

Promoting sustainability in New Zealand's rail system

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An important note for the reader

The NZ Transport Agency is a Crown entity established under the Land Transport Management Amendment Act 2008. The objective of the NZ Transport Agency is to undertake its functions in a way that contributes to an affordable, integrated, safe, responsive, and sustainable land transport system. Each year, the NZ Transport Agency invests a portion of its funds on research that contributes to this objective.

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The material contained in this report is the output of research and should not be construed in any way as policy adopted by the NZ Transport Agency but may be used in the formulation of future policy.

Additional note

The NZ Transport Agency (NZTA) was formally established on 1 August 2008, combining the functions and expertise of Land Transport NZ and Transit NZ.

The new organisation will provide an integrated approach to transport planning, funding and delivery.

This research report was prepared prior to the establishment of the NZTA and may refer to Land Transport NZ and Transit NZ.

Abbreviations and acronyms

ARTA	Auckland Regional Transport Authority
CBA	Cost-benefit analysis
CPTED	Crime prevention through environmental design
DEFRA	Department of Environment, Food and Rural Affairs (UK)
EECA	Energy Efficiency and Conservation Authority
EMS	Environmental Management System
ERRAC	European Rail Research Advisory Council
ETS	Emissions trading scheme
GPS	Government Policy Statement on Land Transport Funding
LGA	Local Government Act 2002
LTA	Land Transport Act 1998
LTMA	Land Transport Management Act 2003 (amended 1 August 2008)
LTCCP	Long-term council community plan
MoT	Ministry of Transport
NIMT	North Island Main Trunk Line
NRAA	National Rail Access Agreement
NRS	National Rail Strategy to 2015
NZ Rail	New Zealand Rail Limited (1990 to 1993)
NZEECS	New Zealand Energy Efficiency and Conservation Strategy
NZES	New Zealand Energy Strategy
NZRC	New Zealand Railways Corporation
NZTA	New Zealand Transport Agency
NZTS	New Zealand Transport Strategy
RLTS	Regional Land Transport Strategy
RMA	Resource Management Act 1991
RMTU	Rail and Maritime Transport Union
RSSB	Rail Safety Standards Board (UK)
RTC	Regional Transport Committee (amended by LTMAA 2008)
SDSF	Strategy for Domestic Sea Freight
SOE	State-owned enterprise
TAC	Track access charges
TAIC	Transport Accident Investigation Commission
TDM	Travel demand management or transport demand management
TMIF	Transport Monitoring Indicator Framework

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Executive summary

The movement of goods and people makes an essential contribution, both directly and indirectly, to the high standard of living enjoyed by New Zealanders. Transport accounts for approximately 44% of New Zealand's energy use and is a vital component of the national economy. Traditionally, the importance of transport as a key requisite for economic development has been well recognised, both in terms of the actual economic costs of transport infrastructure and in terms of the role that it plays in facilitating further economic development.

Increasingly, however, other drivers for transport systems have emerged, most notably environmental sustainability, but also safety, personal security and public health. The focus on environmental sustainability has primarily been promoted by a growing recognition that transport systems can have significant negative impacts on the environment in addition to the positive benefits they provide. One of the most frequently cited of these environmental impacts is greenhouse gas emissions. However, this is just one of many environmental impacts of the construction and operation of transport systems.

The long-term sustainability of transport systems in terms of their resource use and environmental impacts is increasingly being considered in transport decision making. In particular, the level of transport use and energy used in transport systems is being taken into account. As a result, traditional transport and land-use paradigms are increasingly being re-examined and alternative transport solutions to road transport are being (re)considered as part of this paradigm shift. One such transport solution, for the movement of both goods and people, is rail.

Rail has a long history, pre-dating the private motor vehicle and the transport of freight by road. In many countries, particularly in Europe, North America and Asia, rail is increasingly being (re)employed as a transport solution. One of the main drivers for this 'rail renaissance' has been an awareness of increasing energy constraints. The benefit of moving goods and people using less energy and at lower cost has been recognised from an environmental and an economic perspective. Many countries, including New Zealand, have recognised the importance of decoupling economic growth from energy consumption as much as possible.

This research investigated how the sustainability of New Zealand's rail system could be promoted. In this regard, sustainability aspects were considered in two contexts:

- internal to the rail system (systemic)
- external to the rail system (non-systemic).

The key objectives of this research were to:

- examine what sustainability means in the context of New Zealand's rail system
- identify opportunities and barriers to achieving sustainable outcomes in New Zealand's rail system, including:
 - non-systemic barriers and opportunities
 - systemic barriers and opportunities
- identify, where possible, initiatives for addressing barriers and realising opportunities.

The study was based on information gathered from a review of New Zealand and international literature, an analysis of transport policy and legislation, and interviews with 10 key

stakeholders. The information gathered was analysed and 18 key sustainability issues were identified and grouped into five sustainability themes, namely:

- governance and funding
- integration
- social considerations
- natural environment
- infrastructure.

Each of these themes was examined by looking at the opportunities and barriers that existed for promoting sustainability. This included an analysis of key objectives relating to each theme. Opportunities and barriers for moving from the current position to the desired objectives were then explored.

Perspectives on what sustainability meant for the rail system varied. Stakeholders placed a high emphasis on the economic sustainability of the rail system or what could be regarded as the long-term commercial viability. In contrast, economic sustainability was not a strong feature of the literature and policy reviews. In these areas, the environmental and social aspects of sustainability featured much more strongly.

The key findings were that rail has a lot of inherent advantages from a sustainability perspective. In particular, these related to energy efficiency, greenhouse gas emissions and land use. As such, the research found the greatest opportunity for promoting sustainability in the rail system would be for rail to make up a greater proportion of the national transport task, particularly for freight. While it was noted that over the last 15 years the volume of freight moved on the rail system had increased, there was a common belief that the rail system still had significant additional capacity that could be utilised. Taking advantage of a currently under-utilised rail system was widely raised by stakeholders as one of the greatest opportunities. It was also frequently noted that, in many cases, the costs of utilising the existing additional capacity of the rail system would likely be significantly less than the alternatives. In short, most stakeholders believed that the economic benefits of making greater use of the rail system, particularly for freight, were just as great as the environmental benefits.

In terms of environmental benefits, it was found that issues relating to energy efficiency and climate change provided two of the most pertinent drivers for increasing the use of the rail system. In this regard, there was considerable discussion around the possibility of utilising alternative traction methods such as electricity, biofuels or hydrogen. These technologies provide an exciting opportunity to create a decarbonised rail system. It is anticipated that by 2040 total freight volumes will be 2.2 times greater than at present. Based on current predictions and policy objectives this would see an increase in freight volumes for rail of 2.9 times, 1.6 times for road and 3.7 times for coastal shipping. It was suggested by most stakeholders that the greatest contribution rail could make to decreasing greenhouse gas emissions from the transport system would best be achieved by promoting modal shift from higher emitting alternative modes rather than immediately focusing on alternative traction methods.

In order to achieve this modal shift an improvement in the performance of the rail system is required, particularly in terms of the frequency, reliability and speed of services as well as cost and accessibility to freight customers. Although an immediate focus on improving this

performance is recommended, it is recognised that in the longer term (beyond the next 15 years), a decarbonised rail system could realistically be achieved. At the moment, however, some rail systems in Europe are not pursuing electrification in anticipation that methods such as biofuels and hydrogen will become economically viable in the future.

Many of the findings and recommendations relate to increasing the consideration of rail as a component of New Zealand's transport system. Many of these discussions make comparisons between different modes, notably rail and road. The research is not intended to advocate rail at the expense of other modes but rather to understand the economic, environmental and social aspects associated with various transport options. Similarly, although many sustainability advantages of rail over some other modes were highlighted, it is recognised that the rail system needs to continually seek to improve its environmental performance.

It should be emphasised that the research findings are based on the opinions of the stakeholders interviewed and a selection of the international literature. It is expected that the research will contribute to the ongoing debate on the role of rail in New Zealand's transport system into the future. Although perspectives on many of the issues raised will inevitably vary, it is considered that this debate is highly necessary and should be welcomed by all those with a stake in New Zealand's transport system.

Key findings and recommendations

The most significant opportunities for promoting sustainability in New Zealand's rail system are:

- increased use of the rail system, particularly for the transport of long-distance freight
- under-utilised network capacity on many rail lines
- a focus on improving access to the rail network for existing and potential freight customers, possibly through the increased use of branch lines and sidings
- much closer integration of rail (and transport) planning with land-use planning and a recognition that railway stations can act as focal points for communities
- the development of transport decision-making processes that take into account all externalities associated with transport modes
- longer term, the rail system could be operated on renewably generated electricity or alternative non-carbon based energy sources such as hydrogen or biofuels.

The most significant barriers to promoting sustainability are:

- the rail system is currently underperforming and is not providing adequate levels of service to satisfy the demands of some potential users
- rail continues to be seen as a discrete industry, rather than as a component of a wider transport system
- many of the benefits that rail can provide from a sustainability perspective are not well factored into current transport decision-making and funding processes
- a lack of adequate investment in the rail system, required to address a widely recognised infrastructural deficit
- perceptions of rail as a mode of transport and perceptions of the rail industry

- concerns over labour supply and market expertise to undertake required revitalisation work.

The research makes 13 recommendations. The most significant relate to:

- improvements to the performance of the rail system aimed at increasing its use
- improving the accessibility and viability of rail as a transport choice for potential users, particularly for freight users
- relationships and responsibilities between rail organisations, local government and central government
- the degree to which externalities (particularly social and environmental) are accounted for in transport planning and funding decisions
- the current and future capacity of the rail workforce, including recruitment and retention issues
- the ongoing monitoring of the environmental performance of the rail system.

The report concludes with a number of suggested sustainability indicators assembled to measure progress on the sustainability aspects identified in the research. It is suggested that these be incorporated into the existing Transport Monitoring Indicator Framework.

Abstract

This report presents the findings of research investigating the opportunities and barriers to promoting sustainability in New Zealand's rail system. The research involved two main aspects: exploring what sustainability means in a New Zealand rail context; and, investigating what opportunities and barriers might exist to achieving a sustainable rail system. Opportunities and barriers were considered in terms of their likely timescale and whether they were internal (systemic) or external (non-systemic) to the rail system.

The research is intended to stimulate discussion about the role of rail in New Zealand's transport system in the future. As part of this ongoing discussion, this report concludes with a number of recommended actions that could be undertaken to promote sustainability in the rail system.

1 Introduction

1.1 Background

New Zealand's transport sector has undergone significant reform over the last decade. One of the most significant aspects of these reforms has been the incorporation of the concept of sustainability as a core focus for the land transport sector. The purpose of the Land Transport Management Act 2003 (LTMA) is to contribute to 'an affordable, integrated, safe, responsive, and sustainable land transport system'. Similarly, the long-term vision for transport, as outlined in the New Zealand Transport Strategy (NZTS), is that by 2040 'People and freight will have access to an affordable, integrated, safe, responsive and sustainable transport system' (MoT 2008b).

Although sustainability is now well established as a guiding principle for transport planning in New Zealand, its practical realisation has proved to be elusive. In part, this is reflective of the long timeframes associated with transport planning and transport infrastructure, but it is clear that sustainability has yet to be genuinely enshrined as a core principle of public and private decision making in the transport sector. A 2007 review of the transport sector (Next Steps review) suggested that there remains considerable progress to be made in achieving a sustainable transport system (SSC 2007). It was noted that the translation of the core objectives of the NZTS into transport policy and projects has been particularly challenging. These core objectives are:

- ensuring environmental sustainability
- assisting economic development
- assisting safety and personal security
- improving access and mobility
- protecting and promoting public health (MoT 2008b).

One of the main factors identified as inhibiting the achievement of a more sustainable transport system was a continued lack of integration between transport modes, notably road, rail, public transport and coastal shipping. Similarly, it was noted that rail currently sat largely outside the land transport sector when it came to the planning and funding of the sector. As such, it is doubtful that rail is contributing to New Zealand's transport system as fully as it potentially could be. This provided the underlying stimulus for the research, that is, investigating how rail could contribute more fully to achieving a sustainable transport system for New Zealand and investigating how the sustainability of rail as a mode could be improved.

In this regard the term 'sustainability' is used in two main ways:

Internal to the rail system (systemic): The aspects of rail that give it advantages over other modes in terms of sustainability and what can be done to further improve these advantages.

External to the rail system (non-systemic): The opportunities that rail potentially presents for assisting in creating a more sustainable transport system.

To date, the concept of sustainability has not been widely applied to the rail system in New Zealand and there has been no research specifically analysing the rail system from a sustainability perspective. Consequently, many areas of uncertainty and differences of opinion were revealed during the course of the research. The research does not present a

definitive statement of how the rail system should be developed to improve sustainability, but rather it is hoped that it will stimulate a wider, ongoing and reflective discussion about the role of rail in creating a sustainable transport system for New Zealand.

1.2 Purpose of the research

This report presents the findings of research into sustainability within the rail system in New Zealand.

The key objectives of this research were to:

- examine what sustainability means in the context of New Zealand's rail system
- identify opportunities and barriers to achieving sustainable outcomes in New Zealand's rail system, including:
 - shorter-term, non-systemic barriers and opportunities
 - longer-term, systemic barriers and opportunities
 - initiatives for addressing barriers and realising opportunities.

The research was informed by a review of the New Zealand and international literature, analysis of relevant legislation and policy, and interviews with key rail and transport officials and stakeholders.

The research was undertaken between May and December 2008 as part of the NZ Transport Agency's 2007/2008 Research Programme.

1.3 Structure of this report

This report is structured as follows:

- Chapter 1 outlines the purpose and objectives of the research.
- Chapter 2 outlines the structure of New Zealand's rail system and describes New Zealand's current legal and institutional arrangements relevant to rail and transport.
- Chapter 3 outlines the methods used to undertake the research.
- Chapter 4 explores the concept of sustainability both in terms of how the concept has emerged, and how sustainability relates to rail in New Zealand. Five key sustainability themes are also identified, each of which is examined in greater detail in section 5.
- Chapter 5 examines the five sustainability themes and involves outlining relevant objectives and identifying systemic and non-systemic sustainability opportunities and barriers.
- Chapter 6 presents the conclusions and recommendations from the research including how progress on sustainability might be measured through the use of indicators.

2 New Zealand's rail system

This chapter provides an overview of New Zealand's rail system. It includes a brief history of rail in New Zealand before describing how the rail system is structured at present. The institutional context, in terms of policy and legislation, is also described.

2.1 Historical overview

Rail in New Zealand has a history dating back to the late 1870s. The development of the rail network was vital for the early economic development of New Zealand. In particular, the development of the agricultural sector was dependent on the reliable and efficient movement of goods by rail. Since the 1870s a substantial investment has been made in rail and in 1962 a ferry service between the North Island and South Island was added to the network, further increasing its effectiveness.

For the greater part of this 130-year period, the rail network was owned and operated by the Crown. The exact structure changed a number of times during this period. The New Zealand Government Railways Department was responsible for all aspects of the rail system, namely the rail network and the delivery of rail services up until 1982. In 1983, the New Zealand Railways Corporation was formed as a Crown-owned corporation. The aim was to increase the efficiency of rail operations, increase accountability and performance within the industry, and reduce the perceived politicisation of the Railways Department. These changes were part of a wider programme of deregulations across New Zealand's port, sea, road, freight and passenger transport sectors around this time (NZ Treasury 1999). Further changes occurred in 1990 when New Zealand Rail Limited (NZ Rail) was formed as a limited liability company, wholly owned by the Crown. Again, considerable restructuring occurred with the aim of improving overall performance. In 1993 NZ Rail was sold to Tranz Rail Holdings, a private company with a number of affiliated shareholder companies. The name was changed to Tranz Rail Limited in 1995 and was listed on the New Zealand Stock Exchange in 1996. For the next five years the entire rail network and rail operations were in private ownership.

This began to change in 2002 when the government purchased the Auckland suburban network from Tranz Rail. In 2003 an Australian transport company called Toll Holdings¹ purchased Tranz Rail. This was followed in 2004 by the government purchase of the national rail network from Toll NZ. Ownership and control of the network was vested in the New Zealand Railways Corporation (a state-owned enterprise operating under the trading name ONTRACK). Toll NZ had 66-year exclusive access rights to the national network under the National Rail Access Agreement (NRAA), with the exception of rights to use the Auckland suburban network which were given to Veolia prior to the repurchase of the national network. This meant that ONTRACK was responsible for the maintenance and upgrading of the network while Toll NZ operated the rolling stock and negotiated access, based on track access charges, to the network with ONTRACK.

¹ In New Zealand, Toll operates under the name Toll Holdings New Zealand Limited (referred to as Toll NZ) which is a subsidiary of Toll Holdings

2.2 Current structure

On 1 July 2008 the government purchased Toll NZ's rail and ferry business for \$665 million and renamed it KiwiRail. This means that the Crown, once again, has ownership and operation of all aspects of the rail system in New Zealand, with the exception of some heritage operators and suburban rail in Auckland which continue to be operated by Veolia.

Further changes occurred on 1 October 2008 when ONTRACK and KiwiRail Group (KiwiRail) became divisions of the New Zealand Railways Corporation (NZRC). Although both divisions are now under a single SOE they retain their core responsibilities of rail network infrastructure (ONTRACK) and the delivery of rail services (KiwiRail).

At the time of the research, however, the precise nature of the governance arrangements for ONTRACK and KiwiRail were unknown. This should be kept in mind, particularly with regard to the stakeholder comments.

2.2.1 The rail network and operations

The New Zealand rail network consists of approximately 4000 km of tracks with a narrow gauge of 1068 mm (3 feet 6 inches). This narrow gauge was chosen because of the difficult New Zealand topography. It also helped to reduce construction and maintenance costs. New Zealand's difficult terrain also means that the network consists of a large number of bridges (1787), tunnels (150) and culverts (12,000). The network also includes a number of innovative engineering projects, including the Raurimu Spiral, Makatote Viaduct and the Otira Tunnel. Approximately 500 km of the network is electrified, namely the Wellington urban network, the Wellington to Waikanae line and the North Island Main Trunk Line (NIMT) from Palmerston North to Te Rapa. The national rail network (including property and plant) was independently valued in 2006 at \$10.6 billion (ONTRACK 2008).

It can be seen from figure 2.1 that the rail network provides relatively extensive coverage across New Zealand. The freight service is much more extensive than the passenger service which only comprises three significant long-distance services:

- Auckland to Wellington (the Overlander on the NIMT)
- Christchurch to Picton (the TranzCoastal)
- Christchurch to Greymouth (the TranzAlpine on the Midland Line).

In addition, the ferry service between Wellington and Picton (known as the Interislander) is also included as part of the rail network. A number of suburban passenger services are also provided in Auckland and Wellington. Complementing these suburban services are important feeder services, notably:

- Palmerston North to Wellington (the Capital Connection)
- Wairarapa to Wellington (the Wairarapa Connection).



Figure 2.1 New Zealand's rail network

The greatest use of the rail network, however, is for the movement of freight. This is overwhelmingly bulkier, often containerised freight such as milk, coal, fertiliser, timber, paper pulp and grain. Increasingly though, smaller less bulky freight is being transported by rail. Figure 2.2 shows the increase in rail freight over the last 15 years.

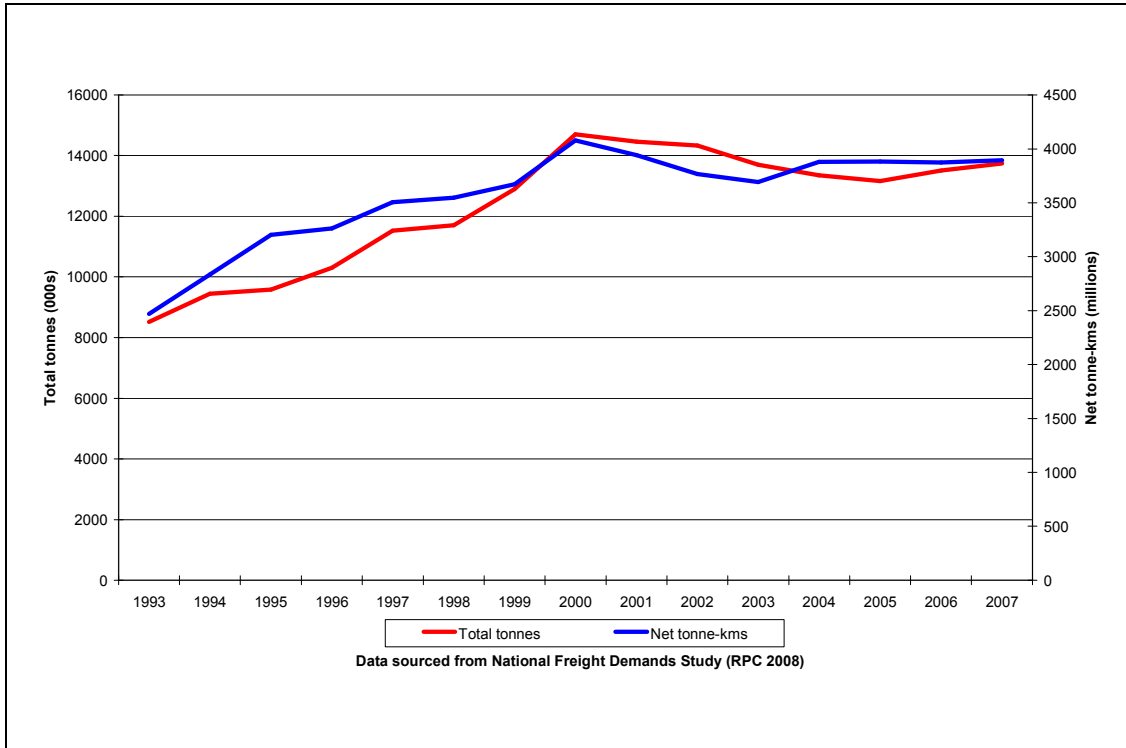


Figure 2.2 Rail freight movements 1993–2007

Although the increase in rail freight over this period is significant, it is much less when compared with the increase in road freight over the same period, as shown in figure 2.3.

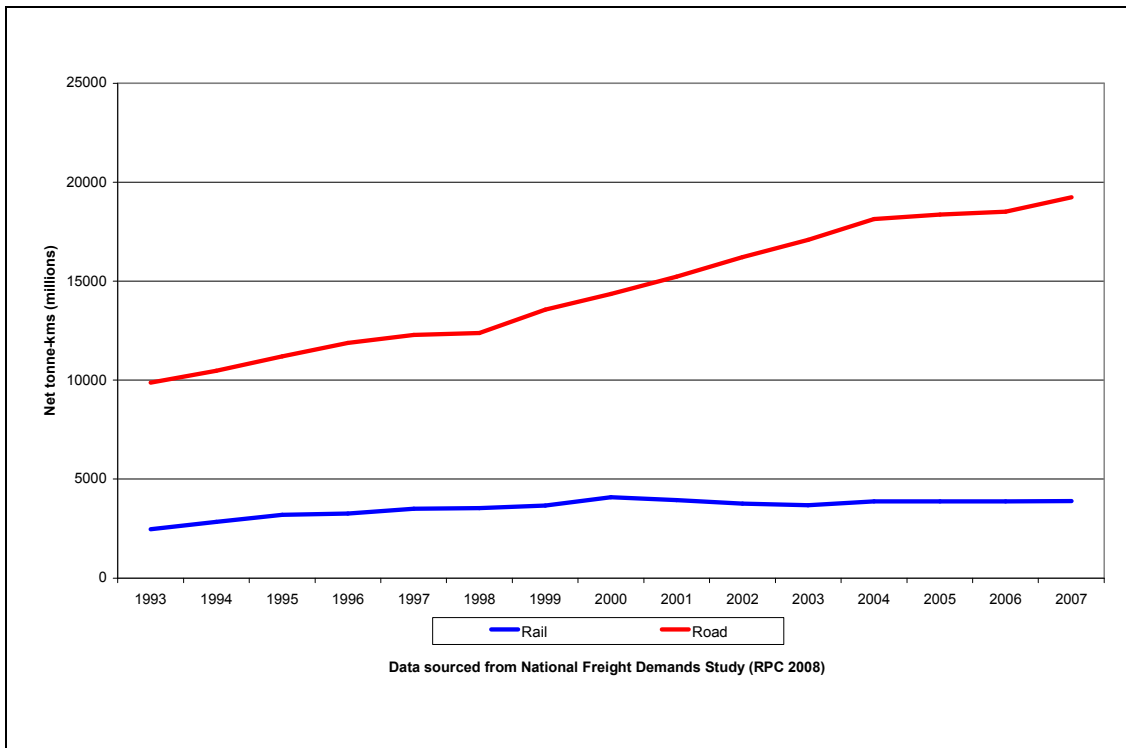


Figure 2.3 Road and rail freight movements 1993–2007

The total number of tonne-kilometres² moved by rail is just under 4 billion, which is the same as coastal shipping (4 billion tonne-km), both of which are much less than the 18.6 billion tonne-km moved on roads.

