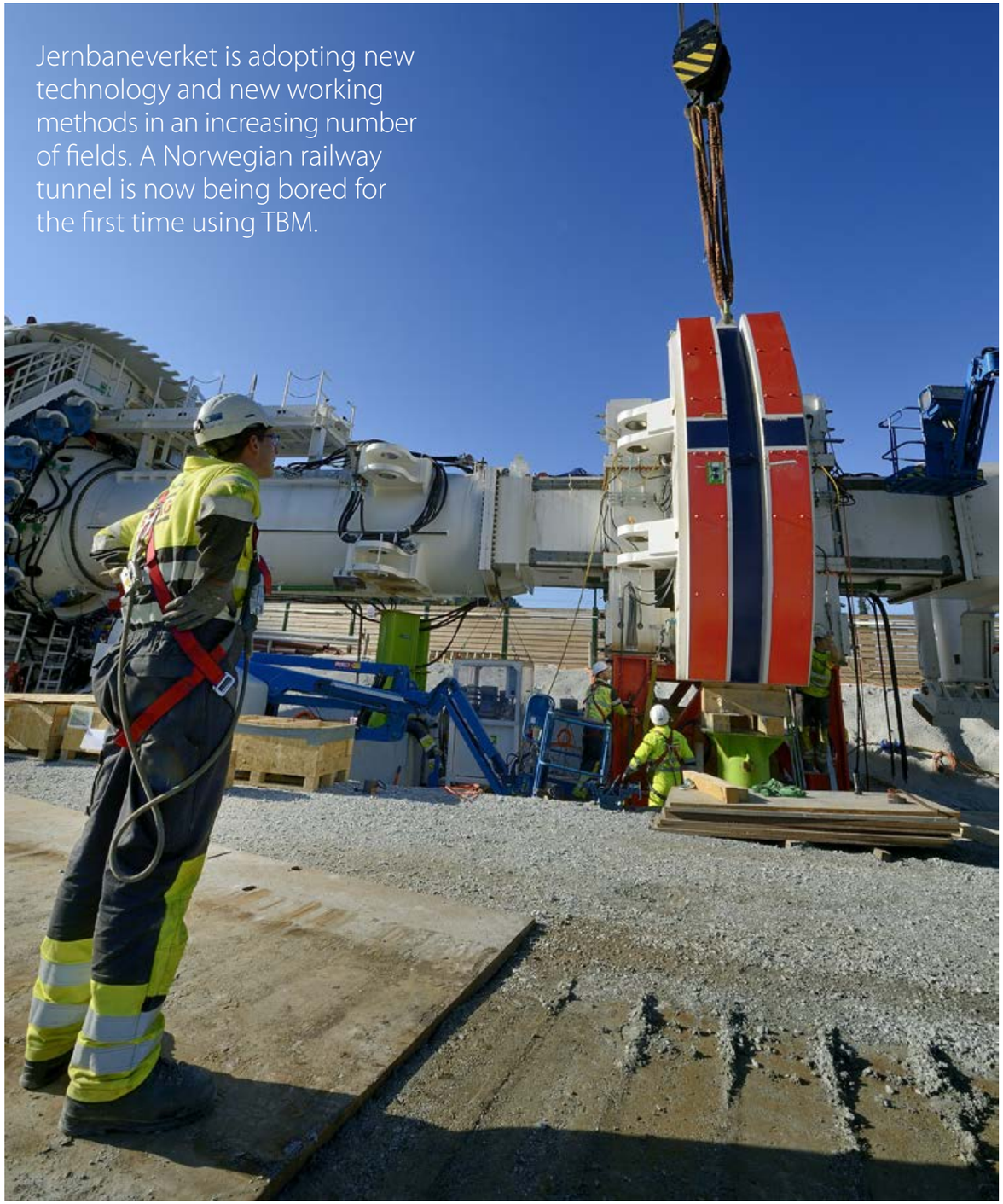
Jernbaneverket

On track

GLIMPSES OF JERNBANEVERKET'S ACTIVITIES IN 2015

Jernbaneverket is adopting new technology and new working methods in an increasing number of fields. A Norwegian railway tunnel is now being bored for the first time using TBM.



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Contents

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"The major basic route change from December 2012 has resulted in formidable growth of passenger rail traffic in Eastern Norway, and the final pieces of the puzzle fell into place when Høvik station became fully operational by the time of the timetable change in December 2015."

Exciting times

In June 2015, the Parliament of Norway made a decision to reform the railway sector. Work relating to that reform has characterised the past year, and will do so to an even greater extent in 2016. The new organisation will come into force on 1 January 2017, and Jernbaneverket will be replaced at that time by a newly established directorate and a state enterprise. Until that time, Jernbaneverket will continue to focus fully on delivering a constantly improving railway.

The punctuality of passenger services in 2015 amounted to 91.5 per cent, thereby achieving the target (90 per cent) for the fourth consecutive year. The punctuality target for freight services was not reached, but the result (79.4 per cent) is still the best since 2012 and a number of measures to make transporting freight by rail, instead of by road, more attractive are in the pipeline.

Work on coming up with smarter ways of working in order to streamline activities is continuing irrespective of the reform. New technology is being adopted in an increasing number of fields, creating exciting new jobs that are attracting talented young employees. The actual number of applicants for vacancies at Jernbaneverket has almost quadrupled over the past two years.

New digital signalling systems were implemented on parts of the rail network in 2015. In late August, the Østfold Line, Eastern Line became the first section of railway in Norway to start using the collective European signalling system ERTMS. Improvement of the railway's own mobile network (GSM-R) and development of a new fibre network are next in line in order to pave the way for further ERTMS development and digitalised infrastructure monitoring.

In December, 17 km of new double track on the Dovre Line along Lake Mjøsa was opened to traffic, and Høvik station on the Drammen Line was completed, along with necessary turning and parking areas for trains. 2015 was also the year in which huge tunnel boring machines (TBMs) were used in Norway for the first time in order to drive a new railway tunnel through Ulriken mountain in Bergen.

With record investments being made in operation and maintenance, a wide range of maintenance measures could be implemented over the past year, and 2015 was the year in which we began to make up some of the backlog that had built up over several decades of low maintenance funding.

The planning activities also reached record levels last year. Among other things, the important perspective analysis "Jernbanen mot 2050", a basis for the revised National Transport Plan, was presented in the spring. This analysis shows that the railway will have to play a greater part in passenger transport in the biggest cities in the future, and that the railway can take on more of the anticipated growth in the flow of goods if there is deliberate, strategic investment in this at a national level.

A safe, reliable railway infrastructure that works well for both passenger transport and freight transport will benefit our entire society. This is the target we are working towards – and nothing less.


Photo: Hilde Lillejord

EEnger

Director General
of Jernbaneverket

"I would like to commend Jernbaneverket, which has sided with freight over the past two years."
CEO Stein Børre Johnsen, Bring Linehaul AS

Photo: Øystein Grue

CargoNet at Saltfjellet

A glimmer of light for freight and rail services

A turning point for freight transport is finally in sight following the tenacious repercussions of the financial crisis in 2008.

Freight transport by rail has been battling a strong headwind for a number of years, but finally things seemed to be turning in 2015. While CargoNet managed to turn around several years of losses, Bring/Posten succeeded in increasing the volume of freight they transported by rail by no less than 13 per cent.

"I would like to commend Jernbaneverket, which has sided with freight over the past two years," says Stein Børre Johnsen. He is the head of Bring Linehaul, the Posten/Bring division that deals with long-distance freight. In his view, this small breakthrough is due to the fact that people are now thinking along more commercial lines.

"If we are to get freight onto the railways, measures have to be controlled by business, not by politicians. Our job is to meet needs in the flow of goods. When it comes to logistics, performance is measured in terms of costs. We have enjoyed so much success because we work with the entire value chain. We work very closely with our customers' businesses. A number of them work in-house with our own people," explains Johnsen.

"Major volumes will be transported by rail when customers are capable of seeing opportunities for savings in their own part of the flow of goods as well and adding up the effects from

Photo: Arvid Bårdstu

Freight boost for Mosjøen

using rail services, which are cheaper than road services," explains Johnsen.

Volume is the key
Volume is the key to economy when it comes to transporting freight by rail. Stein Børre Johnsen emphasises the fact that volume is the be-all and end-all. Ideally, companies offering freight services by rail should overbook their trains in the same way that aircraft are overbooked, he reckons.

Bring provides containers to help its customers, so customers can go on producing goods and fill the containers. This is exactly what aluminium manufacturer Alcoa in Mosjøen does. They order the number they need a week in advance and load them up continuously. Bring then creates predictability, making it easier for them to do their jobs.

Rail services are unrivalled when travelling distances that road vehicles cannot cover all at once, while trains operate seamlessly.

CargoNet began serving the freight terminal in Mosjøen with one train a week, but they are providing two a week now. The industrialisation of the flow of goods is what may encourage the transportation of more freight by rail, reckons Stein Børre Johnsen. And when this has been achieved, this is when we will see the huge volumes. And when these volumes are big enough, Bring can set up its own trains. This is something they have done between Oslo and Jönköping, and between Jönköping and Stockholm.

Strong competition
Nowadays the cost of transporting freight out of Norway is much lower than the cost of bringing goods in. Foreign trailers are paid to drive freight to Norway, and then they position themselves so that they can be loaded with cargo to take back. This transport is offered inexpensively – so inexpensively, in fact, that rail companies are struggling to compete. "When you systematise logistics and find out what effect all the links in the chain have, that is when you can build solutions. Statistics which indicates that our transportation of freight by rail is on the increase are clear evidence that Bring has become adept at doing just that," concludes Stein Børre Johnsen.

Taking action
Jernbaneverket has shone a spotlight on transportation of freight by rail throughout 2015, with two objectives: to find out what can be done by relatively simple means in the short term, and to look at strategic plan from a longer perspective.

Restructuring of terminal operation was first up. The terminals were previously divided into a private section and the public section, but Jernbaneverket will now be managing the terminals collectively.

The freight industry has demanded measures that may boost confidence in the railways. Among other things, customers want to see more activity during traffic deviations. Implementation of contingency terminals that can be used for load transfer if anything happens to the railway was one of the requirements now being adopted through specific action. Implementation of predefined routes for freight trains on the Røros Line in the event of closure of the Dovre Line was another request put forward by industry. This has been put in place, with train paths for five freight trains not exceeding 500 metres.

"Freight General"
Roger Kormeseth was appointed as "Freight General" at Jernbaneverket from 3 August. Kormeseth has a comprehensive background in logistics from companies such as Hakon Gruppen/ICA Norway, Ekspert and international logistics giant DHL. His job will be to act as a driving force and coordinator of efforts to place rail freight on the agenda.

"My job is to involve industry, rail companies and other important stakeholders so that we can work together to select the measures that will have the greatest effect," says Kormeseth, who has put immediate measures in place totalling NOK 1 billion for 2016-2018. These measures will form the foundation for the road ahead.

"As a consequence of general market growth, annual freight transport by rail is expected to increase by 10 million tonnes by 2030. And to that we can add freight that can be transferred from the road sector. We may be talking in terms of up to 13 million tonnes in total, which is 45 per cent more than the current level. Looking ahead to 2050, I would suggest considering new track connections to prevent conflicts between passenger trains and freight trains on heavily used lines. Such conflicts will be particularly apparent in the central part of Eastern Norway in the event of an increase in track usage," says Kormeseth.

However, the first part of the freight strategy will be to construct passing tracks, along with electrification of the Hamar–Elverum–Kongsvinger section, and Heggstadmoen in Heimdal will take some of the burden off the freight terminal in Trondheim.
Lots of other measures will also be implemented to ensure that freight is transported in the most eco-friendly way possible.

"Annual freight transport by rail is expected to increase by 10 million tonnes by 2030. And to that we can add freight that can be transferred from the road sector."
Roger Kormeseth

Photo: Arvid Bårdstu

Stein Børre Johnsen, Bring Linehaul AS

Photo: Øystein Grue

Roger Kormeseth

CargoNet in the black

2015 was the year in which CargoNet operated at a profit again as a result of a rather drastic remedy.

CargoNet last made a profit in 2007. The year after heralded the start of the financial crisis, and the years which followed presented an ever-increasing flow of cheap, foreign trailers. But now the tide has turned, from a deficit of NOK 90 million in 2014 to a profit of NOK 89 million in 2015.

This restructuring initiative cost the jobs of one in five employees at CargoNet and its subsidiary RailCombi. CargoNet also put maintenance out for tender, renegotiated supplier contracts and implemented lots of other measures as well, finally resulting in a sustainable organisation without significantly reducing its offering to customers.

In the future, one of the most important things for CargoNet is that the Alnabru freight terminal remains operational.

