

## NSBs energy project; reducing train energy consumption.

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An energy report in 1994 showed a big potential for energy saving in Norwegian railways. The potential was estimated to be 25 %. In 2002 the report was revised with about the same result. Based on the reports the largest passenger railway operator in Norway, NSB, started working on improving their energy efficiency in 2005. Together with Jernbaneverket (the infrastructure provider) meters were installed onboard the trains, and an energy project was started to achieve both focus and commitment from the management and for establishing facts.

An initial review of NSB's energy consumption was performed. Several focus areas were identified, and potential savings were defined for each of the areas. The energy project was divided into three focus areas, see figure 1, with individual goals for energy savings. These areas were expected to give a combined energy reduction of 15 percent, or about 60 GWh, of the total energy consumption in a period from 2004 to 2008.

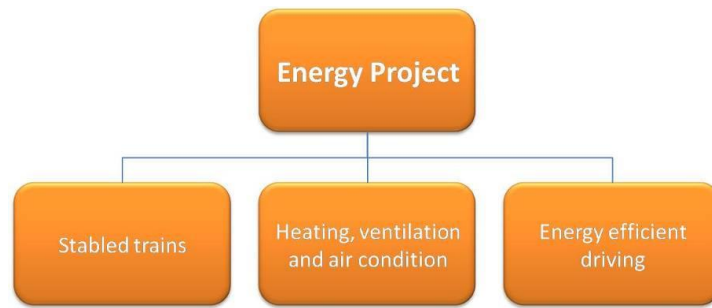


Figure 1: Focus areas in the energy project

Several "energy teams" were established according to NSB's different rolling stock types and given responsibility for finding and implementing solutions in the different focus areas. These teams consisted of technical personnel with responsibility and competence in different areas, on-board personnel and a middle-management representative. This work was led by a consulting firm which was given the role of controlling, documenting and evaluating the progress of the different "energy teams".

The first focus area in the project was stabled trains, where the initial review showed the biggest energy saving potential. Stabled passenger trains were often heated all night, and other unnecessary equipment was never turned off. In Norway, overnight stabling consumed a considerable amount of energy. In 2006 stabled trains accounted for about 20 % of total energy consumption.

Possible solutions for reducing energy consumption were the development and implementation of intelligent control tools for stabled trains or better routines for manual control by personnel. NSB measured and evaluated what they could do for each train type to reduce consumption on stabled trains. There are individual solutions for each type, some manual solutions and some automatic modes. After implementing new solutions NSB needed to get information and procedures out to the personnel and make them aware of the saving potential. So the real challenge was raising awareness among the staff and keeping them motivated.

As NSB now have a good measuring system they are able to see where energy is being wasted because of lack of awareness or procedures being ignored. From 2006 to 2009 the consumption of parked trains were reduced from 20 % to 15 % of the total energy consumption.

The second area of energy reduction was HVAC, heating, ventilation and air condition. Improved climate control was implemented to reduce the energy consumption related to ventilation and heating/cooling of carriages. There were also implemented several measures to reduce the energy consumption such as:

- Labelling switches and temperature controllers
- Standardisation and lowering of the temperature inside carriages
- Improved automatic control of doors
- Predefined stabling modes which automatically reduce heating, ventilation, light etc. (through refurbishment)

On-board personnel also have a large influence on the energy consumption for HVAC. In 2010 a 45 minutes training course for these personnel was started to increase awareness and motivation for energy saving.

The last focus area in project was energy-efficient driving. In 2007 NSB started an energy-efficient driving training course for all drivers which included use of a simulator. Training modules were given in dedicated seminars for new drivers and included as course in the refresher training for existing drivers. This programme was finished in 2009 for existing drivers whilst the programme for new drivers still continues.

The shortest-time driving strategy (maximum acceleration followed by driving at maximum speed and maximum braking before stops) is very energy consuming. Various driving strategies exist that can save considerable amounts of energy at the cost of slightly increased running time by using some of the slack in the timetable. Drivers have to be introduced to these techniques and have to be instructed in how to use them. In these seminars NSB uses a train simulator to show the effect of different driving techniques and important topics is:

- Coasting
- energy efficient driving style (improve driver's skills)
- time-efficient boarding at stations to gain buffer time

The main objective with training programmes is to motivate personnel by showing that their behaviour matters and that they play a major role in successfully achieving NSB's energy saving goals. The use of the simulator shows what drivers can or should do to drive more energy efficiently.