Table 2.1 New Zealand freight movement characteristics

Mode	Total tonne-km moved	Percentage of total tonne-km	Average journey length
Rail	4 billion	15%	280 km
Road	18.6 billion	70%	90 km
Coastal shipping	4 billion	15%	1000 km

Note: Based on data from National Freight Demands Study (RPC 2008) with some rounding of values.

The most significant rail freight movements are coal from the West Coast to Canterbury (20% of total rail freight), forestry movements in the Bay of Plenty (10%), movements between the Bay of Plenty and Auckland (10%) and movements from Waikato to Auckland (10%) (Richard Paling Consulting 2008). Logs, wood products and dairy products account for approximately 60% of rail freight volume by tonne-km.

2.3 Legislative framework

The legislative framework for the land transport sector is relatively complex and rail does not feature strongly. The Railways Act 2005 is the only legislation specifically concerned with rail and this only covers rail safety. Since 2005 a Rail Network Bill has been under development but has recently been withdrawn. As proposed, it would have replaced the New Zealand Railways Corporation Act 1981 and the New Zealand Railways Corporation Restructuring Act 1990 with new governance arrangements for rail. The purchase of rail and ferry operations from Toll Rail NZ by the Crown in July 2008 meant that the arrangements for rail operations required further consideration and the government withdrew the Rail Network Bill.

2.3.1 Railways Act 2005

The Railways Act 2005 is aimed at improving the safety of rail operations. It incorporates many of the actions recommended in the Ministerial Inquiry into Tranz Rail Occupational Safety and Health (Wilson 2000), known as the Wilson report, that investigated safety within the industry. The report found that the deregulation of the industry had created some gaps in the safety licensing regime. The 2005 Act consolidated previously fragmented legislation and restructured the rail licensing regime to address many of the issues identified in the Wilson report. The regulation of rail safety under the Railways Act is undertaken by a cost recovery unit within the NZ Transport Agency (NZTA).

2.3.2 Land Transport Management Act 2003 and Land Transport Act 1998

Land transport planning and funding predominantly occurs under two Acts: the Land Transport Management Act 2003 (LTMA) and the Land Transport Act 1998 (LTA). Broadly, the LTMA is concerned with the management, planning and funding of land transport activities while the LTA (and the Transport Licensing Services Act 1989) deals with the regulation of

² Tonne-kilometres is a measurement used to describe the transportation of a tonne of goods a distance of one kilometre. It allows direct comparison between different modes.

land transport activities. The LTMA is guided by the overall objective for New Zealand's land transport system, which is reflected in the Act's purpose of 'contribut[ing] to the aim of achieving an affordable, integrated, safe, responsive, and sustainable land transport system'. At a local level, regional councils develop regional land transport strategies (RLTSs) which outline the strategic direction for transport in the region. They must be prepared every six years and must take into account how each activity, or activity class:

- assists economic development
- assists safety and personal security
- improves access and mobility
- protects and promotes public health
- ensures environmental sustainability.

Activities identified in RLTSs are then allocated funding within a National Land Transport Programme.

Amendments to the LTMA in August 2008 sought to provide increased legislative guidance for rail (along with coastal shipping) by explicitly recognising these two modes in the purpose of the Act. Specifically:

(2) To contribute to that purpose, this Act -

...

(d) improves long-term planning and investment in land transport, including planning and investment in coastal shipping and rail; and...

It is unknown what effect these changes, if any, will have. The intention of these changes, however, is clearly that rail and coastal shipping will be better integrated with other modes in transport planning. This was in recognition that rail (and coastal shipping perhaps to a lesser extent) has not been well integrated into land use and transport planning to date (SSC 2007).

2.3.3 Resource Management Act 1991

The Resource Management Act 1991 (RMA) aims to promote the sustainable management of natural and physical resources. It is the principle statute under which resources including land are managed. The RMA operates a hierarchy of policies and plans from national policy statements and national environmental standards to regional policy statements, and regional plans to district plans. Policies and plans must give effect to those above them. As yet there are few national policies or standards, although increasing interest has been shown by central government in the development of national guidance.

While the RMA makes no specific reference to transport, amendments made in 2005 have strengthened the mandate for regional councils to integrate infrastructure with land use in regional policy statements. In turn, district councils must give effect to these regional policy statement provisions in their district plans. The intent of these amendments was to have greater coordination of land use and infrastructure (including transport) planning. It is unclear whether these amendments have led to greater levels of integration between land use and transport (Ward et al. 2007) although there is anecdotal evidence of an increased use of urban and regional growth strategies that aim to improve integration.

The RMA also has a role in the consenting of transport projects, including rail projects. This is mainly through the designation process under Part 8 of the RMA although in some cases

resource consents may be required. Where land is compulsorily acquired, provisions for landowner compensation under the Public Works Act 1981 may also be used.

2.3.4 Local Government Act 2002

The Local Government Act 2002 (LGA) provides the general framework and powers under which New Zealand's local authorities operate. The LGA provides for local authorities to play a broad role in promoting the social, economic, environmental, and cultural wellbeing of communities, taking a sustainable development approach. As such, the LGA outlines the obligations of local authorities when planning and making decisions, sets out the steps they must take when planning for the future, and also governs the preparation of long-term council and community plans (LTCCPs).

As part of local authorities' decision making, they must carry out a process to develop and review community outcomes. Community outcomes form the basis of the community input into the LTCCP. These are goals that the community want to see achieved and relate to social, economic, environmental and cultural wellbeing of the community. Most community outcomes contain goals which relate to sustainable transport, such as: a desire to have access to efficient and affordable public transport; accessibility to services and open spaces; an emphasis on walking and cycling initiatives; and a desire to have clean air.

LTCCPs identify projects, policies and programmes which set the agenda for development within that community over the proceeding 10 years and for councils' contribution to achieving community outcomes identified. Funding which has been allocated against projects is also detailed in LTCCPs. Some aspects of a regional land transport programme will also be included in the LTCCP (but will be prepared under the requirements of the LTMA). LTCCPs will therefore include, where relevant, sustainable transport projects (for example, cycleway and walkway improvements or strategies or investment in passenger transport), as well as other infrastructure projects. Rail has not featured strongly in most LTCCPs although some significant funding has been allocated through this process, such as the \$95 million allocated for urban passenger rail in the Wellington Regional Council LTCCP 2006-2016.

2.4 Policy framework

2.4.1 New Zealand Transport Strategy

First released in 2002, and updated in August 2008, the NZTS provides overarching transport policy in New Zealand and outlines the strategic direction for transport. It covers all major modes of transport, namely:

- domestic aviation
- domestic shipping
- road transport, including local roads and state highways
- rail transport
- public transport
- active modes, including walking and cycling.

The vision outlined in the NZTS is that in 2040:

People and freight in New Zealand will have access to an affordable, integrated, safe, responsive and sustainable transport system.

This is underpinned by five core objectives:

- assisting economic development
- assisting safety and personal security
- improving access and mobility
- protecting and promoting public health
- ensuring environmental sustainability.

The NZTS was updated to reflect changes in the focus of transport since 2002. In particular, the updated NZTS has a much greater recognition of the emissions and energy implications of transport. The updated NZTS also aims to include more definitive targets for the sector to work towards. The timeframe was also extended to 2040 in recognition of the long-term nature of many of the changes required in the sector. In relation to rail, there is a target of increasing rail's share of domestic freight to 25% of tonne-km by 2040 from its current level of 18%.

2.4.2 National Rail Strategy

The National Rail Strategy to 2015 (NRS) was released in 2005 and sets out the government's objectives and priorities for rail to 2015. It was developed under the umbrella of the NZTS and has the same five core objectives. Table 2.2 shows how NRS actions relate to NZTS objectives.

Table 2.2 Contribution of NRS actions to NZTS objectives

NZTS objective	NRS action
Assisting economic development	Upgrade the national rail network.
	Improve rail's contribution to regional development.
	Encourage more freight to be carried by rail.
	Optimise the use of the rail network within the wider transport network.
Assisting safety and personal security	Continue to improve the safety and personal security levels of the rail system.
Improving access and mobility	Encourage more use of urban rail passenger services as part of the public transport network.
Protecting and promoting public health	Ensure the public health impacts of rail transport are incorporated into transport planning and decision-making.
Ensuring environmental sustainability	Ensure transport choices take into account the environmental benefits that rail can provide.

The development of the NRS was prompted, in part, by the repurchase of the rail network in 2004 as it was believed that Crown control of these rail assets provided an opportunity to increase the level of government policy in rail transport. It should be noted, however, that the NRS is not ONTRACK or KiwiRail policy.

2.4.3 Government Policy Statement on Land Transport Funding

The Government Policy Statement on Land Transport Funding (GPS) complements the NZTS by allocating funding to achieve the targets and objectives of the NZTS. The current GPS sets

out detailed guidance for the six years 2009/10 to 2014/15, and longer-term funding for a further four years to 2018/19. It describes what is to be achieved through funding in the land transport sector. Rail is not covered directly by the GPS as rail is currently funded directly by Treasury. The GPS notes that 'the government is planning a major investment in passenger and freight rolling stock (such as locomotives and carriages) through KiwiRail' (MoT 2008c: 6). A possible revision of funding arrangements for rail is currently underway led by Treasury and including the NZTA, MoT, the Crown Company Monitoring Advisory Unit and ONTRACK (NZTA 2008).

2.4.4 Sea Change: A Strategy for Domestic Sea Freight

A national strategy for the movement of sea freight (SDSF) was released in May 2008. It was developed in recognition of the potential economic and environmental benefits that sea freight can provide, particularly when compared with alternative transport modes. The SDSF makes specific recognition of the need to consider intermodality (the use of different modes of transport in combination) to achieve 'optimal and sustainable use of resources and the most effective supply chain' (MoT 2008a). In this regard, the SDSF does not aim to support or promote sea freight at the expense of other modes. Rather, it aims to increase the competitiveness of sea freight by improving the understanding of the benefits and costs associated with coastal shipping.

The promotion of an increase in the use of coastal shipping is likely to have implications for rail. Globally, and in New Zealand, shipping is becoming more efficient with a trend towards larger vessels (with increased tonnage), making fewer calls at fewer ports. The international trend towards 'hub and spoke' networks favours larger, more strategically located ports that can handle greater volumes of freight. In New Zealand, shipping companies have signalled a preference for one main port in each island, with three of four smaller feeder ports. In terms of a supply chain approach, it is likely that the trend of rationalisation towards an international 'hub and spoke' network of ports will increase demand for inter-regional freight movement within New Zealand. Currently 67% of this inter-regional movement is by road transport. Some of this increased demand will be able to be met by coastal shipping and some by road, but it is clear that rail will also have a role to play.

2.4.5 New Zealand Energy Strategy

The New Zealand Energy Strategy to 2050 (NZES) was released in October 2007. The NZES sets out the government's vision for a sustainable, low emissions energy system and the actions that will be taken to make this vision a reality. The first aim of the NZES is to assist with the advancement of New Zealand's goals relating to sustainability and economic transformation. The second aim is to help New Zealand respond to the challenges of climate change and, in particular, to reduce greenhouse gas emissions.

A significant focus of the NZES is transport, which makes up 44% of total energy usage nationally. Furthermore, New Zealand's greenhouse gas emissions from transport are relatively high on a per capita basis and constitute 18% of the country's total greenhouse gas emissions (MfE 2008). The NZES has two main objectives in relation to transport:

- To reduce greenhouse gas emissions from transport.
- To reduce dependency on imported oil as an energy source for transport.

Under a continuation of the current trend it is predicted that energy use from transport will increase by approximately 40% by 2030 with similar increases in transport emissions

predicted. Three quarters of this growth will be from road transport. Given the threat of climate change and the uncertainty surrounding future oil supply, this path will not be economically or environmentally sustainable (Ministry of Economic Development 2007).

2.4.6 New Zealand Energy Efficiency and Conservation Strategy

The New Zealand Energy Efficiency and Conservation Strategy (NZECS) is complementary to the NZES and was released in October 2007 under section 10(2) of the Energy Efficiency and Conservation Act 2000. It is also complementary to the NZTS. From a transport perspective, the NZECS aims to progressively shift to more efficient modes of passenger and freight transport as well as working towards increasing the efficiency of all modes. A significant aspect of the strategy is working to reduce demand for transport where possible. Actions specifically related to rail are (EECA 2007b):

- completing Auckland rail electrification with the rolling replacement of diesel trains with electric units
- completing the Wellington rail upgrade
- collecting data on freight movements
- investigating options for improving the efficiency of the NIMT.

The collection of data on freight movements is particularly significant as there is currently no reliable information available about the energy costs and other environmental externalities associated with different transport modes. This long-term project has been commissioned by the Ministry of Transport.

2.4.7 Emissions trading scheme

An emissions trading scheme (ETS) has recently been passed by Parliament through the Climate Change (Emissions Trading and Renewable Preference) Act. Although uncertainty exists as to what effect the ETS will have, as it is very new, it is certain to have some effect on the transport sector.

The fundamental aim of the ETS is to send price signals to promote a transition to a lower-emissions economy. In this regard, the ETS is the primary mechanism designed to achieve New Zealand's emissions obligations under the Kyoto Protocol. Broadly though, the ETS should promote the increased use of more greenhouse gas emissions, efficient modes of freight and passenger transport.

2.5 Summary

The rail system has been an important feature in the economic development of New Zealand and continued to do so into the 1980s. The condition of the rail network declined under almost a decade of privatisation which has led to a significant infrastructural deficit (OAG 2008). Conversely though, during the period 1993-2007, the amount of freight moved by rail increased (Richard Paling Consulting 2008).

The ownership structure of some parts of the rail system has also recently changed with rail operations being purchased by the government. The legislative and policy environment for rail is complex and is likely to be subject to future change. Other than the Railways Act 2005, which deals with rail safety, there is no other legislation specific to rail. Transport legislation (mainly the LTMA) does not specifically incorporate rail, although recent amendments in August 2008 have inserted a reference to rail. Similarly, the decision-making and funding

processes for rail have usually been separate from wider transport sector processes. In effect, rail has been politically and institutionally separated for the last 15 years and although this is beginning to change as the value of rail is again being recognised, many remnants of this separation are still evident.

3 Research methods

The aim of the research was to identify and appraise sustainability issues for New Zealand's rail system. More specifically, issues were appraised in terms of opportunities and barriers to moving towards a more sustainable rail, and transport, system. As the starting point for a consideration of how sustainability related to rail in New Zealand, it was considered that a structured and systematic approach to identifying issues was required. Figure 3.1 shows the overall research strategy.

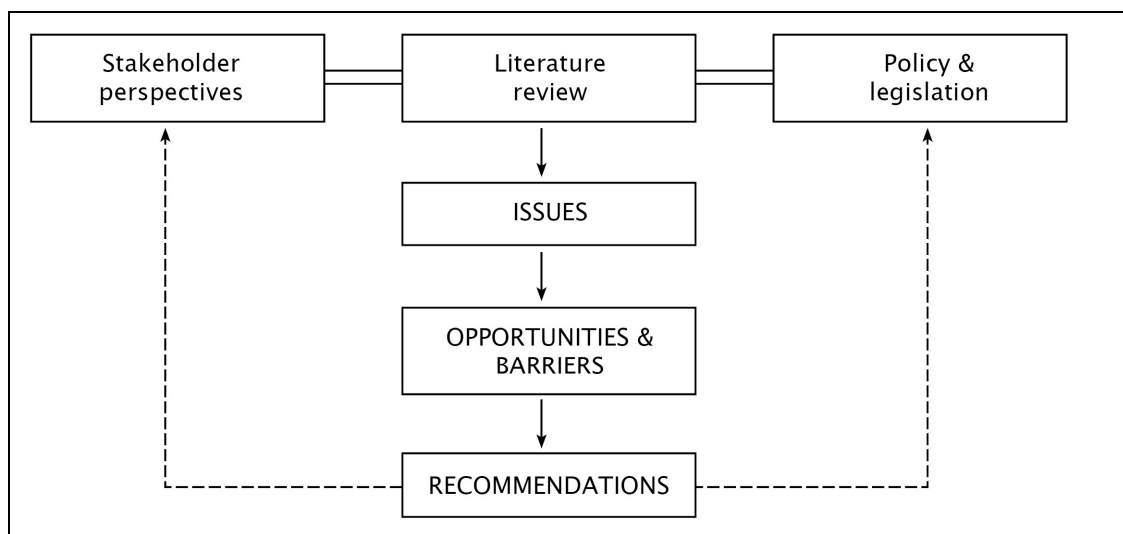


Figure 3.1 The structure of the research

3.1 Information collection

The approach taken aimed to be as inclusive and systematic as possible with the aim of identifying as many aspects of sustainability as possible. This information came from three main sources:

- transport legislation and policy
- international and New Zealand literature
- industry stakeholders, including rail and transport officials.

The review of legislation focused on legislation relevant to rail, land transport, land-use planning and local government as it was important to gain an understanding of the reasonably complex institutional arrangements for rail in New Zealand. In particular, it was important to understand the co-regulatory nature of the sector in which there were multiple parties involved. During the period the research was being conducted the role of some of these parties was changing and some details, notably around the governance arrangements for both ONTRACK and KiwiRail, remained unclear.

Relevant policy guidance and literature was also reviewed. To aid in the review of this material, a preliminary checklist was drafted using the three broad groupings of issues, barriers and opportunities. The main aim of the use of the checklist was to provide focus for the review of material. Although the review was guided by the checklists, additional issues, opportunities and barriers were included as required. Once complete the checklist also provided a simple

reference for the prevalence of particular aspects throughout the reviewed material. It also served as a useful reference for later stages of the research when further information was required on particular aspects. The completed checklist is contained in appendix A.

From the analysis of relevant legislation and the review of policies and literature, a significant amount of information about sustainability issues for rail was obtained. This information was complemented with interviews from individuals in 10 organisations directly or indirectly involved in the rail sector. A set of general questions was developed based on information gathered in the review of literature, legislation and policy.

A representative from each of the following organisations was interviewed:

- Auckland Regional Transport Authority
- Cooperative Research Centre for Rail Innovation (Australia-based)
- Federation of Rail Organisations of New Zealand
- Fonterra Dairy Co-Operative
- KiwiRail
- Ministry of Transport
- Murray King & Francis Small Consultancy Limited
- ONTRACK
- Rail and Maritime Transport Union
- Wellington Regional Council (Greater Wellington).

The interviews were conducted between June and July 2008 and were based around a series of discussion topics identified from the earlier policy analysis and literature review. Similar to the earlier work, the topics were chosen to extract information about the issues, opportunities and barriers to a sustainable rail system. Interviewees were also asked what they believed sustainability meant in the context of rail in New Zealand. This aspect of the interviews was particularly important as it provided some valuable insights into various perspectives of stakeholders on sustainability. An overview of stakeholder discussion topics is provided in appendix B.

Following the literature review, policy and legislative analysis and stakeholder interviews the collected information was drawn together and 18 key sustainability issues were identified. Each was assigned significance in accordance with a simple prioritisation process. The criteria used in this process included frequency of citations in the reviewed literature, weighting in policy and legislation and stakeholder significance. Stakeholder significance was determined from interview responses and was clarified with post-interview forms which were sent to each stakeholder to fill in by assigning importance (with 1 being the least important and 5 being of greatest importance) to each of the 18 sustainability issues that were identified from the research. The same issues analysis forms were used as templates to draw equivalent significance values from the literature reviews and from codified sources. It should be emphasised that the assignment of significance was purely qualitative and involved an unavoidable degree of subjectivity. The aim of assigning significance was to provide focus for the research and also to check the accuracy of qualitative data. It was not used as a basis for any quantitative assessment.

Concurrent to the assignment of significance was the collation of feedback on what sustainability means in a New Zealand rail context (research objective one). This information formed the basis of the discussion contained in chapter 4 (Understanding sustainability in rail). The final aspect of the information collection phase was the grouping of key issues into five sustainability themes which formed the basis of the more detailed appraisal addressing research objectives two and three.

3.2 Appraisal methodology

The detailed appraisal for the five sustainability themes involved two key phases.

3.2.1 Sustainability objectives

For each sustainability theme a number of objectives relating to that theme were identified. These came mainly from transport and energy policy, although some were also from environmental and social policy. For some issues it was found that there were not always clear objectives.

3.2.2 Promoting sustainability: Opportunities and barriers

Once the current sustainability objectives for the rail sector had been established, the various opportunities available for moving towards sustainability objectives were identified from the literature review and key stakeholder interviews. These opportunities were explored with reference to existing policy objectives in New Zealand as well as international experience outlined in the literature review. Some interviews also enabled international experience to be drawn on to assist in developing as broad a range of options as possible for promoting sustainability.

The identification and appraisal of the options and opportunities was a key element of this project as the strategic policy level provided an opportunity to consider many more options than would normally be available at project level. As such, most of the opportunities identified will require further, more detailed, assessment and some options may not be feasible. At such a high level, however, this research provided an opportunity for relatively unimpeded, long-term visioning of what opportunities could be pursued within the rail system. From a sustainability perspective this provided the chance to consider the sustainability implications of issues that is not often possible at a project level.

In conjunction with the development of opportunities for improving the sustainability performance of the rail network, the potential barriers to achieving sustainability objectives were considered. The interviews with key stakeholders in particular, drew attention to a range of barriers that currently existed within New Zealand's rail sector that might inhibit the industry's ability to become more sustainable and contribute to wider sustainability goals. Barriers were also considered in terms of whether they were systemic or non-systemic to the rail industry. That is, barriers that the industry itself could overcome (systemic), or barriers reliant on agencies and factors external to the rail system.

The final aspect to the identification of barriers and opportunities was the exploration of what initiatives could be used to realise opportunities and overcome barriers (research objective three). This was not the primary focus of the research and hence the case studies cited and possible options discussed only provide an example of what could be considered. While the research does make some recommendations about where further research efforts should be directed, it is expected that stakeholders will provide feedback on the issues raised in this research.

4 Understanding sustainability in rail

4.1 The origins of sustainability

The concept of sustainability emerged in its current form in the 1970s, its origins attributable to the 1972 UN Conference on the Human Environment and the global think tank Club of Rome's publication *The limits to growth* (Meadows et al. 1972). These events achieved two crucial factors that gave momentum to the global environmental movement by forcing many national governments to develop domestic environmental programmes and legitimised the biosphere as an object of national and international importance requiring collective management. *The limits to growth* provided a statement of the finite nature of the environment and humankind's relationship with the earth, predicting that:

...if the present growth trends in world population, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached within the next hundred years.

However, the most widely cited understanding of sustainable development has been provided by the Brundtland Commission report *Our common future* (World Commission on Environment and Development 1987), which defined sustainable development as:

...development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The concept of sustainable development pivots on the notion that the consumption of resources has significant moral and ethical considerations concerning equitable resource use, both within and between generations, and recognises that many of the resources society depends upon or values are becoming depleted beyond their carrying capacity, or destroyed outright.

4.1.1 Perspectives on sustainability and rail

There has been a considerable amount of research surrounding how sustainability relates to transportation as a whole, internationally and in New Zealand, but very little rail specific sustainability research outside the United Kingdom and Europe (DfT 2007; RSSB 2006).

The NZTA's own interpretation of a sustainable transport system is derived from a Canadian initiative, The Centre for Sustainable Transportation has prepared working definitions for Transport Canada closely corresponding to the World Commission on Environment and Development's general principles of sustainability. This has formed the foundation of understanding of sustainability within the rail context for this project. It describes a sustainable transport system as one that:

- allows the basic needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations
- is affordable, operates efficiently, offers choice of transport mode and supports a vibrant economy
- limits emissions and waste within the planet's ability to absorb them, minimises consumption of non-renewable resources, limits consumption of renewable resources to

the sustainable yield level, reuses and recycles its components, and minimises the use of land and the production of noise (Transport Canada 2005).