"As long as Alnabru is working, the terminal is efficient. In the short term I am more worried about the fact that Alnabru might stop working, rather than about Alnabru being too small," says Managing Director Arne Fosen at CargoNet.

He would also like to see more passing tracks, and ideally tracks long enough to accommodate a freight train hauled by two locomotives.

Managing Director Arne Fosen

Photo: Brian Cliff Olguin

Photo: Arvid Bårdstu

New offering

In 2015, freight trains started running again to the Port of Grenland terminal in Brevik, where trains can go all the way up to the quayside.

The Brevik terminal is a very active port, primarily serving heavy industry in the Grenland area. The terminal is run by the company North Sea Terminal and is a permanent port of call for DFDS Tor Line, which serves the entire North Sea basin, calling in the United Kingdom, Belgium, Germany, Sweden and the Netherlands.

The special thing about the Brevik terminal, which has a quay 180 metres long, is that trains can go all the way up to the quayside. CargoNet operates two shuttle trains on the Brevik–Alnabru–Bergen route every week. Incoming freight can essentially be distributed all over the country as the train travels via the freight hub of Alnabru before going on to Bergen. The freight carried by train which is to continue its journey by sea is often unloaded at the large Belgian freight hub of Ghent or, usually, in Immingham in the UK. Empty containers are also brought by train from Bergen for use by industry in Grenland.

Timber on the increase

Timber transportation by rail has doubled in a couple of years. Jernbaneverket is assuming that the need to transport timber will remain at a high level for a long time. Norway's largest timber terminal, Norsenga near Kongsvinger, was upgraded in 2015 at a cost of NOK 34 million. Modernisation of the Koppang terminal began in 2014 and continued in 2015.

2015:
- 91.5 per cent punctuality
- 99 per cent uptime
- 13 per cent fewer delays

Punctuality approaching European peak

Photo: Øystein Grue

Bjørn Kristiansen, Jernbaneverket's Traffic Director, is pleased with the 2015 punctuality record.

Passenger trains in Norway achieved punctuality of no less than 91.5 per cent in 2015, setting a new record. According to Bjørn Kristiansen, Jernbaneverket's Traffic Director, the turning point came in 2010 and things have just gone on improving since then.

Rail traffic through Oslo S increased by 25 trains per day in 2015, and the number of train-hours increased by almost 58,000 hours compared with the previous year. And while traffic levels were increasing, punctuality reached new heights.

The best month was February, with a punctuality level of no less than 93.5 per cent. The figures for the Flytoget airport express service show a punctuality level of 96.6 per cent, slightly reduced compared with 2014. The "Rush hour Oslo" category is making considerable progress, finishing up at 87.1 per cent. Freight is also making progress, now approaching a level of 80 per cent.

Norway and Switzerland
At the end of October 2015, statistics showed that the Swiss were achieving punctuality levels of 88.3 per cent within a three-minute margin, while Norway was providing 91.4 per cent punctuality within three minutes and 59 seconds. Punctuality in Austria, within five minutes, stood at 95.4 per cent.

If we consider punctuality levels with a delay limit of three minutes, Norway and Switzerland were fairly similar. Compared with Denmark and Germany, with six minutes, we were slightly above 90, and between these two countries.

The turning point
After the horrendous winter of 2009 and 2010, a methodology was developed which has since resulted in better punctuality. 2010, therefore, was a turning point.

"When it comes to improving punctuality we generally think of traditional maintenance, but stop duration at stations is also important. Sector marking on platforms is a really good measure that will increase punctuality. Just consider people wanting to travel with wheelchairs or pushchairs. Overall, this information will result in a more efficient transport system," says Kristiansen.

Jernbaneverket is exerting pressure on the train companies to increase punctuality, but Kristiansen is impressed with what these same companies have managed to achieve. A survey carried out by NSB shows that delays linked with stop duration at stations account for approximately 35 per cent of the delays for which NSB is responsible.

Not out of the woods yet
"Maintenance and renewal efforts are now bearing fruit, but the rail network is not entirely out of the woods as yet. Problems at Skøyen, for example, bring all of Oslo to a standstill. This causes lots of inconvenience," says Kristiansen, adding that Jernbaneverket is working hard on individual infrastructure faults (often defined as signalling faults) which stop a large percentage of traffic, causing problems for passengers when they occur.

What is the situation as regards information for passengers?

"We have an old system that has to be replaced now. The new one will be state-of-the-art and give us lots of new and improved opportunities for providing passengers with information. NOK 45 million has been earmarked for this project for the next year."

Punctuality

- A train is considered to be on time if it reaches its final station within a margin of three minutes and 59 seconds. For long-distance trains, this margin is five minutes and 59 seconds. The target for passenger trains is for 90 per cent of trains to reach their final station on time, while the target for the Flytoget (airport express) is 95 per cent.
- Figures for your train and section can be found at jernbaneverket.no.

2015:
- The first big year of maintenance
- Renewals worth NOK 2.5 billion
- Reduction in maintenance backlog

Photo: Øystein Grue

Rail replacement on the Dovre Line: Worn out old rails may result in slow running and delays. Old rails are being replaced with new ones so that speed can be increased to 160 km/h.

The beginning of a new era

Thanks to more money for maintenance, Jernbaneverket now has the opportunity to think along new lines when planning. Entire sections can now be renewed for faster and greater benefits. 2015 was the first big year of maintenance in modern times.

Existing systems were renewed at a cost of around NOK 2.5 billion in 2015. Just a couple of years previously NOK 800 million was invested in similar initiatives. For the first time in several decades it was now possible to reduce the maintenance backlog. Plans were also laid for initiatives in years to come, and activities escalated in 2015.

2015 was defined by Jernbaneverket as the first big year of maintenance. The backlog of maintenance on the rail network was estimated to amount to just over NOK 17 billion. The aim is to continue to make inroads into this backlog over the next few years while also maintaining a good level of maintenance for all new and renewed infrastructure.

Extensive maintenance plan

In the summer of 2015, the infrastructure division submitted a maintenance plan for the period until 2027. This plan is 687 pages long and has formed the basis for the maintenance proposal in the forthcoming National Transport Plan period (2018-2029). This maintenance plan outlines measures for dealing with the entire backlog by 2030, and this has also been adopted as the transport agencies' proposal in their essential document for the next National Transport Plan.

The areas and line units at the Infrastructure division were involved extensively in work on the long-term plan to ensure that overall priorities are correct for the railway. The objective has been to unite professional bodies at Jernbaneverket behind a nationwide plan for the organisation of maintenance over the next few years. The increase in budget funding for maintenance has made it possible to plan more systematically. Large proportions of the maintenance budgets to date have been spent on "firefighting work" in order to keep the railway running. More systematic maintenance will reduce the need for emergency maintenance measures as the standard of the rail network improves.

The measures

2015 heralded the start of the initiative. The introduction of the new European signalling system ERTMS, necessary renewal of the catenary systems which, for a number of main routes, are approaching their anticipated service life, and cleaning of the ballast are the biggest renewal and maintenance tasks to be carried out with regard to the existing rail network. Ballast is contaminated over time, and there is a major need to replace it while also improving line drainage systems.

Here is the list of major measures that commenced in 2015:
- Replacement of the signalling systems (ERTMS)
- Renewal of catenary systems
- Cleaning of ballast and preparations for this
- Point switches, replacement
- Substructure measures
- Bridge renewals and replacements
- Machine renewals
- Rails, laying of new ones
- Sleepers, replacement
- Road barrier systems, renewals

Photo: Øystein Grue

A new bridge is put in place on the Røros Line.

The introduction of the new collective European signalling system ERTMS will eliminate the signalling fault types which currently affect the railway. More cleaning of ballast and better drainage will result in tracks that are considerably more robust, withstanding wear and tear and climate impact.

Work carried out in 2015 included the following:
- ERTMS was implemented on the practice section of the Østfold Line, Eastern Line.
- A range of point switches, rails and sleepers were replaced, and extensive adjustment of track and point switches was carried out.
- The catenaries on the Egersund–Sandnes section of the Sørland Line were renewed.
- Ballast has been cleaned on sections of the Gjøvik, Dovre and Østfold Lines.
- Further ballast cleaning has been prepared. This work includes drainage, maintenance of culverts, protection of adjacent terrain and construction of new cable conduits along the track.
- Reinforcement of the ballast bed, extension of embankments, rock protection, larger culverts and landslide prevention were carried out a number of places, most extensively on the Bergen and Dovre Lines.
- Renewal and repair measures of a greater and lesser extent took place on 83 bridges.

Summaries of volumes and costs for maintenance work carried out in 2015 can be found in the figures.

2015:
- 27 stations were given new info screens and loudspeakers
- 17 stations were given better parking

Firmly raising the standard at many stations

The standard of Norwegian stations is continuing to improve, and this is apparent from customer satisfaction. A record amount of money was allocated for station maintenance and renewal in 2015. This has paid off.

More commuter parking
Commuter parking is becoming more and more important in order to persuade passengers to switch to rail services, particularly into and out of towns and cities. Parking was improved at 17 stations in 2015. This work mainly involved increasing capacity by extending, laying asphalt and marking out parking spaces. The text message payment scheme was introduced at 12 stations. Parking spaces at these stations are reserved for people who commute by rail. A total of 35 stations were using this scheme by the end of 2015. 10,000 rail commuters use this offering every month.

Secure bicycle parking
The National Transport Plan 2014-2023 (NTP) has the express target of ensuring that "The growth in passenger transport in urban areas must be absorbed by public transport, cycling and walking". Jernbaneverket offers bicycle parking at most stations. The offering was improved at 13 stations in 2015. Different bicycle parking variants are offered, and of these bicycle hotels are the most modern, most secure solution. Bicycle hotels are opened by text message. Jernbaneverket had 418 registered users over four hotels in 2015. The number of users is expected to increase significantly. As a result, Jernbaneverket will be building more hotels in future and already has concrete plans for six new hotels.

Increased accessibility
All new stations must have a universal design, according to Norwegian law. The NTP also demands this when "significant alteration" of existing platforms are made. Jernbaneverket has been working intensively and proactively over the past few years to improve accessibility at its stations. 104 stations now have "accessible" status, while 13 stations have universal design.

These nine stations received approval in 2015:
- Mysen
- Kråkstad
- Greverud
- Tomter
- Harestua
- Spydeberg
- Høvik
- Stabekk
- Varingskollen

The lifts at Skøyen and Asker have been upgraded in order to improve accessibility. Lighting in public areas has been improved at 10 stations, and better CCTV surveillance has been installed. Stairs and steps have been marked at 30 stations, and glass surfaces have been marked as well. Door pulling force has also been adjusted, and more entrances now have automatic door openers. Requirements have been mapped at a further 150 stations. These will be improved by the end of 2017.

New info screens and loudspeakers
Customer information at stations is becoming more and more important, particularly in connection with traffic deviations. New information screens and loudspeakers were installed at 27 stations in 2015. A further 28 stations were planned for 2015, but these were delayed due to a supplier's shortage of equipment. These will be completed in early 2016. 166 stations had received new information equipment by the end of 2015. The price tag: NOK 81 million. These upgrades will be continuing in 2016, and before the year is up 194 stations will be fully developed with state-of-the-art customer information equipment.

Photo: Hedda Nossen

Jernbaneverket has around 18,500 parking spaces. The picture shows commuter parking at Spikkestad station.

Photo: Brian Cliff Oguin

Mysen station is one of nine stations that received universal design status in 2015.

