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Roads and quality of life

Summary

Quality of life in The Netherlands: even cleaner and quieter

Aspirations

The Netherlands seeks to be a European best achiever when it comes to the natural environment and quality of life. In the traffic and transport context this means reducing harmful emissions and noise pollution while slowing down fragmentation of the countryside. In brief, traffic and transportation of the future will be even cleaner and quieter.

Cleaner

Technological advances and European agreements are making vehicles progressively cleaner. This enables increased mobility with diminishing corrosive emissions. At the same time, a leap forward is needed in those areas where the technology has been slower to evolve – particularly for bus engines, ships and trains. In urban areas local air quality can be improved by transport management, pro-bicycle policy, decreasing short car journeys, speed reduction and traffic circulation measures.

Like air pollution the changing climate also result from exhaust gases. CO_2 emissions are a matter of worldwide concern. Measures comprised in the Climate Policy Implementation Memorandum have been or are being implemented. However, even greater reduction in CO_2 emissions will still be required in the period following 2010. Technological innovations like the "fuel cell" appear promising but will take time. The use of economical engines will be encouraged.

Quieter

A pro-active approach to noise pollution is still a necessity given the growth of traffic in densely populated areas. While quieter cars, trains and plains are top priority, this will not be enough. In many locations in the Netherlands road authorities will be obliged to take ant-noise pollution measures. These will include quieter road-surfaces and noise barriers along roads and railroad-lines. Given that noise barriers are generally unattractive a new innovation programme will seek cost-effective alternatives by testing international knowledge resources in the Dutch context. Long-term potential here includes anti-noise as well as quieter vehicles and even quieter road-surfaces.

Integration of infrastructure

New infrastructure must be carefully woven into the landscape. Good architectural design is important here. Action is also underway to combat the fragmentation by the infrastructure of significant areas of natural/wildlife resources. This is the goal of the government's "De-Fragmentation" programme that will run from 2001 for several years. The main ecological structure will be enhanced with measures including eco-ducts and passages for smaller fauna. Meanwhile, in towns and cities, building below ground will enable more intensive use of space.

The Fuel Cell

Vehicles with a fuel cell only use hydrogen to move. This makes them emission-free. While mass-production of hydrogen does require energy production this is far more efficient than with the conventional internal combustion engine. The fuel cell is expected to achieve a comparable price-quality ratio with the internal combustion engine around 2020 to 2030.

The Netherlands is amassing experience through the Practical Trials on Electrical Vehicles Programme and a range of projects like hybrid buses in *Leiden*, hybrid trucks in *Groningen* and hybrid High-quality Public Transportation in *Eindhoven*. This knowledge is crucial for the eventual application of fuel technology in electric- or hybrid-powered vehicles. At Daimler-Chrysler pre-trial preparations are underway for thirty fuel-cell buses in ten major European cities. *Amsterdam* will be involved with two or three buses. Trials will commence in 2002.

Quality of life in The Netherlands:

even cleaner and quieter

Policy for Traffic and Transport

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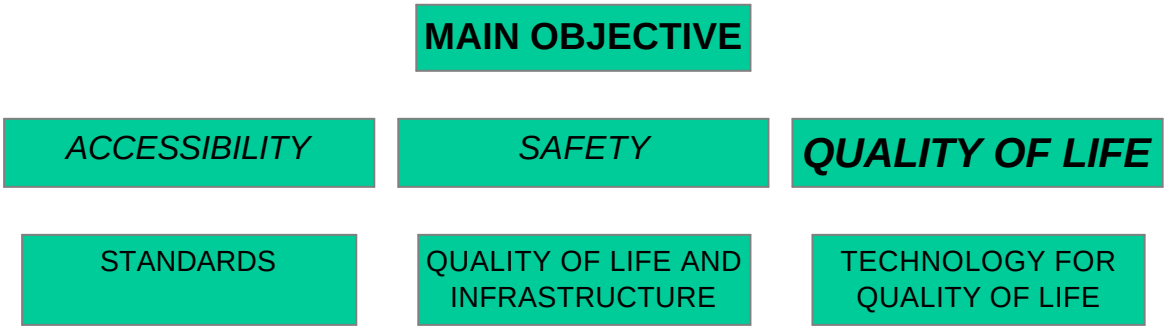
Quality of life in The Netherlands

1. Introduction

Ambitions

- less emissions of acid substances by road traffic, rail transportation, craft used for inland shipping and other mobile sources. In 2010, the threshold will be 150 kiloton NO_x per year, the SO_2 emissions are to be reduced to thirteen kiloton per year and the emission of volatile organic substances (VOS) to 49 kiloton per year (including mobile sources);
- reduced increase in the CO_2 emissions resulting from traffic and transportation in 2010 in accordance with the Climate Policy Implementation Memorandum, and preparations for further CO_2 reductions beyond 2010.
- less noise pollution and noise load due to traffic and transportation (a new target is to be laid down in the National Environmental Policy Plan-4 (NEPP-4);
- realisation of the threshold values for local air quality (forty microgram per cubic metre for NO_2 and fine dust) at the maximum possible number of locations and prevention of damage to health.
- elimination of the most significant physical barriers within the National Ecological Network (NEN) such as railway lines, roads and canals by 2020 (Nature, Forest and Landscape in the 21st Century). Ninety percent of the problem areas, where infrastructure is the only cause of the intersection, are to be solved by 2010.
- more attention for design, the blending in of structures and following the principles of sustainable building when realising infrastructure and large maintenance projects.