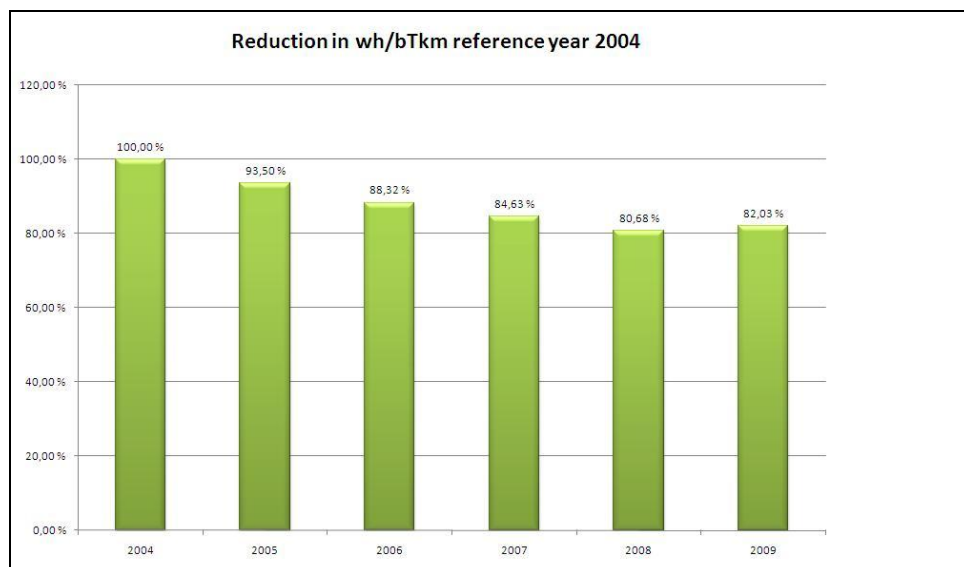


Figure 2: Energy saving

By the end of 2007 NSB reached their goal of saving 15 % of the total energy consumption. At this point they had implemented several technical and routine changes, and a training programme in energy efficient driving techniques had been established. During this period they also went from basing their energy consumption on estimates to basing it on actual energy data collected through the new measurement system.

As the previous project reached its goal early, NSB started a new energy efficiency project in 2008 that is planned to run until 2012. The new project has new targets and objectives, and this time they are based on the actual energy consumption rather than the previous estimates. The new objective is to reduce the energy consumption with an additional 12 % or about 40 GWh in relation to the total energy consumption in 2004. To achieve the new goal NSB is now focusing on energy efficient refurbishment of their trains, energy management, and on a system for monitoring and reporting based on the installed measurement devices in their trains. The complete measurement and reporting system should be fully implemented during the first half of 2010 and is expected to give a reduction in energy consumption of about 6 %. It is expected that the new goal will be more difficult to achieve than the previous one.

In September 2009 NSB conducted a publicity campaign regarding environmental issues. The campaign was aimed both externally and internally and created many local and regional headlines in newspapers and on TV. Internally, NSB produced a version of the UIC brochure “Process, Power, People” called “Energy saving within NSB”, se figure 3.

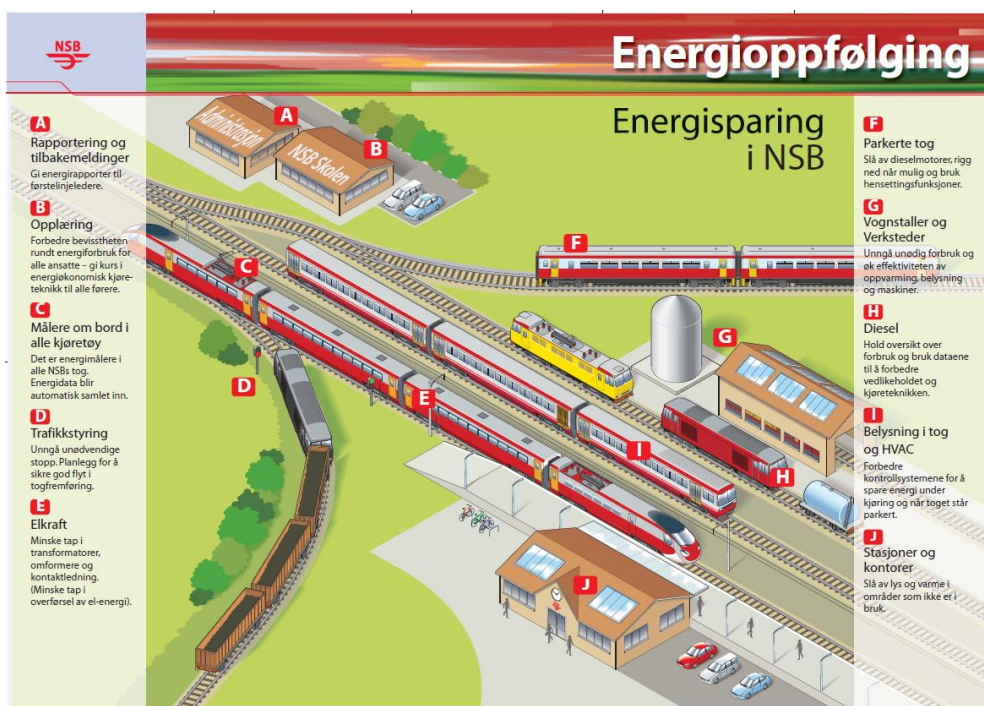


Figure 3: Page 2 of the brochure “Energy savings within NSB”

In 2008 NSB had gained a further 4 % energy reduction, but in 2009 operational problems, delay of the refurbishment projects and a very cold winter resulted in a small increase in energy consumption, about 1 %, se figure 2. The initial work through the energy project has provided NSB with major savings, and a good foundation for establishing the energy management system. As a result of the energy saving project NSB has experienced a gradual increase in commitment to energy saving among train staff.