Using this concept of a sustainable transport system as the reference point, sustainability demands that a more holistic view is required to consider rail alongside other modes in order to find the best balance between the needs of the economy, society and the environment. The following facets of sustainability for rail were conveyed and echoed by many of the stakeholders and throughout the literature:

- an understanding that rail should not be considered in isolation, to the benefit or detriment of other modes, but should be looked at as part of an integrated transport network
- the triple bottom line approach to sustainability should be adopted considering the environmental and social impacts of rail alongside traditional economic considerations (Forum for the Future 2005).

A key message to emerge from both the literature and from stakeholder interviews related to the notion that rail possessed inherent characteristics that were more sustainable than other modes. Qualities mentioned included: the fuel efficiency advantages of rail; reduced emissions of pollutants (air, noise, chemical); and favourable safety performance. However, there was general consensus amongst the stakeholders that in New Zealand the current condition of the physical rail assets and a lack of recent investment in rolling stock and the network meant that many of these sustainability benefits were probably not being realised as well as they could be.

A common theme from stakeholder representatives surrounded the commercial aspects of sustainability; in essence that rail could only make a positive contribution to environmental sustainability if it was financially sustainable. Of particular concern was the subsidy element of passenger rail and its implications for the commercial viability of the network, as well as the ability of the network to absorb increasing demand. High initial direct costs were also cited as a major issue for the commercial sustainability of New Zealand's rail system, specifically referring to freight haulage and the government's commitments to considerably increase rail's share of the nation's freight task. Rail's current dependence on imported oil was also highlighted as an issue that could significantly affect the sustainability of the rail network and the transport system as a whole. It was noted, however, that rail was potentially better positioned than some other modes, such as road and aviation, to make a shift to non-carbon based propulsion methods.

Another fundamental issue surrounding rail's potential to improve sustainability within the transport sector concerns the extent to which the external costs of transportation are internalised for each mode and hence how reflective of their full costs they are. Much of the research relating to sustainability and rail has concentrated on this issue. Overseas experience has shown that the costs of rail are more fully internalised than road transport (Eddington 2006). Institutional and individual bias in favour of road transport means that road transport pays less of its true costs compared with rail's unpaid costs which are lower (OECD 2002). The importance of determining the full costs of different modes has been recognised in New Zealand and was investigated by a Ministry of Transport commissioned study (Booz Allan Hamilton 2005). Although the accuracy of some of the data collected by this 2005 study has been contested, the study suggests that the costs of rail are more closely aligned with their true social and environmental costs than is the case for road transport.

More work is required to investigate this further and the Ministry of Transport has commissioned this work.

The effects of inaccurate representation of costs across transport modes, resulting modal bias and other factors such as a lack of integration between land-use and transport planning leads to a situation where cars take precedence and public transport provision is ineffective, particularly in Auckland (Dodson and Mees 2003). Sources from both the literature and stakeholders suggested that rail, in conjunction with other complementary modes such as coastal shipping, had the potential to begin to redress this imbalance and serve both the freight and passenger markets as businesses and individuals factored carbon costs into their travel and transport decisions. Immediate issues needing to be addressed were pinch points in the network and the reliability and frequency of passenger and freight rail services. The ability of New Zealand's rail industry to accommodate the increasing demands that would be imposed on rail was raised as an area of concern by some of the stakeholders. A particular focus was on the capacity of the industry's ageing workforce, in addition to the sheer scale of work that needed to be done to the network to achieve planned increases in freight and passenger patronage.

A recurring message throughout the research was that the performance of the transport sector is crucial to the functioning of the country in an economic sense, as an enabler of sustained productivity and competitiveness. Intrinsic to this perspective is the belief that the biggest contribution rail can make to goals of economic growth, carbon reduction and minimisation is through modal shift, abstracting demand from less sustainable transport modes from passengers and freight customers (RSSB 2006). This has already been recognised by the New Zealand government and introduced into the political arena by the National Rail Strategy to 2015 (MoT 2005b). The focus remains on addressing the imbalance of agendas surrounding transport modes and the fundamental importance of achieving a sustainable modal mix. Today, it is the renewal of railways, the so-called 'rail renaissance', which is seen as a key ingredient in achieving a sustainable transport system

The sustainability discourse in New Zealand is increasingly turning its attention toward changing land-use practices to better accommodate sustainable transport options, and promotion of community wellbeing benefits associated with passenger transport. Such a step change is espoused through implementation and interpretation of RMA, LGA and LTMA legislation as well as the national energy and transport strategies outlined in chapter 3. This step change and the opportunities it presents for more sustainable outcomes in the rail industry and transport sector generally, are discussed in greater detail in chapter 5. The absence of a prescribed way forward for rail in terms of sustainability offers an opportunity for the rail industry in New Zealand to be proactive in shaping the agenda and contributing to the delivery of key government objectives such as reducing greenhouse gas emissions, achieving carbon neutrality, and sustainable mobility.

4.2 Sustainability issues and themes

From the literature review and interviews with key stakeholders, briefly discussed in the previous section, 18 key factors were determined for considering sustainability in New Zealand's rail industry. In order to provide a sharper focus for the next section of the research the factors were assigned a basic level of significance with regard to sustainability, and subsequently grouped into five sustainability themes that form the structure of the remaining sections of the report.

The process for establishing the significance of each sustainability issue, as discussed in the methodology, included frequency of citation in the literature reviews and policy analysis and stakeholder responses. Each factor was given a rating out of 5 (with 5 being 'major significance' and 1 being 'minor significance'). The aggregated results of this process are displayed in table 4.1. A more detailed breakdown of significance value assignment is contained in appendix C.

Table 4.1 Assignment of significance to issues

Sustainability theme 1: Governance and funding		Overall significance
Funding	Funding of rail network infrastructure, rolling stock and related services.	HIGH
Full-cost pricing	A process of accounting for the environmental, social and economic costs and benefits in determining the price of services.	HIGH
Political support	The level of support of the elected government to rail.	HIGH
Policy	Policy process related directly or indirectly to the rail system.	MODERATE
Sustainability theme 2: Integration		
Modal integration	Integration between different transport modes and the concept of total supply chains.	HIGH
Modal bias	Institutional and/or structural bias towards particular modes of transport.	HIGH
Land-use and transport	The relationship(s) and influences that land-use and transport have on each other.	MODERATE
Travel demand management (TDM)	Tools to encourage people to reduce their reliance on motor vehicles through provision of information on alternative modes such as public transport, cycling and walking. TDM also involves encouraging sustainable transport through land use planning.	MODERATE
Sustainability theme 3: Social considerations		
Safety	Safety of rail operations and the rail network and the management of other activities that may influence safety.	HIGH
Access	The ability of people to access various transport modes (equity).	HIGH
Labour	The capacity and capability of the labour market to provide rail services.	MODERATE
Public perception	The perception of rail as a transport mode.	MODERATE
Sustainability theme 4: Natural environment		
Emissions and energy efficiency	Greenhouse gas emissions from rail operations and methods to reduce emissions through energy efficiency and alternative fuels (non-fossil fuels).	HIGH
Noise and vibration	Noise and vibration as occurring from the maintenance and operation of the rail system.	MODERATE
Biodiversity	The effect of the rail network and operations on biodiversity.	LOW

Diffuse pollution	Pollution of water, land and air (other than greenhouse gas emissions) attributable to the rail network and operations.	LOW
Sustainability theme 5: Infrastructure		
Network capacity	The capacity of the rail network to transport goods and people.	HIGH
Electrification	The operation of rail network on electricity. The most common alternative to using diesel powered locomotives.	MODERATE

Perhaps not surprisingly, all-encompassing issues such as modal integration and accessibility were widely regarded as warranting a ‘high’ rating, as were energy efficiency, emissions, network capacity and safety. Interestingly, issues perceived to be ‘softer’ such as public perception, diffuse pollution and biodiversity were widely rated to be of lesser significance.

A clear difference existed between the results of the significance rating given to issues such as labour, funding and policy: these three issues were not widely regarded as being significant in the literature or policy and legislation. However, stakeholders very clearly viewed these issues as important in the New Zealand context. Again, interestingly, noise and vibration was an issue that came up frequently in rail literature as being significant, but was not viewed by stakeholders or in legislation and policy as being of major significance.

Many of the topics have commonalities and multiple linkages. A general overview of the main linkages between the five sustainability themes is shown in figure 4.1.

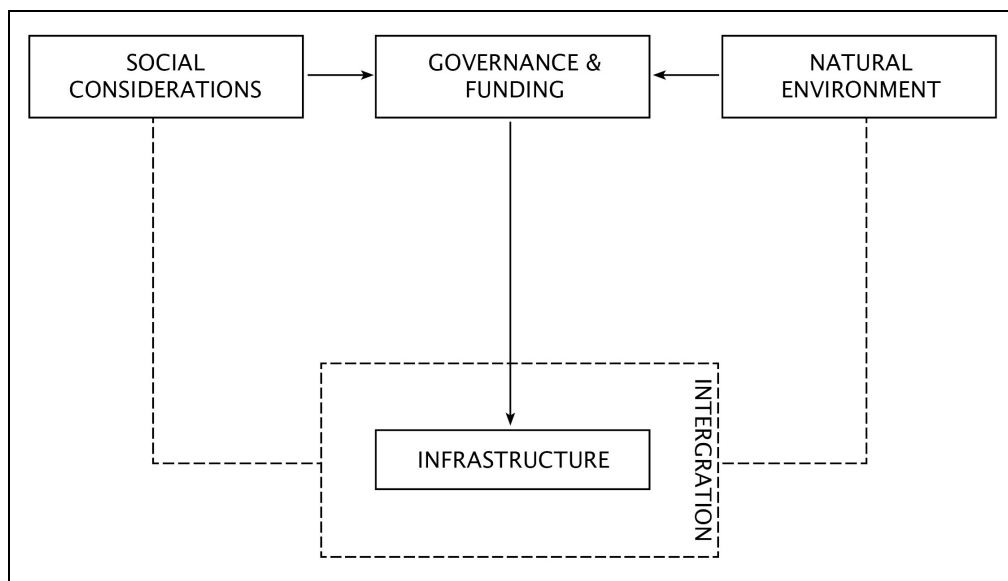


Figure 4.1 Relationship between the sustainability themes

Crucially, no theme stands in isolation and they should be considered as inter-dependent variables. Considerations around the social and natural environment are encapsulated into governance and funding arrangements for the rail system which in turn dictates the nature and development of the infrastructure of the rail system. The multi-faceted concept of integration is essential in the development of rail infrastructure in a physical sense but also encompasses ‘softer’ social considerations such as access and mobility.

5 Promoting sustainability in rail

The sustainability themes identified in the previous chapter are discussed in further detail in this chapter. Each sustainability theme is discussed in relation to the following points:

- sustainability objectives
- opportunities and barriers.

Objectives relating to each theme provide a good basis for discussions and an understanding of the policy setting. In some cases, however, it was found that objectives did not exist in relation to some of the themes.

Following this, the opportunities that have been raised by stakeholders and drawn from the literature were explored and evaluated with reference to their potential contributions toward sustainability, likely timeframes associated with them and the barriers that might inhibit the rail sector's ability to realise particular objectives or exploit latent opportunities. Where appropriate, areas of uncertainty and risk were also considered. Recommendations are also provided throughout the chapter and these are consolidated in the final chapter of the report.

5.1 Governance and funding

Governance and funding is primarily concerned with how decisions about rail are made and how funding for the sector is raised and allocated. This covers issues such as how rail, and transport policy more generally, is developed and the degree to which the costs and benefits of rail are considered and factored into decision making. Governance and funding was consistently identified by stakeholders as a very important factor in promoting sustainability within rail. The view held by the majority of stakeholders was that rail was an inherently sustainable mode and promoting sustainability was best achieved by increasing the use of rail. The most important conduit to improving rail infrastructure and promoting its use was deemed to be the provision of adequate funding and a strong and clear policy and planning direction for the sector.

The overwhelmingly strong emphasis on governance and funding from stakeholders was not as closely mirrored in the literature. Investment and clear policy and planning were not frequently raised as important issues for promoting sustainability in the literature. This is possibly reflective of the fact that most papers were concerned mainly with the rail sector, whereas governance and funding issues often relate to the wider transport sector. Much of the literature was also aimed at an international audience meaning specific governance and funding issues were not appropriate. One notable exception was the issue of cost pricing between different modes which featured in some of the literature.

5.1.1 Objectives

Table 5.1 Objectives: Governance and funding

Issue	Objective
Funding	Improve rail's contribution to regional development (NRS).
Full-cost pricing	Investigate options for better incorporating costs (including social, health and environmental sustainability costs and benefits) of transport modes into the pricing of the transport system (NRS).
	Collect data on freight movements (NZECS).
Policy	The government will continue to develop policies, including policies on funding, to encourage greater provision of public transport, walking and cycling (NZES).
Political support	None.

5.1.2 Opportunities and barriers

Significant barriers and opportunities exist in relation to governance and funding issues. Overall most issues concerned with governance and funding could be more accurately described as potential barriers in that if governance and funding arrangements are not well considered they will present a significant barrier to achieving a sustainable rail system. By definition, virtually all the barriers and opportunities could be considered as being systemic, as this sustainability theme is primarily concerned with the institutional 'system' in which rail operates.

The following three specific groups of issues are discussed in relation to governance and funding:

- The roles and responsibilities of various organisations in the co-regulatory system are described as well as the positive and negative aspects of these arrangements from a sustainability perspective.
- The degree to which benefit and costs associated with different modes are known and incorporated into policy and funding decisions for transport.
- The importance of taking a long-term and coordinated approach to the planning and funding of the rail system.

Roles and responsibilities

The operating environment for rail in New Zealand, as described previously, is particularly complex and involves multiple parties. The complexity of this operating environment was mentioned, in general terms, by most stakeholders as a barrier. The large number of organisations involved under the co-regulatory model was commonly mentioned as causing difficulties in aligning policy concerned with different aspects of rail and in aligning policy with funding.

At the time of the research responsibility for various roles within the sector was held by many organisations, including:

- Treasury, as major funder
- Ministry of Transport, as major provider of rail policy

- Land Transport NZ, (now the NZTA) as regulator of rail safety and as a funder of some rolling stock
- ONTRACK, as the rail network provider
- KiwiRail, (formerly Toll Rail NZ) as major rail operator
- regional councils, as providers of policy and some funding and provision of regional transport, including public transport, projects.

A recurring comment was that although these organisations tended to have clearly defined roles, coordination and cooperation between organisations has not always occurred to facilitate good outcomes for rail. The most frequently mentioned of these issues was the well documented tensions between ONTRACK and Toll NZ, which essentially revolved around the coordination of above-rail and below-rail activities. It was commented that the arrangements relating to NRAA (National Rail Access Agreement) and the use of track access charges effectively pitted the two organisations against each other creating a highly adversarial operating environment for rail. This is not to ignore the progress that has been made by both ONTRACK and Toll NZ in reinvigorating the rail system since 2004 and 2003, respectively. Nonetheless, virtually all stakeholders believed that this adversarial arrangement has been problematic for achieving the best outcomes for rail. The repurchase of rail operations by the Crown in June 2008 was greeted with enthusiasm by all stakeholders, mainly because it was believed that much greater coordination between above-rail and below-rail planning would be achievable.

It was noted, however, that the repurchase of rail operations did not, in itself, ensure that this would occur. At the time of the interviews with stakeholders (June - July 2008), the precise nature of the relationship between ONTRACK and KiwiRail was unknown. The prevailing view, however, was that the existence of two separate organisations still posed a significant risk that they would be forced to have unaligned objectives. This situation would effectively be the same as the impasse that eventuated between ONTRACK and Toll NZ where ONTRACK's revenue was almost exclusively reliant on Toll NZ payment for use of the network under the NRAA.

The most commonly cited model for the future arrangement of above and below rail operations was their amalgamation into a single organisation with two operational arms. Since the interviews were undertaken this has subsequently occurred with a single SOE (New Zealand Railways Corporation) incorporating ONTRACK and KiwiRail. It was noted that some tension between the two operations was healthy to the extent that rail operators needed to hold network operators accountable for the standard of the network, and network operators also needed to collect optimal returns from users to fund maintenance and further improvements to the network. Some stakeholders also discussed the concept of above-rail competition but this was discounted on two grounds: the network is not yet of a standard to make this realistic for international companies; and the New Zealand market is not likely to be large enough to support genuine competition at this stage. It was believed that cooperation between rail participants, rather than competition, would be required to advance the sector.

The specific governance model of above and below rail responsibilities was unclear at the time of the research but it was apparent that with the limited resources and small New Zealand market, a lack of cooperation and coordination between these two would be a very significant barrier to achieving sustainable outcomes in the rail industry. In general terms, it was recommended that each organisation, whether separate bodies or arms of the same body, needed to have clear responsibilities and needed to be held accountable to these

responsibilities. It was suggested that these accountabilities be determined not purely on a financial basis but on a much wider basis that took into account:

- improvements in network performance
- increased use of rail for freight movement and passenger transport
- an increase in environmental performance.

This essentially recognises that the current state of the network and the uneven pricing structures for transport (discussed in the following section) mean rail is almost certainly unable to be profitable in the short term. A number of stakeholders also raised a curious distinction between how rail was viewed as a commercial enterprise, whereas road was seen as more of a public good. ONTRACK's role as a state-owned enterprise (SOE) and Transit New Zealand's (former) role as a Crown entity was cited as being representative of this, as was the privatisation of rail which has never been seriously contemplated for roads. The debate around the degree to which rail and road cover their full financial costs is particularly contentious but it is certainly true that the perception is that rail should be operated as a commercial enterprise whereas this is not necessarily the case for road. Although this distinction was made, there was actually a clear message from stakeholders that the SOE operational model is better for rail than a Crown entity. The main reasons provided for this were:

- SOEs have a more commercial focus. This was viewed as vital if rail is to deliver a level of service that will enable an increase in its use
- SOEs are perceived to be more politically removed in comparison to Crown entities.

Comments from stakeholders around the position of rail in the transport sector and in the wider public sector were particularly interesting. It was frequently noted that up until recently, rail has largely operated outside the rest of the transport sector and has been something of an enigma. No stakeholders offered views as to why this might be the case but it was tentatively suggested that such isolation and insularity may have historical origins in the existence of a sizable Railways Department for many decades prior to privatisation. Such insularity is not particular to rail, indeed other major modes such as road, shipping and air transport, have traditionally viewed themselves as discrete industries, rather than components of wider transport systems and supply chains. Stakeholders commented that the 'Railways Department' image was still often associated with rail today, and this was perceived as a barrier to progressing the sector. The inefficiencies of the 'Railways Department' days have been widely recognised and some stakeholders made a point of noting that rail needed to prove that it was a relevant and effective component of a modern and sustainable transport system. It was noted also that the view of rail as a 'bottomless pit' in terms of the funding it required became somewhat reinforcing in that a sustained lack of infrastructural investment created a network that was almost inevitably underperforming and not funding as much of its own infrastructural improvements as it had the potential to do. It is interesting to note that the comments about the inefficiencies of the former Railways Department cited as a reason not to invest in rail are equally applicable to many other former government departments. It should be recognised that modern government organisations are far more efficient and accountable than they were historically.

The final governance point many stakeholders commented on was the policy direction for rail. The consensus was that the policy framework for rail had been weak to non-existent under privatisation and it had not significantly changed since then. The land transport reforms initiated in 1997 largely ignored rail, and the national and regional land transport

programmes administered by Land Transport NZ (and now NZTA) have not featured rail strongly. Only recently have amendments to the LTMA 2003 in August 2008 specified that rail (and coastal shipping) are to be included in transport planning under this Act. It remains to be seen what effect this will have, but it is clear that the intention is for greater integration between transport modes.

From a governance perspective, the degree to which rail is to be integrated into the wider realm of transport decision-making processes is unclear. Perspectives varied, but in general there was a view that greater institutional integration would not be desirable because of a perceived lack of rail expertise and understanding within the Ministry of Transport and the NZTA. In a quest for further integration there was a suggestion that amalgamation of all rail operations with the NZTA might be an option. No stakeholders were firmly of the view that this would benefit rail because there was a perception that the NZTA, at this stage still in its infancy, would be a road-dominated organisation and rail's interests could be sidelined. This view is likely to be reflective of the nature of the stakeholders interviewed, predominantly experienced rail industry members who remember the marginalisation of rail under privatisation and are wary of a return to such a scenario.

In this regard, it seems clear that to develop New Zealand's rail system and hence promote its sustainability some leeway from the rail sector and from the wider transport sector needs to occur at all levels if genuine integration is to occur. Anecdotally, there is evidence of an increasingly productive relationship between ONTRACK and the NZTA in terms of recognising the effects of each others networks. Ideally, this would be taken even further to actually consider how both rail and road (and coastal shipping) networks operate in conjunction with each other. Although rhetoric about such integration has long been a feature of national and regional transport policy, practical realisation of this goal has proved elusive. There is no doubt that putting in place the right institutional arrangements is a critical prerequisite for genuine integration. Any moves that bring rail as a transport option further into mainstream transport decision-making processes would be viewed as being positive from a sustainability perspective. This is not to say that rail should be blindly promoted in every situation, but rather it should always at least be considered. As one stakeholder succinctly commented, '[Rail] is neither always the answer, nor never the answer'.

On a more pragmatic level it would seem that the transport sector needs to consider rail as a part of the transport solution and recognise the benefits that it can provide in certain situations, while the rail sector needs to be more open to inclusion in the wider transport sector. This relates to previous comments that no transport mode, including rail, can afford to view itself as a discrete industry. Certainly rail has been guilty of this and still is to some degree. Correctly or incorrectly, stakeholders noted that there was a perception by some within the transport industry that rail was still a somewhat inward-looking and difficult sector to engage with. The only way this will be overcome is for the rail and transport sectors to consciously engage on a consistent basis in a constructive dialogue about the role of rail in New Zealand's transport system.

RECOMMENDATION 1

Encourage greater cooperation and coordination between rail participants and greater accountability on delivering on responsibilities.

Stakeholders: ONTRACK, KiwiRail, NZTA, Ministry of Transport

Understanding and recognising cost and benefits

To some degree the hesitancy and weariness of rail to engage and integrate more fully with the wider transport sector stems from a view that the benefits of rail are not well recognised and accounted for in current decision-making processes in the transport sector. This relates to the costs and benefits associated with various transport modes and can be referred to as full cost pricing, meaning that the full costs and benefits (collectively referred to as externalities) are factored into decision-making processes. Ultimately this means that when consumers are making choices about how to move goods and people they face the true cost of their choices. Where full cost pricing does not occur, transport consumers face a distorted pricing regime. This is also explored in sustainability theme 2 (integration) as it is partially responsible for the modal bias

The lack of full cost pricing was raised by stakeholders and cited in the literature as a very significant barrier to achieving a sustainable rail system. As discussed in sustainability themes 4 and 5, there are a number of environmental and social aspects that are critical to sustainability but that are often not well factored into decision making. Examples of these externalities include:

- noise
- use of land
- biodiversity
- greenhouse gas emissions
- community severance
- particulate emissions and air pollution
- contamination of water
- aggregate use
- energy use
- impacts on community health and wellbeing
- road accidents
- congestion.

The recognition of the benefits and costs of different modes in any given situation is critical from a sustainability perspective because it largely dictates the transport choices made. An important component of NZTA's funding allocation process is cost-benefit analysis (CBA). A ratio of greater than one indicates that the benefits outweigh the costs. Many stakeholders made the point that many of the aspects of sustainability were not included in conventional CBA. In effect many of these aspects are ignored by conventional analysis. This does not mean that they do not occur, but rather that they are not priced into the transport system meaning that the consumer is faced with a distorted pricing system. In most cases when a cost is not factored into the CBA it is effectively borne by society as a whole. The Wenita logging case study (box 5.1) illustrates the way in which the conventional CBA employed for determining options for transporting logs in Dunedin did not accurately account for all the costs and benefits of the two options.

Box 5.1: Transporting logs in Otago

Wenita Forest Products owns a forestry block of approximately 4500 ha north of Mosgiel. The forest was to be harvested over an eight-year period beginning in 2007/08. Approximately half of the logs needed to be transported to Port Chalmers while the other half were to be transported to a local mill. Two possible options for transportation of the logs were investigated: road and rail.

Two evaluations were undertaken. The first evaluated the costs and benefits to Wenita of the two options. This evaluation found that the costs associated with the rail option were just over \$5 million higher than for the road option. Rail would have been favoured over road if back-loading could have been guaranteed. Back-loading refers to the loading of wagons on return journeys from the main destination.

