenester med en anslått verdi på minst 500 000 kroner ekskl. mva. (3) Reglene i del III gjelder for kontrakter med en anslått verdi som er lik eller overstiger EØS-terskelverdiene i § 4-2, unntatt kontrakter om særlige tjenester, jf. annet ledd bokstav b. (4) Reglene i del IV gjelder for plan- og designkonkurranser med en anslått verdi på minst 500 000 kroner ekskl. mva.</p>	The rules of part III applies, since the contract exceed the EEA threshold values.	No deviance	No measure.
<b>Kapittel 4. Anvendelsesområde for de ulike delene i forskriften</b>				
§ 4-2. EØS-terskelverdier	<p>(1) EØS-terskelverdien er</p> <p>a) 1 million kroner ekskl. mva. for statlige myndigheters vare- og tjenestekontrakter og plan- og designkonkurranser, b) 1,55 millioner kroner ekskl. mva. for andre oppdragsgiveres vare- og tjenestekontrakter og plan- og designkonkurranser og c) 39 millioner kroner ekskl. mva. for bygge- og anleggskontrakter. (2) EØS-terskelverdien er 6 millioner kroner ekskl. mva. for kontrakter om særlige tjenester. (3) For statlige myndigheters varekontrakter på forsvars- og sikkerhetsområdet gjelder terskelverdien i første ledd bokstav a bare for varer som nevnt i WTO-avtalen om offentlige anskaffelser tillegg I, vedlegg 4, punkt 2, mens terskelverdien i første ledd bokstav c gjelder for øvrige varer. (4) Departementet kan endre terskelverdiene i denne forskriften.</p>	The value of the contract is approximately over 1.2 billion for the KL/AT enterprise, and is therefore above the EEA threshold value.	No deviance	No measure.

§ 4-3. Beregning av anskaffelsens anslåtte verdi	(7) Ved bygge- og anleggskontrakter skal oppdragsgiver ta hensyn til verdien av både bygge- og anleggsarbeidene og alle varer og tjenester som oppdragsgiver stiller til leverandørens rådighet, og som er nødvendige for å utføre arbeidene.	Not known how the projects value is calculated.		
<b>Kapittel 5. Krav til alle anskaffelser</b>				
§ 5-7 Kontraktsvilkår	Oppdragsgiver kan fastsette kontraktsvilkår, inkludert kontraktsvilkår som vedrører økonomi, innovasjon, miljø, sysselsetting og sosiale hensyn. Kontraktsvilkårene skal ha tilknytning til leveransen og angis i anskaffelsesdokumentene.	There is planned to set environmental conditions in the contract, in the form of qualification criteria, award criteria, and demands integrated in sections of the document such as competence.	No deviance.	No measure.
<b>Kapittel 7. Dialog med markedet før konkurranse</b>				
§ 7-1. Forberedende markedsundersøkelser	(1) Oppdragsgiver kan gjennomføre markedsundersøkelser for å forberede anskaffelsen og gi informasjon til leverandører om sine planer og behov. (2) Oppdragsgiver kan søke eller motta råd fra uavhengige eksperter, myndigheter, leverandører eller andre markedsaktører. Rådene kan brukes i planleggingen og gjennomføringen av anskaffelsen. Forutsetningen er at rådene ikke har konkurransevridende effekt eller fører til brudd på prinsippene om likebehandling og gjennomsiktighet.	The environmental advisor has sought information from Difi for possible environmental award criteria. Under the writing of the draft for the award criteria, Sweco has performed some investigation of the market for materials, based on results from the environmental programme. The market for the materials is not well known.	No deviance.	No measure.
§ 7-2. Dialog med leverandører før konkurransen	(1) Når en leverandør eller en virksomhet tilknyttet leverandøren har gitt råd til oppdragsgiver forut for en konkurranse, skal oppdragsgiver treffe egnede tiltak for å sikre at leverandøren ikke får en urimelig konkurransefordel dersom han deltar i konkurransen. Det samme gjelder dersom leverandøren har vært involvert i planleggingen av konkurransen på annen måte. (2) Oppdragsgiver skal sørge for at de andre leverandørene som deltar i konkurransen, mottar de samme relevante opplysningene som er utvekslet i dialogen	The project has had a dialogue conference with potential suppliers to prepare for the invitation to tender. It is not known if (1) and (2) are fulfilled.	No deviance.	No measure.

	med en leverandør i planleggingen av konkurransen. Oppdragsgiver skal fastsette en tilstrekkelig frist for mottak av tilbud for å utjevne eventuelle fordeler			
<b>Kapittel 8. Konkurransesgrunnlag</b>				
§ 8-1. Konkurransesgrunnlag	(1) Oppdragsgiver skal utarbeide et konkurransegrunnlag.(2) Konkurransesgrunnlaget skal inneholde følgende opplysninger, med mindre de allerede er tilstrekkelig beskrevet i kunngjøringen:a) hvilken ytelse som skal anskaffes, inkludert eventuelle kravspesifikasjoner ogmerkekrav, jf. kapittel 11, og absolutte krav som alle leverandører må oppfylle,b) hvilke kontraktsvilkår som gjelder for oppdraget, jf. § 5-7,c) hvorvidt oppdragsgiver vil inngå en rammeavtale eller et innovasjonspartnerskap eller etablere en dynamisk innkjøpsordning, jf kapittel 21, d) hvordan oppdragsgiver skal gjennomføre konkurransen, inkludert 1. hvilken anskaffelsesprosedyre som er valgt, jf. kapittel 9, 2. hvilke frister som gjelder, jf. kapittel 10, 3. hvilke kvalifikasjonskrav og utvelgelseskriterier leverandørene må oppfylle, jf. kapittel 12, 4. hvilke tildelingskriterier som gjelder, jf. kapittel 13, Side 52 5. krav til kommunikasjon, jf. kapittel 15, og 6. hvorvidt elektroniske verktøy vil bli benyttet, jf. kapittel 22, e) hvilke krav som gjelder for innhold og utforming av forespørsler om å delta i konkurransen eller tilbud, og f) andre opplysninger som er av betydning for utarbeidelsen av forespørsler om å delta i konkurransen eller tilbud. (3) Ved inngåelse av innovasjonspartnerskap skal konkurransegrunnlaget i tillegg inneholde følgende opplysninger: a) beskrivelse av behovet for den innovative varen, tjenesten eller bygge- og anleggsarbeidet og b) hvilke ordninger som gjelder for de immaterielle rettighetene. (4) Opplysningene i konkurransegrunnlaget skal være tilstrekkelig presise til	A competition framework is under development. Demand specifications are under development. Qualification criteria and award criteria are under development, as described for § 5-7.	No deviance.	No measure.

	å sette leverandørene i stand til å identifisere anskaffelsens karakter og omfang og vurdere om de ønsker å delta i konkurransen. (5) Oppdragsgiver har risikoen for uklarheter i konkurransegrunnlaget.			
<b>Kapittel 9. Valg av anskaffelsesprosedyre</b>				
§ 9-1. Tillatte anskaffelsesprosedyrer	(1) Oppdragsgiver kan alltid bruke åpen anbudskonkurranse og begrenset anbudskonkurranse. (2) Oppdragsgiver kan bruke konkurranse med forhandling etter forutgående kunngjøring og konkurransepreget dialog bare når vilkårene i § 9-2 er oppfylt.	The project applies competition with negotiation after preceding announcement and competitive dialogue.	No deviance.	No measure.
§ 9-2. Vilkår for bruk av konkurranse med forhandling etter forutgående kunngjøring og konkurransepreget dialog	Oppdragsgiver kan bruke konkurranse med forhandling etter forutgående kunngjøring og konkurransepreget dialog dersom a) oppdragsgivers behov ikke kan oppfylles uten at det foretas tilpasninger i allerede tilgjengelige løsninger, b) anskaffelsen inkluderer design eller innovative løsninger, c) anskaffelsens karakter, kompleksitet, rettslige eller finansielle sammensetning eller tilknyttede risiko gjør det nødvendig å forhandle, d) oppdragsgiver ikke kan utforme kravspesifikasjonene tilstrekkelig presist ved henvisning til en standard, europeisk teknisk bedømmelse, felles teknisk spesifisering eller teknisk referanse eller e) oppdragsgiver i en forutgående åpen anbudskonkurranse eller begrenset anbudskonkurranse bare mottok uakseptable tilbud.	The project is considered to apply to points a)-d).	No deviance.	No measure.

<b>Kapittel 11. Kravspesifikasjoner</b>				
§ 11-1. Kravspesifikasjoner	(1) Kravspesifikasjonene skal angi de krav som stilles til egenskapene til varene, tjenestene eller bygge- og anleggsarbeidene som oppdragsgiver skal anskaffe. (2) Kravspesifikasjonene skal ha tilknytning til leveransen og stå i forhold til anskaffelsens formål og verdi. De kan vise til alle sider av og trinn i livssyklusen til varene, tjenestene eller bygge- og anleggsarbeidene som kontrakten gjelder, inkludert faktorer som inngår i produksjonsprosessen, leveringen av eller handelen med dem, eller en annen prosess.....	The project plan to have environmental demands included in the demand specifications. An example is the requirement of environmental management system in accordance to ISO 14001 or similar, and environmental competence in the organization.	No deviance.	No measure.
§ 11-4. Testrapporter, attester og annen dokumentasjon	(1) Oppdragsgiver kan kreve at leverandørene fremlegger en testrapport fra et samsvarsvurderingsorgan, eller en attest som er utstedt av et slikt organ, som dokumentasjon for at de tilbudte varene, tjenestene eller bygge- og anleggsarbeidene oppfyller kravspesifikasjonene, tildelingskriteriene eller kontraktsvilkårene. Med samsvarsvurderingsorgan menes et organ som utøver samsvarsvurderingsvirksomhet, inkludert kalibrering, testing, sertifisering og inspeksjon, og som er akkreditert etter EØS-vareloven § 2.	This is not planned demanded for environmental demand specifications. It is not known if this is demanded for other functions.	No deviance.	No measure.
<b>Kapittel 12. Kvalifikasjonskrav og utvelgelse av leverandører</b>				
§ 12-6. Dokumentasjon for leverandørens tekniske og faglige kvalifikasjoner	(1) Som dokumentasjon for leverandørens tekniske og faglige kvalifikasjoner kan oppdragsgiver bare kreve følgende dokumenter:.. h) en beskrivelse av miljøledelsestiltak;	Not known which documents Jernbaneverket will demand.	No deviance.	No measure.