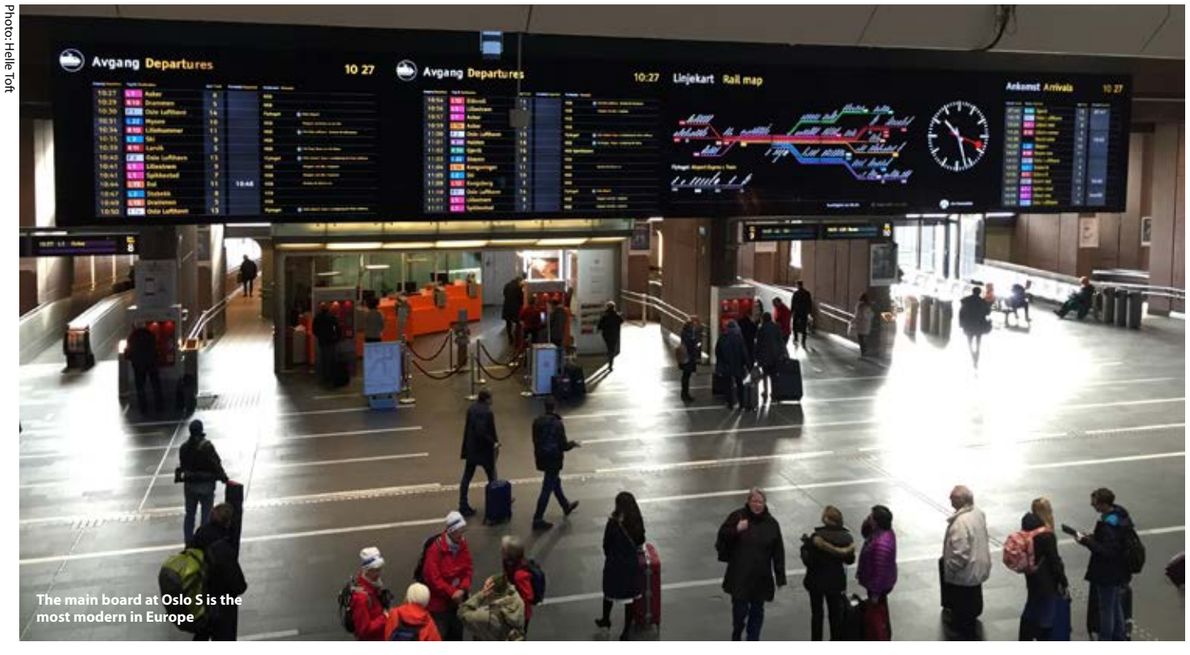
Photo: Arvid Bårdstu

"Bicycle hotel" at Gulskogen station

Photo: Helle Toft/Jernbaneverket

New lighting improves safety at Nationaltheatret station

Photo: Helle Toft



The main board at Oslo S is the most modern in Europe

- Development and maintenance provide many jobs
- Private contracts worth NOK 15 billion

Rail initiative employed thousands

The railway initiative is providing thousands of jobs. In 2015, contracts equivalent to around 6500 man-years were awarded to suppliers outside Jernbaneverket.

The InterCity network in eastern Norway is being developed step-by-step: 17 kilometres of new double track have been opened beside Lake Mjøsa. In addition, more than 65 kilometres of double track are being built on the Farriseidet–Porsgrunn, Holmestrand, Oslo–Ski and Arna–Bergen sections. These major development projects meant that work worth more than NOK 7 billion, or almost 3,000 man-years, was outsourced last year.

In addition the Jernbaneverket Infrastructure division paid out over NOK 8 billion, generating around 3,500 man-years in the supplier market, in which Norwegian investors are heavily involved as owners.

Work done by private companies

"What we call small and medium size projects have a high employment effect as they are mainly outsourced," explains Infrastructure Director Gorm Frimannslund.

The completion of Norway's first ERTMS section on the Østfold Line, Eastern Line, the double track between Hell and Værnes, the securing and redevelopment of level crossings, plus landslide protection measures and a number of other projects, totalled NOK 2.5 billion and around 1,450 man-years.

"The majority of this renewal work was outsourced to external companies, too," says Frimannslund. Renewals include everything from replacement of sleepers and rails, ballast cleaning, preparations for ballast cleaning and substructure measures to renewal of catenaries and replacement of point switches.

A total of NOK 2,550 million was spent on renewal measures, providing around 1,490 man-years of work.

Furthermore, the Infrastructure division outsourced around half of all its preventive maintenance work, such as rail grinding, track adjustment, ballast replenishment and clearance of vegetation. This was equivalent to around 440 man-years.

Baneservice

State-owned Baneservice AS is the biggest railway contractor in Norway. This company, which employs a total of 300 staff, received more than NOK 550 million last year for work carried out on behalf of Jernbaneverket. Baneservice signed its biggest single contract ever at the tail end of last year: the company was contracted to demolish and re-establish technical railway infrastructure in connection with the development of the Follo Line at Oslo S.

"It is now clear that investments are being made in railways, and the future looks bright," says Ingvild Storås, Managing Director. "We are investing in both new facilities and maintenance."

Photo: Baneservice AS

Managing Director Ingvild Storås, Baneservice AS

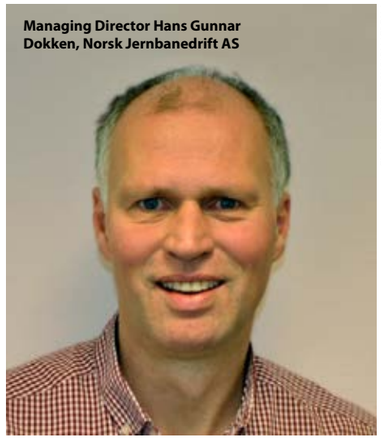


Photo: Norsk Jernbanedrift AS

Managing Director Hans Gunnar Dokken, Norsk Jernbanedrift AS

Norsk Jernbanedrift

Norsk Jernbanedrift AS, which in its day was founded by Jernbaneverket employees, completed contracts for Jernbaneverket worth NOK 325 million last year. Managing Director Hans Gunnar Dokken praises the partnership with Jernbaneverket during Brynsbakken track redevelopment last year, when rail traffic was suspended in July and the first part of August. The company takes on all kinds of technical railway work and is also involved in major projects such as Farriseidet–Porsgrunn, Holmestrand and the Follo Line.

"We had to lay people off previously, but now we can employ our 147 staff all year round," says Dokken, who is anticipating major growth.

"Our order reserves have never been so great."

Photo: Brian Cliff Olguin

Tracklayers from Norsk Jernbanedrift AS working for Jernbaneverket at Skøyen in the summer of 2015.

NRC Rail Norge

NRC Rail Norge AS came third in the Jernbaneverket Norwegian railway contractors payment list.

"We have lots of Jernbaneverket contracts worth less than NOK 10 million," explains Managing Director Robert Norbeck.

"We undertake all kinds of work and are anticipating enormous growth," says Norbeck. This Lillestrøm-based company employs 148 staff and is owned by the listed company NRC Group, which in turn owns Sven Järnvägsteknik AB. NRC Rail Norge had a turnover of NOK 460 million last year, while the overall turnover for the group amounted to NOK 1.5 billion.

Photo: Tore Holtet

Managing Director Robert Norbeck, NRC Rail Norge AS

How much maintenance was exposed to competition in 2015:

- 50 per cent of preventive maintenance
- 85 per cent of renewal work
- 20 per cent of corrective maintenance

Photo: Ingvild Eikeland

The Ulrikke tunnel boring machine during assembly at Arna station in the autumn of 2015.

A new era for tunnel building in Norway

A monster of a tunnel boring machine (TBM) has started a project that is writing Norwegian railway history. This 150 metre-long machine will be measuring forces with hard Norwegian gneiss and granite inside Ulriken mountain in Bergen.

In September 2015, the boring head – more than 9 metres in diameter – was lifted into place using one of the biggest tracked cranes available. Over the course of three months, no fewer than 90 packages arrived at the construction site at Arna station, where the tunnel boring machine was being assembled around the clock.

The historical tunnel boring work from Arna through Ulriken to Bergen began on 4 December 2015 and will continue for 18 months until the boring head will emerge from the mountain in Bergen. The first train will operate on the new double track between Arna and Bergen in 2020.

Chips
The product which the TBM spits out is referred to as "chips". This is what you get when 62 steel cutters, each weighing 250 kilos, is pressed against the rock with enormous force. A boring head weighing 223 tonnes is rotated by twelve powerful electric motors with a total of 5,632 horsepower. A total of 700,000 cubic metres of rock will be carried out of Ulriken on conveyor belts.

First and biggest
According to the plan, work will continue constantly without a break six out of seven days a week. One day a week will be spent replacing cutters and other worn parts.

One tunnel has already been constructed through Ulriken, so geologists can study the rock close to the new tunnel so that water leaks can be prevented and difficult sections can be secured with bolts.

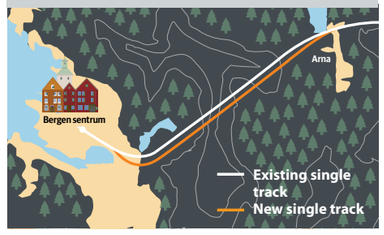
This is the biggest tunnel boring machine used in Norway to date, and the first time a railway tunnel has been drilled using a TBM in this country. The machine being used in Bergen has been named Ulrikke after the mountain, Ulriken.

Advantages of TBMs
Using TBMs has a number of advantages compared with traditional blasting. Electrical tunnel boring means:

- that faster progress can be made, an estimated 15 metres per day on average
- an accurate excavation profile, hence not much surplus extraction of rock masses
- automation of tunnel operation and a more continuous work process
- a better work environment and safety for tunnel workers
- less impact on the surrounding rock and less need for securing
- generally a longer service life than is the case with blasted tunnels
- less noise and vibration, and hence less adverse impact on the surrounding area

Arna–Bergen double track

- Seven kilometres of new railway tunnel will be bored through Ulriken from Arna towards Bergen.
- Sixteen evacuation routes will be constructed between the new Ulriken tunnel and the existing one.
- In order to achieve a transit loop at the east end of Arna station, 764 metres of the main tunnel will be built in the traditional way, with drills and explosives. Two diagonal tunnels will also be blasted between the tunnels, each at 150 metres.
- The existing tunnel, which was completed in 1964, shortened the railway by 16 kilometres and the travelling time between Bergen and Arna by 40 minutes.
- The new Ulriken tunnel will be ready in 2020 if everything goes according to schedule.



The Ulrikke tunnel boring machine:

- built by German company Herrenknecht AG in Schwanau, near the border with France
- owned and operated by contracting consortium Strabag and Skanska
- length: 155 metres, including back rig
- total weight: 1,800 tonnes
- boring head: 9.33-metre diameter, with 62 cutters
- engine output: 5,250 kW
- has equipment for bolting, injection, probing and shotcrete

Projects around the country

Jernbaneverket is blasting, building and improving the railway in many places across the country. Here you can see where the activity is at its peak. There are also a number of smaller maintenance tasks that have not been indicated on the map.

Farriseidet–Porsgrunn:
- Only one-third of the section is out in the open
- One-quarter of the exposed zone is made up of bridges
- Trains will be able to operate at 250 km/h

Ready for railway technology

Seven tunnels of a total length of 15 km and ten bridges of the total length of 1.5 kilometres were built during the construction of new track between Larvik and Porsgrunn.

Nine out of ten bridges have been completed by the end of 2015. All the tunnels for the project have been completed, 37,000 concrete elements providing protection from water and frost have been installed in the tunnels, and all ground-work and finishing work will be completed before the summer of 2016.

The technical railway contracts were awarded in the latter half of 2015. These contracts are divided according to discipline, cover the entire section, and together they are worth just over NOK 600 million.

The project will switch to a new phase when the technical railway works commence in the first six months of 2016. Power and telecom-munications will be first in line, with the track and catenary following hot on their heels. With this, the project is on course for its planned opening in the autumn of 2018.

Farriseidet–Porsgrunn

- Section 22.5 km long
- Involves 65 people, 20 contract staff and 45 permanent Jernbaneverket employees, along with around 549 employees from contractors and consultants
- In December 2015, production had reached around 73 per cent of the cost framework (NOK 5.2 billion)
- Production costs in 2015: approx. NOK 1.5 billion
- Budget for 2016: NOK 980 million
- Cost framework NOK 7.2 billion (2016)
- Completion autumn 2018

Photo: Anne Mette Storvik

Seven tunnels and ten bridges have to be put in place in order to build a double track across the valleys between Farriseidet – pictured – and Porsgrunn.

Photo: Anne Mette Storvik

The construction site at the Nordcem cement facility outside Porsgrunn. Work is taking place very close to existing railway track here.

Photo: Anne Mette Storvik

Assistant construction manager Anders Schulstad tests handrail with integrated emergency light.

From concrete and ballast to steel and cables

The summer of 2015 saw the start of work on the interior of the station hall inside the mountain in Holmestrand when the foundation contractors had finished their work.

The last of the 23,000 concrete elements was installed in the tunnel in January 2015. All foundation contractors completed their work in the first six months of the year. The concrete work was completed, and in November the track-laying machine came along and laid sleepers and rails in the tunnel.

The second half of the year was devoted to work on the steel ceiling of the station hall, weighing a thousand tonnes.

A number of technical buildings and areas were completed, and the power was switched on. All control cabinets, handrails with integrated emergency lighting and signposting in the tunnel were completed. Most of the high-voltage cable and all fibre cable in the tunnel was put in place. Most of the GSMR equipment was installed and work on the signals went as planned.

Holm–Nykirke

- 14.2 km long section
- 12.3 km in tunnel
- Station hall inside the mountain
- 30 permanent employees, 34 contract staff and around 285 people from contractors were employed on the project.
- In December 2015, production had reached around 78 per cent of the cost framework (approx. NOK 4.9 billion)
- Production costs in 2015: NOK 1.156 billion
- Budget for 2016: NOK 975 million
- Cost framework: NOK 6.332 billion (2016)
- Completion November 2016

Photo: Øystein Grue

Intercity trains on the Dovre Line along Lake Mjøsa

Full speed ahead along Lake Mjøsa

The first partial section of Dovre Line double track along Lake Mjøsa opened on 1 December 2015, and work on planning the next stretches is now in full swing.