A second evaluation looked at whether the rail project would be likely to qualify for funding under Land Transport NZ's alternatives to road fund based on their economic evaluation procedures (Land Transport NZ 2005). Although incomplete, this evaluation found that cost savings associated with the rail options would include:

- approximately \$1.3 million on road maintenance savings (the cost avoided by not having the logs moved by road)
- approximately \$5.7 million on safety savings.

It was noted, however, that both of these cost savings would not accrue to Wenita but would be savings to local and central government. Despite the fact that these two savings alone would more than cover the \$5 million difference between the two options, it was advised that the rail option would be unlikely to qualify for Land Transport NZ funding (MWH 2007). This highlights the fact that existing decision-making processes often do not recognise and take into account many aspects of sustainability. Other aspects that were not taken into account included:

- greenhouse gas emissions
- noise and vibration, including the impact of vibration on structures adjacent to proposed transport routes
- air quality impacts
- energy efficiency.

The Wenita case highlights how the costs of various transport options are not always incorporated into decision-making processes. It also highlights how the long-term benefits associated with the rail option were not well considered. The evaluation was only for the costs and benefits for the eight-year timeframe of the logging activity but this ignored the fact that the rail option would have provided a long-term strategic asset with the potential for further use well beyond the immediate eight-year timeframe.

Source: MWH 2007

Issues around full cost pricing are often controversial as they can sometimes require people and organisations to acknowledge some uncomfortable and often unpopular costs. This was certainly the case when the surface transport costs of various modes in New Zealand were first investigated in 2005 (BAH 2005). The pricing of one important externality, greenhouse

gas emissions, has proved to be very contentious. One of the main criticisms of attempts to incorporate these costs into decision making is that the end cost to users (in this case transport users and consumers) will increase. The reality is that modes that are currently imposing unaccounted costs will face increased costs but in the long term this is actually beneficial to overall transport systems as it encourages investment and use of more cost-effective transport choices. In short, it reveals 'truths' about transport choices and makes more sustainable transport choices comparatively more cost-effective. If price signals are accurate, rail will be used where it is the most cost-effective solution. It also encourages all modes to continually strive to reduce the costs they create.

The emphasis on full cost pricing for this research stems from a desire to identify, and have recognised, the costs and benefits of rail compared with other modes. Underlying this interest is recognition of the role all modes of transport play in creating a sustainable transport system. Ultimately, full cost pricing involving the internalisation of externalities should reveal what the most cost-effective transport solution is for any given situation. These costs do not necessarily have to be transferred fully to end users, but it can help to determine where public subsidies may or may not be appropriate. The Wenita case study is an example of a situation where a potential cost to the public may have been avoided or reduced through the use of rail and some form of subsidy could have been warranted. It is clear that the current lack of full cost pricing with regard to the benefits of rail is a very significant barrier to the commercial success of rail freight operators and a potential barrier to further investment and development of the rail system.

An uneven regulatory environment also creates distortions in the pricing of transport systems. Stakeholders raised this as an issue in relation to both safety standards and employment conditions. It was noted that the safety standards for rail, in comparison with those for road, were much more onerous: rail safety is much more heavily regulated than road safety, particularly in terms of maximum speeds and driver hours. All rail incidents are reported to the NZTA and any accidents, however minor, are subject to investigation by the Transport Accident Investigation Commission (TAIC). In addition there are very strict rules around the recording and monitoring of driver hours in the rail sector. Comparative measures for road, in particular heavy freight vehicles, are not nearly as robust. The TAIC does not investigate accidents involving heavy vehicles and the enforcement of speed restrictions is left to the New Zealand Police. In this regard it was noted that significant accidents in both the road and rail sectors are dealt with very differently and the incentives and requirements to operate safely and continually strive for improvement are substantially different. It was also noted by stakeholders that recent amendments to the Transport Licensing Services Act 1989 are intended to improve the recording and reporting of heavy vehicle driving hours but it is unclear what effect this will have.

A further disparity mentioned by some stakeholders was that international ships often use foreign labour and are not subject to New Zealand employment requirements. This was raised because international ships are also able to make a certain number of inter-regional movements between New Zealand ports. This means that in some cases they are able to transport freight inter-regionally at reduced labour costs compared with road and rail which also creates a market distortion.

RECOMMENDATION 2

Establish, within the wider transport sector, decision-making and funding mechanisms that take into account all benefits and costs.

Stakeholders: Treasury, Ministry of Transport, NZTA

Long-term, coordinated planning and investment

Underlying all of the previous discussions about how the rail sector is funded and governed is the reality that rail operations are expensive and require a long-term perspective. This long-term perspective refers to how the development of the rail network is planned and how it is funded. For example, rolling stock has an average life of 30 to 40 years and some of the network infrastructure in New Zealand such as tracks, bridges and tunnels are close to 100 years old. Furthermore, rail infrastructure and locomotives often need to be ordered years in advance of their actual deployment.

As was shown in the Wenita logging case (box 5.1) a long-term perspective is not always taken in transport planning and this can be to the detriment of rail. A potential barrier to investment in rail is that, compared with modes such as road, it is relatively more susceptible to political cycles as various governments can have different commitments to rail. This uncertainty can make long-term planning and funding very difficult. Some stakeholders believed that now all major aspects of the rail system were in Crown ownership there was greater potential for this to occur, although the fact that the NZRC is an SOE may go some way to addressing this issue.

There appears to be a growing recognition of the long-term nature of transport planning in general with the updated NZTS adopting a vision to 2040. A similar perspective needs to be taken on rail. Some trade-offs will have to be made but it is clear from these discussions about governance and funding that failure to get these institutional arrangements right will almost certainly act as a barrier to the revitalisations and further development of the rail system.

Development plans for the short (next five years), medium (5–10 years) and long term (10 years and beyond) must be put in place and must be accompanied by a funding commitment. The current situation, where ONTRACK has largely been planning the network on an ad-hoc and reactive basis due to resource constraints (OAG 2008), will not allow this sort of comprehensive planning to occur. Planning also needs to maintain a network perspective, particularly if the coverage of the network is expanded. The economic viability of branch lines is often marginal but the wider benefits they bring in terms of increased main line traffic and flexibility of rail operations need to be recognised. Although somewhat contradictory to the highly devolved planning mandate under the RMA, a degree of centralised planning will be necessary for the development of New Zealand's rail system. Regional government will be an essential participant in this process and it is expected that most regions would be more than willing to participate, but regional parochialism can sometimes inhibit the development of the network in the national best interest. This is not to advocate that regional interests should be ignored, but rather that the interests of the national network must also be kept in mind. The national rail network is perhaps different to some other national networks, such as electricity transmission, in that the regional benefits are often clearer. It would be advantageous for rail if ONTRACK and KiwiRail were to establish ongoing relationships with regional councils to discuss how rail, as part of the national network, could contribute to regional transport

systems more fully. In most regions, rail is relatively absent from regional transport planning undertaken under the LTMA.

RECOMMENDATION 3

Ensure rail organisations and regional councils work together more closely to examine the potential role of rail in assisting meet the transport needs of regions. The RLTS process would likely be the most appropriate mechanism to achieve this.

Stakeholders: ONTRACK, KiwiRail, regional councils, NZTA, Ministry of Transport

5.1.3 Summary

Table 5.2 Opportunities and barriers: Governance and funding

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Legacy of institutional bias toward road transport.	✓		✓	
	Lack of long-term funding commitment.	✓		✓	
	Lack of accountability on performance measures.	✓		✓	
	Lack of clear policy direction.	✓		✓	
	Difficulties in translating transport policy objectives into action.	✓		✓	
	Lack of recognition of importance of management of a national network.	✓		✓	
	Marginalisation of rail within national and regional transport planning.		✓	✓	
	Lack of full-cost pricing.		✓	✓	
	Lack of funding for immediate works.		✓	✓	
	Overly complex regulatory environment.		✓	✓	
	Organisations with highly adversarial relationships.		✓	✓	
	Lack of political support.	✓	✓		✓
	Insularity and isolation of the rail sector.	✓			✓
Incorporation of transport emissions into ETS.			✓	✓	

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
Further incorporation of environmental and social costs into CBA.			✓	✓	
Forge constructive relationships with regional government.			✓		✓
Develop long-term accountability measures for all rail participants.		✓		✓	
Develop a commercially viable rail system.		✓		✓	

5.2 Integration

Integration is a topic that incorporates a number of elements relating to achieving sustainable outcomes in rail including: modal integration, land use, modal bias, car dependency and travel demand management. Although each of these elements of integration is considered, their interrelationships are also outlined. Understanding 'integration' in relation to the sustainability of the rail industry involves taking a contextual approach in order to examine the historical institutions and structures which have resulted in the rail network New Zealand has today. This in turn helps to identify the barriers that exist in relation to achieving sustainable outcomes.

Similarly, examining the current and future drivers resulting from policy changes and global trends is equally important, as a number of emerging issues have brought a new mindset and a new relevance for rail in New Zealand and globally. Cities are experiencing traffic congestion, oil prices are rising and climate change is becoming one of the most pressing global issues. These factors have contributed to an increasing sense of urgency for establishing an integrated transport network in New Zealand.

Integrated transport was an issue frequently explored in both the literature and in stakeholder interviews. The concept of 'integrated transport' or modal integration, was viewed ubiquitously in the literature and by stakeholders as a highly significant issue. Establishing integrated transport represents one of the most significant opportunities in terms of promoting sustainability in New Zealand.

However, in order to understand modal integration the issues surrounding modal bias, including land-use practices, need to be explored. Travel demand management too can be seen as an aspect of modal integration but has been discussed separately for the purposes of this research.

5.2.1 Objectives

Table 5.3 Objectives: Integration

Issue	Objectives
Modal integration	Enhance rail's contribution to sustainable economic development. Key priorities emerging from this objective include: <ul style="list-style-type: none"> • encouraging more freight to be carried by rail • optimising use of the rail network within the wider transport network (NRS).
Land use and transport	In Auckland by 2016, 28% of the population will live within 800 metres walk of rail station and 62% will be within a 5 km bus, car or ferry ride from a train station (ARTA).
	Increase use of public transport to 7% of all trips by 2040 (ie from 111 million boardings in 2006/7 to more than 525 million boardings in 2040) (NZTS).
Travel demand management	The aim is to move people out of cars for urban journeys and freight off roads wherever possible. For freight this means a focus on bulk or containerised loads For passengers it means a focus on busy urban corridors in the main centres.
	Reduce the kilometres travelled by single occupancy vehicles in major urban areas on weekdays by 10% per capita by 2015 compared with 2007.
	Increase walking and cycling and other 'active modes' to 30% of total trips in urban areas (currently about 17%). <i>Rail is often used as a transport option for commuters in conjunction with active modes.</i>
Modal bias	Enhance rail's contribution to an energy efficient and environmentally sustainable land transport system. A key priority emerging from this is: 'ensure transport choices take into account the environmental benefits that rail can provide' (NRS).

5.2.2 Opportunities and barriers

Modal bias

A number of stakeholders believed that structural or institutional bias within the transport sector has skewed development away from rail and toward road as a result of distorted pricing structures. There has been a significant lack of investment in the New Zealand rail industry to date and a period of privatisation of the rail industry in New Zealand has also led to under-investment in the network, eroding its viability. This was a central theme of all stakeholder interviews and provided some interesting insight from stakeholders:

Institutional bias from government has involved 'block grants' for roads, whereas rail has been made to look after its own infrastructure commercially. This has led to a significant distortion in a couple of billion dollars is given as a grant to road, whereas rail has to fund its own infrastructure. Road is heavily subsidised, whereas rail is less so which makes attaining a sustainable rail system difficult. The playing field is not level for competition with roads for freight because trucks don't pay the full costs of the roads and rail has to.

Furthermore, Transfund's (a former Crown entity which became part of Land Transport NZ in 2004) stated goal was to 'invest road user funds to achieve a world class road system for NZ'. Dodson and Mees (2003) point out that unsurprisingly, of the \$5.2bn spent between 1996

and 2003, only 5.1% was spent on public transport. Similarly, an evaluation of the 1999 Wellington Regional Land Transport Strategy was symptomatic of a pro-road bias, as

improvements to public transport were evaluated on the basis of benefits provided to motorists (decreased road congestion) rather than to the patrons of public transport or the environment (Dodson and Mees 2003: 31).

Dodson and Mees (2003) explain that public transport has been institutionally weak in comparison with roads. While a single national agency existed for planning, construction and operation of major roads, no such agency existed for public transport. Instead public transport planning, financing, operations and management were distributed among a variety of national and regional, public and private agencies with divergent interests. This issue, combined with a regulatory bias and pricing framework favouring road transport, has led to significant under-spending and consequent underuse of the rail system. Unless this is addressed it will represent a systemic barrier to achieving sustainable outcomes in the rail industry in New Zealand.

It is also worth noting that the institutional, structural or societal bias towards road-based transport is not unique to New Zealand. There is a pronounced dominance of road transport over rail for both passenger and freight movements internationally. In Europe, over half the structural expenditure on transport infrastructure has, at the request of member states, favoured road over rail, indicating a lack of government priority to invest in alternative transport modes, and leading to dependence on the car and expansion of road networks (European Commission 2001).

To compound this, great strides have been made in the automobile industry, crucially the industry is powerful and globalised compared to the rail industry with perhaps as much as a hundred times greater spent on research and development over rail (Smith 2003). Stakeholders agreed that public perception has mirrored the institutional view, leading to road having more political popularity than rail. Additionally, a number of societal and demographic factors exist which have led to the decline in rail and a bias toward roads, for example:

- Development of 'just in time' markets where goods and services are needed quickly requires a highly flexible transport system, both temporally and spatially. Rail can sometimes compete if an extensive network is in place but generally road transport is in a better position to achieve these objectives.
- Decentralisation of the service sector has meant that services have moved to peripheral locations due to the cheaper cost of labour/office space. This has led to an increase in multidirectional travel, a need for accessibility to labour and an increase in work-related travel. Rail is not well suited to accommodate these travel needs unless an extensive network is in place but can at times serve 'edge cities', unless an improved focus on land use and transport integration occurs.
- Women's participation in the labour force means that work and children related schedules need to be coordinated: these require high flexibility to meet rigid time constraints – often met by the private car.
- Younger cohorts have had greater accessibility to cars and are therefore more likely to get licences and then purchase and use cars.
- An increase in leisure time means more leisure trips, for which rail is not competitive (Feitelson 1994: 18).

These too, represent non-systemic barriers for rail. Nonetheless, one opportunity which may curb the flow is a changing demographic with an ageing population that is likely to become more reliant on public transport once again.

A shift in modal bias?

A step change is occurring in the rail and policy environment both internationally and in New Zealand representing a shift in modal bias. This represents a significant opportunity for achieving sustainability outcomes in the rail industry in this country.

An increasingly congested and unreliable road network is one factor in this shift in modal bias, as there are very high returns from making the best use of existing networks, particularly in those places that are important for economic success: congested and growing city catchments; key inter-urban corridors; and key international gateways that are showing signs of increasing congestion and unreliability. As Eddington (2006: 31) states, 'any sensible business would ensure that existing assets perform properly before embarking on new speculative investments'. A change in public perception is also contributing to a shift in modal bias from road use. The growth of environmental consciousness and fuel price rises, combined with traffic congestion in cities and highway safety compromised by the transport of freight, has heightened public appreciation of the rail network's value.

Furthermore, access to public transport is increasingly being considered a basic human rights issue (MoT 2005b). Issues surrounding access to passenger services for 'transport impaired' - those who have difficulty using or are unable to use public transport facilities because of a disability - have been identified by a Human Rights Commission inquiry. This is explored further in sustainability theme 4: Social considerations.

According to the NRS (MoT 2005b) the government's focus is now on shifting commuter and freight traffic from road onto rail to ease road congestion, benefit the environment, and improve safety, personal security and health. As one stakeholder commented, the government buying Toll NZ was about gaining decision rights so that decision mechanisms are in place to deliver better policy. Another stakeholder commented that the fact that rail operations are being brought back under Crown control indicates recognition of the advantages rail has in terms of sustainability and utilising rail more, particularly for freight

It is imperative that changes in public perception and the changes in the global environment are capitalised upon by the government in order to encourage change in New Zealand so that the country is proactive about responding to global drivers, rather than reacting to events affecting rail's operating environment. Internationally, some governments are ensuring that land use, transport policy and environmental policy are far more closely aligned, meaning that sustainable transport is a key driver behind land-use policy. This is particularly the case in Europe as a result of the Strategic Environmental Assessment directive which is applicable to all land use policy (Tricker 2007). Local government too can set land-use policy that would alter transportation use patterns, and set and enforce restrictions on the time and place of vehicle use.

Land use

There is a strong relationship between land use and transportation. Land-use practices and spatial planning policies represent long-term non-systemic barriers to sustainable rail. Existing policies have promoted dependence on cars leading to urban sprawl and the proliferation of low-density housing (Szyliowicz 2003; Richardson 2005). This phenomenon generates additional demands that can only be met by more private cars and makes effective

provision of public transport (bus or rail) difficult. To compound the problem, one of the market's responses to road congestion has been the decentralisation of home, services and workplaces – again leading to the use of cars to navigate between these locations. A lack of integrated land-use planning has led to increased private vehicle ownership and road dominated logistics and freight industries (Haywood 2007). Emerging land-use policies need to challenge this pattern in order to make rail and public transport a viable alternative to the private motor vehicle (Feitelson 2004). The key question now facing policy-makers and the public is how to combat congestion and the legacy of land-use policies leading to such a high degree of car dependence. It is well documented in much of the literature that road transport has impacted negatively on living space and people's health (ERRAC 2006). The marginalisation of certain groups as a result of the perpetuation of land use, which leads to car dependence, may also represent an opportunity for rail and public transport generally.

Regardless of the many advantages of rail over road transport in relation to greenhouse gas emissions, rail also has a number of key advantages in terms of land use. Rail is much more efficient than road in terms of the transport capacity provided proportional to the amount of land required (OECD 2002). This, coupled with difficulties in acquiring land for road projects to cater for increased traffic, gives rail a significant advantage (ARTA 2006). As Peet (2007: 8) notes 'the under-utilised rail corridor provides a resource that begs to be developed at a time when acquiring new land for roads is difficult and expensive'. Furthermore, rail lines are fixed infrastructure meaning that they provide certainty for land-use development. It has been well documented in Europe that new rail lines significantly increase land values in catchment areas (ERRAC 2006).

Rail corridors in certain parts of New Zealand, particularly Auckland, are considered to be underutilised currently (ARTA 2006). ARTA's assessment of an 'exit rail' strategy, involving abandoning rail and adopting high-capacity bus lanes, showed the benefit of the rail network. It was considered that the 'exit rail' option would take five years to implement, be prohibitively expensive and only provide enough capacity to 2016. Furthermore, as table 5.4 below illustrates, there are significant land-use efficiencies associated with rail compared with motorways and dedicated bus ways. Developing increased capacity through road projects is costly; as one stakeholder pointed out costs of rail projects are minimal in comparison with some highway projects. Equivalent benefits for the movement of people and freight can often be achieved for a lot less cost on rail projects and with fewer environmental impacts.

Table 5.4 Capacity of various transit corridors

4 to 5 metre corridor width through city	Capacity per hour
An extra lane of motorway	2400 people
Dedicated bus way	12,000 people
Suburban heavy rail	20,000–25,000 people

Source: ARTA 2006 from a US Transit Study with factoring applied for New Zealand's narrow gauge

Central and local governments internationally are promoting urban design and land-use policies which favour intensification of development in urban areas therefore leading to an urban fabric which is more supportive of public transport use. In parallel with this, travel demand management (TDM) is a concept increasingly championed by local authorities and central government. In early 2008, Transit New Zealand (now NZTA) ran free travel demand management workshops in all regional centres in early 2008 encouraging planners, architects

and engineers from local authorities, consultancies and other transport agencies to engage in the concept of travel demand management.

Another key opportunity for promoting rail is the opportunity to contribute to urban renewal and regeneration. Rail stations could be natural focus points for commercial, industrial, or residential development (MoT 2005b; ARTA 2006). Government and land-use policies have a large role to play in the fostering of dense development around rail stations to generate significant demand within walking and cycling distance of stops. This requires the integration of land-use and transportation planning in order to build sustainable travel into communities. Rail can make the case for higher-density city centre regeneration served by high-capacity rail lines thereby maximising sustainability and improving quality of life (ERRAC 2006).

Opportunities exist for an increased role for rail in the major urban centres of Wellington and Auckland. A recent 're-urbanisation' trend in Wellington represents a change in land use that rail could serve efficiently with high-capacity commuter services. Intensification of urban development around transport hubs can be a driver for regeneration of that area. Similarly, implementing transport projects can be a driver of land-use change, economic growth and improved urban design (Tricker 2007; Haywood 2007). Urban design of some European light railway projects has added to the aesthetic quality of the urban environment and light rail often reinforces public realm improvements, as illustrated in the Nantes case study below (Tricker 2007).

Box 5.2: Light rail in Nantes

During the 1950s, tramways almost entirely disappeared from the French urban landscape. Nantes was the first French city to reintroduce a modern light rail system in early 1985 with a first line of 6 km. The system was extended over the years to a network of three lines and 36 km, carrying 200,000 passengers a day, which is in addition to the 160,000 passengers using the complementary bus system.

The urban development profited strongly from a renovation of the urban fabric all along the lines, as has been the general case for the numerous light rail systems that developed afterwards throughout the country. The results are remarkable: quieter, safer and less polluted town centres that have become significantly more attractive to both citizens and visitors, thus giving a boost to the local economy.

Source: ERRAC 2006: 21

Modal integration

A number of factors have led to modal integration representing one of the most significant opportunities for New Zealand to achieve sustainable outcomes in the rail industry. Such factors include: legislative drivers relating to reducing New Zealand's greenhouse gas emissions; spatial planning policy changes leading to intensification of development (and therefore land-use patterns more conducive to public transport use); increasing road congestion; and a more environmentally aware public. The external influence of high oil prices is also an important driver as it is characterised by increasing prices and scarcity. This may result in road transport costs becoming if not prohibitive, at least discouraging, meaning that public transport, including rail, may emerge as a preferred mode of transport (Peet 2007).

It is widely agreed in the literature that urban passenger transport has the greatest potential for displacing private car use and is therefore the single issue through which rail could have the greatest contribution to a lower carbon society. While the rail industry can do more to minimise its energy consumption and CO₂ emissions, the impact of reducing the number of car journeys made, by transferring those journeys to rail, is likely to have a more significant effect in the long term (Peet 2007; Arthur D. Little 2007). By integrating with other modes of transport and adapting to changing travel patterns and demand, rail can form part of a viable alternative to the private car and encourage modal shift (RSSB 2006).

The importance of modal integration was strongly echoed in the stakeholder interviews, where it was suggested that if New Zealand wanted to meet its Kyoto Protocol targets, looking at each transport mode in isolation and trying to reduce emissions of each mode was an inefficient strategy. A significant shift from road to rail would achieve more than an increase in rail emissions efficiency itself. In particular, it was considered that rail could become a viable alternative to the private motor vehicle in Auckland and Wellington. Stakeholders saw the use of rail as a 'conduit between nodes or destinations'. However, stakeholders also counselled that both planning and funding needed to consider all modes of transport holistically rather than in isolation if a modal shift or modal integration was to be successful.

Fortunately, such a shift from road to rail also has economic development benefits through reducing congestion on roads, and this in turn benefits those who continue to use the road. However, according to one stakeholder the concept that rail would be of benefit to the whole of New Zealand needed to be demonstrated in order to make it publicly acceptable.

Barriers to integration

The lingering effects of modal bias and land-use practices means that some systemic and non-systemic barriers to modal shift exist. Many stakeholders also believed that part of the difficulty in developing rail to its fullest extent was the multitude of agencies involved in land-use and transport planning and transport regulation. Each mode of transport has developed its own infrastructure, culture and orientation. Overcoming these traditional patterns requires new decision-making structures and approaches at various levels and government support and willingness to act is critical.

There is potential competition between rail and sea transport with both modes being particularly suited to bulky non-time sensitive goods. Furthermore, the government's Sea Change strategy (MoT 2008a) promotes transport of freight by coastal shipping. Stakeholders had differing opinions over whether this would be a competitor to rail as both modes were well suited to similar sorts of freight. Some, however, felt that both modes were complementary rather than competing.