<p>§ 12-7. Kvalitetssikringsstandarder og miljøledelsesstandarder</p>	<p>(2) Oppdragsgiver kan kreve fremlagt sertifikater utstedt av uavhengige organer som dokumentasjon for at leverandøren oppfyller visse miljøledelsessystemer eller -standarder. Oppdragsgiver skal vise til EU-ordningen for miljøstyring og miljørevisjon (EMAS), andre anerkjente miljøledelsessystemer i forordning nr. 1221/2009 artikkel 45 eller andre miljøledelsesstandarder basert på relevante europeiske eller internasjonale standarder fra akkrediterte organer. Oppdragsgiver skal godta tilsvarende sertifikater utstedt av organer i andre EØS-stater.</p> <p>(3) Oppdragsgiver skal godta annen dokumentasjon for tilsvarende kvalitetssikringstiltak eller miljøledelsestiltak dersom leverandøren ikke har mulighet til å få slike sertifikater innen fristen og dette ikke skyldes leverandøren selv. Dette forutsetter at leverandøren dokumenterer at disse tiltakene tilsvarer de etterspurte kvalitetssikringsstandardene eller miljøledelsessystemene eller -standardene.</p>	<p>An environmental management system in accordance to ISO 14001 or similar will be demanded, but it is not known if documentation will be demanded for this.</p>	<p>No deviance.</p>	<p>No measure.</p>
<p><b>Kapittel 13. Tildelingskriterier</b></p>				
<p>§ 13-1. Tildelingskriterier</p>	<p>3) Ved valg av tilbud på grunnlag av beste forhold mellom pris og kvalitet skal oppdragsgiver fastsette tildelingskriterier som har tilknytning til leveransen. Tildelingskriteriene har tilknytning til leveransen når de relaterer seg til varene, tjenestene eller bygge- og anleggsarbeidene som kontrakten gjelder. Dette omfatter alle sider av og trinn i deres livssyklus, inkludert faktorer som inngår i</p>	<p>There is made a draft for award criteria related to environmental aspects.</p>	<p>No deviance.</p>	<p>No measure.</p>

	<p>produksjonsprosessen, leveringen av eller handelen med dem eller en annen prosess i livssyklusen. Dette gjelder også når slike faktorer ikke påvirker deres egenskaper. (4) Tildelingskriterier som nevnt i tredje ledd kan gjelde kvalitative, miljømessige og sosiale sider ved tilbudene, i tillegg til enten pris eller kostnad. Slike kriterier kan for eksempel være</p> <p>a) kvalitet, inkludert tekniske, estetiske og funksjonelle egenskaper, tilgjengelighet, universell utforming og miljømessige, sosiale og innovative egenskaper,</p>			
<p>§ 13-2. Beregning av livssyklus kostnader</p>	<p>(1) Hvis oppdragsgiver skal beregne livssyklus kostnadene ved varene, tjenestene eller bygge- og anleggsarbeidene, skal han angi i anskaffelsesdokumentene hvilke opplysninger leverandørene skal gi, og hvilken beregningsmetode han skal bruke.</p> <p>(2) I beregningen av livssyklus kostnadene skal alle eller noen av følgende kostnader inngå så langt de er relevante:</p> <p>...</p> <p>b) kostnader som skyldes miljøbelastninger knyttet til varene, tjenestene eller bygge- og anleggsarbeidene gjennom livssyklusen, inkludert kostnader ved utslipp av klimagasser og andre forurensende utslipp og andre klimatiltakskostnader. Dette gjelder bare hvis verdien kan tallfestes og etterprøves.</p>	<p>Not known.</p>	<p>No deviance.</p>	<p>No measure.</p>

## Appendix H: Draft of demand specification for EPDs

For følgende materialer/produkter som brukes i prosjektet må tilhørende CO<sub>2</sub>-utslipp for ulike faser i livsløpet og bruk av sekundærmaterialer/resirkulerte materialer ved produksjonen dokumenteres av en tredjepartsverifisert EPD (Environmental Product Declaration i henhold til EN 15804) (Selsbak, 2016a):

Material	Produkt	Bruksområde	PCR for produkttypen (som beskriver hvordan produktspesifikk EPD utarbeides)	Sanksjoner
Stål	Armeringsstål	Stål til armering av fundamenter i master til kontaktledningsanlegget	EN 15804:2012+A1:2013 tjener som kjerne-PCR. PCR for byggeprodukter og byggetjenester: PCR 2012:01, v. 2.0	Dersom ikke-godkjente produkter benyttes, må entreprenøren betale et gebyr på ??? kr per fundament.
Stål	Konstruksjonsstål	Stål i master i kontaktledningsanlegget	EN 15804:2012+A1:2013 tjener som kjerne-PCR. PCR for stål som konstruksjonsmateriale: NPCR 013, v. 2.0	Dersom ikke-godkjente produkter
Betong	Ferdig betong	Betong i fundamenter i master til kontaktledningsanlegget	EN 15804:2012+A1:2013 tjener som kjerne-PCR. PCR for betongelementer: NPCR 020, v. 1.0 (det finnes ikke noen spesifikk PCR for ferdig betong)	Dersom ikke-godkjente produkter benyttes, må entreprenøren betale et gebyr på ??? kr per fundament.
Betong	Prefabrikerte betongelementer	Betongelementer i profilutvidelser under overgangsbruer	EN 15804:2012+A1:2013 tjener som kjerne-PCR. PCR for betongelementer: NPCR 020, v. 1.0	Dersom ikke-godkjente produkter benyttes, må entreprenøren betale et gebyr på ??? kr per m <sup>3</sup> betong.



# Appendix I: Draft of environmental award criteria for contractor

(Selsbak, 2016d)

## Tildelingskriterier KI/AT. Skisse

Har tatt utgangspunkt i NTP sine etappemål for ytre miljø: Klima -ren luft/støv- støy- naturmangfold. Dette er mål som også er reflektert i prosjektets miljøprogram og miljøbudsjett, samt at de også er JBV's egne miljøindikatorer som vi rapporterer på. Denne skissen har som utgangspunkt at tilbyder skal levere en systembeskrivelse som svarer ut temaene (noen eller alle?) som er beskrevet under, og at det skal være fokus på entreprenørens helhetlige løsning for miljøledelse (temaene griper noe inn i hverandre). Da det har vist seg vanskelig å sette opp konkrete og målbare indikatorer på ytre miljø (ved å måle/kontrollere) på CO2-utslipp bør det gjøres en skjønnsmessig vurdering av forslagene. Vi har ingen fastsatte mål/ tak på hvor mange tonn CO2 vi ønsker at anleggsvirksomheten skal holde seg under. Dersom vi innfører en månedlig rapportering, og rapportering på årsresultat kan prosjektet bruke disse tallene som datainnsamling på CO2 som senere kan benyttes i Jernbaneverkets prosjekter som sammenlikningsgrunnlag/referansepunkt. Som forslag til bonussystem på CO2-utslipp kan entreprenøren beskrive i sin redegjørelse hvilke grep han ønsker å ta gjennom prosjektperioden for å redusere utslipp. (For eksempel ved anskaffelse av nye maskiner el), det vil si de stipulerer et maks-utslipp gjennom prosjektet- og hvis de går under dette til slutt i regnskapet kan det utløse en bonus. Mulkt kan evt utløses ved manglende miljørapportering innen frist (har ikke tatt stilling til rapporteringens innhold her nå) eller antall avvik i forhold til egen miljøbeskrivelse.

MILJØTEMA	Beskrivelse	Kommentar	Kontrolleres ved
<b>KLIMA/ CO2-avtrykk</b>			
<b>CO2-budsjett</b>	Budsjettering av eget CO2-avtrykk gjennom prosjektperioden. Dette kan være flyreiser, utslipp fra anleggsmaskiner og øvrig transport. (Vi bør da stille med en miljøkalkulator)	Vanskelig for oss å vite om tallene ligger høyt eller lavt. Har vil noe å måle mot?	Sluttregnskapet for ytre miljø. For kalkulator se eksempel neste arkfane, klimakalkulator hentet fra miljøfyrtårn
<b>Skissere potensiell reduksjon av CO2-avtrykk gjennom prosjektperioden</b>	Leverandøren tar utgangspunkt i nåsituasjon når beregner CO2-avtrykk. Vi ønsker å oppfordre dem til å være innovative i sitt miljøarbeid. De kan beskrive hvordan de planlegger redusere CO2-avtrykket sitt gjennom prosjektet i forhold til eget budsjett (evt etappemål?). Reduksjon i CO2-avtrykk skal da komme frem i det totale CO2-regnskapet til slutt, og kan da utløse bonus. Transport og logistikk-løsninger kan f.eks. være momenter her, plassering av riggområder, korteste materialer osv.	Vi kan utforme rapporteringsmål på ytre miljø slik at tallene kan benyttes som datainnsamling for utslipp, noe som kan være av verdi for Jernbaneverket i andre sammenhenger.	Sluttregnskapet for ytre miljø samt månedlig: Entreprenør rapporterer dieselforbruk, flyreiser osv. månedlig