Three and a half years after the official breaking of the ground in April 2012, 16.75 km of double track between Langset at Minnesund and Kleverud, south of Espa, was finally completed. The first train began using the section at 02.30 on 1 December 2015.

"Standing at Lake Mjøsa in the middle of the night, seeing the train running along fresh rails and the green light of the new signalling system was a special moment. It is fantastic to see, after several years of planning and construction, how everything we had been working towards for so long was finally finished and working exactly as intended," explains Anne Braaten, Jernbaneverket project manager.

One project – three openings
The E6-Dovre Line joint project issued invitations to its official opening on Saturday, 12 December 2015, and Minister of Transport and Communications Ketil Solvik-Olsen was the person to cut the ribbon. This is not the first time the Minister has cut the ribbon for this project. The Norwegian Public Roads Administration and Jernbaneverket shared the task of developing a new motorway and new double track, and December 2014 saw the opening of the E6 with its 21.6-kilometre, four-carriageway road from Minnesund to Labbdalen.

"There is one last opening ceremony pending for the E6-Dovre Line joint project. When the new double track was put into service in December, work immediately began on removing the old tracks and signals in order to create the 18.6 kilometre 'Mjøstråkk' hiking route along the disused railway route. The project is also completing the construction of around 20 kilometres of local roads. We will have completed the last phase in the autumn of 2016 and will then invite people to the final opening ceremony, hopefully with a bike ride on the new hiking route," says Braaten.

The cost framework for the joint project totals NOK 11,964 billion; NOK 5,328 billion for the railway and NOK 6,636 billion for the four-carriageway E6 (figures in whole NOK, taken from the state budget).

More punctual services
From its very first day of operation, the double track has provided an important contribution to more flexible traffic flow on the Dovre Line, which is used frequently by InterCity trains, long-distance trains and – not least – heavy freight traffic.

"But only when we have cohesive double tracks both north and south of the joint project will we really stand to make the major gains," says Braaten.

Prepared for further construction work
Braaten has combined the completion of the joint project with building up the new project organisation for the development of a double track from Venjar to Langset in Eidsvoll and from Kleverud to Sørli in Stange. The aim is for the development plans to be approved in 2016 and for construction to commence in 2018.

13.3 kilometres of double track will be constructed from Venjar to Langset, including a 480-metre long loose mass tunnel (which will be constructed in an open construction trench) and, at 860 metres, the second longest railway bridge in Norway. A 15.8-kilometre double track is planned from Kleverud to Sørli, including a railway tunnel three kilometres long, Norway's longest railway bridge at 1,070 metres and the new Tangen station.

Langset–Kleverud

- Design speed: 200 km/h
- Track: concrete sleepers, rail weight 60 kg/m, with nine point switches on the section
- Catenary: System 25 with auto transformer system
- Signalling system: Thales electronic signalling system with axle counters
- Telecommunications: GSM-R (train radio), TETRA (emergency services communications) and commercial GSM. Fibre cables.

Substantial capacity increase on the Ofoten Line

September saw the official opening of the two new passing tracks at Rombak and Bjørnfjell, increasing the capacity of the Ofoten Line by 30 per cent.

Photo: Njål Svingheim

Work on increasing the capacity of the Ofoten Line reached an important milestone when the two new, long passing tracks were officially opened in the autumn of 2015. Three new tracks with an effective length of more than 1,000 metres have been built at both Rombak and Bjørnfjell. Together with the passing tracks at Katterat and Straumsnes stations, which were completed a few years ago, the capacity of the Ofoten Line has been increased by 30 per cent.

Important for many people
"This is a really important track for both ore traffic and the supply of goods to Northern Norway," said former State Secretary John-Ragnar Aarset at the Ministry of Transport and Communications when the track was opened. "The capacity increase we have now achieved will be very important to huge number of people and is an important step towards a double track on the Ofoten Line in the future," said Aarset.

A year early
The original plan indicated that Rombak would not be put into use until the autumn of 2016, but efficient construction work has made it possible to make use of the passing track a whole year ahead of schedule. Mining company LKAB, by far the biggest user of the Ofoten Line, is paying 30 per cent of the costs for the development of the two new passing tracks. "This capacity increase is absolutely crucial if we are to be able to implement our plans going forward," said Anders Björnström, LKAB's Head of Logistics. The Bjørnfjell passing track was opened to traffic in the autumn of 2014 but was officially opened at the same time as Rombak.

Further work
Work on increasing the capacity is continuing. Preliminary work on the next new passing tracks to be constructed at Djupvik, halfway between Narvik and Straumsnes, followed by the extension of Narvik station, began back in October.

Rombak passing track

- Construction commenced: July 2014
- Opened to traffic: September 2015
- Effective length: 1,067 metres, three tracks (previously 568 metres)
- New underpass beneath the tracks
- New platform for passenger trains
- Cost NOK 395 million
- Blasting and moving of 120,000 m^3 of solid rock
- New catenary system and new external signalling system
- 4,110 metres of new track and five new point switches
- New 50 Hz power supply
- New construction road

Source: Jernbaneverket

In just a few years' time, Ski will be upgraded with a state-of-the-art public transport hub and travel plaza.

Cómo está in Ski

Spanish is being heard more and more frequently in Ski since a Spanish company was awarded one of the turnkey contracts for the Follo Line project, and children in Ski now share their classrooms with pupils from Spain.

More and more foreign contractors are wanting to build railways in Norway, and in the late summer of 2015 it became clear that Spanish company Obrascón Huarte Lain S.A. (OHL) had been awarded the Follo Line contract for development in the little town of Ski. Since then, the contractor has built up its organisation and some staff have brought their families along from Spain.

Globetrotters to Norway
The Follo Line project is now in full swing, working on development from four different construction sites in Oslo and Ski since the contractors set up in 2015. The first of five major turnkey contracts was concluded by Jernbaneverket and Italian company Società Italiana per Condotte d'Acqua S.p.A (Condotte) in February. Later came OHL of Spain, which is now established on a construction site in Kvakestad to the north of Ski.

Many OHL staff have worked at a number of the company's sites all over the world, and some opt to take their families along with them. These families are expected to remain in the Ski and Oslo area until the development work is completed in late 2021.

Pioneering work
Based at Sydhavna in Oslo, the northern part of the Follo Line's long tunnel and a new section for an inbound track on the Østfold Line are being constructed. In September, contractor Condotte began to create two access tunnels for the route to the railway tunnels. Both blasting and mechanical rock breaking were used for this work. There is not a lot of space in Ekebergåsen, and mechanical rock breaking is used when tunnels are bored particularly carefully near to oil storage facilities and other existing infrastructure. This is the first time this method has been used in Norway.

The Follo Line:
- International work environment
- Environmental considerations crucial when selecting TBM
- Boring machines suitable for geological conditions

Heart of the megaproject
The biggest construction site for the Follo Line project is in Åsland, Oslo, and major resources have been invested in the arrangement of this site in 2015. Turnkey contractor Acciona Ghella JV has built up an infrastructure on the construction site and prepared it for handling of stone masses. A range of service facilities are necessary when four huge tunnel boring machines (TBMs) are to be put in place in order to bore 18.5 km of what will be the longest railway tunnel in the Nordic region, totalling 20 km. Two huge caverns in which the four tunnel boring machines will be installed will be completed before Christmas.

Gentler with TBM
The environment and consideration for the surrounding area were vital when choosing to bore the tunnels with TBMs. This method requires only one crosscut tunnel and one rigging area for the Follo Line's TBM section, while conventional blasting would have needed seven crosscut tunnels and rigging areas in areas with pockets of dense population. Using electricity is also making a positive contribution to the environmental accounts, and bored tunnels generally have a longer service life than blasted tunnels.

From the capital city Oslo to a small town
To make space for new railway lines in Ski, Langhusveien has been diverted and Roåsbekken has been placed in a tunnel beneath existing Østfold Line track. Extensive stabilisation of the ground is necessary on account of the ground conditions.

Back in Oslo, a cable tunnel 420 metres long will soon be in place in order to prepare for the work of contractor Condotte. This company concluded its second contract with the Follo Line for work on bringing the new railway to Oslo S. In the same area, archaeologists have found some new contributions to the history of Oslo, including traces of a moat linked with the King's courtyard in what is now known as Middelalderparken, around 120 skeletons in the churchyard of Nikolaikirken, and a very rare 23-carat gold ring.

And Italians with extensive experience of construction work close to archaeological findings in Rome, Florence and Naples are working right next to the excavations.

Photo: Øystein Grue

Italian tunnel specialists are using "Drill & split" – or mechanical rock breaking – to create an access tunnel for the Follo Line in Ekebergåsen from Sørenga. When a boring rig has bored up to 500 holes, what is known as a Superwedge splitter equipped with a wedge of around one metre will be used. This method does not cause vibration, but it is time-consuming; with progress of just one metre a day as compared to 10-15 metres in the case of standard blasting.

- Two new signalling systems approved and commissioned in 2015
- 5,000 km of fibre will be laid along the track
- Nationwide ERTMS before 2030

Photo: Britt Johanne Wang

"One small step for man, one giant leap for Norwegian railways," said Robert Lund on Monday, 10 August last year, when he seated himself behind the levers and drove the first Flirt train on Norway's first ERTMS section – the Østfold Line, Eastern Line.

Norway's biggest digitalisation project

A fibre network 5,000 kilometres long will provide the artery for the digital railway, where more and more technology is being moved away from the track and onto trains.

In 2015, Norwegian railways began using the European software-based signalling system ERTMS for the first time on the Østfold Line, Eastern Line. This initiative is in sharp contrast to the signalling technology that still dominates the rest of the railway network: 80 per cent of Norwegian railways are based on relay technology invented by Joseph Henry in 1835. 150 systems will soon be 50 years old, and it is getting harder and harder to come by spare parts. This is why all signalling and interlocking systems will be replaced by a cohesive ERTMS network by 2030.

European dream

"Communication via fibre forms the foundation for the digital railway. This is why the railway is extending a fibre network that will allow us to use available technology," explains Sverre Kjenne, Director of Signalling and Telecommunications.

Jernbaneverket will also be renting fibre capacity in the near future in order to ensure redundancy.

Kjenne reminds us that Norway is in the fortunate situation whereby the railway has a complete mobile network (GSM-R).

"When we roll out fibre and further improve the GSM-R network as well, everything will be in place for a gradual transition to ERTMS, an increasingly advanced data system that carries with it a European dream: to be able to take the same train set from Italy in the south to Narvik and Bodø in the north," explains Kjenne.

More intelligent trains

"What this modern technology does is remove objects from the infrastructure and place them inside trains instead. The red and green lights are the first thing we will be removing. We will then be replacing the vulnerable system based on track circuits with axle counters," he divulges.

ERTMS makes it possible to maintain full control over all trains at all times, in terms of both position and speed.

"Trains are becoming more and more intelligent, while infrastructure is becoming easier to maintain as we are removing sources of problems from the track. In the next generation of ERTMS (level 3), GPS will be used so that train detection is unnecessary – and the axle counters will disappear."

Starting monitoring

In the short term, it is nevertheless absolutely crucial to reduce the number of infrastructure problems. And in this case, maintenance and renewals are not the only measures necessary. New technology will be an important tool in this regard as well. In 2015, Jernbaneverket devised a programme for monitoring the condition of the infrastructure. The purpose of this monitoring is to detect the onset of faults so as to prevent delays and cancelled services affecting passengers.

"In April 2016, we will be starting to monitor the most critical point switches in order to reduce the number of signalling faults in the most central part of the rail network. We are measuring the power consumption of a number of point machines. We can see straight away when the machines start to use more power or take more time to move points, so we will be able to get out there and rectify the fault before we end up having to stop trains," explains Sverre Kjenne. "In the long term, we are intending to build up a database which will allow us to view more and more of the infrastructure on computer monitors."

Photo: Øystein Grue

The red and green lights currently installed will be removed from the track. With ERTMS, more and more objects will be moved from the track and into trains.

The digital railway

"We are aiming to reach three target groups when we develop IT systems for the railway. First of all, everyone working with the infrastructure will have easy access to updated electronic documentation. Secondly, Jernbaneverket has already done away with lots of paperwork for train company employees by giving them necessary information on portable data devices. Thirdly, rail passengers will be able to view more updated information about their trains in various ways. All this will culminate in the digital railway," concludes Director Sverre Kjenne. – The railway has the biggest digitalisation programme ever!