One barrier to rail and road transport planning is the current rationalisation of ports. As two stakeholders pointed out it was very difficult to plan transport infrastructure around ports at the moment, as ports were on the one hand being promoted by local councils with parochial interests, and on the other hand main shipping lines were 'playing them off against each other'. However, the Sea Change strategy promotes the idea of a 'hub and spoke' network which means effective feeder services (spokes) conveying freight to and from the gateway ports (hubs). As stakeholders pointed out, time-sensitive products would continue to go by road as, in most cases, the journey would be quicker by road than by rail or coastal shipping.

Similarly, for passenger rail to succeed it needs to be able to compete with cars on an hour for hour basis. This was a theme raised by stakeholders. Furthermore, rail has a clear disadvantage compared with road transport in terms of its spatial inflexibility as rail lines will never be able to go everywhere and provide a network with the coverage of the road network. In terms of passenger rail, its utility depends on convenient spatial relationships between stations and places that passengers need to travel from (Haywood 2007). Nonetheless, specific opportunities for achieving modal integration and modal shift in New Zealand exist in the short and longer term both for passenger transport and freight transport.

Freight transport

The volume of freight in New Zealand is estimated to increase by about 70% from 2005 to 2020 (RPC 2008). As the road network is already under pressure, the potential for development of the existing, under-utilised rail corridor to take advantage of rail's surplus capacity is increasingly seen as an opportunity.

It was widely agreed in the literature and by stakeholders that in terms of the operation of a transport system, rail and road transport were more complementary rather than competing in most cases. For instance, a rail system can be excellent for transporting bulk commodities and containers to centralised points from where they are then moved by road transport. The trend in freight is towards consolidation with rationalisation of ports and major industries tending to consolidate their goods in centralised distribution plants. Stakeholders regarded this as a major opportunity for rail and suggested that a focus should be put on improving levels of service between distribution hubs and ports.

Rail can play an important role in the national inter-modal logistics market by establishing rail links to ports to ease congestion on existing road infrastructure. The Port of Auckland, for instance, is experiencing significant congestion, with trucks queuing to collect containers. Moreover, the underutilised rail corridor provides a resource to be developed at a time when acquiring new land for new roads is difficult and expensive. In many parts of New Zealand, freight depots have been closed, meaning some opportunities have already been lost. Stakeholders suggested that there should be a focus around re-connecting access nodes.

Passenger transport

Passenger transport is affected by the peak oil phenomenon as well, which represents an opportunity for rail passenger transport in some locations. As one stakeholder pointed out, a significant increase in demand for public transport was being experienced as a result of recent rises in fuel prices, making road transport increasingly unaffordable and public transport more attractive: 'we're in the happy position that we're not looking for customers but they are demanding more capacity'.

Significant opportunities exist for modal shift on certain routes and in certain locations within New Zealand. Stakeholders generally perceived shorter trips to have the greatest possibility for passenger transport. Stakeholders identified two major opportunities:

- provision of fast inter-regional trains within the 'golden triangle' between Auckland, Hamilton and Tauranga
- the Canterbury region could benefit from an integrated passenger rail service as they have several satellite towns which could encourage the use of rail.

There is potential for the increase in the use of rail for passenger movement to conflict with freight movement, particularly where suburban passenger services and freight share the

same line. Areas where nodal intensification occurs around rail lines may encounter reverse sensitivity issues relating to noise and vibration.

RECOMMENDATION 4

Investigate key commuter hubs and passenger routes and promote integration with other modes.

Stakeholders: Regional councils, ONTRACK, KiwiRail, NZTA

Passenger transport intermodality has been successfully implemented in the Netherlands through the integration of buses and rail services, as illustrated in the case study below (box 5.3).

Box 5.3: Integrated regional transport in East-Netherlands

During the 1990s, an integration and decentralisation scheme to improve the quality of public transport in the rural eastern region of the Netherlands was implemented. This started with tariff integration and better connections and ultimately resulted in the establishment of a single franchise contract for all transport in that region.

The new operator started in 1999 with the 'fishbone model', in which the railway serves as backbone, and parallel bus lines are replaced by new bus lines feeding to the railway. Connections are also guaranteed (trains and buses wait for each other). Moreover, frequencies were doubled and new light trains and buses were introduced. In just over five years, this has led to a doubling in passenger numbers. Recently, the system has expanded through tendering and now covers four rail and more than 30 bus lines.

Source: ERRAC 2006: 12

This is a model with potential to be implemented in a New Zealand context too (as stated in the literature and by stakeholders), and is in fact crucial if the rail network in urban centres such as Auckland, Christchurch and Wellington is to succeed. However, in order for passenger transport to succeed in New Zealand a number of complementary facilities and services need to be implemented to cater for public transport users. This is discussed further under 'Travel demand management' below.

Travel demand management

Travel demand management or transportation demand management (TDM) can be viewed as a subset of intermodality, as it is a crucial part of promoting modal integration and modal shift. There are a number of definitions for TDM, for example, Land Transport NZ (2005) described it as:

various strategies that encourage more efficient and sustainable travel and transport behaviour. TDM has the objective of encouraging motor vehicle users to use alternative, more sustainable, means of transport when appropriate, while also reducing total vehicle kilometres travelled. TDM is an increasingly common response to urban traffic congestion and pollution problems, and to reduce general problems associated with vehicle dependency.

Transit New Zealand had a more road focused definition of TDM describing it as:

Travel demand management (TDM) involves measures to reduce road traffic growth and actively manage use of the road network.

As discussed, New Zealand is not immune from urban passenger issues. Levels of congestion in morning and evening peaks in Auckland and Wellington are high even by international standards. It has been estimated that a 4% increase in public transport in Auckland would mean 18,000 fewer vehicle journeys/day, saving \$200 million/year in congestion costs, a reduction in fuel use by 52 million litres/year and a reduction in the need for road spending of around \$3.8 billion (ONTRACK 2008).

TDM therefore represents an important opportunity to overcome some barriers associated with rail transport, and its promotion can have significant effects on the road environment, economic development and sustainability. TDM is a multidisciplinary area requiring partnerships working from a number of agencies. Broadly, it is a three-pronged strategy involving the following areas of work:

- land-use policy which encourages public transport use
- infrastructure and services – the ‘right product’
- education, awareness-raising and marketing.

Each of these is discussed briefly, as follows:

Land use TDM involves implementing land-use policies which support and promote public transport use, for example:

- intensification of urban development and development of centres
- car parking facilities/‘park and ride’ associated with public transport
- cycleways and pedestrian walkways to link to public transport nodes – these are especially important where transport corridors sever the community and integration.

All such land-use measures strengthen the attractiveness of public transport to potential users.

Transport framework and the ‘right product’ It is important that ‘products’ or services offered by a rail system reflect and support how people want to travel.

This means providing efficient connections, choice and coordination, and therefore requires cooperation across a range of transport providers and land-use plans. The need to provide efficient connections was raised frequently in the literature and by stakeholders who saw provision of buses, cycling or walking facilities feeding into rail stations as crucial to rail’s success.

A key element of providing the right product is providing better information to potential transport users. It is the public that an intermodal system is designed to serve; that influences decisions on projects and policies; and that will make a new transportation system an effective one. Appropriate, high-quality information infrastructure is needed. There is often a lack of clear information about how to shift from one mode to another and this can be a barrier to a potential public transport user. Provision of information to non-rail users to allow them to make a more informed choice about their mode of travel may be one way to attract more passengers onto trains (Peet 2007).

Providing the right transport framework or product, therefore involves the following main elements:

- provision of fast, accurate and helpful information in order to make public transport easy to use and navigate. Transport for London's online 'Journey Planner' is a good example of this³. This timely provision of information also has implications for perceptions of personal safety and security
- a fare structure that people can understand and which builds confidence. This may involve more flexible fares to encourage passengers to tailor their travel, ie fares that reward travel outside the busiest times, season tickets with different numbers of days in the week (such as 3-4 day tickets)
- easy ways to buy tickets (use of technology) and provision of integrated ticketing to combine public transport in a single ticket
- frequent services
- meeting the specific needs of disabled passengers
- urban design involving better access to stations
- improving conditions at stations
- better travelling conditions on trains
- provision of facilities to carry bicycles on public transport
- in some locations, related services such as baggage handling for transition between modes, may become important.

Education, awareness-raising and marketing There is a need to showcase a more appealing sustainable transport network through engagement with schools, employers and the community. Although there is increasing awareness amongst the population of the need to take individual action to reduce impacts on the environment, the benefits and advantages of using public transport need to be advertised in order to influence transport choices.

A nationwide media campaign is needed that will target car users and get non-users of public transport to use sustainable modes of transport such as rail, bus, walking and cycling. One such campaign has been employed in the London Borough of Sutton to great effect and is detailed in the case study below (box 5.3).

5.2.3 Summary

The table below provides a summary of the barriers to and opportunities for achieving sustainable outcomes in the rail system in terms of integration.

³ For more information, see: www.tfl.gov.uk

Box 5.4: Smarter Travel Sutton

Smarter Travel Sutton⁴ is a partnership project between Transport for London and London Borough of Sutton which aims to reduce traffic congestion in the borough.

The project was launched in September 2006 with a budget of around £5 million.

London Borough of Sutton lies on the southern fringe of Greater London and is not served by the London Underground. The borough is home to 180,000 residents and has a workforce of 67,000. Car ownership is high, with 77% of households having access to at least one car. For the journey to work, car has the largest mode share (47%).

The Smarter Travel Sutton awareness raising project encourages people to use the most sustainable method of transport appropriate for their journey. It is an all encompassing project which aims to raise awareness in all sectors of the Sutton community. Therefore, Smarter Travel Sutton is working with residents, schools and businesses to reduce car dependency and promote walking, cycling, using public transport, car sharing and car clubs. The project covers four main work areas: school travel plans, workplace travel plans, personalised travel planning and travel awareness. Specific strands of the project include a cycle delivery project, cycle training and an 'active travel' GP referral scheme.

Smarter Travel Sutton aims to reduce residents' car trips by between 5 and 10% over a three-year period.

After just one year, the project has obtained the following positive results:

- Car mode share among local residents for all trips has fallen from 49% to 47%.
- 38% of residents have reduced the amount of driving they do, are considering doing so or are willing to consider it.
- Awareness of car reduction advertising is at 39%, while awareness of local activities promoting travel behaviour change has risen significantly, from 15% to 25%.

A 2007 Ipsos Mori survey also found that Smarter Travel Sutton was the Council's most recognised service, with 29% of residents recalling the project.

Table 5.5 Opportunities and barriers: Integration

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Legacy of institutional/structural bias toward road transport	✓		✓	
	Lack of investment in the rail network resulting in an infrastructural deficit.	✓		✓	

⁴ For more information, see: www.smartertravelsutton.org

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Multi-agency approach to public transport and the rail network.	✓		✓	
	Pricing structures have not taken into account social and environmental externalities associated with road transport.	✓		✓	
	Land-use practices favouring urban sprawl and resulting in car dependence.	✓		✓	
	Demographic and societal changes leading to reliance on private motor vehicles and road transport for 'just in time' markets.	✓			✓
	Differing health and safety regulatory environments for modes.		✓		✓
Government regulation can internalise environmental costs to better reflect the externalities of road transport.			✓		✓
Better provision of information for potential rail-users.			✓	✓	
Infrastructural improvements, eg improvement of rolling stock and reliability, greater choice and connections for passengers.		✓		✓	
Better conditions at stations and on trains.		✓		✓	
Increases in fuel prices leading to greater demand for public transport as road transport becomes more expensive.			✓		✓
Kyoto Protocol obligations and other legislative drivers in New Zealand towards reducing greenhouse gas emissions favouring non-carbon based transport.			✓		✓
Greater public awareness of environmental issues leading to more openness to public transport use.			✓		✓
Access to public transport and services increasingly considered in a human rights context.			✓		✓

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
Promotion of travel demand management tools.			✓		✓
Demographic changes such as an ageing population leading to increased demand for public transport.		✓			✓
Land use patterns favouring densification of development and supporting public transport are increasingly pursued.		✓			✓
Widespread belief in the benefits of rail in the context of urban regeneration.		✓			✓
Rail provides an efficient use of land for transporting people and freight.					
Roads are already under pressure and an increase in volume of freight in New Zealand (increasing 2.2 times by 2040) represents an opportunity for rail.		✓			✓
'Spoke and hubs' freight transport system to maximise use of ports and rail.		✓			✓
Intermodalism within passenger transport sector leading to integration of rail with bus 'feeders' and improved cycle and walking facilities.		✓			✓

5.3 Social considerations

This sustainability theme consists of issues surrounding safety, access, labour concerns and public perceptions of rail. These issues were identified with mixed priority across the literature reviews, stakeholder interviews and within policy. In general, the issues of safety and access were perceived as being significant to the promotion of sustainability performance in rail, as indicated in the National Rail Strategy to 2015 (MoT 2005b) and the Rail Safety Targets position paper (MoT 2005a). Accessibility and safety were also assessed as issues with a high degree of significance to sustainable outcomes in rail. Conversely, labour issues were viewed with minimal significance in the literature reviewed but were frequently raised during the stakeholder interviews when sustainability and rail were considered in a New Zealand context.

The four issues can be characterised as follows:

Safety – including the perceptions of safety and how it compares with other modes is an important aspect of public transport provision and applies to employees, passengers and third party users (ie those who use level crossings).

Access – issues surrounding social inclusion and exclusion are a priority for an effective public transport network. Inadequate provision may create barriers, limiting certain individuals and groups from fully participating in key activities such as employment, education, healthcare and recreation. Barriers to access are grouped here as being physical, financial or informational.

Labour – this is a key input into the rail industry and plays an important role in the long-term viability, and hence sustainability, of the sector. Due to recent activity, or inactivity in New Zealand, concerns regarding the capacity of the workforce were raised.

Public perception – represents a way of assessing the relative merits of rail against alternative modes. Overcoming adverse perceptions of the rail network is a critical factor in achieving some of the high-level government objectives such as modal shift in relation to passenger services.

It is also worth noting that an issue which would sit comfortably under the umbrella of the social considerations chapter relates to public health. This was not, however, raised by stakeholders nor did it feature as a significant issue in the literature. Nonetheless, health benefits associated with a reduction in car dependency and an increase in active modes⁵ of transport should not be excluded from the debate on sustainability. The health benefits of sustainable transport are widely recognised in walking and cycling strategies which promote sustainable transport, and in the travel demand management discourse. It is also worth mentioning that even transport modes not considered to be ‘active’ per se, such as rail and bus travel often involve some active transport as people may walk or cycle to stations/stops. Certainly the health benefits of modal shift and a resultant decrease in road transport has been discussed in terms of air quality improvements, and this too is of benefit to public health.

5.3.1 Objectives

Table 5.6 Objectives: Social considerations

Issue	Objectives
Safety	Improving rail safety and personal security (NRS).
	A reduction of rail trauma, which includes level crossing accidents, trespass and vandalism accidents and rail operations accidents, by either 15%, or a reduction of 25% over a seven-year period, the latter is in line with reduction sought on the road network. (MoT 2005a).
	Reduce the number of people exposed to health-endangering noise levels from transport.
	Reduce the number of people exposed to health-endangering concentrations of air pollution in locations where the impact of transport emissions is significant.

⁵ An active mode of transport is described in the New Zealand Transport Strategy (MoT 2008b) as being powered by humans, and therefore could include walking, cycling, using a wheelchair, in-line skating and skateboarding.

Issue	Objectives
Access	Public transport providers make immediate improvements to visual and audible information at staffed stations, timetabling display and on-board announcements (Human Rights Commission 2005).
Labour	None.
Public perception	Increase use of public transport to 7% of all trips by 2040 (ie from 111 million boardings in 2006/7 to more than 525 million boardings in 2040) (NZTS).

5.3.2 Opportunities and barriers

Opportunities and barriers cover the issues of: public perceptions around personal security in relation to use of passenger rail; perceptions around rail safety in comparison to competing modes; responsibilities for third-party accidents on the rail network; education campaigns around rail safety; modal bias and car dependency in New Zealand; the potential for marginalisation of certain groups and individuals; and labour issues surrounding an ageing workforce.

Safety

Although rail is the safest mode of transport in New Zealand, the Wilson (2000) report on rail safety suggested that rail safety performance could be improved to meet international best-practice standards. Safety also includes personal security concerns about crime, fear of crime, harassment, vandalism and theft which can act as barriers to rail patronage. An important aspect is the public's perception of rail safety and how rail's performance compares with other modes, especially relating to the issue of personal security at stations and on trains.

Table 5.7 Rail accidents 2001-2007 by type

Accident type	Fatal	Serious	Minor	Total	Average/year
Level crossing	44	34	36	114	16
Trespass and vandalism	67	27	48	142	21
Rail operations accidents	5	42	125	172	25
Total	116	103	209	428	61

Source: MoT dataset

A summary of the safety performance of the rail system is shown in table 5.7. It should be noted that of the 116 fatalities over the seven-year period, only five are directly attributable to rail operations with the vast majority being attributable to trespass on the rail network and level crossing accidents involving road users. Rail is inherently safer in comparison with other modes with significantly less fatalities over a seven-year period than a single year on New Zealand's road network. A significant opportunity therefore exists to promote rail as a less harmful mode of transportation. Some stakeholders drew attention to the mismatch between 'actual' safety (reflected by statistics on road and rail accidents) and public perceptions of the relative safety of the different modes, suggesting that the public is less concerned about safety issues in relation to road fatalities. Such fatalities are an accepted

externality of the road network and therefore the public has become desensitised to such outcomes.

Several of the stakeholders also drew attention to the link between safety compliance disparities between modes. Regulatory compliance is far stricter and the costs higher for rail operators than for their road equivalents such as trucking companies. This is despite the proven safety record of the railway where fewer people are killed or injured than on roads. Nonetheless this represents a real cost issue for the rail industry. Stakeholders were clear, however, that this was not an argument for relaxation of the safety regulation framework, but instead suggested that there should be a tightening of safety responsibilities in the road network in order to create a more even regulatory environment between different transport modes.

A related safety issue concerns the allocation of responsibilities for level crossing and trespasser accidents on the rail network which are largely outside the control of rail operators and access providers. Level crossing accidents occur where public or private roads cross railway tracks. Driver error and road user behaviour have been identified as the biggest contributing factors to such accidents. Trespassing accidents are also the outside the direct control of rail operators. Several rail organisations felt that rail safety targets that included level crossing and trespasser accidents unfairly placed a burden of responsibility on the rail industry alone to improve safety in these areas (MoT 2005a).

To address issues surrounding rail safety, trespasser accidents and level crossing accidents, a partnership approach is recommended between road controlling authorities, private road owners, local authorities, the police and private owners of land adjacent to the network in conjunction with the rail operators and access providers.

RECOMMENDATION 5

Adopt a partnership approach to address issues surrounding rail safety, trespasser accidents and level crossing accidents.

Stakeholders: ONTRACK, KiwiRail, Ministry of Transport, NZTA

Recent education and media campaigns to increase awareness of level crossing safety and trespassing on the rail corridor include the 'Tracks are for Trains' campaign and the Australasian Rail Safety Awareness Week, which ran from 21-27 July 2008, showing where opportunities exist for educating users and influencing travel behaviour. By using advertising and promotional activities to reduce trespassing and by promoting the 'stop, look and live' theme, the initiative urges motorists, pedestrians and cyclists to take extreme care when entering or crossing the rail network.

Barriers also remain about the effective measuring and monitoring of rail's safety performance as stated by the Ministry of Transport Report (2005a) and the United Kingdom's Department for Transport report 'Delivering a Sustainable Railway' (2007). This is because the fewer accidents there are the more difficult it is to statistically infer actual underlying safety performance by just counting the number of accidents. Outcomes can be subject to a relatively wide, and random, variation meaning that can make it difficult to determine when a real change in safety level has occurred. For example, a single fatal accident does not necessarily mean that the railway has become less safe, and conversely a long period without fatal accidents does not mean the railway has become safer.

Land Transport NZ (2008) investigated personal security in public transport travel in New Zealand using surveys, a literature review and focus groups. The study found that awareness of security measures was low with only one in six users having observed security measures such as CCTV. It also found that people disliked station designs which made them feel enclosed or vulnerable, and that darkness was a major issue and barrier to using public transport. Therefore improving lighting is a crucial and cost-effective means of improving public perceptions of safety. Another aspect of rail travel that made people feel unsafe or uneasy included uncertainty over when a service was going to arrive.

Measures to improve the sense of personal security at train stations that received widespread support by respondents included random security guard patrols during less busy times; emergency alarms or 'panic buttons' to alert guards; open cafes and kiosks at stations; and security cameras. There was overwhelming support for personal presence at stations which has implications both for the use of cameras and for automatic ticketing machines. The walking and waiting stages of train use also raised personal security fears, for example issues around darkness, alleyways and secluded pathways and quiet and isolated streets. A key step for promoting modal shift to train use was identified as the provision of better lighting and vehicle security at station car parks and park and ride facilities, as people feared vehicle and bike theft from these places (Land Transport NZ 2008).

Much of the research carried out in Australia, the United Kingdom and the United States is also applicable to New Zealand. The New Zealand results are corroborated with those found in Australia and opportunities to address perceptions of safety are similar.

Box 5.5: Safer Stations Safer Trains, NSW

The New South Wales State Rail Authority put into place 'local environment' and 'victimisation prevention' strategies to try to reduce actual crime and the fear of crime on some of its suburban routes. The 'safe station' programme aimed at providing stations with:

- a) an enhanced level of services in terms of
 - being staffed 24 hours a day while trains are running
 - predominantly easy or level access to stations
 - location at major interchanges (bus stops, car parks, taxi ranks)
- b) a high level of security in terms of:
 - improved lighting
 - contract security as required
 - implementation in particular of crime prevention through environmental design (CPTED) recommendations
 - closed circuit TV remote monitoring.

The 'victimisation prevention' strategy primarily involved reducing trains to two carriages after evening peak time. The idea being self-supervision via concentrating a number of people in a smaller space (Tulloch et al. 1998).

As illustrated in the Safer Trains NSW case study above (box 5.5), opportunities exist to address issues surrounding fear of crime or actual crime in rail, including through CPTED measures at stations, good urban design and other operational changes.

RECOMMENDATION 6

Implement measures to address crime, fear of crime and perceptions of personal security in order to promote the use of public transport, including rail.

Stakeholders: ONTRACK, KiwiRail, district and regional councils

Accessibility

Accessibility can be provided by a range of transport modes, including public transport. It can also be supported by measures such as land-use planning and improved modal integration. However, there are individuals and groups within society that face particularly problematic accessibility issues, such as the elderly, mobility impaired people, people on low incomes, isolated rural communities and young people. The difficulties surrounding access to land transport faced by disabled people in New Zealand has been highlighted by a Human Rights Commission report (2005) which concluded that in spite of progress made in improving accessibility, 'significant numbers have acute and ongoing difficulties with using public land transport services', including trains in New Zealand.

Four ways in which transport can socially exclude people from participation in the normal institutions and processes of society include (DETR 2000):

- spatially – the infrastructure is limited in spatial scope
- temporally – the service does not operate at appropriate times
- financially – cost of use is too high for some users
- personally – information is not presented in a way that is understood by everyone.

The same report also identifies four attributes of 'adequate public transport': availability, accessibility, affordability and acceptability, which mirror the four ways that people can be socially excluded by transport:

- availability – where a person has access to the infrastructure, ie train stations but faces timetabling issues such as frequencies and timings
- accessibility – the ease with which all people can use the infrastructure, covering access for the mobility impaired, provision of information and on-board facilities
- affordability – refers to the financial cost of the journey to the user
- acceptability – the condition of the network in terms of comfort, cleanliness, facilities on-board and at stations, and staff competency.

Poor accessibility to transport enforces social exclusion meaning the location and accessibility of the infrastructure are fundamentally important in determining the ability of individuals to participate in normal social institutions and processes.

The imbalance and car dependence which currently exists has wider implications for accessibility, excluding certain individuals and groups from normal activities within society. A strong dependence on cars can cause unchecked urban sprawl and low-density housing

which in turn generates additional demands that can only be met by more private cars and makes effective provision of public transport difficult. This can have social effects as, although cars increase mobility and freedom for those who can utilise them, other groups such as the poor, elderly and disabled can easily be marginalised and isolated from the community if alternative public modes are not available.

