Features

Sustainable Development Using Environmental Indicators

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The Challenge of Sustainable Development

The 1992 UN Conference on Environment and Development (UNCED), or Earth Summit, in Rio de Janeiro discussed global sustainability in detail; global sustainability means satisfying present needs without reducing the ability of future generations to meet their needs. The present transport system as a whole is not sustainable—the major threat is transport-related emissions of carbon dioxide (CO_2). Other problems are air pollution, noise, congestion, and use of urban space.

Environmentalists have long discussed how to make transportation sustainable, proposing that transport systems should:

- Use land so that there is little or no impact on the ecosystem
- Use renewable energy sources such as sunlight, wind, and water
- Re-use and recycle vehicles and infrastructure components
- Produce only emissions and waste that can be accommodated by the planet's restorative ability

Society is becoming more sustainable in many areas—buildings use less energy, and electricity is generated more efficiently. However, improvements are generally modest, and they are often offset by population growth resulting in the use of more resources and causing more pollution. Railways have a comparative lead over other transport modes, but the gap is closing. This is another reason why railways must make progress in environmental protection.

Environmental Reporting as First Step Towards Sustainability

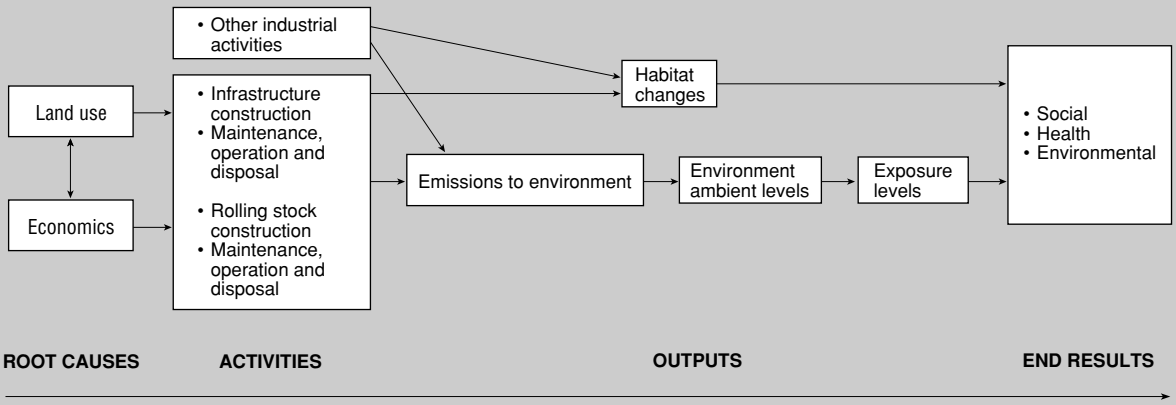
Figure 1 shows the causes and effects of transport activities. Transport affects all aspects of the environment (air, water and land) over the entire system life-cycle from construction to disposal.

How can railways pave the way towards a more sustainable form of development? Changes are required in monitoring and reporting practices. There must be a switch from merely describing the environment and related problems, to monitoring changes and trends and, above all, to providing assessments and reports justifying the modifications in production and consumption patterns; this is known as environmental reporting.

Environmental reporting has become the main channel for companies, especially railways, to communicate their philosophy, objectives, practices and achievements in relation to traditional, new, and emerging environmental management issues. It will become a competitive and strategic dimension for all businesses, and is also inextricably linked to the expanding range of environmental management tools, such as auditing, life-cycle assessment and full-cost accounting, not to mention external environmental costs. As a result, it is very likely that environmental reporting will play a key role in reaching the ultimate goal of sustainable development.

Environmental reporting looks at the interplay between three core areas of environmental management: responsibility, accountability, and sustainability. The United Nations Environment Programme

Figure 1 Causes and Effects of Transport Activities



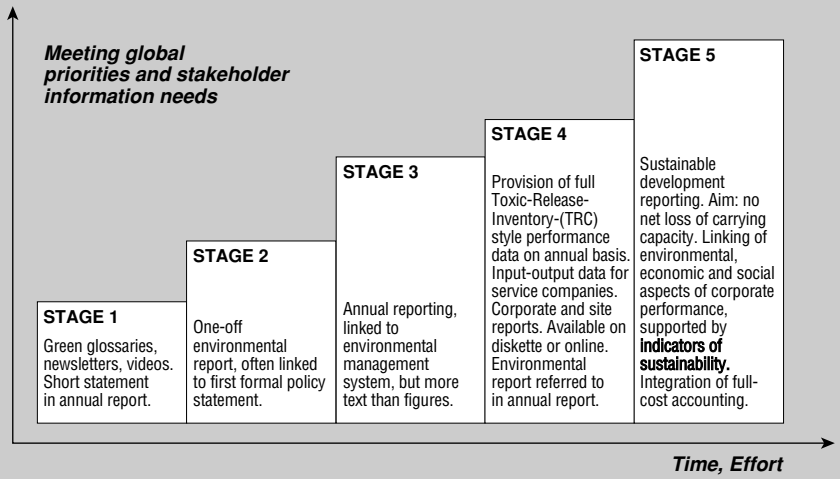
Source: Modified from Indicators of the Environmental Impacts of Transportation (Policy, Planning and Evaluation 2126) United States Environmental Protection Agency