> "Trains are becoming more and more intelligent, while infrastructure is becoming easier to maintain."
>
> **Sverre Kjenne, Director of Signalling and Telecommunications at Jernbaneverket**

ERTMS

- An abbreviation for European Rail Traffic Management System.
- ERTMS is a data-based system which transmits information and operating permits via the railway's own mobile network to a monitor located in the train driver's cab. This renders external light signals superfluous to requirements.
- ERTMS will modernise rail traffic management and, in the long term, help to simplify tasks related to the maintenance and renewal of signalling systems.
- The system will help to increase safety and speed. It will also pave the way for greater capacity on double-track sections.
- ERTMS will help to simplify the transportation of passengers and freight across national borders and meet joint standard requirements for rail traffic control in Europe.
- The Parliament of Norway has decided to introduce ERTMS in Norway.
- Jernbaneverket has devised the plan for introduction of ERTMS across the entire national network by 2030.

Helicopter scan facilitates planning

The helicopter flies back and forth at low altitude over the ground, carrying a large, circular antenna underneath. This advanced equipment is carrying out electromagnetic surveys which provide information about the ground conditions.

Photo: Anne Mette Storvik

In summer last year, 19 municipalities in the InterCity area were visited by a helicopter which flew along planned and as yet not finalised railway routes. This was the first time such surveys had been carried out in connection with the planning of new railway routes in Norway.

"Electromagnetic surveys of the ground conditions are best suited to areas where no surveys have been carried out previously, and the advantages are that we can map large areas quickly and efficiently," says Toril Wiig, project planning and design manager for the Tønsberg–Larvik section.

She is working on a pilot study in which staff are gathering information and laying the foundation for recommendation of alternative corridors for further investigation.

Mapping quick clay
The results of the helicopter scan, together with standard ground boring, are providing good information about the ground conditions. "The results are giving us some important answers and a basis on which to adjust the corridors in order to make construction work simpler and more predictable. We can see where we have to have tunnels and where we can place open construction trenches," says Wiig.

The surveys provide a rough chart of the surface and how much soil there is over the rock. This information is input in 3D models which the project designers use to plan railway routes.

The surveys also provide some information about the properties of the soil. "There is a lot of clay between Tønsberg and Larvik. We can now identify potential quick clay hazard zones and can take this into account in our ongoing planning," concludes Wiig.

2015:
- The perspective analysis "The railway towards 2050" has been compiled
- The Oslo Hub concept selection report has been compiled

A year of investigations

The majority of track sections have been involved in planning and investigation work in 2015.

All investigations are looking at potential and future development. The purpose is to create as much information as possible for the Government's and Parliament of Norway's 12-year plan for Transport Development, the National Transport Plan (NTP), which will next be presented in the spring of 2017. The transport agencies presented their united essential plan for NTP in February 2016. Most of the investigation work focused on the concept selection report for increased transport capacity to and through Oslo.

From hub to network in the capital
Together with Ruter (the public transport company for Oslo and Akershus) and the Norwegian Public Roads Administration, Jernbaneverket has examined what provision of public transport has to be developed in order to cope with the growth in passenger traffic in terms of public transport, cycling and walking.

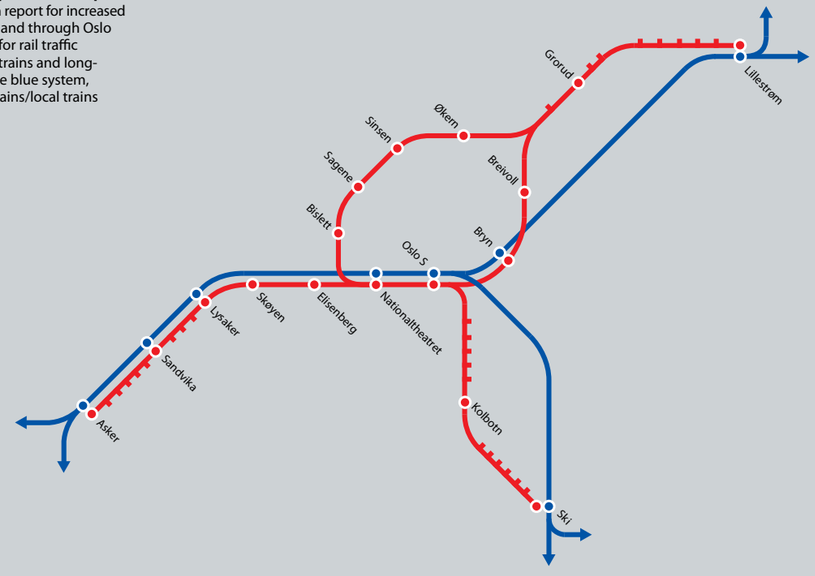
It was concluded that the current service focused on the city centre must be developed to provide a more continuous public transport service with good crossover lines. A new Oslo Metro tunnel, new tram lines and railway tunnels will also increase frequency and capacity.

New tunnels
A new Oslo Metro tunnel from Majorstuen to Bryn via Stortinget will allow five-minute frequencies on Oslo Metro branch lines.

Two new railway tunnels, one from Oslo S to Lysaker via Nationaltheatret and one from Nationaltheatret via Bislett and Økern to the Main line in the Alnabru area, will allow for increased frequencies for both local and regional train services. A new north-south link will connect the suburbs in the north-east and the south with the inner city and Hovinbyen. Local and regional train traffic will have separate systems with fewer operational disruptions. There will also be room for more freight trains.

"Metropolitan line"
Current local trains will be developed to provide a Metropolitan line system. This "Metropolitan line" is designed to serve local markets in Asker, Lillestrøm and Ski. These are high capacity, single-operator trains which run on railway tracks.

The Oslo Hub concept selection report
The concept selection report for increased transport capacity to and through Oslo shows the principles for rail traffic separation. Regional trains and long-distance trains use the blue system, while Metropolitan trains/local trains use the red system.



The Ringerike Line:
- The Ringerike Line may be completed by 2024
- Frequent rail links to and from the Oslo region
- Oslo–Bergen travelling time reduced by one hour

Green light for the Ringerike Line and the E16

The Government has asked Jernbaneverket and the Norwegian Public Roads Administration to start planning the Ringerike Line and the E16 as a joint project. The project organisation was put in place last winter, And the objective is to start constructing both the railway and the road in 2019.

"The Ringerike Line and the E16 will link the Ringerike region with the Oslo region, the tourism centres of Hallingdal will forge closer links with Eastern Norway, and travelling times between Oslo and Bergen will be reduced by one hour," said Prime Minister Erna Solberg when she announced the decision of the Government. The introductory planning work has now been completed, and work on development plans and detailed planning will begin in the first six months of 2016. The Ringerike Line from Sandvika to Hønefoss will be around 40 km long. Double track will be constructed along the entire section, with a new station at Sundvollen. The E16 from Skaret to Hønefoss will involve around 30 km of new, four-lane motorway. The overall project is estimated to cost around NOK 26 billion.

Own project organisation

The objective is to start construction in 2019 and open the road and railway for traffic in 2024. The Government has decided that the project will be developed by means of a state plan. Jernbaneverket has established its own project organisation for the planning and construction of the Ringerike Line and the E16, with Morten Klokkersveen as the project director.

The route for the development planning work will essentially follow the recommended solution submitted by Jernbaneverket and the Norwegian Public Roads Administration. The railway will pass through a tunnel from Sandvika to Sundvollen. There will be a station at Sundvollen in Hole. Both the road and the railway will cross Kroksund and continue on a shared route towards Hønefoss.

Major significance

The plans for a direct rail connection between the Oslo region and Ringerike have existed for more than a century. The Ringerike Line has been discussed by the Parliament of Norway on a number of occasions, most recently in the 1990s. The Ringerike Line will be constructed as an InterCity line and will provide fast, frequent connections between Ringerike and the Oslo area. As a result, this line will pave the way for new housing and establishment areas close to the capital city. The Ringerike Line will also shorten the travelling time on the Bergen Line by almost an hour. Together with the planned improvements to the Voss Line, this will mean a massive improvement in connections between the two biggest cities in the country, and between Eastern and Western Norway.

Route guidelines past Kroksundet, viewed from Kongens utsikt. The road is shown on the far left and the railways nearest to Sundvollen.

Illustration: Nordconsult, Norwegian Public Roads Administration and Jernbaneverket

- Track maintenance time will be used optimally
- Real-time monitoring will ensure faster elimination of faults

Systematic working to enhance efficiency

Jernbaneverket has implemented a wide selection of measures to increase efficiency and improve control over the state of its infrastructure. Its objective is to use its resources efficiently 24 hours a day, irrespective of geography or specialist field.

Photo: Tore Holtet

Lean: Keeping tools in good order permits more efficient working.

Photo: Øystein Grue

Tablet: handheld devices facilitate many tasks.

Photo: Lena Knutli

Digitisation: all technical drawings will be made accessible by digital means.

Better utilisation of long periods of downtime, introduction of set times for maintenance and optimisation of the contingency level for fault elimination have been central elements of streamlining work.

Here is a summary of a few of the streamlining measures worked with in 2015.

Digitalisation of technical documentation
The TekDok project aims to collect, record, verify and digitalise all technical drawings for railways in Norway. This project will ensure that everyone working with technical systems and rolling stock will always have access to updated drawings when necessary. TekDok ensures that we maintain full control over the technical condition of the railway network.

Extensive work on digitalising technical drawings for the Trønder Line, the Østfold Line and the Kongsvinger and Gjøvik Line began in 2015. Training of staff on the Nordland Line North, the Nordland Line South, the Sørland Line West and the Sørland Line East, which will be doing similar work, began at the same time. All technical documentation will be digitalised and verified before the end of 2017.

Better utilisation of track access
Jernbaneverket has implemented measures for more efficient use of time available for maintenance and renewal (track downtime). The planning and registration of track activities will commence 48 months in advance. This will make things more predictable for the train companies and make it possible to implement several activities at the same time. This will also establish guidelines and similar practices with regard to how track access is planned and utilised optimally. Jernbaneverket has also introduced a new function, total downtime owner, who will maintain an overview and control all activities in connection with track downtime.

The rota planning tool GAT will ensure that an overview is maintained and make it easier to control resources in the event of planned downtime. GAT was put into use in the Eastern Region and the Northern Region in 2015. Preparations were also made to start work in the Mid-Norway Region in 2016. The entire Infrastructure division will have commissioned GAT before the end of 2017.

Optimum localisation and contingency team
Defining the boundary between what operation and maintenance tasks Jernbaneverket is to be designed to handle, and what tasks are to be carried out by external railway suppliers has been central in 2015.

Discussions with staff and associations in all regions took place last year. The aim is for representatives of various specialist fields to be cited in the same locations and form part of a joint contingency team. Local management is responsible for the planning and implementation of all tasks. A number of home stations were taken out of use in 2015, and the renewal of larger home stations commenced.

Renewal of the machine fleet
Maintenance section at Jernbaneverket worked on upgrading used maintenance machines and purchasing new machinery last year. The first two multidisciplinary LTR 17s were supplied in the spring of 2016. 40 new standard wagons were ordered to replace end-of-life stock. New machines will help to increase efficiency and reduce response times in the event of incidents on the railway line.

New storage and logistics system
The development of a new purchasing, warehousing and logistics system at Jernbaneverket began in the autumn of 2015, and the system was implemented in January 2016. The new system will permit paperless administration of 120 warehouses all over Norway, with a collective value of around NOK 500 million. Staff at the warehouses will use handheld devices with barcode readers and tablets instead of paper-based picking lists. Digitalising and automating the ordering system aims to achieve more efficient logistics and distribution of equipment across the organisation, while reducing manual sources of error.

Smart maintenance
Jernbaneverket also spent last year working on a project for real-time monitoring of components on point machines, track circuits and heating systems. The aim of this is to identify and eliminate faults before they impact on rail traffic.

Signalling and Telecommunications has devised a roll-out plan for 2016 which includes monitoring 321 point machines, 60 track circuits and 200 heating systems. Central component monitoring work is ongoing in 2016.

LEAN
Jernbaneverket's first Lean project was implemented on the Main Line and the Gardermoen Line, with very encouraging results. The results included an increase in registration in the infrastructure register BaneData, improved multidisciplinary planning of tasks, daily staff involvement in problem resolution, and improvement of "mustering time" in the event of emergency corrective maintenance.

Key activities included standardisation of the appearance of vehicles, warehouses, etc., standardisation of recurring tasks, structuring of leaders' working days, frequent, relevant information for staff and staff-driven improvement groups.

Efficient car ownership
Electronic logbooks were introduced in 823 of Jernbaneverket cars last year. Carpool schemes were also established in the larger mustering locations, and 40 self-owned cars were disposed of.