Auckland is particularly vulnerable to these sorts of access and exclusionary issues as it is one of the most car dependent cities in the world. This is an outcome of transport planning that explicitly rejected alternatives to total dominance by the car (Mees and Dodson 2002). A lack of, or poorly integrated transport and land-use planning has given rise to dispersed land-use patterns, increased car ownership and a road dominated freight and logistics industry. This has created a key problem for the rail industry; how to enhance rail's accessibility given its spatial inflexibility

Labour

The performance of the industry's workforce plays a key role in the long-term viability and, by extension, the sustainability of rail. Labour issues raised in the context of this research through stakeholder interviews have principally concerned the capacity and ability of the current workforce to manage the expected demands on the rail infrastructure.

Data illustrating rail's particular workforce demographic is not readily available; however, various representatives in the stakeholder interviews stated that the industry has an ageing workforce and graduate recruitment programmes have been neglected or completely terminated, meaning there are few replacements for some of the senior management who are reaching the ends of their careers.

Many stakeholders believed that the industry needs more people to inject youth and skills into it, especially as the government is committed to major expenditure on rail infrastructure in New Zealand. There has been an apparent exodus of skilled workers to Australia to assist in their 'rail renaissance', as stated by Wayne Butson, Rail and Maritime Transport Union (RMTU) General Secretary, in a recent press release : 'recent years have seen an exodus of key skilled workers, who were leaving because they didn't see this industry going anywhere' (RMTU 2008).

RECOMMENDATION 7

Review career paths for rail employees and implement initiatives to promote careers in rail.

Stakeholders: ONTRACK, KiwiRail, Rail and Maritime Transport Union, Ministry of Transport, Department of Labour

Public perception

The public perception of rail is crucial if rail is to succeed in increasing patronage and achieving government targets pertaining to modal shift as a solution to climate change, environmental challenges and personal mobility requirements. Rail depends upon customer acceptance and support for its viability. To be acceptable rail needs to demonstrate that it can benefit the whole of New Zealand. Relevant issues include:

- safety, not only operational safety but perhaps more importantly personal security concerns compared with travelling by car

- factors of pricing and value
- comfort of the rail travel experience
- convenience of the rail network; and the 'green' credentials of rail travel may influence patronage.

In sum, perceptions of the four attributes of accessibility noted above, affordability, availability (physical and geographical), accessibility and acceptability, whether based on fact or otherwise, form the filter through which people compare alternative modes and make their travel choices.

Due to the wide range and subjective nature of the perceived advantages and disadvantages of differing transport modes it is particularly hard to assess the current situation and it is certainly an area that requires further research and understanding. The United Kingdom government has established an independent national rail consumer watchdog 'Passenger Focus'. This entity has conducted the National Passenger Survey⁶ to measure passenger opinion on overall satisfaction for 29 separate aspects of rail service, using knowledge gained to influence decisions on behalf of rail passengers. New Zealand could also benefit from some market research in targeted locations to assist in the development of physical assets (particularly stations) and rail services.

Current low public transport patronage and high levels of car ownership, at 0.7 vehicles per person in 2005, means that New Zealand has the fifth highest rate of vehicle ownership among member countries of the OECD (MfE 2008). Therefore, the contemporary 'car culture' and dependence on the road network to access services and amenities means a certain amount of inertia exists where travel behaviour is concerned. The comfort and efficiency of present transport arrangements creates a barrier to greater use of rail, and warnings of future distress resulting from climate change and increased fuel prices appear insufficient to impel any major change to this. However, opportunities do exist to challenge public perception and increase levels of education and awareness around public transport use. Challenging negative public perceptions about public transport, including rail, and increasing patronage are imperative if rail is to accomplish sustainable outcomes. As one stakeholder pointed out, the more people use rail, the more it contributes to a sustainable transport system.

RECOMMENDATION 8

Implement public relations campaigns to encourage people to use public transport.

Stakeholders: KiwiRail, regional councils, NZTA

5.3.3 Summary

Table 5.8 provides a summary of the barriers and opportunities to achieving sustainable outcomes in the rail industry, as identified through the social consideration sustainability theme.

⁶ See www.passengerfocus.org.uk

Table 5.8 Opportunities and barriers: Social considerations

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Varying safety regulation compliance and costs across different modes	✓			✓
	Ageing workforce and inadequate recruitment damaging productivity and long-term viability of the rail sector.	✓		✓	
	Undue responsibility placed on rail operator and access providers concerning third party incidents.	✓			✓
	Public perceptions and New Zealand's 'car culture' favours individual car ownership rather than more inflexible public transport use.	✓			✓
	Public opinion generally favours funding for road projects rather than rail projects.	✓			✓
Rail is an inherently safer mode of transport than road transport.			✓	✓	
Education and awareness-raising campaigns promoting rail safety and trying to influence user behaviour.			✓		✓
Implementation of CPTED and other measures at stations, around stations and on trains to improve perceptions of personal security.			✓		✓
Access to public transport seen as a human right.		✓			✓
Links between public health and sustainable modes of transport (especially active modes) increasingly promoted by local authorities.		✓			✓

5.4 Natural environment

The effects on the natural environment (or biophysical externalities) associated with rail operations considered in this research were diffuse pollution, air pollution, biodiversity, noise and vibration, and greenhouse gas emissions. The research did not involve a comprehensive

assessment of all the environmental impacts of the rail system. The externalities considered are primarily concerned with the extent to which the operations of the rail network and its assets impact upon the natural environment. The main impacts include:

- **Diffuse pollution** - land contamination from accidental spillages and leaks of hazardous substances, and from historical uses of land; and water pollution associated with discharges (eg run-off from tracks and vehicle cleaning, and leaks from fuel storage containers). Pollution from rail can also be attributed to accidental spillages of materials transported by rail; however, the low accident rate of rail suggests this is a minor risk, although the impact of any such event could be major.
- **Air pollution** - from vehicle exhausts, construction and maintenance of rolling stock and other physical assets.
- **Biodiversity** - rail may have a positive or negative effect on this. In some areas rail corridors are used to enhance biodiversity and provide ecological corridors. In other areas rail corridors may sever habitats.
- **Noise pollution and vibration** - particularly from the rolling stock operations, though this tends to be localised.
- **Greenhouse gas emissions** - emissions from rail that contribute to climate change.

Pollution from rail can be grouped into three general sources:

- historical legacy (eg route crossing contaminated land, railway sleepers)
- operational (day-to-day operations)
- maintenance and renewal (of rolling stock and infrastructure).

A general trend which emerged from the research was the different emphasis placed upon the biophysical externalities by the literature reviewed and the stakeholders interviewed. The literature placed much more importance on these issues whereas, in general terms, the stakeholders skimmed over specific environmental impacts of rail, and when impacts were mentioned it was largely in the context of accentuating rail's advantages in comparison with other modes, particularly road.

Pricing of costs was discussed in sustainability theme 1 but it is worth mentioning here as it is often the biophysical externalities (effects on the natural environment) and social environment that are not appropriately factored in to pricing of transport projects. Costs include those associated with accidents, climate change, air pollution, noise and congestion. As a result of the failure to price resources at their marginal social and environmental costs, competition within the transport system is distorted and there is no real incentive to use the cleanest modes or least congested networks.

5.4.1 Objectives

Table 5.9 Objectives: Natural environment

Issue	Objectives
Diffuse pollution	Enhance rail's contribution to an environmentally sustainable land transport system...minimising adverse effects on land, air, water, communities and ecosystems (NRS).
Air quality	In October 2004, the government introduced the national environmental standards under the RMA for air quality, which include: <ul style="list-style-type: none"> • seven standards banning activities that discharge significant quantities of dioxins and other toxics into the air • standards for ambient (outdoor) air quality of five emissions; carbon dioxide (CO₂), nitrogen dioxide (NO₂), ozone (O₃), particulate matter (PM₁₀), sulphur dioxide (SO₂)
Greenhouse gas emissions and energy efficiency	Halve per capita greenhouse gas emissions from domestic transport by 2040 (NZTS).
	An emissions trading scheme (ETS) for greenhouse gases is also part of the government's response to climate change to: <ul style="list-style-type: none"> • reduce New Zealand's net emissions below business-as-usual levels • comply with international obligations, including those under the Kyoto Protocol (ETS).
	Reduce the overall energy use and greenhouse gas emissions from New Zealand's transport system (NZECS).
Noise and vibration	Reduce the number of people exposed to health-endangering noise levels from transport (NZTS).
	The AS/NZ 2107:2000 Acoustics Recommended Design Sound Levels and Reverberation Times for Building Interiors include 'satisfactory' and maximum values for noise. However, the standard only prescribes levels for areas adjacent to major or minor roads and not rail. To date, no explicit national noise criteria have been developed and there is no international common standard for railway lines.
Biodiversity	Increase the area of Crown transport land covered with indigenous vegetation (NZTS).

5.4.2 Opportunities and barriers

As illustrated by recent improvements in the environmental performance of motor vehicles through gains in fuel efficiency, reduced emission outputs and the emergence of hybrid fuel technologies, there are opportunities for all transport modes to address their adverse impacts on the natural environment. In addition, there are increasing expectations, and legislative and international drivers to do so, and a mounting awareness of the need to protect and preserve the world's natural resources. Therefore, as environmental sensitivity increases, rail is likely to come under greater public and regulatory pressure to improve its environmental performance further.

Diffuse pollution

This factor is focused upon issues of water, air and land pollution. A feature of this issue is the variation of temporal and spatial scales over which pollutants can act, and that the point of discharge may not be where the most significant impact occurs. There are a variety of pathways by which pollutants from the rail industry can be dispersed into land and water by:

- direct discharge from a fixed site such as a depot or station, also known as point source
- diffuse/non-point sources which are one of the main means of rail industry pollution, such as herbicides applied at rail sidings or oil and fuel leaks.

Other operational sources of diffuse pollution could be from the cleaning of rolling stock at depots, rail track run-off and discharging of toilet waste.

Historical uses of land that the rail infrastructure traverses may have been subject to activities that subsequently contaminated the land, which the network operators now own and are responsible for. The Ministry for the Environment has undertaken a work programme to address the risks from land contamination resulting in a series of Contaminated Land Management Guidelines in New Zealand. Very little information, however, exists in relation to diffuse pollution from the rail sector.

Air quality

A recently completed study estimates air pollution from motor vehicles contributes to the premature death of 500 people per year in New Zealand and that a further 809 people are suffering serious illnesses. Although these figures are the result of private motor vehicle use and not train use, the transport sector as a whole has a responsibility to ameliorate the public health impacts of its emissions (Fisher et al. 2007).

The case of the Otira tunnel, on the Midland line, which runs for 8.5 km under the Southern Alps from Arthur's Pass to Otira, was mentioned by some of the stakeholders for a number of reasons. One of these was the localised impacts of air pollution on the natural environment. The natural vegetation that resides in the immediate vicinity of the external outlet fans, which enable gases (mainly carbon dioxide and carbon monoxide) to be extracted from the tunnel, was said to be severely withered or dead. This case serves to emphasise the potentially destructive but currently largely contained impacts of rail on the natural environment, in addition to the global impacts of climate change.

While technological opportunities such as electrification exist to tackle such issues as air pollution, the rail sector is responsible for only a small proportion of overall air quality pollutants and its sector contribution is minimal compared with other modes. Rail can, however, have a more significant impact in localised areas, for example the pollution caused by the idling of diesel trains at railway stations.

Biodiversity

The latest State of New Zealand's Environment report states that New Zealand is 'one of the richest and most threatened reservoirs of plant and animal life in the world' (Conservation International 2007 in MfE 2008). Ecologically, rail has the potential to utilise comparative advantages over other modes as its infrastructure has a much smaller physical footprint and is thus less damaging than the direct environmental impacts of roads. In some parts of the world rail is recognised as an important wildlife corridor assisted by biodiversity action plans that encourage the sensitive management of lineside biodiversity and reduce the need for additional transport infrastructure, such as roads, in sensitive areas (Network Rail 2005).

In the case of Network Rail, United Kingdom's network owner and operator, biodiversity is an important environmental issue as the rail infrastructure passes through more than 400 sites of special scientific interest. Thus Network Rail is obliged to manage their operations in an environmentally sensitive manner. In conjunction with regulators, Network Rail has developed site management statements, prioritised sites within the programme and committed to various schemes to conserve fragile species in partnership with conservation groups. Rail infrastructure may, however, also sever ecological communities with significant adverse effects on the movement of wildlife and the splintering of flora and fauna habitats. Railways can create disturbance and pollution (including air, water, land and noise/vibration) in areas they pass through, potentially damaging ecosystems. This is especially important for sensitive ecosystems that may be found in areas designated for nature protection such as national parks.

Relevant research surrounding claims of the potential of rail to enhance biodiversity in New Zealand is scarce and the lack of monitoring of environmental impacts of transport makes this an area requiring further research. Biodiversity as an opportunity or a barrier was referred to only occasionally by stakeholders; this suggests lack of knowledge of beneficial or detrimental environmental effects of the rail sector.

Noise and vibration

The localised noise and vibration impacts of rail can be significant, especially in high-density urban areas surrounding rail stations and depots. Currently, local authorities and the NZTA receive a significant number of complaints about rail noise. A lot of these complaints relate to warning bells at level crossings rather than noise from the trains. The promotion of intensification around rail nodes means that railway noise disturbance may become an increasingly important issue. Acceptable noise level guidelines have been established by the World Health Organization (WHO 1999), although these are considered to be very low and are exceeded in many environments. The guidelines are not transport specific but do make reference to transport-related noise. For outdoor living areas in residential areas the guidelines recommend exposure levels should not exceed 55dBA Leq, and in internal sleeping areas should not exceed 30dBA Leq (8 hr). Internationally, these levels have not been adopted for the design or management of land transport corridors, as they may be unachievable in areas next to major land transport corridors. This demonstrates the need for early land-use planning to avoid exposing people and communities to excessive noise levels (WHO 1999).

Railway noise is a complex phenomenon (Brons et al. 2003). Social and economic consequences do not just depend on the noise level, which is hard to measure accurately in itself, but also on noise characteristics, such as the type of noise, frequency, temporal distribution and other subjective characteristics. In the United Kingdom the Department for Food and Rural Affairs (DEFRA) has begun to address the issue of transport noise by creating noise maps of the road and rail networks in the United Kingdom. These noise maps have been produced by DEFRA to meet the requirements of the Environmental Noise (England) Regulations 2006 and are intended to inform the production of noise action plans for large urban areas, major transport sources and significant industrial sites in England. They:

- provide an overview of the ambient noise environment in large urban areas and from major transport sources in England

- allow the determination of the number of people affected by different levels of ambient noise, the source of that noise (ie road, rail, air or industry) and the locations of the people affected.

Noise action plans will seek to manage noise issues and effects including noise reduction, if necessary, based on the results obtained through the mapping process.

In New Zealand too, noise mapping could be used as an effective means of monitoring land transport noise and determining appropriate management strategies. Currently this tool is restricted to noise contour mapping around ports and airports in New Zealand, but it has the potential to be employed in a wider transport context.

Energy efficiency and climate change

One of the most pressing contemporary issues is climate change and rail, as an emitter of greenhouse gases, contributes to the phenomenon. It is an issue central to the concerns of sustainability and increasingly central to national and international policy, for instance under New Zealand's commitments as a signatory of the Kyoto Protocol. Despite the debate surrounding the nature and degree of climate change, there is a broad consensus that anthropogenic actions are making contributions to the observed climatic changes of the past couple of decades (Intergovernmental Panel on Climate Change 2007). Transport has a role to play in climate change due to the greenhouse gas emissions created by many modes. Infrastructure can also suffer the consequences of climate change, for example through flooded coastal lines and damaged bridges.

Transport accounts for 19% of New Zealand's greenhouse gas emissions⁷ so is one of the largest contributors by sector. Rail emits less greenhouse gas per passenger km or tonne km than road or aviation. In Britain it is estimated that the average carbon dioxide emissions for the same passenger rail journey is about half that of an equivalent car journey and about a quarter of an equivalent journey by air. Overall, rail constitutes 0.4% of the United Kingdom's overall carbon dioxide emissions whereas road transport accounts for 26% (RSSB 2007). In Sweden, the rail sector has a very impressive sustainability record; trains use 1.8% of total transport energy to carry 7% of the passenger/km and 38% of the freight tonne kilometres (Smith 2003).

Rail is also considered to be a low emitter of climate change gases over its full lifecycle. A study in Australia revealed that trams are the lowest emitters of carbon dioxide (at 0.2 kg CO₂/km) which is less than both cars (0.34 kg CO₂/km) and buses (0.22 kg CO₂/km) (Tricker 2007). Much work is also being carried out internationally, particularly in Europe, to improve the eco-efficiency of rail in terms of a full life-cycle assessment. The RAVEL (rail vehicle eco-efficient design) knowledge system is a sector-wide system providing environmental performance indicators for rail vehicles and their components throughout the supply chain (Dewulf et al. 2004).

Some stakeholders believed that the contribution the rail industry could make to New Zealand's national and international commitments to carbon reduction through reducing its own carbon footprint was likely to be less significant than the contribution rail could make by promoting a modal shift to rail, and increasing its capacity to accommodate a greater level of demand from businesses and individuals. Despite rail's inherent environmental advantages, the rail sector cannot afford to neglect its own carbon efficiency as other modes,

⁷ www.mfe.govt.nz/publications/climate/gas-emissions-flowchart/gas-flowchart.html

such as modern road vehicles, are currently significantly improving theirs. Furthermore, an increase in the use of rail will increase the environmental impacts of the rail system. Rail therefore needs to continue to improve its environmental performance to take into account expected increases in demand and patronage in light of government policies to encourage passenger and freight mode shift from road to rail.

Operational changes can contribute significantly to energy efficiency. Toll Rail recently won an Energy Efficiency and Conservation Authority (EECA) award for a project to reduce fuel consumption on a route where coal is transported between Lyttelton and the West Coast. The most fuel-efficient driving behaviours were determined and then demonstrated to drivers who went on to modify their driving techniques. As a result there has been a 9% reduction in fuel use. This example provides opportunities for use in other parts of New Zealand (EECA 2007a).

Electrification is one method for rail to improve its carbon efficiency, as electrification of the network allows operational power to be sourced from renewable sources and eliminate emission of air pollutants. Electrification was discussed repeatedly during the interviews with stakeholders and in literature with varying degrees of support. In general, it was met with scepticism in stakeholder interviews in terms of the value of benefits offered in relation to its costs and the alternative benefits that could be provided. Opportunities for electrification in New Zealand are examined in greater detail in the infrastructure theme.

Other opportunities that exist for rail to reduce its carbon footprint and impact on the environment include implementation of alternative fuels such as biofuels and hydrogen. The possible use of biofuels was not raised as an opportunity by stakeholders, but the NZTS does state that one of the key components for delivering the targets and objectives identified in the strategy is the use of new technology and fuels. While this is mostly directed toward fuel for road transport, opportunities may exist in the future for alternative fuels in the rail industry too. For example, in 2007 Virgin Trains in the United Kingdom launched their trial of a passenger train running on a 20% biodiesel blend, thereby reducing carbon emissions by 14%.

Hydrogen is also touted as presenting an opportunity for reducing rail's carbon footprint, with some arguing that hydrogen could be the next liquid fuel to replace oil. However, it is an energy carrier rather than an energy source and is currently available as a direct fuel for internal combustion engines. Such engines are slightly more efficient than diesel-powered engines and no carbon dioxide emissions or particulates result from hydrogen power, with water being the main discharge. However, hydrogen requires energy to be manufactured, and is currently regarded as being less fuel efficient than using electrification directly. Hydrogen also requires a large area for storage. Furthermore, it is currently a very expensive fuel. A suburban train unit powered by hydrogen would currently be twice as expensive as a diesel train and a freight locomotive five times more expensive (King 2008). Some countries, such as Denmark and Japan, are using hydrogen-powered trains. Interestingly, the United Kingdom has dismissed calls for further electrification in order to explore options which may arise from the use of biofuels and from using renewable energy to create hydrogen from water (King 2008).

Significant technical progress has been made in the road sector to improve environmental performance and energy efficiency. Rail too should concentrate on its environmental credentials to ensure it maintains the 'green' advantage. One tool available to assist in determining and improving the environmental performance of systems and sectors is an environmental management system (EMS).

Box 5.7: Environmental management systems in transport

A valuable management tool, an EMS can be used to identify and assess environmental issues, implement key actions for improvement, monitor environmental performance and progress, and as a minimum prove compliance with applicable environmental legislation and regulations. Further, when fully integrated and used strategically, an EMS can be used to implement organisational environmental goals and drive improvements and best practice in environmental management.

Air New Zealand has been using an EMS to improve its own environmental performance since 2006. This has involved:

- environmental policy development and review
- development of new or the revision of existing environmental management operating procedures, particularly in response to changing standards of industry practice or legislative requirements
- identification and assessment of significant environmental aspects and impacts
- development of control measures to mitigate environmental risks
- development of environmental objectives and targets
- whole-of-system EMS review and performance auditing
- delivery of environmental training and programmes to increase awareness of significant environmental aspects among employees.

Overall, these have been implemented through an ISO 14001 accredited EMS. A similar approach could be used for the rail industry although it would have to be tailored to the co-regulatory nature of the rail system.

RECOMMENDATION 9

Develop and implement an environmental management system to monitor and improve the environmental performance of the rail system.

Stakeholders: ONTRACK, KiwiRail

The major risks and uncertainties for the rail industry in relation to the natural environment are:

- the impacts of climate change on infrastructure operation and maintenance
- changing patterns of travel behaviour as a result of increased awareness of climate change

- the price of carbon due to government initiatives to transform into a post-carbon economy
- severe weather events resulting from climate change.

The issue of climate change is arguably more pertinent for rail than for any of the other transport modes due to the longevity of rail assets. Some of the rail infrastructure such as bridges, tunnels and tracks are only now reaching the end of their life-span after 100 years in use.

Although there is a current growing awareness and public concern about the effects of climate change, research has suggested a weak link between awareness and actual travel behaviour at the individual level. Therefore raising public awareness of this link is necessary but not sufficient to change behaviour on its own. Some studies suggest that travel behaviour is expected to change over a long time horizon - around 30 years - as people and businesses become more sensitive to the carbon cost of travel placing further pressure on the capacity of the network to meet expectations (DfT 2006). However, as some stakeholders pointed out, other drivers such as rising oil prices provided economic incentives for behaviour change which were taking effect in the short term.

Further uncertainties surround the operational consequences of climate change for the railway. Although weather patterns, including temperature variations and precipitation levels, are unlikely to change significantly in New Zealand, the frequency and intensity of severe weather events is expected to increase. Such severe weather events may include high winds and heavy rainfall inducing land slips and flooding. The longevity and capital-intensive nature of the rail infrastructure increases the vulnerability of the rail sector to these types of events, with the potential for significant infrastructure damage and capital depreciation if rail infrastructure requires greater maintenance and replacement before the end of its expected life.

5.4.3 Summary

Table 5.10 provides a summary of the barriers to and opportunities for achieving sustainable outcomes in the rail industry, as identified in relation to the natural environment.

Table 5.10 Opportunities and barriers: Natural environment

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Poor condition of rolling stock.	✓		✓	
	Lack of pricing of some environmental externalities into transport decisions.	✓			✓
	Lack of monitoring of the environmental impacts of transport in NZ.	✓		✓	✓
	Technical progress of road potentially eroding rail's environmental advantages.	✓			✓
Rail's inherent environmental advantage		✓	✓	✓	

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
Increased carrying capacity a greater contribution rail can make to sustainability than reducing its own carbon 'footprint'		✓		✓	
Electrification of the network can enhance environmental performance		✓		✓	
Rail has a smaller land-take than other modes and could potentially be an important wildlife corridor			✓	✓	✓
Compelling case for mitigating and adapting to climate change		✓		✓	✓

5.5 Infrastructure

In the context of this research infrastructure refers to rail network infrastructure and rolling stock. This final sustainability theme follows on from the previous four and addresses what might need to be done to the rail system, in a physical sense, to achieve the sustainability benefits previously identified. These discussions are of a general nature and are not intended to represent a comprehensive infrastructure development plan for the sector. Rather these discussions could be seen as a link between the sustainability issues highlighted in the research and the development of more detailed rail development plans.