(UNEP) classified annual and ad-hoc environmental reports across a range of industrial sectors into five stages (Fig. 2). The long-term objective of all companies should be stage 5, which is based on extensive use of quantitative methods (such as life-cycle assessments and mass balances) and on strong links with industry-wide and national sustainable development reporting set against agreed targets.

Most railway businesses have only started environmental reporting in recent years in response to growing environmental awareness. Their reports are generally at stages 2 and 3 in which annual reporting is linked to the environmental management system, but is more qualitative description of aims rather than quantitative results.

Banestyrelsen, the Danish National Railway Agency (an infrastructure company created in 1997), has the most advanced environmental reporting system in Europe. It publishes an Annual Green Statement (Fig. 3) on consumption and emissions (inputs and outputs). Along with the financial report, environmental reporting provides a valuable new tool for judging the effectiveness of company management. The Green Statement indexes the annual inputs and outputs against 1995 as the baseline. It uses life-cycle assessment which even incorporates disposal. However, accurate life-cycle assessment is very difficult. For example, disposal of nickel-cadmium batteries, metals and used oil, is hard to monitor, and many rolling stock, etc., are sold or exported.

Figure 2 Stages in Corporate Environmental Reporting



Source: Company Environmental Reporting, Technical Report No 24, UNEP

Environmental Indicators

Environmental reporting is based on indicators expressing the magnitude or severity of environmental damage caused by transport systems. Figure 1 shows a framework for selecting environmental indicators, which can measure the root causes (such as land use changes), the activities themselves, the outputs of these activities (such as emissions), and the actual results (such as changes in public health). This makes it possible to clarify trends over time (Fig. 3). Environmental indicators are very powerful policy tools and should help decision makers, scientists and the public understand and take into account environmental results. Furthermore, the results must be published in corporate reports, a step that will require fundamental changes in accounting practices.

Figure 1 also shows that unrelated activities, such as industrial operations, contribute to total emissions, making it difficult to isolate the impact of transport in cases where indicators measure ambient pollution levels, or public health, etc.

The Environment Working Group of the International Union of Railways (UIC) tries to integrate measurement of indicators at all levels of its work programme. Some quantitative indicators, such as energy consumption, noise emissions, and herbicide use, are relatively easy to obtain for tracking the environmental impact of rail transport.

Energy Consumption

Energy consumption is a prime concern. Emissions from combustion of fuel depend on the type of fuel and quantity of energy, which in turn, depends on fuel efficiency. Trains use diesel or electric power. Although electric trains are clean and do not cause air pollution directly, the facilities for generating electricity often use non-renewable energy resources (coal, oil and natural gas). Their combustion products pollute the air as well as the ground and water.

The degree to which operation of electric rail transport contributes to total atmospheric pollution depends on the fuel used to generate the electricity. Although air pollution from nuclear and hydroelectric power stations is minimal, coal and other fossil-fuel power stations emit large amounts of nitrogen and sulphur oxides (NOx and SOx), and particulates, as well as smaller amounts of carbon monoxide (CO), volatile organic compounds (VOCs), and lead (Pb). Sulphur dioxide from these stations is a major cause of acid rain.

Figure 3 Banestyrelsen Annual Green Statement 1996

Environmental performance indicators are useful to enable reasonable judgements on the success of environmental management activities. Like financial accounting, the Green Statement considers inputs and outputs of selected parameters. By using an index, the environmental changes from one year to another are clear. However, since this is the first Green Statement, it has not been possible to calculate indexes for all parameters.

Consumption (inputs) –selected parameters	Unit	Quantity 1996	Index 1996	Index 1995
Energy and water consumption				
Electricity, fixed installations	MWh	11,524	97	100
Heat, fixed installations	MWh	9,810	103	100
Diesel, work vehicles	litre	420,337	–	–
Petrol, cars and vans	litre	771,683	–	–
Water	m^3	34,549	–	–
Chemical products				
Pesticides (glyphosate)	tonne	4	101	100
Urea	tonne	26	–	–
Raw materials				
Broken stone	tonne	76,356	–	–
Wood for sleepers	tonne	859	–	–
Iron for rails, new	tonne	7,284	66	100
Iron for rails, recycled	tonne	5,092	91	100
Concrete for sleepers	tonne	22,288	109	100
Overhead wire, etc.	tonne	239	86	100
Steel for overhead masts	tonne	240	41	100
Cables with PVC	tonne	18	48	100