<b>Støv</b>	Løsninger (for eksempel anskaffelse av utstyr) som demper støvplager. Håndtering av svevestøvproblematikk ved generelt anleggsarbeid/vegtransport og boring av hull. Støvflukt begrenses mest mulig	Differensiering av områder. Ikke så aktuelt ute i periferien, men spesielt i de sentrumsnære områdene hvor det i utgangspunktet er støvproblematikk. Stasjonsområder.	Skal ikke forekomme klager fra naboer/3-person. Støvmåling/stikkprøver? Inspeksjon; påse at entreprenør bruker utstyr som spesifisert
<b>Støy</b>	Beskrive hvordan den foreslåtte løsningen også ivaretar støyproblematikk. Hvilke type maskiner skal brukes og evt anskaffelse av støysvake maskiner	Unngå nattarbeid på enkelte strekninger. Friluftsområder kan være utfordring	Støymåling/stikkprøver?
<b>Naturmangfold</b>		Planlegging av gode riggområder kan være viktig i flere sammenhenger; i forhold til transport, logistikk, gunstigst mulig ift 3.person, det visuelle (viktig for JBVs rennommé). Områder/hensynssoner	
<b>Riggområder-natur</b>	Beskrivelse av hvordan og hvor riggområder skal etableres for å redusere inngrep i natur eller dyrka mark (inngrep i form av forandret arealbruk-også midlertidig). Oppfølging av eventuelle nyplantinger?	MOP (marksikringsplan) vil inneholde kart som viser sårbare områder ift vegetasjon, artsmangfold osv.	Inspeksjon. Kvalitet på reetablering av område etter endt arbeid. Maks-størrelse på riggområdene
<b>Riggområder-visuelt</b>	Hvordan kan entreprenøren på best mulig måte finne et område som også kan utformes godt ift visuelt miljø. For eksempel ryddighet fremfor skjermes, hensyn til omkringliggende landskap for plassering av utstyr osv. Lage illustrasjonsplan	Også viktig med gode og ryddige riggområder sett med hensyn til SHA.	Inspeksjon. Kvalitet på reetablering av område etter endt arbeid

# Appendix J: Control plan for the project

(Bygd, 2016)

Fag	Planfase	Beskrivelse av aktivitet	Kravreferanse	Kontrollansvarlig	Utførende	Kontrolltype	Kontrollmåte	Hyppighet/omfang	Dokumenttype	Resultat dokumentasjon verifikasjon	Resultat	Merknad	Kontroll	Utført
SHA	Detaljplan	Godkjent enkel risikovurdering	BHF § 5	Prosjektleder	SHA-rådgiver	A	Sc	En gang	Risikovurderingsrapport	Utført, må ha Dok.nr.				
SHA	Detaljplan	Godkjent SHA-plan	STY-601652	Prosjektleder	SHA-rådgiver	A	Sk	En gang	Plandokument					
SHA	Detaljplan	Inngått avtale med byggherres representant og KP	STY-601652	Prosjektleder	SHA-rådgiver	A	E	En gang	Avtale					
SHA	Byggeplan	Inngått avtale med byggherres representant, KP og KU	STY-601652	Prosjektleder	SHA-rådgiver	A	E	En gang	Avtale					
SHA	Byggeplan	Godkjent SHA-plan	STY-601652	Prosjektleder	SHA-rådgiver	A	Sk	En gang	Plandokument					
SHA	Byggeplan	Godkjent risikovurdering SHA	STY-601652	Prosjektleder	SHA-rådgiver	A	Sk	En gang	Risikovurderingsrapport					
SHA	Detaljplan	Godkjent risikovurdering SHA	STY-601652	Prosjektleder	SHA-rådgiver	A	Sk	En gang	Risikovurderingsrapport					
Ytre miljø	Detaljplan	Godkjent avfallsplan	STY-601325	Prosjektleder	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Detaljplan	Godkjent miljøsaneringsbeskrivelse	STY-601325	Prosjektleder	Miljørådgiver	A	Sk	En gang	Rapport	Ikke relevant				?

Ytre miljø	Detaljplan	Godkjent miljøoppfølgingsplan	STY-603046 STY-603096	Prosjektleder	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Detaljplan	Godkjent tiltaksplan basert på miljøteknisk grunnundersøkelse	STY-602964	Kommune	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Detaljplan	Dokumentert støykartlegging	Forurensingsforskriften, T-1442	Prosjektleder	Miljørådgiver	A	E	En gang	Rapport					
Ytre miljø	Detaljplan	Godkjent risikovurdering, tema ytre miljø	STY-603046 STY-603169	Prosjektleder	Miljørådgiver	A	E	En gang	Risikovurderingsrapport			Følge opp rådgiver		
Ytre miljø	Detaljplan / byggeplan	Sjekkliste for ytre miljø	STY-603448	Prosjektleder	Miljørådgiver	A	E	En gang	Sjekkliste					
Ytre miljø	Byggeplan	Tillatelse fra kommune vedrørende støy	STY-601322	Kommune	Miljørådgiver	A	E	En gang	Brev					
Ytre miljø	Byggeplan	Godkjent utslippstillatelse	Forurensingsloven § 11.	Kommune	Miljørådgiver	A	E/prod	En gang	Brev					
Ytre miljø	Byggeplan	Godkjent avfallsplan	STY-601325	Prosjektleder	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Byggeplan	Godkjent tiltaksplan basert på miljøteknisk grunnundersøkelse	STY-602964	Kommune	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Byggeplan	Godkjent miljøoppfølgingsplan	STY-603046 STY-603096	Prosjektleder	Miljørådgiver	A	Sk	En gang	Plandokument					
Ytre miljø	Byggeplan	Godkjent risikovurdering, tema ytre miljø	STY-603046 STY-603169	Prosjektleder	Miljørådgiver	A	E	En gang	Risikovurderingsrapport					

## Appendix K: Difi -Suggestions for environmental demands construction projects

The appendix contains suggested 1) qualification requirements, 2) award criteria, and 3) requirements specifications for use of public procurement in construction (Difi, 2015).

### Qualification requirements (Difi, 2015)

Krav	Dokumentasjon	Kommentar
<p><b>Basis:</b></p> <p>Det kreves at entreprenøren har et miljøledelsessystem<sup>1</sup> som styrer hvordan virksomheten ivaretar relevante miljøhensyn knyttet til leverandørs aktiviteter, produkter og tjenester.</p>	<p>Skriftlig dokumentasjon:</p> <p>Entreprenøren skal levere en &lt;x sider&gt; beskrivelse av sitt miljøledelsessystem inkludert beskrivelse av bedriftens miljøpolicy, miljømål og årlig miljøhandlingsplan/ Miljøforbedringsprogram, rapportering og oppfølging av uønskede miljøhendelser.</p>	<p>Dette er krav til et miljøledelsessystem som ikke følger noen bestemt standard.</p> <p>Miljøledelse er ofte en del av kvalitetssystemet. Forklaring av begreper og definisjoner finnes i ISO 14001, NS 3466.</p>
<p><b>Proaktivt:</b></p> <p>Det kreves at entreprenøren har et miljøledelsessystem<sup>2</sup> som oppfyller kravene i Miljøfyrtårn iht. aktuelle bransjekrav, eller oppfyller tilsvarende krav.</p>	<p>Skriftlig dokumentasjon:</p> <p>Entreprenøren skal vedlegge gyldig sertifikat.</p> <p>ELLER</p> <p>Entreprenøren skal levere en &lt;x sider&gt; beskrivelse av sitt miljøledelsessystem som forklarer hvordan det oppfyller kravene i Miljøfyrtårn.</p>	<p>Dette er krav til et miljøledelsessystem som følger standarden til Miljøfyrtårn. Kravet innebærer at systemet enten må være tredjeparts verifisert (dvs. at man har et gyldig sertifikat) eller at entreprenør kan dokumentere på annen måte at kravene i Miljøfyrtårn er oppfylt.</p> <p>Miljøfyrtårn er en nasjonal sertifiseringsordning for små og mellomstore bedrifter.</p>
<p><b>Kompetanse</b></p>		
<p><b>Basis:</b> Entreprenøren skal ha relevant erfaring fra å ivareta følgende miljøtema i utbyggingsprosjekter &lt;plukk miljøtemaene som er viktigst for prosjektet og presiser innhold&gt;:</p> <ul style="list-style-type: none"> <li>• Miljøstyring</li> <li>• Naturmiljø             <ul style="list-style-type: none"> <li>○ Natur- og nærmiljø</li> </ul> </li> <li>• Forurensning             <ul style="list-style-type: none"> <li>○ Utslipp til luft</li> <li>○ Utslipp til grunn og vann</li> </ul> </li> </ul>	<p>Skriftlig dokumentasjon:</p> <p>Entreprenøren skal levere en kort beskrivelse &lt;ikke mer enn x sider&gt; av hvordan miljøhensyn ble ivaretatt i &lt;angi antall&gt; relevante referanseprosjekter bedriften har utført de siste &lt;angi tidsperiode&gt; årene.</p> <p>ELLER</p> <p>Entreprenøren skal levere en kort beskrivelse &lt;ikke mer enn x sider&gt; av hvordan miljøhensyn ble ivaretatt i &lt;angi antall&gt; relevante referanseprosjekter bedriften har utført de</p>	<p>Her etterspørres kun en beskrivelse av referanseprosjekter</p> <p>Her etterspørres beskrivelse av referanseprosjekter og kontaktpersoner. Dette er mer krevende å følge opp i en</p>