Upgrading of line capacity and establishment of wireless networks
Jernbaneverket charted network capacity for all its locations. A list of priorities and progress plan were set up for 230 different locations where capacity is to be increased in order to ensure that staff have the same conditions for efficient working whether they are working indoors or outdoors. Some locations will have to replace old copper wiring with new fibre. This project will ensure doubling of capacity in the majority of locations, while some workplaces will see capacity being increased even more.

Mobile device management
The introduction of Enterprise Mobility Management (EMM) for iPad means that staff both indoors and outdoors will have approximately the same user experience and working conditions. This system provides automatic access to wireless networks, Jernbaneverket applications and the intranet, and automatic configuration of work emails. EMM will help to make life simpler and reduce the amount of time required for tasks. This introduction is a step towards meeting information security requirements specified for handheld devices.

- Jernbaneverket had 194 apprentices and trainees working in 2015
- Jernbaneverket's objective is to take on 75 apprentices in 2016

On the right shelf

Jernbaneverket apprentices are far happier in their work and feel they learn more than average. Oddbjørn Larsen is one of them.

When Oddbjørn Larsen, aged 19, needed to get practical work experience of construction machinery, his teacher advised him to submit an application to Jernbaneverket in Støren. He enjoyed this work so much that things snowballed from there, and when he had the opportunity to apply for an apprenticeship, he grabbed it with both hands. Now he knows that he is in the right place, working on the railway.

"I enjoy doing something a bit different. I can't just sit quietly, I like to be out and about," says Larsen.

En echo
For John Kåre Gylland, his supervisor, this is like listening to an echo of himself.

"That was what I thought, too. I have to be out and about. The great thing about it is that even if you do the same thing several days in a row, no two days are alike. I feel privileged to have been able to do a job like this.

Every day is different." John Kåre has more than 40 years of experience throughout the entire Norwegian railway network, including the Ofoten Line, and a little experience in Sweden as well when Baneservice was working in the Borlänge–Falun region. Now his apprentice will be reaping the rewards of his knowledge; especially as regards the track route, track geometry and dealing with temperature and track cutting, but also with regard to all the other jobs a tracklayer has to do.

Swapping roles
There are times when he has to summon Oddbjørn and ask him for help.

"We 'oldies' do not create Safe Job Analyses for routine work. We learned to take care by carrying out small jobs and doing routine work. There is a generational shift in this regard as well. Young people learn how to compile SJAs. I sometimes get told off about it, so I tell Oddbjørn that he has to write the analysis. All the apprentices I have been in touch with have been good at that."

The same is true of the new tools requiring a knowledge of computers.

"It won't be long before we have to produce everything on a tablet. The young people are good at things like that, but it's something we old boys find more difficult. In that case, giving Oddbjørn a shout is easy. With all these young people around I'm not worried about the future and using these kinds of tools, no," says John Kåre Gylland.

Good labour market
This experienced supervisor is absolutely certain that railway apprentices will be attractive on the labour market.

"Employers are definitely keen to take them on. Many of them are crying out for specialists. Personally, I've never dreaded going to work. I've had a good place to work. I hope these apprentices will have the same."

Oddbjørn Larsen is not afraid of being out of work, either. He does not mind whether he gets a job at Jernbaneverket or a smaller company.

"I've already been asked when I'll be qualifying, and that's after being an apprentice for just six months!"

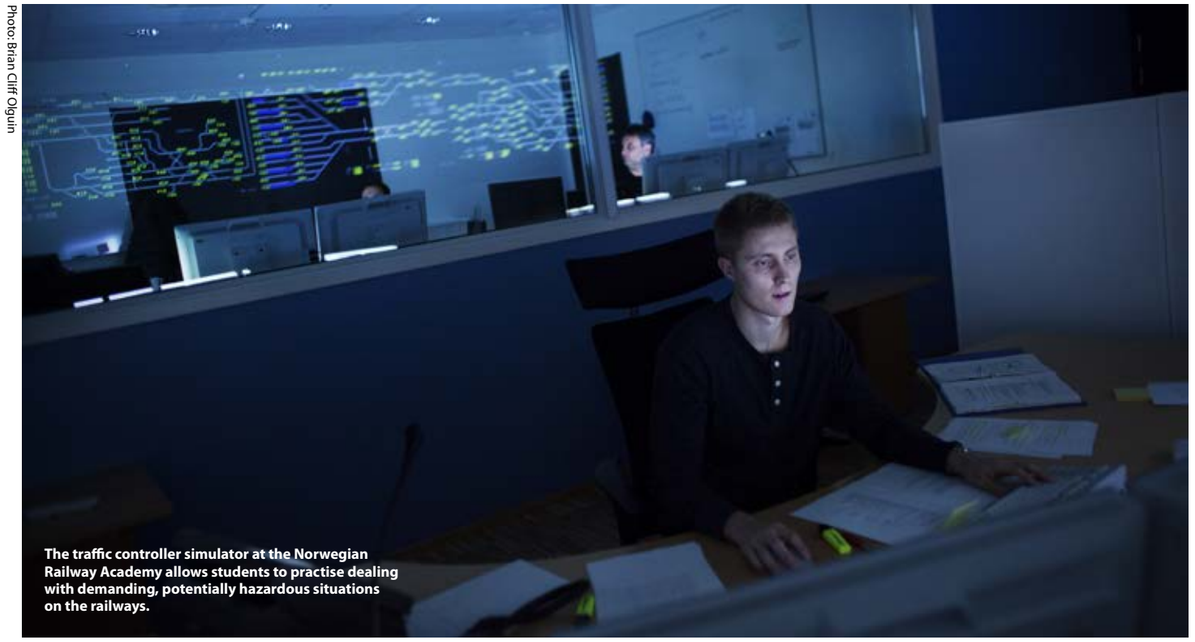
Photo: Arvid Bårdstu

Photo: Arvid Bårdstu

Tracklayer John Kåre Gylland (left) and apprentice Oddbjørn Larsen enjoy working together.

"We have to create safety every single day, and we still have a lot of things to work on."
Elisabeth Enger, Director General of Jernbaneverket

Photo: Brian Cliff Oguin



The traffic controller simulator at the Norwegian Railway Academy allows students to practise dealing with demanding, potentially hazardous situations on the railways.

Safety work bears fruit

The safety culture at Jernbaneverket is strengthened, according to a survey carried out in 2015. Progress has been made in all areas, but there is still a lot to be done.

The survey of the safety culture was carried out by Safetec, and the results show that there is now much greater awareness as regards safety. The report concludes by stating that in 2015, Jernbaneverket is an organisation which acknowledges, far more than it used to, that safety is a dynamic state and has to be created every single day. The same type of survey was carried out in 2010 and 2011/12, so there is plenty of data for comparison purposes.

Encouraging results
The survey in 2010 indicated that Jernbaneverket was an organisation that seemed to be rather complacent. Jernbaneverket employees said they were keen on safety issues, but they did not demonstrate this in practice. On that occasion, Jernbaneverket concluded the survey with no fewer than 21 areas with major potential for improvement – a discouraging result, you could say.

Here are a few important points to highlight from the report following the 2015 survey:
- Overall, Jernbaneverket should be pleased with the work done to reinforce the safety culture since the 2010 survey
- This positive development means that Jernbaneverket is less vulnerable to incidents and accidents and better equipped to achieve its targets
- Jernbaneverket has improved its learning capacity and is hence better at change as well

"The results of last year's survey of the safety culture provide us with some great encouragement going forward," says Elisabeth Enger, Director General of Jernbaneverket.

What has been surveyed?
Here are the ten areas included in the safety survey:
- Expertise
- Cooperation
- Dealing with conflict of objectives
- Compliance
- Incentives
- Organisational learning
- Being alert to risks
- The robustness of the organisation
- Leadership and commitment
- Challenges going forward

In other words, there has been good, clear progress since 2010, but there was also plenty of potential for improvement. This is why it is important to carry on with this work, according to Safetec's comments. Use of the reporting system Synergi as a training tool is one of the fields which still failed to achieve a particularly good result. As a result, Jernbaneverket has implemented a major initiative in order to reinforce the use of Synergi and data from the system in training work across the units and geographical locations. Its objective is to increase understanding and improve attitudes towards the use of reporting tools for safety work.

Not resting on laurels
The Director General of Jernbaneverket reckons it is important to highlight the fact that we are not resting on our laurels and claiming that our targets have been reached, or that we are good enough when it comes to safety. "We have to create safety every single day, and we still have a lot of things to work on," she says.

Photo: Njål Svingheim

Sleeper replacement on the Gjøvik Line

Photo: Esben Svendsen

A new footbridge and barrier system were implemented at Steinberg station on the Sørland Line in 2015.

Safety culture: We are reducing risks

Level crossings present the greatest risk of accidents associated with railways in Norway, and this is why we are constantly working to reduce the number and make them safer.

NOK 75 million on average has been granted for such work over the past couple of years, and 109 safety measures were implemented at level crossings in 2015.

A risk-based action plan for the period 2014 to 2023 ensures that measures with the greatest impact on safety will be implemented first. Close proximity to school routes and the risk of illegal crossing of tracks are some of the situations emphasised when determining the sequence. The plans will be updated in 2016 as part of Jernbaneverket's action programme for the period 2018 to 2021.
Statistics show that motor vehicles were involved in nine out of 10 accidents involving level crossings over the past 24 years. Therefore, the highest priority is given to securing or closing down the 330 or so level crossings with gates used every day by motor vehicles on track sections where trains operate regular services. However, other measures are also included, such as activities for raising awareness aimed at reducing the risk of accidents through information and raising awareness.

Level crossings

- A total of 3,610 level crossings (31 December 2015)
- Around 740 of these are on lines without regular traffic
- Of level crossings on lines with regular traffic:
  - around 1,120 are out of use or on connecting lines which are not used frequently
  - around 250 are not accessible to road traffic
  - around 450 have technical safety measures of various kinds in place
  - around 720 are used in connection with agriculture/forestry
  - around 330 have gates and are used by motor vehicles every day

- 109 safety measures implemented on level crossings
- Lukas the Lion will be turning up at the MiniØya Festival in June 2016 as well

Who will you look after

The majority of accidents on the railway take place when people have to cross the track. This is why Jernbaneverket has taken drastic measures for its work aimed at raising awareness among young people.

Last year, Jernbaneverket continued its work on improving attitudes towards trains and safety among children and young people who live and travel near the railway.

"In 2015, we decided to highlight the risk involved in using headphones while people are out and about," says Maria Dahl, who works with communication on level crossings and safe travel.

"Live images are ideal for capturing the attention of young people. This is why we chose to use film as a way of warning them about wearing headphones when using level crossings," she explains.

The film, which was produced in the winter of 2015/2016, has been titled "Be alert!". This is aimed at young people aged 10 to 18 and will be used for teaching purposes at schools near railways. The question "Who Will you look after?" is asked in the film – and the answer is an encouragement: Start with yourself. This is why the film might be a good starting point for discussions about taking responsibility yourself when you have to cross a railway track.

Photo: Cathrine Riis-Ulsbøl

A real festival lion

The Jernbaneverket mascot went to the MiniØya Festival to teach children about trains and safety.

Lukas the Lion has been developed as a way of talking to children about trains and safety. His most important message is that you have to watch out for trains; take care, do not play at stations, wait behind the yellow line, STOP, LOOK and LISTEN for trains.

Jernbaneverket and Lukas the Lion took part in the MiniØya Festival last year, which was visited by 15,000 children and adults. Jernbaneverket set up a tent where festival attendees could take part in a simple railway quiz and do drawings and colouring in. Lion face painting was also available for the children. Lukas the Lion was popular, and the Jernbaneverket Mascot will be taking part in the MiniØya Festival in Oslo in June this year as well.

Jernbaneverket's educational toolkit includes:

- **Be alert!** A film for children and young people aged 10 to 16, encouraging them to "keep an ear" on the traffic.
- **Stop.Look.Listen** A film for children aged 6 to 10 about dangerous situations when crossing railways on their way to school.
- **Lukas the Lion:** cuddly toy, costume, story and activity book for children. Aids for chatting with children about how to behave safely around railway lines.
- **Shortcut** A film for young people aged 12 to 18 about illegal access to railway lines.
- **It'll never happen to me** A Norwegian version of a Swedish film issued by the Swedish Transport Administration. Various versions of level crossing accidents, with informative graphics on the law, the stopping distance for trains, train weight, etc. Previously used during ATL (Norwegian Driving School Association) driving instruction. Target group 18+.

Photo: Anette Bjonli Rudi/Rambøll

The clarification corridors for further development of double track on the Dovre Line were mapped in the summer of 2015.

Gathering local knowledge from farm owners

When selecting routes for new double tracks, it is important to take into account the local countryside and cultural landscape. And in 2015, Jernbaneverket started using a new method for registering valuable information from farm owners along the Dovre Line who may be affected by ongoing development work.