Emissions (outputs) –selected parameters	Unit	Quantity 1996
Atmospheric emissions, fixed installations		
CO_2	tonne	10,255
NO_x	tonne	25
SO_2	tonne	34
Atmospheric emissions, petrol for cars		
CO_2	tonne	1,853
NO_x	tonne	10
SO_2	tonne	0.2
HC	tonne	17
CO	tonne	103
Particulates	tonne	0.1
Waste		
For special treatment	tonne	2,878
For incineration	tonne	516
For disposal	tonne	37,123
Recycled	tonne	73,329
(incl. from track maintenance)	tonne	70,608

Source: Banestyrelsen (1997)
The data are from very different sources; some were obtained from the internal registration system and others are from financial records or from suppliers.

Discharge of cooling water from nuclear, and fossil-fuel power stations causes thermal pollution of rivers and coastal regions and can have a substantial adverse impact on aquatic chemistry, habitat, and species diversity. Hydroelectric power stations affect the flow and temperature of rivers by holding water in reservoirs. To better evaluate the environmental impact of railways, from 1997, the annual UIC statistics provide data on their energy consumption and primary energy source.

Noise Pollution

In addition to energy consumption, noise is an important criterion in assessing the environmental impact of railways. In Europe, reducing noise is a main task in railway development. Some railways are already monitoring noise in response to the growing awareness of its adverse effect on health and quality of life, but cutting noise to the legal levels is very costly.

In Switzerland, a cost-benefit model has been used successfully to determine the optimum deployment of noise control measures, and it is planned to extend this model to all of Europe. An important aspect is the ability to calculate the costs of the different measures and to determine their benefits in terms of noise reduction for local residents. Noise control measures at source (active noise abatement) are cheaper than noise control barriers along the line (passive noise abatement). As a rule, the control methods consist of a mix of improvements to rolling stock and use of noise barriers, providing the most economic option.

The UIC is planning a European-wide project to change cast-iron brake blocks on freight wagons to the quieter composite brake blocks. This requires fitting new rolling stock with composite brake blocks (K-blocks) and retrofitting existing rolling stock with so-called LL-blocks that generate less noise.

Herbicides

A third major concern is the use of herbicides to control weeds on tracks. In the future, railways will be confronted increasingly with:

- National bans on use of herbicides acting through plant roots
- A general ban on use of herbicides in

protected areas (e.g. near water)
- High ecological taxation

In June 1998, the Second Conference on Weed Control took place under the auspices of Swiss Federal Railways (SBB), German Railways (DB AG), and UIC. It concentrated on non-chemical weed control methods such as embankment design using competing vegetation, and the use of 'sprout-unfriendly' macadam ballast and an asphalt layer under the ballast. In addition to exchanging information, the objective was to propose a research programme within the UIC Infrastructure Commission because more railways are being forced to reduce their herbicide usage. Four major topics emerged as a result of a questionnaire to the railways and the above conference:

- Investigation of whether all plants growing in the track bed cause damage to the track characteristics
- Cost-benefit analysis of different weed-control measures (especially alternative measures) on existing and new tracks
- Optimizing the effectiveness of alternative weed-control measures
- Communication strategies within UIC and between railways for disseminating information on environment-friendly weed control

The Annual Green Statement (Fig. 3) includes the quantity of all chemical products used, and the UIC is encouraging its members to monitor total annual herbicide use.

Delinking Traffic Growth and Environmental Damage

Sustainable transport requires railways to meet two fundamental requirements—to increase traffic while reducing environmental impact. To achieve this aim, policy-makers must understand the key causal factors in environmental impact. Most importantly, understanding the key factors will help formulate policies to control the parameters determining the magnitude of the impact.

Successful management depends largely on the structure for environmental reporting and the people who implement it. The final goal must be to break the link between increasing railway activity and resulting environmental impact. ■

Freight train of SBB passing through beautiful natural scenery of St Gotthard Pass near Wassen *(EJRCF)*

Gunther Ellwanger

Dr Gunther Ellwanger joined DB in 1970 and was involved with planning the Mannheim-Stuttgart high-speed line. From 1979 to 1983, he was responsible for PR in connection with new DB high-speed lines. After 3 years as Manager of the Chairman's Staff for the DB Stuttgart region, he became head of the Transport and Corporate Policy Department at DB Headquarters in Frankfurt handling deregulation, EC topics, corporate environmental matters, etc. He was Director of the High Speed Division from 1991 to 1995 when he was appointed Director of the Economics and Environment Division for UIC Headquarters in Paris.

Stella Lindeke

Ms Lindeke has a Bachelor's degree in Environmental Chemistry from the University of Edinburgh. Before joining the Economics and Environment Division of UIC in 1997, she worked for the Federal Environmental Agency in Berlin and for a private company in the fields of environmental remediation and waste treatment.