<ul style="list-style-type: none"> <li>○ <i>Støy, støv og vibrasjoner</i></li> <li>○ <i>Belysning</i></li> <li>• <i>Ressursbruk</i> <ul style="list-style-type: none"> <li>○ <i>Energieffektivisering</i></li> <li>○ <i>Material- og produktvalg</i></li> </ul> </li> </ul> <p><i>Avfallsminimering- og håndtering</i></p>	<p>siste <i>&lt;angi tidsperiode&gt;</i> årene. Oppdragsgivers kontaktperson(er) og telefonnummer skal angis.</p>	<p>evaluering, men i noen prosjekter kan innkjøper ønske å sjekke referanser.</p> <p>Det kan være nyttig å legge ved en mal som tilbyder skal benytte til å beskrive sine referanseprosjekter.</p>
<p><b>Proaktivt</b> Entreprenøren skal ha relevant erfaring fra å ivareta miljøaspekter i utbyggingsprosjekter.</p> <p style="text-align: center;">OG</p> <p>Entreprenørens tilbudte organisasjon skal inkludere personell med relevant utdanning og/eller erfaring til å kunne utføre miljøriktig entreprisearbeid i tilknytning til anlegg, herunder innen <i>&lt;plukk miljøtemaene som er viktigst for prosjektet&gt;</i>:</p> <ul style="list-style-type: none"> <li>• <i>Miljøstyring</i></li> <li>• <i>Naturmiljø</i> <ul style="list-style-type: none"> <li>○ <i>Natur- og nærmiljø</i></li> </ul> </li> <li>• <i>Forurensning</i> <ul style="list-style-type: none"> <li>○ <i>Utslipp til luft</i></li> <li>○ <i>Utslipp til grunn og vann</i></li> <li>○ <i>Støy, støv og vibrasjoner</i></li> <li>○ <i>Belysning</i></li> </ul> </li> <li>• <i>Ressursbruk</i> <ul style="list-style-type: none"> <li>○ <i>Energieffektivisering</i></li> <li>○ <i>Material- og produktvalg</i></li> <li>○ <i>Avfallsminimering- og håndtering</i></li> </ul> </li> </ul>	<p>Skriftlig dokumentasjon: Entreprenøren skal levere en kort beskrivelse <i>&lt;ikke mer enn x sider&gt;</i> av hvordan miljøhensyn ble ivaretatt i <i>&lt;angi antall&gt;</i> relevante referanseprosjekter bedriften har utført de siste <i>&lt;angi tidsperiode&gt;</i> årene.</p> <p>ELLER</p> <p>Entreprenøren skal levere en kort beskrivelse <i>&lt;ikke mer enn x sider&gt;</i> av hvordan miljøhensyn ble ivaretatt i <i>&lt;angi antall&gt;</i> relevante referanseprosjekter bedriften har utført de siste <i>&lt;angi tidsperiode&gt;</i> årene. Oppdragsgivers kontaktperson(er) og telefonnummer skal angis.</p> <p>Entreprenøren skal levere CV-er eller lignende for tilbudt personell som dokumenterer deres utdanning og/eller erfaring innen relevante miljøtemaer.</p>	<p>Her etterspørres kun en beskrivelse av referanseprosjekter</p> <p>Det kan være nyttig å legge ved en mal som tilbyder skal benytte til å beskrive sine referanseprosjekter.</p> <p>Her etterspørres beskrivelse av referanseprosjekter og kontaktpersoner. Dette er mer krevende å følge opp i en evaluering, men i noen prosjekter kan innkjøper ønske å sjekke referanser.</p> <p>Det er også mulig å stille krav til miljøkompetanse hos nøkkelpersoner i prosjektet, eksempelvis prosjektleder.</p> <p>Relevant utdanning kan for eksempel være fagbrev.</p>

## Award criteria

I entrepriser vil det som hovedregel ikke være lovlig å benytte kompetanse som tildelingskriterium.

Ved totalentreprise, hvor entreprenør skal beskrive løsninger inkludert hvordan miljøaspektene ivaretas, kan kvaliteten av tilbudte løsninger brukes som et tildelingskriterium.

Innkjøper må selv sette opp en vektingsmodell for å evaluere tildelingskriteriene. (Difi, 2015)

<b>Tildelingskriterier (aktuelt ved totalentreprise)</b>	<b>Dokumentasjon</b>	<b>Kommentar</b>
<p>Kvalitet på miljøhensyn i tilbudte løsninger herunder &lt;plukk miljøtemaene som er viktigst for prosjektet&gt;:</p> <ul style="list-style-type: none"><li>• Miljøstyring</li><li>• Naturmiljø<ul style="list-style-type: none"><li>○ Natur- og nærmiljø</li></ul></li><li>• Forurensning<ul style="list-style-type: none"><li>○ Utslipp til luft</li><li>○ Utslipp til grunn og vann</li><li>○ Støy, støv og vibrasjoner</li><li>○ Belysning</li></ul></li><li>• Ressursbruk<ul style="list-style-type: none"><li>○ Energieffektivisering</li><li>○ Material- og produktvalg</li><li>○ Avfallsminimering- og håndtering</li></ul></li></ul> <p><b>(Kun aktuelt for totalentreprise)</b></p>	<p>Entreprenøren skal gi en beskrivelsestekst &lt;ikke mer enn x sider&gt; hvor det redegjøres for hvordan tilbudte løsninger ivaretar relevante miljøaspekter.</p>	<p>Dette punktet kan benyttes som plukklister til å spesifisere nødvendig kvalitet i tjenestene for å ivareta de viktigste miljøaspektene</p> <p>Presisering av miljøtemaene finnes i bakgrunnsrapporten og videre i kriteriesettet.</p>

## Kravspesifikasjon

Tabellen under er en plukkliste med forslag til krav som kan inngå i en kravspesifikasjon. Innkjøper må vurdere hvilke miljøkrav som er aktuelle for hvert prosjekt. Innkjøper må videre sørge for at kravene er tilpasset de oppgavene som er tillagt entreprenøren i den aktuelle kontrakten. (Difi, 2015)

Plukklisten er delt inn i to kategorier:

- Krav til hvordan entreprenøren gjennomfører arbeidene (byggeprosessen)
- Krav til anlegget, eller den del av anlegget som entreprenøren skal levere (sluttproduktet)

Det er medtatt noen lovkrav i tabellen under og det angis i kommentarfeltet hvilke som er lovpålagte. Hensikten er å bidra til at kravene ikke glemmes - erfaringsmessig kan krav utebli selv om de er lovpålagte. Det er viktig å få med lovkravene for ivareta miljøet. (Difi, 2015)

I kommentarfeltene i tabellen under er det henvist til NS3420 Beskrivelsestekst for bygg, anlegg og installasjoner, der standarden har aktuelle poster eller kapitler. Statens vegvesens håndbøker nr. 025 ”Prosesskode 1 – Standard beskrivelsestekster for vegkontrakter” og nr. 026 ”Prosesskode 2 – Standard beskrivelsestekster for bruer og kaier” kan også brukes til standard arbeidsbeskrivelse og eventuelle spesielle beskrivelser, men prosesskoder er ikke tatt med i tabellen under. (Difi, 2015)

Krav	Kommentar
<b>Krav til byggeprosessen</b>	
<i>Miljøstyring</i>	
- Entreprenøren skal utpeke en miljøansvarlig som skal ha det daglige ansvaret for miljøarbeidet og se til at det blir utført i henhold til krav og beskrevne rutiner og prosedyrer.	<b>Proaktivt krav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i>  Tilpasses kontraktens størrelse og kompleksitet. Det kan stilles krav til egen miljøansvarlig med miljøfaglig kompetanse, eller at prosjektleder, HMS-leder eller tilsvarende kan være byggherrens kontaktperson ved miljøspørsmål, rapportering og oppfølging i prosjektet. Navngitt person med kontaktinformasjon.



Krav	Kommentar
<p>- Entreprenøren skal innen &lt;angi antall uker&gt; etter kontraktsinngåelse levere en prosjektilpasset miljøoppfølgingsplan til Byggherren. Planen skal dokumentere hvordan byggherrens miljømål og -krav skal ivaretas gjennom:</p> <ul style="list-style-type: none"> <li>o referanse til de aktuelle kravene</li> <li>o referanse til prosedyre eller lignende for gjennomføring av aktivitetene</li> <li>o referanse til dokumentasjon av at kravene er oppfylt</li> <li>o utpeke hvem som er ansvarlig for aktiviteten og for å kontrollere at kravene er oppfylt</li> </ul> <p>Planen skal omfatte så vel entreprenørens egne aktiviteter som aktiviteter utført av underentreprenører og leverandører.</p> <p>Miljøoppfølgingsplanen kan være en del av entreprenørens internkontroll- eller kvalitetsstyringssystem, innarbeides i SHA-plan, kontrollplan e.l.</p>	<p><b>Proaktivt krav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Dette bør prises i egen post.</i></p> <p>Byggherren utarbeider miljøprogram tilpasset prosjektets kompleksitet og størrelse, se NS 3466. Entreprenøren er ansvarlig for å kvalitetssikre egne systemer / planer mot byggherrens krav i utførelsen og revidere ved behov.</p> <p>For mindre bedrifter kan det være aktuelt for bestiller å tipse om hjelpemidler som bransjen har utarbeidet. Byggemiljø har utarbeidet miljørutiner som kan benyttes i internkontrollsystem for å tilfredsstille lover, krav og målsetninger. Miljørutinene tar for seg temaene avfall, substitusjon, støy og rystelser, forurenset grunn, anleggsgfyllplasser, håndtering av miljøfarlige stoffer på byggeplass, radon og støv. Rutinene er generelle og bør tilpasses den enkeltes bedrifts systemer.  <a href="http://www.byggemiljo.no/article.php?articleID=860&amp;categoryID=6">http://www.byggemiljo.no/article.php?articleID=860&amp;categoryID=6</a></p>
<p>- Entreprenør skal gjennomføre &lt;oppstartsmøte / introduksjonskurs&gt; for personell i prosjektet, inkl. innleide og enkeltmannsforetak, hvor også prosjektets miljømål, -krav og -risikomomenter gjennomgås.</p>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Ytre miljø kan inkluderes som en del av HMS-introduksjonskurs. Dersom det er nødvendig med egen miljøopplæring, må det spesifiseres hva som kreves og prises som egen post. Dette tilpasses prosjektets kompleksitet og størrelse.</p>
<p>- I prosjektet skal det gjennomføres risikovurderinger som omfatter miljøforhold. Hvilke vurderinger som er gjort skal kunne fremlegges skriftlig.</p>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Dette er et Lovkrav i Internkontrollforskriften men man må passe på at miljø tas med.</p>
<p>- Entreprenørens beredskapsplan skal inkludere varsling og håndtering av uønskede miljøhendelser og forurensning. Planen skal beskrive forebyggende tiltak, samt tiltak for å begrense skadevirkninger hvis en uønsket miljøhendelse skulle oppstå. Planen skal være gjort kjent blant alle arbeidstakere / enkeltmannsforetak og alle skal vite hvor beredskapsmateriell er oppbevart.</p> <p>- Utslipp og andre uønskede miljøhendelser skal registreres og rapporteres i prosjektets avvikssystem.</p>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Dersom det er nødvendig med egen beredskapsøvelser for forurensning, må det spesifiseres hva som kreves. Dette tilpasses prosjektets kompleksitet og størrelse og prises som egen post.</p>