The relevant farmers in Stange, Hamar and Ringsaker were invited to complete a questionnaire in May 2015 and were then interviewed about natural diversity, cultural heritage and farming on their properties. The aim was to map both potential advantages and disadvantages of the new double track.

A GIS app and iPad were used to directly record the information emerging during interviews and surveys in a digital map. As a result, the data collected can be used easily in future planning.

"Information on local conditions is important when it comes to weighing up the advantages and disadvantages against one another before finally recommending a route for the new double track," says Harald Monsen, planning manager at Jernbaneverket.

"Good communication at an early phase can create win-win solutions for both the railway and the landowners," reckons Monsen. For example, smart positioning of construction roads and spoil landfill may also meet the future needs of both parties.

Lake Mjøsa just as clean as it used to be

The development of the double-track railway and four-lane E6 on the east side of Lake Mjøsa has not led to contamination of the lake.

This is the conclusion of a report compiled by the Norwegian Institute for Water Research (NIVA) on behalf of the project.
The E6-Dovre Line joint project was launched in 2012 and is a partnership between Jernbaneverket and the Norwegian Public Roads Administration. This work could be a potential source of contamination for the ecosystem in the lake, so the condition of Lake Mjøsa was monitored between 2012 and 2014. According to specialist Rolv Anders Systad, who worked on the joint project, NIVA's final report states that the measures implemented have worked and that both the construction teams and the contractors have done a good job.

Photo: Øystein Grue

Pesticide use halved

Pesticides are used on the track to keep it clear of weeds and vegetation, ensuring good track quality. Jernbaneverket's aim is to minimise the use of such agents in order to reduce environmental impact. Spraying according to requirements and targets is the key to reducing pesticide usage.

A new spray train from British company Weedfree on Track Ltd. was commissioned in 2015. This train uses modern technology such as optical reading and computerised, targeted spraying of unwanted vegetation. This avoids spraying in places where a risk of run-off into waterways has been deemed to exist. According to Tore Brynslund of Infrastructure Maintenance, this resulted in halving of consumption between 2014 and 2015.

Photo: Njål Svingheim

The spray train uses technology which ensures that weedkiller is only applied when necessary.

2015 in brief

January

Photo: Tone Yvonne Sundhagen

The Norwegian Railway Academy in Grorud, Oslo, celebrates its 10th anniversary and marks the anniversary of its first cohort of train drivers with coffee and cake in the canteen at the school.

Storm "Nina" moves inward from the coast with its full strength and extends onwards into Norway. This storm causes the closure of track sections in a number of places.

Photo: Erling Akerli

This was what the Ljosanbotn stop on the Bergen Line looks like in January 2015. Ljosanbotn is located in the municipality of Voss.

February

Jernbaneverket and Società Italiana per Condotte d'Acqua S.p.A (Condotte) conclude the first turnkey contract for the construction of the Follo Line project, with a value of approximately NOK 1.2 billion. This contract includes drill & blast and drill & split (without blasting) tunnel work and is one of five turnkey contracts (EPC contracts) for the project.

March

16 March sees the conclusion of the last three major consultancy contracts for section-by-section InterCity planning. And with this, planning on all InterCity sections is in progress.

That same day, Elisabeth Enger, Director General of Jernbaneverket, presents Jernbaneverket's perspective analysis towards 2050. This analysis shows that passenger traffic may be tripled and that more freight traffic can travel by rail if investments are made in increasing capacity.

April

Photo: Trine B. Evensen

More than 400 people travel to Solum, outside Larvik, when the Farriseidet–Porsgrunn project organises an open day on Sunday, 19 April.

Photo: Ronald Holmstrøm

Ketil Solvik-Olsen, Minister of Transport and Communications, highlights the fact that a new, paperless system for providing information about train operations and works on and alongside tracks has been implemented at Jernbaneverket. Jernbaneverket will save around NOK 10 million each year by distributing necessary information to train drivers and others via tablets instead of on paper.

May

Work on further developing the railway station at Oslo Airport begins in late May. The station will be centrally located when a new arrivals and departure hall is completed in 2017.

June

Photo: Freddy S. Fagerheim

Wednesday, 24 June saw the firing of the final tunnel salvo for the Farriseidet–Porsgrunn project in the Eidanger tunnel. With this, seven tunnels of a total length of 15.3 km have been completed after two and a half years of tunnel boring.

July

State Secretary John-Ragnar Aarset at the Ministry of Transport and Communications visits the renewal works at Brynsbakken and Tomter station. As well as bridge renewals, almost 1,200 metres of new double track were built over the course of four busy summer weeks.

August

The Government gives Jernbaneverket and the Norwegian Public Roads Administration the green light to start planning the Ringerike Line and the E16 as a joint project based on a state development plan. The objective is to start constructing both the railway and the road in 2019.

Photo: Anne Rognes

On 17 August, around 800 visitors are welcomed to celebrate the opening of the new Tverlandet stop on the Nordland Line. State Secretary John-Ragnar Aarset gives a speech, and there is a ribbon-cutting ceremony and music to enjoy before the celebration comes to an end with coffee and cake. The new stop provides a news stopping point for the Saltenpendelen service/the Nordland Line and will allow more people to use rail services.

Photo: Ronald Holmstrøm

Towards the end of August, the Minister of Transport and Communications marks the opening of Norway's first ERTMS section on the Østfold Line, Eastern Line. This is an enormous technological step forward for the railway, although the launch is not entirely without problems.

September

Photo: Njål Svingheim

Thursday, 17 September sees the official opening of the two new passing tracks at Rombak and Bjørnfjell by State Secretary John-Ragnar Aarset, increasing the capacity of the Ofoten Line by 30 per cent.

October

Jernbaneverket has entered into a partnership with five other stakeholders in order to reinforce efforts to make construction sites safer. Zero injuries is the target, and the SHA days take place between 13 and 15 October. How best to plan a safe construction site is on the agenda for this event.

Photo: Hilde Marie Braaten

Saturday, 12 December sees the official opening of 17 km of new double track along Lake Mjøsa.

November

The Jernbaneverket trainee programme is now being extended in terms of both numbers and specialist fields as a result of good experience with the scheme. There are now more than 1,450 applicants for 25 places.

December

On Tuesday, 1 December, the Dovre Line is opened to traffic with 17 kilometres of new track along Lake Mjøsa. The winding old single track dating back to 1880 has been replaced with modern double tracks capable of accommodating trains travelling at 200 km/h. The official opening ceremony takes place on Saturday, 12 December, and Ketil Solvik-Olsen, Minister of Transport and Communications, cuts the ribbon.

4 December: 200 guests are invited to a marker 800 metres inside the mountain at the point where the new Ulriken tunnel will be constructed in Bergen. Anna Elise Tryti, Commissioner for Urban Development in Bergen, played godmother and solemnly babtises tunnel boring machine Ulrikke before it is started up.

This year's timetable change comes into force as of Sunday, 13 December. The Drammen Line is opened to traffic between Lysaker and Sandvika, and Stabekk and Høvik stations are reopened after renewal work. Services to Blommenholm station are resumed, and changes are made to a number of other sections as well.

Photo: Øystein Grue

162 years of Norwegian railway history

1854 The first railway line in Norway (Kristiania–Eidsvoll) opens.

1890–1910 1,419 kilometres of tracks are built in Norway.

1909 **The Bergen Line** is completed. The price was the equivalent of an entire national budget.

1938 **The Sørland Line** to Kristiansand opens.

1940–1945 **German forces assume control of NSB** Restrictions on energy consumption give the railway a near-monopoly on transport. The railway network is expanded by 450 km using POWs.

1952 Funds are granted for the **electrification of the railway network** under the motto "Away with the steam" ("Vekk med dampen").

1969–1970 The 1952 electrification plan is completed.

1996 NSB is split into NSB BA and Jernbaneverket.

1999 **The Gardermoen Line.** The first high-speed railway in Norway is a success.

2000 The tragic **Åsta accident,** the third big railway accident in Norway in 50 years, leaves its mark on the railway at the turn of the Millennium.

2004 NSB and Jernbaneverket celebrate the **150-year anniversary of the railway together**

2005 **The largest development project** within Norway, the double track between Sandvika and Asker, opens.

2007 In Jæren, the **Ganddal freight terminal** near Sandnes is completed in December. In total, about 100 development projects worth NOK 2.2 billion were completed.

2008 The Oslo project for the renewal of the railway network through Oslo starts up during the spring. The introduction of a new **travel guarantee scheme** is approved.

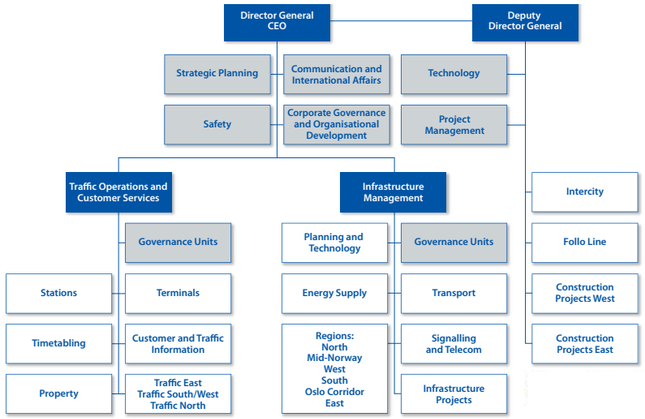
2010 A decision is made to build a dual tunnel in what will become **the longest railway tunnel in Norway** on the Follo Line, the 22 km new double track that will be built between Oslo and Ski.

2012 The punctuality of train traffic is better than for years, with **nine out of ten trains running on time.**

2013 The national transport plan for 2014-2023 is presented, according to which an investment of **168 billion Norwegian kroner will be spent on the railway in the next ten years.**

2014 Full route restructuring allows more trains from December.

2015 The Parliament of Norway undertakes to reform the railway sector in Norway. The Railway Reform comes into force on 1 January 2017.



About Jernbaneverket

Jernbaneverket plans, constructs, operates and maintains the Norwegian railway network and is responsible for traffic control. Among other things, traffic control entails distributing available track capacity to the different train companies, timetabling, train management and public information at the stations. Jernbaneverket is a subsidiary agency of the Ministry of Transport and Communications.

Jernbaneverket is managed by Elisabeth Enger, Director General of Jernbaneverket. In 2013 a new organisation was adopted. From 1 April 2014 Jernbaneverket consists of the following main divisions: Infrastructure Division, Traffic and Marketing Division and the staff of the Director General of Jernbaneverket, as well as the major development projects that report directly to management via the Deputy Director General.

Jernbaneverket employees are spread across much of the country and have a broad range of professional competencies. In Jernbaneverket, you can find dispatchers, traffic controllers, railway fitters, land consolidation graduates, construction managers, architects, geotechnicans, supervisors, environmental advisers, engineers and track coordinators, to mention some of the many occupations represented. As of 31 December 2015 Jernbaneverket employed 4,039 staff, including apprentices.

Photo: Njål Svingheim

The Railway Reform in brief

In June 2015, the Parliament of Norway resolved to reform the railway sector. This reform involves phasing out Jernbaneverket, as we know it today.

Instead a Directorate of Railways and a state railway infrastructure enterprise will be set up, both of which will be owned by the Ministry of Transport and Communications.

The Directorate of Railways will be based in Oslo and will be fully financed via the state budget. The Directorate will deal with overall management and coordination in the railway sector under the leadership of Elisabeth Enger. The work of the Directorate will include dealing with the transport needs of the future, subjecting passenger rail services to competition and defining framework conditions for the company that will own the rolling stock.

The enterprise, which will manage the infrastructure pursuant to the railway legislation, will bear overall responsibility for offering functioning railway infrastructure to the train companies and will bear responsibility for ensuring that it is safe and can be accessed by traffic.

Photo: Øystein Grue

The enterprise will take over ownership of ROM Eiendom AS from NSB AS.

The activities of the enterprise will be managed by means of statutes and governance, and also by means of agreements with the Directorate. The activities of the enterprise will essentially be financed by means of contracts/the purchasing of services by the Directorate of Railways, along with income from the sale of services to train companies, track access charges and income linked with property activities. The Reform will come into force on 1 January 2017.

General Meeting: The Director General of Jernbaneverket notifies Jernbaneverket employees of the status of the reform work.