5.5.1 Objectives

Table 5.11 Objectives: Infrastructure

Issue	Objectives
Network capacity	Increase rail's share of freight to 25% of tonne-kilometres by 2040 (NZTS).
	Increase use of public transport to 7% of all trips by 2040 (ie from 111 million boardings in 2006/7 to more than 525 million boardings in 2040 (NZTS).
	For identified critical routes: <ul style="list-style-type: none"> improve reliability of journey times reduce average journey times (NZTS).
Electrification	Conduct a desktop feasibility study into options including further electrification, for improving the efficiency of the NIMT and report with recommendations by the end of 2010 (NZTS).
	Reduce the overall energy use and greenhouse gas emissions from New Zealand's transport system (NZECS).

5.5.2 Opportunities and barriers

The opportunity to promote sustainability by increasing the use of rail was raised by stakeholders more than any other issue. Implicit in this opinion is the view that rail is a more sustainable transport mode than other alternatives, notably road. Reasons given for this included the lower environmental impacts of the construction and operation of rail compared with road and its lower energy use. Rail was commonly cited as being four to seven times more energy efficient than road.

There was a commonly held view that rail needed to increase its market share to promote sustainability. In this regard, 'sustainability' was used by stakeholders in two senses: 'environmental' sustainability and 'financial' sustainability, or what could also be regarded as commercial viability. Both perspectives are relevant in that there is no chance of a rail system being environmentally sustainable if it is not commercially sustainable. Overall, it was clear that for rail to become more sustainable it needed to be used more as a mode for freight movement and passenger transport. Both of these goals are key objectives of the NZTS and the NZEECS.

The most significant barrier that exists to achieving this greater use is the inadequate levels of service currently provided. Opinions on how inadequate current levels of service are varied between stakeholders and over different locations. In general, a view was expressed that the suburban networks in Wellington and Auckland, while not perfect, were well on the way to achieving good services. This is reassuring given the high level of investment in these networks in recent years. Of greater concern was the level of service provided on the freight routes. Unreliability, slow travel times and an inability to use rail were cited as the main barriers to increasing the use of rail for freight.

Freight movement

It was noted by stakeholders that large bulky commodities, such as logs, coal and dairy products were particularly well suited to rail as they generally required point-to-point service, which rail could provide. Although most rail freight is not highly time sensitive, reliability and speed of transport are still important. It is clear that in these two areas, rail lags behind road transport. A road journey time from Auckland to Wellington of approximately nine hours is significantly quicker than the approximate 12-hour journey by rail. In addition, rail freight is frequently delayed and late arriving at its destination. Some stakeholders believed that the performance of the network had deteriorated over the last five years with more speed restrictions creating longer journey times. In reality, most of the increases in speed restrictions can be attributed to works being carried out on the network rather than further network deterioration. It was also noted that the fastest Auckland to Wellington rail freight times of approximately 8.5 hours were achieved in the early 1980s, but the network in its current state would be unable to achieve such results. Although the Auckland to Wellington journey time example was mentioned specifically by stakeholders, the message is equally applicable to many parts of the network. The deterioration of the network and the severe infrastructural deficit has been well documented in general terms and is widely recognised. The exact extent of this deficit is, however, less clear. One of the main findings of the Auditor-General's report on maintaining and renewing the rail network was that there were some information gaps about the condition and performance of the network (OAG 2008). It was found that given ONTRACK's resource constraints their main focus had been on day-to-day maintenance to keep the network operational and that no clear processes seemed to be in place for deciding on the scheduling and prioritisation of works. As a result, works appeared to have been conducted on a rather ad-hoc basis, rather than as part of a long-term network upgrade plan. One of the main reasons for this was that ONTRACK and Toll both

underestimated how dilapidated some parts of the network were when it was repurchased in 2004. As a result, the challenge confronting ONTRACK of reinvigorating the network has been greater than expected.

Given that stakeholders were in almost unanimous agreement that increasing the use of rail for long-haul freight transport was the greatest opportunity for promoting sustainability in the immediate term, it is appropriate to consider how this could best be achieved. In terms of attracting more custom to use rail for long-distance freight transport, there were three key aspects frequently commented on:

- increasing the reliability of services
- reducing journey times
- responding to increasing freight dimensions and weights.

These requirements are very closely linked in that they all relate to removing and reducing constraints on the network. In general this refers to areas of the network which require a reduction in speed to maintain the safety of operations. Speed restrictions are necessary due to steep gradients, tight tunnels, sharp corners, worn tracks and bridges. Owing to New Zealand's terrain, all these are common features of the network and are known as 'pinch points' as they require a reduction in speed, which increases overall journey times and fuel consumption. Collectively, they significantly reduce the efficiency of rail operations. The predominant view was that with a significant, but not excessive, level of investment, many of these pinch points could be removed or at least reduced. This would likely involve a considerable amount of civil works including lowering curve gradients, increasing tunnel clearances, and replacing and improving rail bridges.

The other major aspect of network capacity is the size of freight loads able to be transported by rail. Similar to road networks, there is a maximum weight that can safely be transported on any given section of rail. This is known as axle load and is based on a number of factors such as the weight of rails, the density of sleepers, the amount of ballast and the strength of bridges. Most parts of New Zealand's network are rated to at least 16-tonne axle load, but on some lines it is only 15 tonnes. Most stakeholders also noted that axle loads were becoming an important issue due to the trend in the freight transport market towards larger, less frequent movements of freight. This is evident in the international shipping market and upper axle load limits for road transport are currently being examined with a view to being increased. This trend towards larger, heavy volumes of freight has two important implications for rail. Some parts of the network, particularly bridges, may not be able to handle increased weight of freight and tunnel and bridges act as physical barriers.

The issues surrounding the upgrades of bridges and tunnels relate to the clearance, which in some cases, is as little as 100 mm. Some of Fonterra's new Hi-Cube containers are larger than current stock and are currently not able to be transported on some parts of the rail network due to inadequate clearances on many tunnels. Clearance can be increased by boring out tunnels, day-lighting tunnels and renewing bridges with increased clearance heights.

Axle loads can be increased by increasing track weights which often requires a renewal of ballast and sleepers. Increasing axle loads can be a costly exercise because a line must be upgraded in its entirety as an axle load for a line is only as high as its weakest point. For New Zealand, bridges (of which there are 1787) are particularly problematic as they are often the weakest point in a line. Some bridges on the network were constructed in the 1890s and were not designed to handle the weight of modern rail loads.

It is clear that in terms of encouraging more freight to be transported on the rail network, slow delivery times and weight restrictions are both significant barriers. It is clear also that one of the most significant opportunities for contributing to sustainable outcomes in rail is in undertaking a large number of civil works to address these barriers. Although it is widely acknowledged that an enormous amount of work is needed on the network, it is less clear how this work should be prioritised. For instance:

- Should increasing axle loads be pursued ahead of reducing speed restrictions?
- What routes should be prioritised for investment - those currently carrying the greatest volumes of freight or those with the greatest potential for future growth?

Reducing speed restrictions at certain points will lead to an overall reduction in freight times whereas increasing axle loading will only provide a tangible benefit once an entire line has been completed. In reality, it is not simply a case of choosing between these options but it does illustrate some of the difficulties in deciding where investment in the network should be targeted. It should also be remembered that some of the barriers that have been discussed could potentially be addressed through above-rail solutions, that is, modifying locomotives and wagons. Clearances, for instance, can be increased by lowering wagon platforms by up to 200 mm. It is hoped that consideration of above and below rail options will be given to current network constraints.

RECOMMENDATION 10

Improve network performance on key routes so that journey times are reduced and reliability is improved. The implications of increasing freight dimensions and weights also need to be considered.

Stakeholders: ONTRACK, KiwiRail

Increasing the level of service provided by rail for freight movement will be the single most important aspect to achieving the target of increasing the volume of freight carried from 18% to 25% by 2040. Generally, there was a view that the existing network should be made more robust before any expansion was contemplated. Many stakeholders thought that seeking to expand the network before improving the performance of the core of the network would be detrimental to the overall system. A 'network' perspective has to be maintained and it is clear that a strong core network must be the immediate aim.

RECOMMENDATION 11

Articulate and develop a clear, long-term vision for New Zealand's rail system.

Stakeholders: ONTRACK, KiwiRail, Ministry of Transport, regional councils

There was also recognition that if the 25% target was to be achieved, rail freight would need to attract a wider range of customers. Currently, only about six major companies use rail in any great capacity. These are large companies transporting large volumes of freight, usually from point to point such as Solid Energy transporting coal and Fonterra transporting dairy products. Most of these current users have made a significant investment in rail. These companies have ultimately chosen rail because they believe that in the long term it will be more economical than the alternatives. Many stakeholders commented, however, that there

were many other companies beyond those in dairying, coal and logging that could potentially utilise rail for freight transport but, unlike the bigger companies, were unable to invest large amounts of capital. Their volume of freight would be less than that of the current main users. They might have enough freight for two or three wagons a day, but not enough to warrant a full 18-wagon train. Many of the companies interviewed for the National Freight Demands Study (RPC 2008) also indicated that they would like to use rail more in the future for long-haul freight movement. This confirms a strong demand for increased rail freight services.

Stakeholders also believed that overcoming this problem, and ultimately attracting more customers to rail freight, would best be encouraged through the increased use of sidings and branch lines. Sidings are sections of track that are not part of the main network but are connected to it for storage and manoeuvring of locomotives and wagons. One of their main uses is as an effective passing lane, particularly on single track lines. The other main advantage is that they allow greater flexibility of network operations, particularly when used in conjunction with branch lines. Branch lines generally connect warehouses, wharves, mines and factories to main lines. A siding next to a main line can be used as a collection point for multiple smaller loads which can be combined to form a full load which is then economical to move on a main line. Greater use of sidings and branch lines could help to provide access from adjacent potential rail users. There are currently some proposals to add branch lines, such as the proposed Clandeboy line near Timaru.

It would appear that attempting to provide greater accessibility and flexibility to rail users will be vital to attracting more custom. Usually the construction of branch lines to individual plants or industrial complexes is funded in partnership between ONTRACK, the company or companies using the line, and sometimes local government. Regional government would generally justify spending funds on branch lines on the basis that it would benefit the regional economy and have indirect benefits such as reducing heavy vehicle volumes on local roads. As was shown in the Wenita logging example discussed earlier, there are considerable institutional barriers to gaining funding for projects to provide access to the rail network. At the time of the research, details of funding arrangements for the rail sector were not known but a number of stakeholders commented that an agency such as the NZTA could administer a fund with the sole objective of increasing freight access to the rail network. How such a scheme would work would need further consideration, but in simple terms a fund of approximately \$100 million could be set aside for businesses to apply for. Applicants, together with ONTRACK, KiwiRail and local government could prepare a business case and apply for financial assistance in the form of grants or loans or both. Such a scheme would be separate to the funding provided for the upgrading of rail infrastructure and would be focused solely on facilitating greater use of rail for small to medium potential users.

RECOMMENDATION 12

Investigate options for the development of a funding programme dedicated to facilitating increased access to the rail network for potential freight users.

Stakeholders: ONTRACK, KiwiRail, NZTA, regional councils

Passenger transport

The other main objectives for rail relate to increasing the use of rail for passenger transport. Passenger rail operates on two main scales: suburban commuter rail within Auckland and

Wellington and long-distance inter-regional passenger transport. The long-distance passenger service is not as extensive as the freight routes and operates three main routes: Greymouth to Christchurch; Christchurch to Picton; Auckland to Wellington. The passenger service between Auckland and Wellington, known as the Overlander, was due to be closed in 2006 because it had been operating at a loss for a long time. The service was retained after some vocal opposition to the plan and an injection of government funds. The case of the Overlander highlights the difficulties faced by long-distance passenger rail in terms of its inability, in most cases, to compete with road and aviation in terms of price and journey times. These two critical factors could change in the future. The previous discussions about improving the robustness of the network and increasing its reliability and performance are equally as relevant for long-distance passenger transport as for freight. In terms of price, it is unlikely that the cost of rail services could be substantially reduced but possible increases in fuel prices in the future could make rail a more favourable option as rail is between four and seven times more fuel efficient than road (MoT 2008b).

Most stakeholders believed, however, that fuel prices would have to increase very significantly from present levels for rail to become genuinely viable as a popular option for long-distance passenger travel. This is not to ignore that long-distance passenger rail does provide an important service and is well patronised in some areas, particularly on tourist routes, such as the TranzAlpine from Christchurch to Greymouth. It was also noted that on some select routes there were good opportunities for increasing the use of passenger rail. The first was the Auckland to Hamilton route and to a lesser extent the route from Tauranga to both Auckland and Hamilton. Many stakeholders believed that a reliable high-speed service, especially between Auckland and Hamilton, could be developed as a viable alternative to road and aviation. The journey time by road is significantly increased by congestion, while the flight is comparatively expensive and is not able to deliver passengers to the city centre at either end of the journey. Similar comments were made about the Palmerston North to Wellington service, which has grown considerably in recent years. This is another example of a route where rail has been able to offer a good level of service and be competitive with the alternatives. Consequently, the Palmerston North to Wellington service is one of the most heavily patronised long-distance services in the country, proving to be particularly popular with long-distance commuters during weekdays.

Other than on some discrete routes, however, it is not believed that long-distance passenger transport presents the greatest opportunity for increasing the use of rail. As a relatively sparsely populated country with difficult terrain, New Zealand is not particularly well suited to high-speed inter-regional passenger services in the same way as Europe or Australia. Experience in Europe and Australia has shown that there are frequently tensions between operating passenger and freight service on the same network with both uses often conflicting over access arrangements to the network. In many cases this can only be resolved by having separate lines dedicated to either passenger transport or freight. In New Zealand it would appear that long-distance freight should be focused on initially, rather than passenger transport.

That said, all improvements to the network and planning for future development should, as far as is practicable, aim to allow for further possible use of the network for greater volumes of passenger transport in the future. This could be through the retention of rail corridors and the design capacity of bridges and tunnels. It is estimated that approximately half the bridges on the network will need to be replaced in the next 20 years and it would seem prudent to replace them with bridges wide enough for double tracks and capable of handling at least 20-tonne axle loads. Essentially, the network should be future-proofed as much as possible to

avoid prematurely foreclosing options in the future or creating additional costs. It is recognised, however, that uncertainties around fuel sources and technology make this task exceedingly difficult. Nonetheless, at least attempting to consider and anticipate future scenarios is likely to be more helpful than detrimental. Once again, this relates to having a long-term development plan for the network.

The other main opportunity to increase rail usage is in the area of suburban passenger transport. Most stakeholders were in agreement that the development of suburban rail services in Auckland and Wellington over the last few years has been very positive. With increases in fuel prices affecting the affordability of private vehicle use, demand for public transport has noticeably increased. It was acknowledged that in both Auckland and Wellington, transport users and transport authorities had been frustrated by the speed with which services were able to be upgraded due to delays in acquiring rolling stock and funding limitations. There was a common view, however, that ARTA and Greater Wellington had effective long-term plans and funding in place to improve suburban rail services in Auckland and Wellington, respectively.

Other than these two existing suburban networks, the only other urban centre where suburban rail was considered to be a viable option was Christchurch. Various stakeholders held the view that commuter services from Christchurch to settlements such as Rangiora, Amberly and Pegasus could be viable. Issues as to re-establishing a connection into the centre of Christchurch would need to be resolved and some new land for rail corridors would be required, but these issues were not believed to be insurmountable. It is recommended that a more detailed investigation of options for commuter rail within Canterbury be undertaken.

Electrification and alternative traction methods

The other main set of objectives, as well as increasing the use of rail, is to reduce greenhouse gas emissions and improve energy efficiency in the transport sector. It is clear that rail could have a valuable role in reducing transport emissions and improving energy efficiency. There are two closely related reasons for pursuing these objectives: to reduce dependency on fossil fuels as a source of energy for transport and to reduce the emission of gases that contribute to climate change. Reducing the use of non-renewable fossil fuels has two main advantages: it reduces greenhouse gas emissions and increases resilience in the future as the world energy market becomes increasingly carbon constrained. The environmental benefits of reducing fossil fuel use are commonly cited, but the economic benefits of insulating the transport sector from further likely increases in fuel prices are often overlooked. In short, there are strong economic, as well as environmental, reasons for attempting to reduce fossil fuel use. These objectives have been well documented in transport and energy policy in New Zealand. Attention has now turned to how these objectives can be achieved.

Many of the stakeholder representatives drew attention to the current poor state of rolling stock and infrastructure in New Zealand, citing under-investment in the past two decades as a barrier to promoting improved sustainability. The energy efficiency performance gap between the old rolling stock and modern road vehicles is reducing, hence investment is needed to upgrade the assets and maintain rail's 'green' advantages by phasing out the older rolling stock and improving the network and rolling stock interface.

Rail is particularly well placed to reduce its use of fossil fuels. It has the advantage over road transport of already being at least four times more energy efficient on a tonne-kilometre basis. Much of this advantage comes from economies of scale in terms of rail having

dedicated corridors and a single locomotive capable of hauling the equivalent of up to 80 heavy vehicle truck loads. Rail also has the distinct advantage of being able to run on electricity as well as operating on biodiesel. Some parts of the network, including the Wellington suburban network and the NIMT from Palmerston North to Te Rapa, are electrified but the greater part of the network remains reliant on diesel-powered locomotives.

One of the actions contained in the NZTS is to investigate options for the further electrification of the NIMT. Most stakeholders commented that the desire for further electrification of the network could potentially detract from the objectives relating to increasing the use of the network by attracting more custom. The main reason given was that, in most cases, electrification would not be likely to provide the improvements in network performance and levels of service required to attract greater use of rail for freight and passenger transport. It is well recognised, however, that electrification does provide benefits over diesel locomotives, namely:

- higher speeds
- higher average speeds
- better acceleration
- better energy efficiency
- reduced dependence on oil supplies, particularly if electricity is generated from renewable sources
- lack of greenhouse gas emissions
- reduced air quality impacts (King 2008).

Although electrification has many benefits in terms of promoting sustainability it is also extremely expensive. It is approximately \$2.5 million per kilometre for a single track and \$4 million per kilometre for a double-track (King 2008).

The majority of stakeholders believed that improving the performance and capacity of the network to carry freight should be pursued ahead of further electrification. In most cases a dilapidated and poorly performing network is not going to be improved purely through electrification. There are some cases where electrification could increase capacity and robustness. For instance, the Otira Tunnel on the Midland Line currently limits the movement along the line as trains must wait for fumes from previous trains to disperse before going through the tunnel in order to maintain a safe environment for drivers. This tunnel was previously electrified but this was removed in 1997 and a pressurised ventilation system was installed. There have been reports that the area surrounding the exhaust of this ventilation system has been negatively affected. A return to electrification of the Otira Tunnel could potentially help to increase capacity along this line which is used for the transport of coal from Greymouth the Port Lyttelton.

Similarly, ARTA has carried out a cost-benefit analysis to determine the pros and cons of whether new trains should be diesel or electric. Their analysis marginally favours electric, but also points out the benefits of electrification in relation to reduced noise, vibration and increased air quality. In the longer term the maintenance costs associated with electric trains are also considered to be marginally lower per car (ARTA 2006).

RECOMMENDATION 13

In the short term, consider electrification only in cases where it would lead to network efficiency benefits.

Stakeholders: ONTRACK, KiwiRail

The greatest risk to the development of the rail system is that a clear long-term infrastructure plan will not be developed and/or adequate funding will not be provided to achieve the plan. A further uncertainty is that international shipping schedules will almost certainly change over time and rail may not be able to respond to this. As a mode, rail is at a disadvantage in that it can be less able to respond to economic changes and changes in transport requirements than some other modes. Similarly, future technological advancement such as traction methods is difficult to predict and plan for.

In terms of promoting sustainability it seems clear that the greatest opportunities are in attracting more freight to use the network and to a lesser extent, encouraging greater use of rail for passenger transport. For this to occur, substantial improvement in the robustness and capacity of the network, particularly the freight network, will need to occur. This will mainly involve removing and reducing speed restrictions and increasing axle loads. In addition, the ability of transport users to utilise rail as a freight transport option also needs to be increased through the use of branch lines, sidings and an increased focus on meeting the requirements of freight users.

This is not to say that widespread electrification of the network should be ruled out. Rather, electrification should be pursued in the much longer term as in the next 15 to 30 years. It is entirely realistic to envision a fully electrified network powered completely by renewable electricity sources but this is a much longer-term goal. Unless the immediate focus is on improving network capacity, it is almost certain that the 25% target by 2040 will not be achieved. In real terms achieving this target is likely to do more to reduce greenhouse gas emissions and improve energy efficiency than widespread electrification, as electrification will do little to displace freight volumes from road transport. It should be remembered that for the 25% target to be achieved, the overall volume of freight transported by rail will need to increase by approximately 2.8 times from its present level.

5.5.3 Summary

Table 5.12 Opportunities and barriers: Infrastructure

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Significant infrastructural deficit in the rail system.	✓	✓	✓	
	Legacy of insufficient investment in rail infrastructure.	✓		✓	✓
	Increased freight dimensions and weights may not be able to be carried on some parts of the rail network.		✓	✓	

Opportunities	Barriers	Long term	Short term	Systemic	Non-systemic
	Demographic and societal changes leading to reliance on private motor vehicles and road transport for 'just in time' markets.	✓			✓
	The rail network does not have the coverage and/or flexibility of the road network.	✓		✓	
Underutilised network capacity in the rail system.		✓	✓	✓	
Increased use of rail for long distance freight movement.		✓	✓	✓	
Increases in fuel prices leading to greater demand for public transport as road transport becomes more expensive.			✓		✓
Infrastructural improvements, eg improvement of rolling stock and reliability, greater choice and connections for passengers.		✓		✓	
Demographic changes such as an ageing population leading to increased demand for public transport.		✓			✓
Potential for alternative energy sources such as electricity, biofuels and hydrogen.		✓		✓	

6 Conclusions and recommendations

This final chapter provides a summary of the key findings of the research. This is in the form of two summary tables showing the key opportunities and barriers which are characterised as being either systemic or non-systemic. Some indication of the likely timeframe associated with barriers and opportunities is also given.

The recommendations made throughout the previous chapter are then consolidated and briefly explained. Although these recommendations provide an overview of the key points they should be taken in the context of wider discussions. The chapter concludes by outlining where additional information could be collected to measure progress on some of the sustainability aspects identified throughout the research. These suggestions for further information are intended to link in with the current land transport sustainability trends framework.

6.1 Conclusions

6.1.1 Key opportunities for promoting sustainability

Table 6.1 below provides a summary of the key opportunities for promoting sustainability in the rail system.

Table 6.1 Key opportunities for promoting sustainability

Systemic	Timeframe
Increased use of a currently under-utilised rail network.	Short-term
Improved integration of rail with other transport modes.	Long-term
Point to point long distance transport of bulk commodities as a complementary mode to road transport.	Short-term
Lower greenhouse gas emissions and improve energy efficiency of rail compared to other transport modes.	Long-term
Technical opportunities for pursuing electrification and alternative fuels.	Long-term
Improvement in the efficiency and reliability of passenger and freight rail services.	Short-term and long-term
Better passenger conditions at stations and on trains such as CPTED measures.	Short-term
Improve access to the rail network for potential freight users through the development of sidings and branch lines.	Short-term
Non-systemic	
Congestion on roads leading to an exploration of alternatives for transport.	Short-term
Difficulties in acquiring more land for road projects and available capacity on some parts of the rail network.	Short-term
Uncertainty regarding future global energy supply and need to de-carbonise transport systems in response to climate change.	Long-term
Ageing population making public transport more popular.	Long-term
Land use policies favouring intensification of development, integration and using rail to promote regeneration in urban areas.	Short-term
Promotion of travel demand management tools.	Short-term

6.1.2 Key barriers to achieving sustainability

Table 6.2 below provides a summary of the key barriers to promoting sustainability in the rail industry identified in the preceding chapter.