Krav	Kommentar
<p>- Vernerunder skal omfatte miljøforhold. Som et minimum skal miljøforhold omfatte &lt;stryk det som ikke er relevant for prosjektet&gt;:</p> <ul style="list-style-type: none"> <li>○ Avfallshåndtering og kildesortering</li> <li>○ Lagring og håndtering av helse- og miljøfarlige stoffer</li> <li>○ Rensing av vann før utslipp</li> <li>○ Støysikring</li> <li>○ Støvsikring</li> <li>○ Beredskapsutstyr</li> <li>○ Avvikshåndtering av miljøavvik og uønskede miljøhendelser</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Hvor ofte verne-/miljøunder går tilpasses kontraktens størrelse. Entreprenør kan innarbeide miljøforhold i egne sjekklister / verneundeprotokoller.</p>
<p>- Entreprenøren skal føre &lt;månedlig / kvartalsvis&gt; miljøregnskap (dvs statistikk) for prosjektet som omfatter følgende miljødata &lt;velg det som er relevant&gt;:</p> <ul style="list-style-type: none"> <li>○ Antall uønskede miljøhendelser / avvik i perioden [antall og kort beskrivelse av status (registrert, lukket)]</li> <li>○ Drivstofforbruk [liter diesel, liter bensin, liter biodiesel]</li> <li>○ Energiforbruk [kWh]</li> <li>○ Avfallsmengder og kildesorteringsgrad [kg pr avfallstype] og [% sortert / totalt avfall]</li> <li>○ Antall miljømerkede produkter i bruk på prosjektet [antall med Svanemerke, EU-blomst, eller tilsvarende]</li> <li>○ Antall miljøfarlige produkter i bruk på prosjektet [antall merket miljøfarlig]</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Miljø bør følges opp gjennom månedsrapportering for prosjektet for å sikre fokus på ytre miljø, på samme måte som helse og sikkerhet følges opp gjennom sykefravær og annen SHA-statistikk (H-verdi osv).</p> <p>Bestiller angir hva miljøregnskapet som minimum skal omfatte. F. eks. månedlig statistikk basert på de viktigste miljøaspektene fra prosjektets miljøprogram. Det må være målbart og mulig å samle inndata:</p> <ul style="list-style-type: none"> <li>- Uønskede miljøhendelser / avvik registreres i eksisterende avvikssystem</li> <li>- Drivstoffmengder kan fås fra drivstoffleverandør og er interessant ift kommunenes Klimaplaner</li> <li>- Energiforbruk kan fås fra måler eller fra leverandør og er interessant ift kommunenes Klimaplaner</li> <li>- Avfallsstatistikk leveres av avfallsfirma / mottak</li> <li>- Miljømerkede og miljøfarlige produkter i bruk kan hentes ut fra prosjektets stoffkartotek</li> </ul> <p>Evaluering og oppsummering av prosjektet med hensyn til miljø bør gjennomføres ved avslutning av kontrakten, inkludert oppsummering av miljøregnskapet. Dette danner grunnlaget for referansen entreprenøren får i forhold til miljøriktig gjennomføring prosjektet, samt Byggherrens måloppnåelse f.eks ift Klimaplaner.</p>

Krav	Kommentar
<b>Naturmiljø</b>	
<i>Natur- og nærmiljø</i>	
<ul style="list-style-type: none"> <li>- Entreprenør skal gjøre seg kjent med verneområder og vernede planter i anleggsområdet eller i direkte tilknytning til anleggsområdet, og er ansvarlig for sikring av anlegget, inklusive gjerder.</li> <li>- Oversikt over verneområder/vernede elementer med vernebestemmelser er vist i &lt;angi vedlegg som er utarbeidet av byggherren&gt;.</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass ELLER ifm. aktuelt arbeid (eksempelvis inngjerding/beskyttelse av trær, merking/avgrensning av vernede områder).</i></p> <p>Dersom områder er vernet etter Naturmangfoldloven er dette et lovkrav</p>
<ul style="list-style-type: none"> <li>- Entreprenøren skal planlegge og koordinere anleggsarbeidene inkl. transport og massehåndtering på en slik måte at belastningen på nærmiljøet minimeres</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p>
<ul style="list-style-type: none"> <li>- Plassering av lys i anleggsområdet må planlegges med tanke på omgivelsene slik at naboer skjerms fra sjenerende lys i anleggsperioden, spesielt kveld/natt</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p>
<ul style="list-style-type: none"> <li>- Anleggskjøretøyer skal holde seg til definerte veier for anleggstrafikk for å unngå unødige sår i naturen. Områder som er påvirket av anleggsarbeidene skal settes i stand etter endt anleggsdrift</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p>
<ul style="list-style-type: none"> <li>- På grunn av viktige lokale fiskestammer skal det i gytetiden eller umiddelbart før gytetiden, &lt;dvs fra ...til...&gt; ikke utføres arbeid som kan påvirke vannkvaliteten i vesentlig grad på &lt;angi steder/strekninger&gt;</li> <li>- På grunn av viktige lokale fuglearter skal det i hekketiden, &lt;dvs fra ...til...&gt; ikke utføres arbeid som kan påvirke fuglene i vesentlig grad på &lt;angi steder/strekninger&gt;</li> </ul>	<p><b>Basiskrav</b>  <i>Prises ifm. aktuelt arbeid (for eksempel graving eller sprengning). Krav må også angis under krav til fremdrift.</i></p> <p>Lovkrav</p>

Krav	Kommentar
<ul style="list-style-type: none"> <li>- Vassdrag som er smittet av <i>Gyrodactylus salaris</i>, krepspest eller annen smitte, er opplistet i <i>&lt;angi vedlegg (utarbeides av byggherren)&gt;</i>. Vann fra disse vassdragene og/eller utstyr som kan overføre smitte derfra, skal ikke brukes ved gjennomføring av anleggsarbeidet</li> </ul> <p style="text-align: center;">ELLER</p> <ul style="list-style-type: none"> <li>- Det skal kun brukes vann fra offentlig godkjent vannverk/tappedsted ved gjennomføring av anleggsarbeidet</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Lakseparasitten <i>Gyrodactylus salaris</i> kan spres med utstyr og vann fra smittede vassdrag og anlegg. Se brosjyre for smittede elver og annen info:  <a href="http://www.mattilsynet.no/publikasjoner/brosjyrer/slik_hindrer_du_spredning_av_gyrodactylus_salaris_11672">http://www.mattilsynet.no/publikasjoner/brosjyrer/slik_hindrer_du_spredning_av_gyrodactylus_salaris_11672</a></p>
<ul style="list-style-type: none"> <li>- Spredning av høy risiko planter nevnt på Norsk svarteliste 2007 skal forhindres ved å unngå spredning av jord og plantemateriale og ved å slå før frøspredning. Kjente problemsteder/-strekninger og plantesorter er oppgitt i <i>&lt;angi vedlegg (utarbeides av byggherren)&gt;</i></li> <li>- Der det er registrert forekomster av kjempebjørnekjeks / tromsøpalme skal byggherrens rutiner for håndtering følges</li> </ul>	<p><b>Basiskrav</b>  <i>Prises ifm. aktuelt arbeid (for eksempel markkrydding).</i>  Mer informasjon om Norsk svarteliste finnes her (høyrisikoplanter er listet på s. 78):  <a href="http://www.artsdatabanken.no/artArticle.aspx?m=172&amp;amid=2581">http://www.artsdatabanken.no/artArticle.aspx?m=172&amp;amid=2581</a></p> <p>Krever at Byggherren har prosedyrer (f.eks kommunale instruksjoner)</p>
<ul style="list-style-type: none"> <li>- Ved skade på vernede trær som medfører at treet/trærne dør, skal entreprenør betale <i>&lt;angi bot kr ..., -&gt;</i> per tre</li> </ul>	<p><b>Proaktivt</b>  Vurder bot/sanksjoner i forhold til verneverdien på trær.</p> <p>Trær/vegetasjon kan ønskes beholdt av byggherren. Ellers kan dette være et lovkrav hvis trær/vegetasjon er vernet av Naturmangfoldloven.</p>
<b>Forurensning</b>	
<i>Utslipp til luft</i>	
<ul style="list-style-type: none"> <li>- Maskinførere og sjåfører som arbeider på prosjektet skal ha gjennomført kurs i økonomisk kjøring som et tiltak for å redusere drivstofforbruk og tilhørende utslipp</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Bør prises i egen post.</i></p> <p>Før kravet stilles bør bestiller undersøke om ”økokjøringskurs” er tilgjengelig i området, evt. fra kjøretøy-/maskinleverandører.</p>