Key figures for the Norwegian railways as of 31 December 2015

Extent of the railway network

EL	Name of line	Km line, main track [4]	Km double track	Bridges	Tunnels	Level crossings	Stations
●	Nordland Line (Trondheim–Bodø)	729	0	300	155	690	42
■	Sørland Line (Drammen–Stavanger)	546	14	498	190	126	45
■	Dovre Line (Eidsvoll–Trondheim)	475	14	327	42	259	28
●	Røros Line (Hamar–Støren)	384	0	227	6	468	27
■	Bergen Line (Hønefoss–Bergen)	371	0	204	145	172	33
■	Østfold Line, Western Line (Oslo S–Kornsjø border)	169	64	131	17	71	23
■	Vestfold Line (Drammen –Eidanger)	140	23	98	17	102	12
■	Gjøvik Line (Oslo S–Gjøvik)	124	2	73	7	90	22
■	Kongsvinger Line (Lillestrøm–Charlottenberg border)	115	0	62	0	69	13
●	Rauma Line (Dombås–Åndalsnes)	114	0	106	5	179	4
●	Solør Line (Kongsvinger–Elverum)	94	0	31	1	194	0
■	Main Line (Oslo S–Eidsvoll)	68	20	66	5	19	21
■	Østfold Line, Eastern Line (Ski–Rakkestad) [1]	55	0	31	0	57	11
●	Meråker Line (Hell–Storlien)	70	0	47	1	47	4
■	Gardermoen Line (Etterstad–Eidsvoll)	64	60	24	4	0	3
■	Randsfjord Line (Hokksund–Hønefoss) [2]	54	0	22	1	70	2
■	Bratsberg Line (Eidanger–Nordagutu)	47	0	45	20	48	2
■	Ofoten Line (Narvik–Vassijaure border)	39	0	7	23	43	5
■	Drammen Line (Oslo S–Drammen)	41	41	27	11	2	16
■	Arendal Line (Nelaug–Arendal)	36	0	17	3	44	8
■	Roa–Hønefoss Line	32	0	27	3	47	0
■	Flåm Line (Myrdal–Flåm)	20	0	2	21	39	8
■	Asker Line (Lysaker–Asker)	17	17	9	8	1	0
■	Spikkestad Line (Asker–Spikkestad)	14	0	10	0	8	5
■	Tinnos Line (Hjuksebø–Notodden) [3]	9	0	17	5	17	2
■	Brevik Line (Eidanger–Brevik)	10	0	18	0	5	0
●	Stavne–Leangen Line	6	0	10	2		1
■	Alnabru–Loenga	7	0	0	0		0
■	Alna Line (Alnabru–Grefsen)	5	0	6	0	1	0
■	Skøyen–Filipstad	2	1	0	0	1	0
	Total lines with regular traffic	**3,857**	**256**	**2,442**	**692**	**2,869**	**337**
	Side tracks without regular traffic	**352**	**0**	**135**	**44**	**741**	
	Total	**4,209**	**256**	**2,577**	**736**	**3,610**	**337**

■ Electrified ● Non-electrified

[1] The Østfold Line, Eastern Line (Ski-Sarpsborg) has regular traffic to Rakkestad.
[2] The Randsfjord Line, 1630 (Hønefoss) - Bergmoen turning facility does not have regular traffic.
[3] The Tinnos Line has regular traffic to Notodden.
[4] Distance between station centres.

ENVIRONMENT

Environment

	2013	2014	2015
Electricity consumption at Jernbaneverket (GWh) [1]	111	102	100
No. of collisions with animals	2,152	1,447	1,915
Clean stations (percent)	93	94	95

[1] Electricity consumption for operation and maintenance.

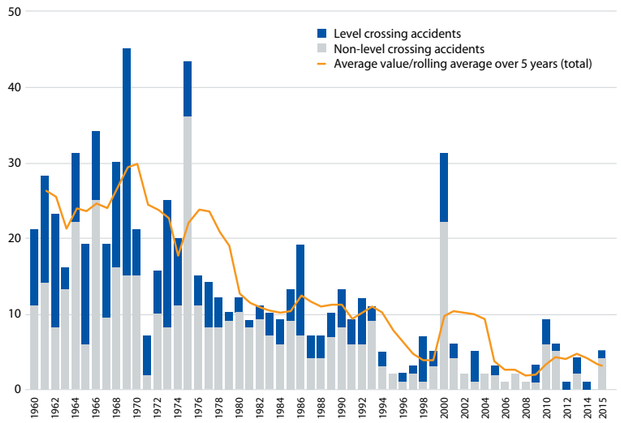
Accidents in 2015 and developments over time

- Accidents by type
- Accidents by the Norwegian Railway Authority's definitions: Train directly involved, cost per incident > EUR 150,000, track closed > 6 hours, fatality or serious injury. Operational railway

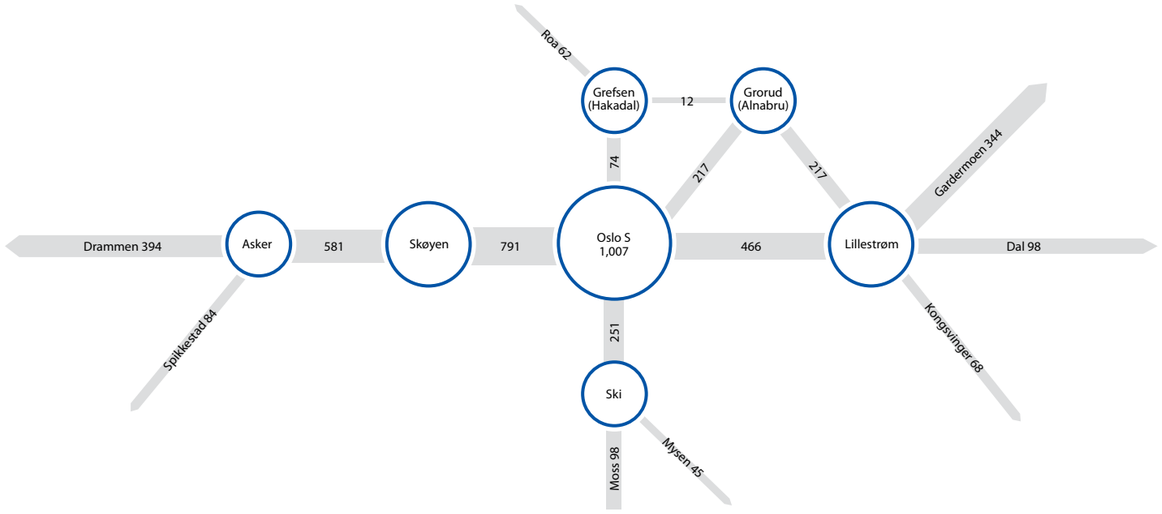
Type of accident	Number of incidents	Fatalities	Serious injuries
Collisions	**9**	**0**	**0**
- Train operations (train – train)	0	0	0
- Train operations (train – object)	9	0	0
- Shunting	0	0	0
Derailments	**4**	**0**	**0**
- Train operations	4	0	0
- Shunting	0	0	0
Level crossing accidents [1]	**3**	**1**	**2**
- Crossings with barriers, lights and claxons	3	1	2
- Crossings with gates	0	0	0
Other level crossing accidents	**0**	**0**	**0**
Rolling-stock fires	**0**	**0**	**0**
Other accidents [2]	**5**	**3**	**2**
Total:	**21**	**4** [3]	**4**

[1] Applies to collisions between road vehicles and rolling stock.
[2] Applies to other accidents resulting in death or serious injury.
[3] Two cases remain subject to police investigation.

Long-term development, fatalities, Norwegian railway 1960-2015



Total number of trains per day in the Oslo area



Million tonne-kilometres [1]

	2010	2011	2012	2013	2014	2015
Domestic transport	**2,157**	**2,089**	**2,775**	**2,346**	**2,366**	**2,415**
Of this:						
CargoNet AS	2,113	2,049	2,034	1,823	1,820	2021
Others	44	40	741	523	546	394
Cross-border transport [2]	**1,065**	**1,367**	**931**	**897**	**1,158**	**926**
Of this:						
CargoNet AS	255	182	111	53	57	59
LKAB Malmtrafikk AS	683	696	737	714	732	691
Others	127	489	83	130	369	176
Total	**3,222**	**3,456**	**3,706**	**3,243**	**3,524**	**3,341**

Source: Cargo Net AS, LKAB Malmtrafikk (Malmtrafikk AS), Tågåkeriet AB, Ofotbanen AS, Green Cargo, Peterson Rail AB, CargoLink AS, Railcare tåg AB, TX Logistikk AB, Grenland Rail, Hector Rail.

[1] Tonne-kilometre: term describing the transport of one tonne of freight over a distance of one kilometre.
[2] Tonne-kilometres calculated on sections in Norway for cross-border transport.

Data from HectorRail AB is missing for 2009-2010, data from CargoLink is missing for 2009-2010, data from TX Logistics is missing for 2013 and 2015, data from Tågåkeriet is missing for 2014.

Million passenger-kilometres [1]

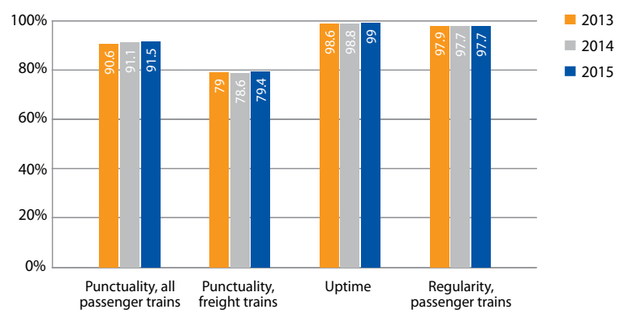
	2010	2011	2012	2013	2014	2015
Domestic train transport	**3,023**	**3,030**	**3,042**	**3,215**	**3,379**	**3,491**
Of this:						
NSB AS	2,668	2,659	2,659	2,805	2,942	3,062
NSB Gjøvikbanen AS	59	61	63	64	66	68
Flytoget AS	286	298	306	330	355	344
Flåm Utvikling AS	10	12	14	16	16	17
Cross-border transport[2]	**71**	**72**	**44**	**44**	**41**	**44**
Of this:						
NSB AS	71	72	44	44	8	8
SJ AB					33	36
Total	**3,094**	**3,102**	**3,086**	**3,259**	**3,420**	**3,535**

Source: NSB AS, NSB Gjøvikbanen AS, Flytoget AS, SJ AB.

[1] Passenger-kilometres: the number of passengers multiplied by distance driven.
[2] Passenger-kilometres calculated on sections in Norway for cross-border transport.

Data for SJ AB's transport work for the period 2005-2013 is included in NSB AS data. Data for Tågkompaniet AB is included in NSB AS data for the entire period.

Punctuality, regularity and uptime



Financial key figures (NOK millions)

Excerpt from cash accounts

	2013	2014	2015
Operation and maintenance	5,429	6,547	7,309
Operation and maintenance, Gardermoen Line	109	107	140
Investments in the line	6,546	9,072	9,823
Grant-funded expenditure	**12,084**	**15,726**	**17,284**
Track access charges	138	163	171
Sale of electricity for train operations	233	198	162
Other incoming payments	492	481	460
Incoming payments to state accounts	**863**	**842**	**793**

Excerpt from accrued accounts

	2013	2014	2015
Total operating revenue	6,614	6,468	6,810
Total operating costs	6,142	6,725	7,123
Total financial items and other items	-6	-7	-10
Results for the year	**466**	**-263**	**-323**
Grant coverage (as a percentage)	84.4	89.2	88.4
Payroll (as percentage of operating expenses)	38.5	36.4	34.9
Full-time equivalent employees, including apprentices	3,837	3,981	4,218

The state accounts are based on cash accounting and follow the classifications in the national budget. The result for the year is in accordance with the accrual principle.

Price level for maintenance and renewals per metre of main track

Track section	Operation, corrective and preventive maintenance (NOK per metre)	Renewals, incl. the Oslo project (NOK per metre)
Main line including the Oslo area	1,826	2,538
Drammen line	977	571
Gardermoen line	707	178
Kongsvinger line	370	385
Gjøvik line	470	828
Østfold line, western line	563	935
Vestfold line	385	195
Sørlandet line	572	818
Bergen line/Randsfjord line	491	745
Dovrebanen	616	917
Røros line	216	200
Nordland line	207	154
Ofoten line	2,124	3,163
Other lines	214	258
Unspecified and Infrastructure Division staff	52	16
2015 average	**536**	**615**

The figures apply to the Infrastructure Division, including Energy, and are partially based on estimated distribution.
The figures are also based on the accruals principle. The figures are not directly comparable to previous years. Among other things, changes have been made to the line sections in connection with reorganisation.

Some of the maintenance work in 2015

Action	Amount	Unit
Ballast cleaning	50	main line km
Preparations for ballast cleaning	50	main line km
Replacing sleepers	127,000	pieces
Replacing track	78	main line km
Replacing points	30	pieces
Contact line renewal	48	main line km
Track adjustment, continuous	1,097	line km