Table 6.2 Key barriers to achieving sustainability

Systemic	Timeframe
A complex institutional and operating environment for rail	Short-term
A relatively weak policy environment.	Short-term
Ageing workforce and difficulties in recruitment.	Short-term
State of infrastructure means rail transport is currently slower than road over long distances in many cases.	Short-term
Poor quality of the rolling stock.	Short-term
Infrastructure may struggle to cope with the increased freight dimensions and weight requirements of freight carriers.	Short-term
Non-systemic	
History of isolation of rail from mainstream transport planning in New Zealand.	Short-term
Perceptions of the rail industry being an insular and inefficient.	Short-term
Uneven regulatory environment in terms of health and safety and employment standards between different modes.	Long-term
Lack of full cost pricing where pricing structures do not necessarily fully factor in external social and environmental costs of transport decisions.	Short-term and long-term
Long-term planning means rail is susceptible to short political cycles.	Short-term and long-term
Legacy of land-use policies and practices leading to car dependence and bias toward road transport.	Long-term
Development of 'just-in time' markets requiring speedy delivery of goods and people.	Short-term
Differing treatment of rail transport to road transport where rail is seen as a commercial enterprise and road as a public good.	Short-term
Lack of monitoring of the environmental impacts of transport in NZ and a lack of fully incorporating these into transport decisions.	Long-term
Technical progresses of road-based transport reducing the energy efficiency and low-carbon advantages of rail compared to road.	Long-term

6.2 Recommendations

RECOMMENDATION 1: Encourage greater cooperation and coordination between rail participants and greater accountability in delivering on responsibilities.

It is recommended that accountabilities for rail participants, particularly ONTRACK and KiwiRail, be closely examined and procedures put in place to ensure that these accountabilities are delivered on. Similarly, value for money and efficiency needs to be a strong focus for the sector. This focus on efficiency and accountability would also help to improve the image of rail as a relevant and vital component of the modern transport system.

Stakeholders: ONTRACK, KiwiRail, NZTA, Ministry of Transport

RECOMMENDATION 2: Establish within the wider transport sector decision-making and funding mechanisms that take into account all benefits and costs associated with various modes.

It is clear that current transport decision-making processes often do not recognise some of the benefits rail can provide. In addition, the rail system is funded virtually entirely separately from the rest of the transport sector. In the long term it would be desirable for the rail system to be funded in conjunction with the wider transport system. This would require more sophisticated evaluation techniques that fully internalise all the costs associated with transport modes. It is suggested that under such a system, the benefits rail can provide would mean that it would compare much more favourably than it does at present.

Stakeholders: Treasury, Ministry of Transport, NZTA

RECOMMENDATION 3: Ensure rail organisations and regional councils work together more closely to examine the potential role of rail in assisting meet the transport needs of regions.

Relationship building will be essential for mainstreaming rail as a greater transport solution. It is suggested that relationships between rail participants and regional councils should be a specific focus, particularly for the planning of freight movements at a regional level. Existing RLTS and LTCCP processes and regional development strategies may provide appropriate vehicles for this or alternatively regional freight strategies could be developed (Donovan et al. 2008; IPENZ 2008). Regardless of the process used, rail should be actively involved in regional transport planning.

Stakeholders: ONTRACK, KiwiRail, regional councils, NZTA, Ministry of Transport

RECOMMENDATION 4: Investigate key commuter hubs and passenger routes and promote integration with other modes.

In order to reduce road congestion and promote a more sustainable mode of transport for journeys for which rail is feasible, a number of key routes have been identified as appropriate for further investment. These are primarily commuter routes, as follows:

- provision of fast inter-regional trains within the 'golden triangle' between Auckland, Hamilton and Tauranga
- services between satellite towns surrounding Christchurch and Christchurch town centre
- Wellington to/from Palmerston North.

Such routes would need to be complemented by integrated transport options such as buses and ferries, providing 'feeders' to train services.

Stakeholders: ONTRACK, KiwiRail, regional councils, NZTA

RECOMMENDATION 5: Adopt a partnership approach to address issues surrounding rail safety, trespasser accidents and level crossing accidents.

Although rail is a safer mode of transport than road transport, with significantly fewer fatalities, there are still incidents around rail safety, trespasser accidents and level crossing accidents. In order to address this issue, a partnership approach is recommended between

rail and road controlling authorities, rail operators, private road owners, councils, police, ACC and private landowners of land adjacent to the network. Education and public awareness campaigns such as 'stop, look and live' are also crucial for reaching the general public.

Stakeholders: ONTRACK, KiwiRail, Ministry of Transport, NZTA

RECOMMENDATION 6: Implement measures to address crime, fear of crime and perceptions of personal security in order to promote the use of public transport, including rail.

A barrier to using rail is the perception of personal security, both on the train and during the 'walking and waiting' phase of the journey. Crime prevention through environmental design (CPTED) principles is useful in order to make stations and areas around stations feel safer. Good lighting is a crucial and cost-effective element too. In addition, provision of 'real time' information so people are more informed about arrival times is important. One of the most influential factors in assisting people to feel safe at stations is the presence of people, be it uniformed security guards, or a more informal presence such as staff at cafes and shops.

Stakeholders: ONTRACK, KiwiRail, district and regional councils

RECOMMENDATION 7: Review career paths for rail employees and implement initiatives to promote careers in rail.

A crucial issue for the rail industry is that a large proportion of the current workforce is nearing retirement. In order to ensure skills are maintained within New Zealand it would be advisable to pursue a graduate recruitment scheme, an apprenticeship scheme and to try to entice New Zealand and foreign workers in rail industries abroad to come to New Zealand. Strengthening the capabilities of the New Zealand rail industry workforce will also have flow-on effects for New Zealand in terms of pursuing good practice such as research and development into energy efficiency and other technical measures which promote the environmental sustainability of the New Zealand rail industry.

Stakeholders: ONTRACK, KiwiRail, Rail and Maritime Transport Union, Ministry of Transport, Department of Labour

RECOMMENDATION 8: Implement public relations campaigns to encourage people to use public transport.

Promoting travel demand management measures to make public transport a more attractive option to non-users. This calls for education and awareness-raising of both the sustainability benefits of such travel, and provision of appropriate, easy-to-understand and 'real time' information to make public transport more accessible especially to non-users.

Stakeholders: KiwiRail, regional councils, NZTA

RECOMMENDATION 9: Develop and implement an environmental management system to monitor and improve the environmental performance of the rail system.

It is recommended that an EMS be developed to assess and monitor the environmental sustainability performance of the rail system. This could be jointly undertaken by ONTRACK

and KiwiRail and look holistically at above and below-rail operations under a single framework.

Stakeholders: ONTRACK, KiwiRail

RECOMMENDATION 10: Improve network performance on key routes so that journey times are reduced and reliability is improved. The implications of increasing freight dimensions and weights also need to be considered.

One of the most critical aspects of increasing the use of the rail for freight and passenger services will be the improvement of service levels. In relation to passenger rail, predominantly in Auckland and Wellington, development plans are reasonably well advanced although some important aspects relating to potential electrification in Auckland are still undecided. The performance of key freight routes needs to be closely examined. Rail has several significant issues to respond to, notably: increasing axle loads and freight dimensions; increased freight tracking requirements; increased route flexibility and a requirement for reduced journey times.

Stakeholders: ONTRACK, KiwiRail

RECOMMENDATION 11: Articulate and develop a clear, long-term vision for New Zealand's rail system.

There must be a clear vision for New Zealand's rail system. Some form of strategic planning focusing on the role of rail in meeting New Zealand's transport needs into the future might be helpful. While recognising the need for flexibility, this must adopt a long-term perspective, particularly in the development of the core rail network and upgrading of rolling stock. This network perspective is important for coordinating different projects as well as assuring rail users that a plan is in place for the development of the system.

Stakeholders: ONTRACK, KiwiRail, Ministry of Transport, regional councils

RECOMMENDATION 12: Investigate options for the development of a funding programme dedicated to facilitating increased access to the rail network for potential freight users.

One of the greatest opportunities for increasing the use of rail is in the movement of freight. New freight users will need to be attracted to rail. The quality of service provided and the ability to access the rail network will be crucial in realising this opportunity. Physical and economic factors may limit the ability of some potential users to access the rail network. A programme should be implemented with the specific aim of facilitating increased use of rail for freight movement, for example through further use of branch lines and sidings.

Stakeholders: ONTRACK, KiwiRail, NZTA, regional councils

RECOMMENDATION 13: In the short term, consider electrification only in cases where it would lead to network efficiency benefits.

Electrification provides an exciting opportunity for rail to reduce its greenhouse gas emissions as well as improving network performance in some cases. It is recommended that electrification be considered in two respects. In the short term on select routes where it

would provide network performance improvements, and; in the long term the rail system could conceivably be powered entirely by renewably generated electricity or a non-carbon based energy source such as hydrogen.

Stakeholders: ONTRACK, KiwiRail

6.2.1 Measuring progress on sustainability

Sustainability in the New Zealand rail industry encompasses a vast array of issues from governance and funding, integrated transport, social considerations, natural environment and infrastructure. This research has attempted to explore what sustainability means in the New Zealand rail context and to distil the vast sustainability discussions into key themes in order to identify opportunities and barriers.

Measuring progress on the sustainability of the rail industry will be a crucial element of ensuring that the opportunities identified are realised and the barriers are overcome. There is currently a reasonably comprehensive transport monitoring programme administered by the Ministry of Transport known as the Transport Monitoring Indicator Framework (TMIF). It is proposed that some additional indicators be added to the existing TMIF in order to monitor progress on some of the issues identified in this research. The following additional indicators are recommended:

- affordability of rail transport
- customer use (and acceptance)
- perception of climate change and importance of individual action
- percentage of stations in which CPTED measures have been employed
- percentage of population exposed to noise levels exceeding those recommended by the WHO
- noise mapping carried out for monitoring land transport noise
- reduction in deaths related to air pollution
- track conditions
- average journey times
- number of restrictions on a line
- axle loads of bridges
- maximum loads able to be carried on lines
- energy efficiency of locomotives
- maintenance standards of rolling stock
- average journey times
- reliability of service and percentage of journeys achieving target requirements
- rail's contribution of New Zealand's overall greenhouse gas emissions
- rail network severance of ecological communities
- rail corridor used for biodiversity enhancements

- incidences of spillages
- travel behaviour change funding (eg school and workplace travel plans)
- current congestion costs (as a percentage of GDP)
- capacity and ability of rail workforce.

The full set of indicators in the TMIF and the recommended additional indicators are provided in appendix D.

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Appendix A: Literature review checklist

Source	Issues							Barriers							Opportunities											
	Emissions	Access/equity	Safety	Noise	Diffuse pollution	Material use	Biodiversity	Resource efficiency	Cost	Urban design	Car dependency	Un-integrated transport	Lack of alternative	Public support	Lack of consensus	Govt. priority/support	Alternative/bio-fuels	Travel demand mgmt	Land-use change	Recycling/procurement	Education/media campaign	Modal shift/integration	Retro-fitting	EMS accreditation	Offsetting/ETS	
1. A pathway to sustainable transportation	X	X	X	X	X									X		X		X								
2. Estimation and valuation of environmental and social externalities for the transport sector	X		X	X	X		X									X			X							
3. Rail Development Plan 2006	X		X	X							X		X			X			X							
4. Assessing cumulative environmental effects from major public transport projects	X			X		X					X			X					X							
5. Britain's national railway network - fit for purpose in the 21st century?		X									X		X			X		X								
6. Decision-making, intermodal transportation and sustainable mobility - towards a new paradigm	X	X	X	X	X	X					X		X			X				X						
7. Defining sustainable transportation 2005	X	X	X	X		X					X			X		X										
8. Sustainable rail systems for a connected Europe												X		X												

Source	Issues												Barriers								Opportunities							
	Emissions	Access/equity	Safety	Noise	Diffuse pollution	Material use	Biodiversity	Resource efficiency	Cost	Urban design	Car dependency	Un-integrated transport	Lack of alternative	Public support	Lack of consensus	Govt. priority/support	Alternative/bio-fuels	Travel demand mgmt	Land-use change	Recycling/procurement	Education/media campaign	Modal shift/integration	Retro-fitting	EMS accreditation	Offsetting/ETS			
9. EU White Paper - European transport policy for 2010	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X			X	X						
10. MoT - rail safety targets		X	X		X			X						X		X					X							
11. NZ National Rail Strategy to 2015	X	X	X	X	X			X	X	X	X	X	X			X		X	X		X	X						
12. OECD - environmentally sustainable transport - is rail on track?	X	X	X	X				X	X	X	X	X	X			X	X				X	X						
13. Office of Rail Regulation - sustainability benchmarking	X	X	X	X	X			X							X			X			X			X				
14. ONTRACK Annual Report 2007	X		X					X	X									X										
15. Railways - how they may contribute to a sustainable future	X		X					X	X								X				X	X						
16. Realistic sustainability - urban transport planning in Wellington, NZ		X	X							X	X	X	X			X		X	X		X	X						
17. Sustainable transport - analysis frameworks	X	X	X					X		X						X	X	X	X		X	X						
18. The potential of rail as an environmental solution	X		X					X	X	X	X	X	X			X		X	X		X	X						
19. Toward a sectorwide design for environment support system for rail				X		X		X	X							X									X			

Source	Issues			Barriers			Opportunities																		
	Emissions	Access/equity	Safety	Noise	Diffuse pollution	Material use	Biodiversity	Resource efficiency	Cost	Urban design	Car dependency	Un-integrated transport	Lack of alternative	Public support	Lack of consensus	Govt. priority/support	Alternative/bio-fuels	Travel demand mgmt	Land-use change	Recycling/procurement	Education/media campaign	Modal shift/integration	Retro-fitting	EMS accreditation	Offsetting/ETS
20. SD Review of mainline railways of GB	X	X	X	X	X	X	X	X	X	X	X						X	X			X	X			
21. Eddington transport study	X	X						X	X									X	X						X
22. UK DfT - White paper - sustainable railway	X	X	X	X	X		X		X								X	X			X	X			X
23. A way forward on SD	X	X	X	X	X	X			X			X				X					X	X			X
24. Review of research relating to SD for the railway	X	X	X	X	X	X	X	X								X	X	X			X	X			
25. Peet - The future of rail	X							X				X				X	X	X							
26. Extension of electrification: Benefits and costs: Report to ONTRACK	X							X								X	X	X							
27. Analysing the business case for sustainable rail -forum for the future	X	X	X	X	X	X	X	X	X							X	X	X			X	X			
28. Developing metric and benchmarking for SD in the rail industry - UK	X	X	X	X	X	X			X						X						X	X			

Appendix B: Overview of stakeholder discussion topics

Introduction

- Organisation's role in the rail sector.
- Meaning/s of sustainability in a transport context.

Sustainability and rail

- Meaning/s of sustainability in a rail context.
- Visions for a sustainable rail system in New Zealand.
- Opportunities to promote sustainability in the rail system.
- Timeframes associated with opportunities.
- Barriers that might prevent opportunities being realised.
- Risks and uncertainties surrounding opportunities.

Selection of topics for specific organisations

- Position of rail compared with other transport mode.
- Recent changes to transport and rail institutional and operating environment.
- Passenger rail outside of Auckland and Wellington.
- NZTS target of increasing rail freight to 25% of freight task.
- Improved performance and possible electrification of the NIMT and other lines.

Appendix C: Assignment of significance values to issues

	Literature review	Policy/legislation	Stakeholders	Overall
Sustainability theme 1: Governance and funding				
Funding	1	2	4.5	4
Full-cost pricing	4	2	3.5	4
Policy	1	4	4	3
Political support	4	1	4.5	4
Sustainability theme 2: Integration				
Modal integration	5	4	4	4.5
Land-use and transport	2	4	3.5	3
Travel demand management	3	3	3	3
Modal bias	3	3	3	3
Sustainability theme 3: Social considerations				
Safety	5	3	3.5	4
Access	4	3	3.5	4
Labour	1	1	4	3
Public perception	2	1	3	2.5
Sustainability theme 4: Natural environment				
Diffuse pollution	3	2	2.5	2.5
Greenhouse gas emissions and energy efficiency	5	5	3.5	4
Biodiversity	2	2	2.5	2
Noise and vibration	5	2	3	3
Sustainability theme 5: Infrastructure				
Network capacity	3	3	4.5	4
Electrification	2	4	2.5	3

5 = Highest significant value

Appendix D: Indicators for sustainability in rail

The table below illustrates the relevant indicators from the Transport Monitoring Indicator Framework which was launched alongside the NZTS. Additional indicators identified throughout the research as potential being useful are also incorporated and are highlighted in green. Their links to the five sustainability themes identified in section 5 of this report have also been identified where appropriate.

Indicator set	Specific indicator/s	Sustainability theme link
Transport volume	<ul style="list-style-type: none"> Road VKT per capita Road VKT in major urban areas 	
People volume	<ul style="list-style-type: none"> Total person-km travelled Distance travelled in single occupancy vehicles in major urban areas on weekdays 	
Cycling and walking	<ul style="list-style-type: none"> Distance cycled (people aged five and over) Distance cycled per person aged five and over Time spent walking (people aged five and over) Time spent walking per person aged five and over Distance travelled by walking and cycling by residents of main and secondary urban areas Number of walking and cycling trip legs 	Integration
Public transport volumes	<ul style="list-style-type: none"> Total PT boardings Total PT boardings per capita 	Integration
Freight volumes	<ul style="list-style-type: none"> Total freight tonne-kilometres by mode (road, rail, maritime, aviation) Freight tonne-km - mode share Freight tonne-km - inter-regional mode share 	
Speed and variance of travel time	<ul style="list-style-type: none"> Percentage variability of travel time (road, rail, maritime, aviation) Average journey times for identified critical routes Average reliability of journey times for identified critical routes 	Infrastructure
Freight	<ul style="list-style-type: none"> Freight tonne-km growth by mode (road, rail, maritime, aviation) Freight tonne-km growth compared to GDP growth by mode (road, rail, maritime, aviation) 	
Access to public transport	<ul style="list-style-type: none"> Total mobility boardings per year Percentage of fully accessible buses/trains on specified routes Percentage of fully accessible bus stops/train stations Availability of accessible information Public transport services 	Social considerations Integration
Social connectivity	<ul style="list-style-type: none"> Access to essential services Percentage of the population who can get to key locations door-to-door by public transport 	Social considerations Integration

Indicator set	Specific indicator/s	Sustainability theme link
Access and social connectivity	<ul style="list-style-type: none"> Affordability of rail transport 	Social considerations Integration
Travel perceptions	<ul style="list-style-type: none"> Travel perceptions by mode (road, rail, maritime, aviation) 	Social considerations Integration
Travel perceptions	<ul style="list-style-type: none"> Customer use (and acceptance) Perception of climate change and importance of individual action 	Integration
Security	<ul style="list-style-type: none"> Perceptions of personal security while using the transport network (road, rail, ferry, aviation) Personal security incidents while using the transport network (road, rail, ferry, aviation) Resilience of the transport system Security of the transport system 	Social considerations
Security	<ul style="list-style-type: none"> Percentage of stations in which CPTED measures have been employed 	Social considerations
School travel plans	<ul style="list-style-type: none"> Modal shift in schools with travel plans 	Social considerations Integration
Household travel	<ul style="list-style-type: none"> Mode share of total trip legs Public transport mode share of all trip legs Ratio of public transport trip legs to driver trip legs Mode share of travel to work Mode share of travel to school 	Integration
Business/workplace travel plans	<ul style="list-style-type: none"> Change in mode share of workplace travel (modal shift) Kilometres travelled for workplace travel (all modes) 	Integration
Accident occurrences	<ul style="list-style-type: none"> Number of accidents by mode (road, rail, maritime, aviation) Number of accidents per capita by mode (road, rail, maritime, aviation) Number of fatal accidents (road, rail, maritime, aviation) 	Social considerations
Deaths and injuries	<ul style="list-style-type: none"> Number of deaths by mode (road, rail, maritime, aviation) Number of injuries by mode (road, rail, maritime, aviation) 	Social considerations
Social cost of accidents	<ul style="list-style-type: none"> Social cost of accidents by mode (road, rail, maritime, aviation) 	Social considerations
Occupational health	<ul style="list-style-type: none"> Total number of transport-related occupational health incidents (long-term and short-term) by mode (road, rail, maritime, aviation) 	Social considerations
Noise	<ul style="list-style-type: none"> Social cost of transport-related noise Percentage of population exposed to noise levels exceeding those recommended by the WHO. Noise mapping carried out for monitoring land transport noise. 	Natural environment Social considerations

Indicator set	Specific indicator/s	Sustainability theme link
Air quality	<ul style="list-style-type: none"> • Emissions of particulates (PM₁₀ and PM_{2.5}), nitrogen oxides (NO_x, NO and NO₂), carbon monoxide (CO), sulphur dioxide (SO₂), benzene (C₆H₆) and 1,3 butadiene (C₄H₆) by mode (road, rail, maritime, aviation) • Social cost of transport-related air pollution to human health • The number of occasions that ambient concentrations of particulates (PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂), carbon monoxide (CO) and sulphur dioxide (SO₂), measured in areas where the impact of transport emissions is significant, are in excess of the relevant standards and guidelines specified: <ul style="list-style-type: none"> • In the National Environmental Standard for Air Quality • In the Ministry for the Environment Ambient Air Quality Guidelines • By the World Health Organization • Percentage of the total population residing in areas where the impact of transport emissions is significant, and the exposure to ambient concentrations of particulates (PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂), carbon monoxide (CO) and sulphur dioxide (SO₂) is in excess of the relevant standards and guidelines specified: <ul style="list-style-type: none"> – in the National Environmental Standard for Air Quality – in the Ministry for the Environment Ambient Air Quality Guidelines – by the World Health Organization 	Natural environment Social considerations
Air quality	<ul style="list-style-type: none"> • Reduction in deaths related to air pollution 	Social considerations Natural environment
Infrastructure size	<ul style="list-style-type: none"> • Length of rail track • Ability of freight to access national network 	Infrastructure
Infrastructure quality	<ul style="list-style-type: none"> • Rail track quality • Rail station quality 	Infrastructure
Tracks	<ul style="list-style-type: none"> • Track conditions • Average journey times 	Infrastructure
Bridges, culverts and tunnels	<ul style="list-style-type: none"> • Number of restrictions on a line • Axle loads of bridges • Maximum loads able to be carried on lines 	Infrastructure
Rolling stock	<ul style="list-style-type: none"> • Energy efficiency of locomotives • Maintenance standards of rolling stock 	Infrastructure
Freight movement	<ul style="list-style-type: none"> • Average journey times • Reliability of service / percentage of journeys achieving target requirements 	Infrastructure
Waste management	<ul style="list-style-type: none"> • Percentage of deregistered/wrecked vehicles, aeroplanes, ships, trains recycled 	Natural environment

Indicator set	Specific indicator/s	Sustainability theme link
	<ul style="list-style-type: none"> Tonnes of waste product used for biofuel / biodiesel production 	Infrastructure
Infrastructure investment	<ul style="list-style-type: none"> Expenditure on infrastructure and services by mode (road, rail, maritime, aviation) 	Infrastructure
Climate change related emissions	<ul style="list-style-type: none"> Tonnes of CO₂ equivalent emissions from domestic transport by mode (road, rail, maritime, aviation) Tonnes of CO₂ and tonnes of CO₂ equivalent emitted from domestic transport per tonne-km by mode (road, rail, maritime, aviation) Tonnes of CO₂ and tonnes of CO₂ equivalent emitted from domestic transport per person-km travelled by mode (road, rail, maritime, aviation) Total emissions of methane (CH₄) and nitrous oxide (N₂O) by mode (road, rail, maritime, aviation) 	Natural environment
Climate change related emissions	<ul style="list-style-type: none"> Rail's contribution of New Zealand's overall greenhouse gas emissions 	Natural environment
Biodiversity	<ul style="list-style-type: none"> Area of Crown transport land covered with indigenous vegetation 	Natural environment
Biodiversity	<ul style="list-style-type: none"> Rail network severance of ecological communities Rail corridor used for biodiversity enhancements 	Natural environment
Sector energy use	<ul style="list-style-type: none"> Energy use (PJ) per vehicle km travelled by domestic transport mode (road, rail, maritime, aviation) Energy use (PJ) per capita by domestic transport mode (road, rail, maritime, aviation) Energy use (PJ) per tonne-km by domestic transport mode (road, rail, maritime, aviation) Energy use (PJ) per person-km travelled by domestic transport mode (road, rail, maritime, aviation) 	Natural environment
Land use	<ul style="list-style-type: none"> Land devoted to transportation facilities per capita 	Integration Natural environment
Land and water pollution	<ul style="list-style-type: none"> Incidences of spillages 	Natural environment
Travel demand management initiatives	<ul style="list-style-type: none"> Travel behaviour change funding (eg school and workplace travel plans) 	Integration
Costs of road congestion	<ul style="list-style-type: none"> Current congestion costs (as a percentage of GDP). 	Integration
Labour	<ul style="list-style-type: none"> Capacity and ability of workforce 	Social considerations