Krav	Kommentar
<ul style="list-style-type: none"> <li>- Biler og lette kjøretøy (&lt;3,5 tonn) som skal benyttes &lt;angi evt. begrensning, f.eks til persontransport&gt; i prosjektet må som minimum oppfylle Eurokrav &lt;angi nivå, f.eks 4 eller 5&gt;</li> <li>- Tunge kjøretøy som skal benyttes &lt;angi evt. begrensning, f.eks til brøytebiler i bystrøk&gt; i prosjektet må som minimum oppfylle Eurokrav &lt;angi nivå, f.eks 4 eller 5&gt;</li> <li>- Anleggsmaskiner og utstyr som skal benyttes &lt;angi evt. begrensning, f.eks halvparten av gravemaskinene &gt; i prosjektet må som minimum oppfylle Eurokrav &lt;angi nivå, f.eks Stage II eller III A&gt;</li> </ul>	<p><b>Proaktivt krav</b>  <i>Kan prises i egen post dersom man stiller Euro 5 eller nyere</i></p> <p>Ved å stille krav til minimum Euro 5 innebærer det at kjøretøy som skal benyttes i prosjektet må være fra 2009 eller nyere. Euro 4 trådte i kraft i 2005. Feil bruk av dette kravet kan føre til færre anbydere eller store investeringsbehov for å kunne delta.</p> <p>Krav kan evt. stilles til deler av maskinparken som skal benyttes i utførelsen. F.eks begrense Euro 5 kravet til noen få nøkkelkjøretøy og still mindre strenge krav til resten av maskinparken som skal benyttes.</p> <p>Lette kjøretøy er f.eks varebiler og pick-uper under 3,5 tonn.  Tunge kjøretøy er f.eks lastebiler.  Anleggsmaskiner er f.eks gravemaskiner. Eurokrav for anleggsmaskiner finnes her:  <a href="http://www.dieselnet.com/standards/eu/nonroad.php">http://www.dieselnet.com/standards/eu/nonroad.php</a></p>
<ul style="list-style-type: none"> <li>- Det skal benyttes fornybare energikilder i prosjektet som &lt;angi: type og bruksområde&gt; <ul style="list-style-type: none"> <li>o biodrivstoff fra bærekraftig produksjon til &lt;angi type/antall kjøretøy&gt;</li> <li>o varmpumpe til oppvarming på &lt;angi hvor på anlegget / i brakker&gt; i stedet for varmluftsvifter</li> </ul> </li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Prises i egen post</i></p> <p>Vurder hva som er tilgjengelig / aktuelt og angi krav for prosjektet.  Vær obs på egenskapene til biodrivstoff – sjekk frysepunktet for drivstoffet i forhold til klima, sjekk at maskinprodusent tillater bruk av biodrivstoff.</p>
<b>Utslipp til grunn og vann</b>	
<ul style="list-style-type: none"> <li>- Entreprenøren skal i størst mulig grad bruke biologisk nedbrytbar oljeprodukter, eksempelvis hydraulikkolje, smøreoljer, forskalingsoljer, sagkjedeoljer</li> </ul>	<p><b>Proaktivt krav</b>  Aktuelt krav for eksempel hvis anleggsarbeid foregår nær vann og sårbare områder.</p>
<ul style="list-style-type: none"> <li>- Entreprenør skal lagre, håndtere og avhende kjemiske produkter, drivstoff osv på en slik måte at søl og lekkasjer til avløp, grunn eller vann forhindres</li> <li>- Lagerområder, fyllestasjoner osv skal angis på riggplan og godkjennes av Byggherren før oppstart</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i>  Lovkrav</p>
<ul style="list-style-type: none"> <li>- Drivstofftanker som benyttes på anlegget skal ha overflyllingsvern og mekanisk/elektronisk overflyllingsvarsel &lt;angi type ADR/IBS godkjent / tank i container / spillsikker tank&gt;. Tanker som skal benyttes i miljøfølsomme områder skal være utstyrt med spilloppsamling fra leveringsutstyr, lufting og påfyllingsstusser.</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p>

Krav	Kommentar
<ul style="list-style-type: none"> <li>- Drivstoffylling skal kun skje fra tankbil på angitt sted</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>På større anlegg kan det være aktuelt å benytte tankbil på ett tilrettelagt påfyllingsområde for å unngå mange dieseltanker på området.</p>
<p>Ved etablering og bruk av tankplass skal entreprenør</p> <ul style="list-style-type: none"> <li>- utføre en risikovurdering for å kartlegge farer og problemer knyttet til håndteringen av brannfarlig væske</li> <li>- kun benytte tanker / beholdere – godkjent og merket for formålet. Det skal etableres drifts- og sikkerhetsinstruks for tankplassen</li> <li>- etablere fysisk barriere i tilknytning til tank og eventuelt pumpeuttak for å hindre påkjørsel</li> <li>- sørge for at drivstofftanker plasseres på fast dekke på byggeplass</li> <li>- sørge for at tankanlegg holdes i forsvarlig stand og i henhold til forskrift</li> <li>- gjennomføre systematisk tilstandskontroll av tanker, minimum etter hver flytting eller transport</li> <li>- oppbevare absorberende middel i tilknytning til tankanlegg. Etter bruk skal absorbent behandles som farlig avfall</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420</i></p> <p>Ref. Håndtering og lagring av drivstoff i overgrunnstanker  <a href="http://www.np.no/lagring/veiledning-for-haandtering-og-lagring-av-drivstoff-i-overgrunnstanker-article189-134.html">http://www.np.no/lagring/veiledning-for-haandtering-og-lagring-av-drivstoff-i-overgrunnstanker-article189-134.html</a></p>
<ul style="list-style-type: none"> <li>- Feiemasser og snø skal håndteres slik at spredning av forurensning unngås og leveres til &lt;angi deponisteder&gt;</li> <li>- Snø skal ikke dumpes i sjøen</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Mange kommuner har egne krav. Kan medtas i avfallshåndtering.</p>
<p>Rensing av tunnelvann og anleggsvann skal skje ved følgende eller likeverdige metoder:</p> <ul style="list-style-type: none"> <li>- &lt;Sedimenteringsanlegg&gt;</li> <li>- &lt;Sedimenteringsanlegg med tilsetning av koaguleringskjemikalier foran sedimenteringsanlegget&gt;</li> <li>- &lt;Sedimenteringsanlegg og filtrering i hurtigsandfilter, ev. med tilsetning av koaguleringskjemikalier foran sedimenteringsanlegget&gt;</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Prises i egen post i tilknytning til det aktuelle arbeidet</i></p> <p>Lovkrav, men metode varierer. Krav til rensing av anleggs- og tunnelvann må beskrives for hvert enkelt prosjekt – type rensing, dimensjonering, utforming, utstyr, kjemikalier, drift, ombruk av tunnelvann, beredskap, måling, kontroll, rapportering osv.</p> <p>Mer informasjon om potensielle miljøproblemer og aktuelle tiltak finnes her:  <a href="http://www.nff.no/article.php?id=365">Teknisk rapport nr. 09: Behandling og utslipp av driftsvann fra tunnelanlegg</a>  <a href="http://www.nff.no/article.php?id=365">http://www.nff.no/article.php?id=365</a></p>

Krav	Kommentar
<p>Midlertidige sedimenteringsanlegg skal bygges på følgende eller tilsvarende måte:</p> <ul style="list-style-type: none"> <li>- &lt;Utgravde/utsprengte bassenger i jordmasser/fjell&gt;</li> <li>- &lt;Støpte bassenger&gt;</li> <li>- &lt;Ved at én eller flere stålcontainere settes sammen slik at det oppnås det nødvendige volum og areal&gt;</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Prises i egen post i tilknytning til det aktuelle arbeidet</i>            Lovkrav, men metode varierer. Krav til rensing av anleggs- og tunnelvann må beskrives for hvert enkelt prosjekt – type rensing, dimensjonering, utforming, utstyr, kjemikalier, drift, ombruk av tunnelvann, beredskap, måling, kontroll, rapportering osv.            Mer informasjon om potensielle miljøproblemer og aktuelle tiltak finnes her:  <u>Teknisk rapport nr. 09: Behandling og utslipp av driftsvann fra tunnelanlegg</u>  <a href="http://www.nff.no/article.php?id=365">http://www.nff.no/article.php?id=365</a></p>
<ul style="list-style-type: none"> <li>- Entreprenør skal sikre at det ikke spres forurensning fra kjøretøy og utstyr til veinettet</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p>
<ul style="list-style-type: none"> <li>- Vaskeplass for kjøretøy og utstyr skal ha vanntett dekke og kontrollert oppsamling av vann som ledes til slam- og oljeutskiller</li> <li>- Entreprenør er ansvarlig for at utskiller(e) har tilstrekkelig kapasitet og for at det foreligger utslippstillatelse i tilknytning til entreprenørens anleggsvirksomhet.</li> </ul>	<p><b>Basiskrav</b>  <i>Prises i egen post i tilknytning til det aktuelle arbeidet.</i></p>
<ul style="list-style-type: none"> <li>- Entreprenøren skal sørge for at sanering av forurenset grunn utføres iht &lt;tillatelse&gt; samt beskrivelser i &lt;angi aktuelle dokumenter som tiltaksplan og graveplan&gt;</li> </ul>	<p><b>Basiskrav</b>  <i>Prises som egen post i kapittel CD Miljøsanering, demontering, riving iht. NS3420.</i>            Lovkrav, men metode og organisering varierer. Aktuelt for prosjekter hvor forurenset er et tema</p>
<ul style="list-style-type: none"> <li>- Som beredskap mot forurensningsspredning i &lt;navn på sjø/vassdrag/elv&gt; skal det legges ut &lt;siltgardin, oljelenser&gt;. Entreprenøren skal rengjøre/ skifte siltgardin ved behov. Dette skal beskrives i entreprenørens &lt;angi hvor: Beredskapsplan, Miljøoppfølgingsplan eller HMS-plan&gt; for prosjektet</li> </ul>	<p><b>Basiskrav</b>  <i>Prises i det aktuelle arbeidet (Del F Grunnarbeider) iht. NS3420.</i></p> <p>Lovkrav            Siltgardin er mest aktuelt ved arbeid i eller nær sjø og vann, oljelenser ved sjø, vann, elv osv.</p>
<p><i>Støv, støy og vibrasjoner</i></p>	
<ul style="list-style-type: none"> <li>- Ved gjennomføring skal T-1442 ”Retningslinjer for behandling av støy i arealplanlegging” 26.01.2005, kapittel 4 ”Retningslinjer for begrenning av støy fra bygg- og anleggsvirksomhet” benyttes. Det vises til &lt;angi rapport / vedlegg&gt; der gjeldende krav er behandlet for prosjektet.</li> <li>- Entreprenøren skal sette seg inn i støyforskriftene på stedet og om nødvendig kontakte ansvarlig lokal myndighet (kommunelege e.l.), og eventuelt søke om tillatelser og/eller dispensasjoner</li> </ul>	<p><b>Basiskrav</b>  <i>Prises i det aktuelle arbeidet.</i></p> <p>Retningslinjer fra myndighetene.            T-1442 krever kompetanse både hos byggherre og entreprenør. Entreprenøren skal bruke støykrav / prognose levert av byggherren i utarbeidelse av anbud og planlegging av anleggsarbeidene.</p>

Krav	Kommentar
<ul style="list-style-type: none"> <li>- Entreprenøren skal under utførelse av anleggsarbeidene utvise hensyn til omgivelsene, slik at naboer og berørte parter sjeneres minst mulig av støv, støy og rystelser</li> <li>- I samarbeid med byggherren skal entreprenøren bidra til løpende informasjon til berørte parter i god tid før oppstart av støyende aktiviteter</li> </ul>	<p><b>Basiskrav</b> <i>Beskrives i Bok 0 Generelle Bestemmelser.</i></p> <p>Hensyn kan være å ikke arbeide netter / helger, spesielle tidsrom når det ikke skal utføres støyende arbeider. Informasjon kan være infoskriv, oppslag i nærmiljø og lokal presse, møter med naboer, varsling.</p>
<ul style="list-style-type: none"> <li>- Entreprenør skal foreta kontrollmålinger av støy under arbeidene &lt;krav angis nærmere basert på støyprognoser osv&gt;</li> </ul>	<p><b>Basiskrav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420. Prises i egen post.</i></p>
<ul style="list-style-type: none"> <li>- Det skal gjøres tiltak i tørre perioder for å unngå støvproblemer fra byggegrop og veier</li> </ul>	<p><b>Basiskrav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420</i></p>
<b>Ressursbruk</b>	
<i>Energieffektivisering</i>	
<ul style="list-style-type: none"> <li>- Entreprenøren skal ved oppstart presentere konkrete tiltak for å sikre at energibruk i utførelsesfasen skal holdes på et lavt nivå</li> </ul>	<p><b>Proaktivt krav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Entreprenør må få god kjennskap til byggherrens mål og ev. enøk-analyser for anlegget, f.eks belysning, oppvarming, lager. Dersom entreprenør kan påvirke det ferdige anlegget i driftsfasen, kan også slike tiltak inkluderes. Det kan vurderes å knytte sanksjoner/insentiver til slike krav.</p>
<i>Material- og produktvalg</i>	
<ul style="list-style-type: none"> <li>- Det skal benyttes et elektronisk stoffkartoteksystem for dokumentasjon av materialvalg og substitusjonsvurdering</li> </ul>	<p><b>Proaktivt krav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Stoffkartotek er lovkrav, men ikke at det er elektronisk. Substitusjonsplikt er lovkrav, viktig å minne bransjen på det. Et elektronisk stoffkartotek gir gode muligheter for dokumentasjon av substitusjonsvurdering. Spesifiser hvordan materialvalg og substitusjonsvurderinger skal gjennomføres.</p>



Krav	Kommentar
<p>- Produkter som inneholder &gt; 0,1 vektprosent av stoffer på KLIFs prioritetsliste skal så langt som mulig unngås. Dersom slike materialer ønskes brukt, skal Byggherren godkjenne dette</p>	<p><b>Basiskrav</b>  <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Lovkrav ift forbudte stoffer, men viktig å minne bransjen på det. Byggherren skal vurdere substitusjon for produktene som de spesifiserer, men entreprenør skal vurdere substitusjon av produkter de står fritt til å velge. Eget skjema for materialvalg kan lages for prosjektet. Link til prioritetslisten finnes <a href="#">her</a>.</p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.</p>
<p>- Helse- og miljøfarlige stoffer og produkter som planlegges brukt i byggefasen skal vurderes med hensyn til mulighet for erstatning med mindre farlige stoffer (jf. Substitusjonsplikten)</p>	<p><b>Basiskrav</b>  <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Lovkrav ift forbudte stoffer, men viktig å minne bransjen på det. Byggherren skal vurdere substitusjon for produktene som de spesifiserer, men entreprenør skal vurdere substitusjon av produkter de står fritt til å velge. Eget skjema for materialvalg kan lages for prosjektet. Link til prioritetslisten finnes <a href="#">her</a>.</p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.</p>
<p>- Entreprenøren skal prioritere produkter som oppfyller kravene i miljømerker som eksempelvis Svanen, EU Blomsten eller tilsvarende &lt;spesifiser eventuelt aktuelle produkter&gt;</p>	<p><b>Proaktivt krav</b>  <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Miljømerkede produkter blir vurdert i forhold til mange miljøtema (for eksempel innhold av helse- og miljøfarlige stoffer, opprinnelse av tre-baserte produkter, returordninger for avfall) før de får miljømerke. For miljømerkede produkter trengs det derfor ikke ytterligere dokumentasjon rundt disse miljøtemaene.</p> <p>Eksempler på aktuelle Svanemerkede produkter er:</p> <ul style="list-style-type: none"> <li>- Industrielle rengjørings- og avfettingsmidler</li> <li>- Kompressorer</li> </ul> <p>Kriterier finnes på Svanemerkets hjemmeside: <a href="http://www.ecolabel.no">www.ecolabel.no</a></p>
<p>- Det skal utarbeides en massedisponeringsplan som beskriver håndtering av rene og forurensede masser knyttet til prosjektet.</p>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i>          Lovkrav for forurenset masse.</p>

Krav	Kommentar
<b>Avfallsminimering og -håndtering</b>	
<ul style="list-style-type: none"> <li>- Entreprenøren skal presentere tiltak for å redusere avfallsmengder i prosjektet &lt;for eksempel 2-4 uker etter oppstart&gt;</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises i Del AJ Planlegging av kontraktsarbeidet iht. NS3420.</i></p> <p>Eksempelvis kan avfallsminimering gjøres ved at entreprenøren benytter ferdig tilpassede materialer, prefabrikkerte og prekappede elementer, gjenbruk av materialer (se under), stiller krav til resirkulert eller lett nedbrytbar emballasje på varer han kjøper, avtale med leverandører om returordninger for emballasje, restmateriell, paller, etc.</p>
<ul style="list-style-type: none"> <li>- Lokalt gjenbruk skal prioriteres i prosjektet. Gjenbruk av materialer omfatter &lt;angi det som er aktuelt, f.eks asfalt, betong, kantstein, skiltfundamenter, skiltmateriell, støyskjermer, gjerde, materialer fra tilstøtende anlegg eller bearbejdede masser (knust betong etc.) hentet fra foredlingsanlegg&gt;</li> </ul>	<p><b>Proaktivt krav</b>  <i>Gjenbruk av materialer eller forhold som medfører spesielle tiltak for å ivareta andres forurensning og permanente tiltak. Dette må beskrives i egne prisbærende poster.</i></p>
<ul style="list-style-type: none"> <li>- Entreprenøren skal utarbeide og implementere avfallsplan for prosjektet som oppfyller byggherrens mål om &lt;angi prosent&gt; kildesorteringsgrad*</li> <li>- Avfallsplanen skal inneholde alt avfall som planlegges produsert i området – type, mengde og behandlingsmåte. Avfallsplanen skal sendes inn til offentlig myndighet for godkjenning, samt kopi til Byggherre</li> <li>- Hovedbedrift skal utarbeide sluttokumentasjon på alt avhendet avfall innenfor sitt område og innlevere til Byggherre og til offentlig myndighet når kontraktsarbeidet er ferdig</li> </ul>	<p><b>Basiskrav ved 60-80% kildesorteringsgrad.</b>  <b>Proaktivt krav &gt;80% kildesorteringsgrad</b>  <i>Prises i Del AJ Planlegging av kontraktsarbeidet iht. NS3420.</i>  Lovkrav</p>
<ul style="list-style-type: none"> <li>- Entreprenør skal etablere avfallstasjon tilrettelagt for kildesortering</li> <li>- Entreprenør skal ha et system for merking av avfallscontainere i prosjektet</li> </ul>	<p><b>Basiskrav</b>  <i>Prises i Del AK tilrigging av bygge- eller anleggsplass iht. NS3420.</i></p>
<ul style="list-style-type: none"> <li>- Entreprenøren skal ved forespørsel kunne dokumentere avfallsleveransene ved å fremlegge kvitteringer for levert avfall av alle kategorier, inklusive kopi av utfylt skjema for levert farlig avfall (deklarasjonsskjema)</li> </ul>	<p><b>Basiskrav</b>  <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.</i></p> <p>Deklarasjonsskjema er lovkrav.</p>

Krav	Kommentar
<p>- Miljøkartlegging av mulig forekomst av farlige stoffer i objektet skal utføres av kvalifisert personell, og det skal utarbeides en miljøsaneringsrapport for det som må saneres ut før riving</p>	<p><b>Basiskrav</b>  <i>Prises i Del CD Miljøsanering, demontering, riving iht. NS3420.</i></p> <p>Lovkrav, men viktig å ta med siden miljøkartlegging kan gjøres på forskjellige stadier i prosjektet. Gjøres med fordel i prosjekteringsfasen men kan også gjøres i utførelsesfasen. Kravet gjelder ved:</p> <ul style="list-style-type: none"> <li>• vesentlig endring, reparasjon, eller riving av bygning eller del av bygning &gt;100 m<sup>2</sup></li> <li>• oppføring, tilbygging, påbygging, underbygging, endringer eller riving av konstruksjoner og anlegg dersom tiltaket genererer &gt; 10 tonn bygge- og rivingsavfall</li> </ul> <p>Mer informasjon finnes i Byggeteknisk forskrift, §9-7:  <a href="http://www.lovdatab.no/cgi-wift/ldles?doc=/sf/sf/sf-20100326-0489.html">http://www.lovdatab.no/cgi-wift/ldles?doc=/sf/sf/sf-20100326-0489.html</a></p>
<p>- Miljøsanering i forbindelse med rivearbeid skal gjennomføres og dokumenteres i henhold til miljøsaneringsrapport i &lt;angi rapport / vedlegg&gt;</p>	<p><b>Basiskrav</b>  <i>Prises i Del CD Miljøsanering, demontering, riving iht. NS3420.</i></p> <p>Lovkrav. Kravet gjelder hvis riving av bygg eller konstruksjoner inngår prosjektet. I dette kravet henvises det til miljøsaneringsrapport som er utarbeidet før utførelsesfasen. Kravet gjelder ved:</p> <ul style="list-style-type: none"> <li>• vesentlig endring, reparasjon, eller riving av bygning eller del av bygning &gt;100 m<sup>2</sup></li> <li>• oppføring, tilbygging, påbygging, underbygging, endringer eller riving av konstruksjoner og anlegg dersom tiltaket genererer &gt; 10 tonn bygge- og rivingsavfall</li> </ul> <p>Mer informasjon finnes i Byggeteknisk forskrift, §9-7:  <a href="http://www.lovdatab.no/cgi-wift/ldles?doc=/sf/sf/sf-20100326-0489.html">http://www.lovdatab.no/cgi-wift/ldles?doc=/sf/sf/sf-20100326-0489.html</a></p>

## Krav til sluttprodukt (Difi, 2015)

Krav	Kommentar
<b>Krav til sluttprodukt</b>	
<i>Ressursbruk</i>	
<i>Material- og produktvalg</i>	
<ul style="list-style-type: none"><li>- Produkter som inneholder &gt; 0,1 vektprosent av stoffer på KLIFs prioritetsliste skal så langt som mulig unngås. Dersom slike materialer ønskes brukt, skal Byggherren godkjenne dette</li></ul>	<p><b>Basiskrav</b> <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Lovkrav ift forbudte stoffer, men viktig å minne bransjen på det. Byggherren skal vurdere substitusjon for produktene som de spesifiserer, men entreprenør skal vurdere substitusjon av produkter de står fritt til å velge. Eget skjema for materialvalg kan lages for prosjektet. Link til prioritetslisten finnes <a href="#">her</a>.</p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.</p>
<ul style="list-style-type: none"><li>- Helse- og miljøfarlige stoffer og produkter som planlegges brukt i byggefasen skal vurderes med hensyn til mulighet for erstatning med mindre farlige stoffer (jf. Substitusjonsplikten)</li></ul>	<p><b>Basiskrav</b> <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Lovkrav ift forbudte stoffer, men viktig å minne bransjen på det. Byggherren skal vurdere substitusjon for produktene som de spesifiserer, men entreprenør skal vurdere substitusjon av produkter de står fritt til å velge. Eget skjema for materialvalg kan lages for prosjektet. Link til prioritetslisten finnes <a href="#">her</a>.</p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.</p>
<ul style="list-style-type: none"><li>- Entreprenøren skal fremlegge EPD (miljødeklarasjoner) for de vektmessig 10 mest brukte byggematerialene i prosjektet</li></ul>	<p><b>Proaktivt krav</b> <i>Prises typisk i Del A Etablering, drift og avvikling av bygge- eller anleggsplass iht. NS3420.Egen prisbærende post.</i></p> <p>Se <a href="http://www.epd-norge.no">www.epd-norge.no</a> for relevante materialer: f.eks sement, betong, takbelegg, rør, trepanel, stålkonstruksjon, gips, isolasjon, membran, osv.</p> <p>En EPD gir en nøytral vurdering av et produkts miljøbelastning. EPDer bidrar til å øke tilgangen til miljødokumentasjon for byggevarer. Informasjon kan benyttes i klimagassregnskap for anlegget. Det foreligger ikke miljødeklarasjon for alle byggematerialer derfor anbefales det å etterspørre et realistisk antall deklarasjoner (&lt; 20 ansees som realistisk).</p>

Krav	Kommentar
<p>- Det skal ikke brukes tremateriale med tropisk tømmer i selve anlegget eller i materialer som brukes i byggetiden.</p>	<p><b>Basiskrav</b>  <i>Prises i post for det aktuelle arbeidet, eksempelvis Del K Utomhus eller Del Q Tømrerarbeider.</i></p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.  Her finnes Regnskogfondets liste over tropiske treslag:  <a href="http://www.regnskog.no/Hvordan+vi+jobber/Forbrukersp%C3%B8rsm%C3%A5l/1827.cms">http://www.regnskog.no/Hvordan+vi+jobber/Forbrukersp%C3%B8rsm%C3%A5l/1827.cms</a></p>
<p>- Det skal ikke brukes tremateriale med tropisk tømmer i selve anlegget eller i materialer som brukes i byggetiden.  Øvrig trevirke og trebaserte produkter skal være produsert av tømmer fra FSC-sertifisert, Levende Skog/ISO 14001-sertifisert skog eller PEFC-sertifisert skogsdrift eller tilsvarende sertifisering.</p>	<p><b>Proaktivt krav</b>  <i>Prises i post for det aktuelle arbeidet, eksempelvis Del K Utomhus eller Del Q Tømrerarbeider.</i></p> <p>I de tilfeller miljømerkede produkter leveres behøver ikke dette kravet dokumenteres da forholdet allerede er vurdert i forbindelse med miljømerking.</p> <p>Her finnes Regnskogfondets liste over tropiske treslag:  <a href="http://www.regnskog.no/Hvordan+vi+jobber/Forbrukersp%C3%B8rsm%C3%A5l/1827.cms">http://www.regnskog.no/Hvordan+vi+jobber/Forbrukersp%C3%B8rsm%C3%A5l/1827.cms</a></p>
<p>- Entreprenøren skal prioritere produkter som oppfyller kravene i miljømerker som eksempelvis Svanen, EU Blomsten eller tilsvarende &lt;spesifiser eventuelt aktuelle produkter&gt;</p>	<p><b>Proaktivt krav</b>  <i>Prises i post for det aktuelle arbeidet.</i></p> <p>Miljømerkede produkter blir vurdert i forhold til mange miljøtema (for eksempel innhold av helse- og miljøfarlige stoffer, opprinnelse av tre-baserte produkter, returordninger for avfall) før de får miljømerke. For miljømerkede produkter trengs det derfor ikke ytterligere dokumentasjon rundt disse miljøtemaene. I denne tabellen er det kommentert dersom et krav kan utgå når leverandøren tilbyr miljømerkede produkter.</p> <p>Eksempler på aktuelle Svanemerkede produkter er:</p> <ul style="list-style-type: none"> <li>- Holdbart trevirke</li> <li>- Maling</li> <li>- Gipsplater</li> </ul> <p>Kriterier finnes på Svanemerkets hjemmeside: <a href="http://www.ecolabel.no">www.ecolabel.no</a></p>

Krav	Kommentar
<ul style="list-style-type: none"> <li>- Lokalt gjenbruk skal prioriteres i prosjektet. Gjenbruk av materialer omfatter &lt;angi det som er aktuelt, f.eks asfalt, betong, kantstein, skiltfundamenter, skiltmateriell, støyskjermer, gjerde, materialer fra tilstøtende anlegg eller bearbeidede masser (knust betong etc.) hentet fra foredlingsanlegg&gt;</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises i post for det aktuelle arbeidet.</i></p>
<ul style="list-style-type: none"> <li>- Kun stedegne plantearter, dvs planter med samme proveniens, skal benyttes slik at man unngår spredning av fremmede arter</li> </ul>	<p><b>Basiskrav</b>  <i>Prises i post forleveranse av planter, Del KB Vegetasjon iht. NS3420.</i>  Stedegne planter er planter som vokser naturlig et sted og er tilpasset forholdene. Proveniens er betegnelse for et planteslags klimarase eller geografiske opprinnelse. For å sikre stedegne planter bør nye planter ha samme proveniens som de eksisterende.</p>
<ul style="list-style-type: none"> <li>- Entreprenøren skal prioritere beplantning fra økologisk planteproduksjon</li> </ul>	<p><b>Proaktivt krav</b>  <i>Prises i post forleveranse av planter, Del KB Vegetasjon iht. NS3420. Egen prispåbærende post</i>  Bestiller må undersøke om dette er tilgjengelig for prosjektet.</p>