Mobility should be possible within the preconditions of environment and quality of life. This is no short order, because the traffic on the roads is increasing greatly. Policy has focused on improving the quality of life in recent years. This has involved measures for tackling the source, targeting clean, quiet, economical vehicles, and measures concentrating on car use and driving behaviour. These measures have certainly been effective.

Measures relating to the quality of life often go hand in hand with interventions made for other reasons. There is a clear connection between the quality of life, the economy, safety and the interests of nature conservation. Cities become rejuvenated, for example, if motorised traffic is correctly managed and the use of alternatives, such as public transport, bicycle or transportation management increases. The introduction of areas where traffic has priority side by side with areas where living, shopping and recreation have priority also helps add to the vigour of urban areas. This applies to rural areas, too. Furthermore, special environmental measures are required, for example, because the public health, vital nature and biodiversity are under threat. Noise pollution is a prominent problem. The same applies to local air pollution, acidification and the fragmentation of the countryside, although considerable progress has been achieved in these areas during the last few years. The authorities are also keen to decrease the contribution made by traffic and transportation to climate change. This environmental problem is undoubtedly one of the biggest challenges of the new century. There are technological possibilities available, but their development and implementation will require a great deal of energy.

The strategy consists of three elements. Firstly, the government lays down environmental thresholds which may not be exceeded (see section 1: Standards). Furthermore, the government invests in the quality of the infrastructure for an optimum living environment (2) and in new technology (3).

2. STANDARDS

The government sets standards in the fields of air and noise pollution and has, on an international level, agreed on targets for slowing down climate change.

2.1 AIR POLLUTION

Acidification results in damage to ecosystems. This manifests itself in the reduced vigour of wood and heathland. Acidification also leads to damage to materials such as paper, to buildings and to agricultural crops. Thirty percent of this acidification can be attributed to the traffic and transportation sector, but this figure has been falling rapidly recently. The local air quality is such that health problems can arise. The traffic adds to this (the percentage varies according to the substance in question). A great deal of progress has been booked with regard to most substances in recent years. The number of kilometres of roads on which the NO_2 threshold values are exceeded will decrease considerably. The threshold value for fine dust is exceeded as a national average; in time, exceedances will concentrate at a number of locations. The new indicative threshold value applied by the European Union for fine dust is not a feasible target in other sectors or in neighbouring countries for 2010 unless additional measures are taken. The target is, on the one hand, to reach the threshold values and thus reduce health risks, and on the other, to reduce acid emissions.

The source policy (stimulating cleaner vehicles and fuels) has, in recent years, proved extremely effective in achieving a better air quality. This policy will, therefore, be continued. A great deal of resources and energy have been invested in the development of gaseous fuels for heavy vehicles. The technology is already available. The government will promote the introduction of this technology on the market by means of a specific incentive scheme and flanking policy. Incidentally, within ten years diesel will also become cleaner as a result of tighter emission standards.

The local air quality is being improved by the application of new engine technologies such as new generations of catalytic converters and soot filters for diesel engines. A further reduction in the sulphur content of fuels is necessary for the introduction of this technology. The rapid introduction of low-sulphur fuels for road traffic will be stimulated by means of tax incentives if it becomes apparent that this introduction is cost effective.[13] Additional policy is necessary for ocean and inland shipping, diesel-electric locomotives and other mobile sources in particular. Considerable benefits can still be achieved in these sectors with stricter emission standards for new engines and the accelerated modernisation of existing marine engines. As regards aviation, long-term objectives for clean technologies and the related NO_x emission requirements are currently under discussion on an international level. The implementation of new technologies will be achieved in this way.

[13] see letter to the Lower House, Airway-2 77

In addition to measures taken at the source, other measures are also needed locally to reduce NO_2 and fine dust emissions in urban areas. Local authorities have a number of possibilities at their disposal in this respect. These possibilities include transportation management, cleaner urban distribution vehicles, the tackling of short trips, reduced car access policy in cities, cleaner buses and taxis, and parking policy. The environment must also play a role in the granting of licences for collective transportation. It is possible to link licences to the environmental performance of the vehicles. Another possibility is to limit the access of heavy diesel vehicles to inner cities. For example, only electrically-powered vehicles (with hybrid drives, fuel cells etc.) are allowed access to certain areas. So-called zero-emission zones might be advisable with regard to preventing harmful effects on public health from traffic emissions. The authorities will consider this possibility partially on the basis of the Urban Air Quality Action Plan. The authorities will, furthermore, be examining the legal possibilities of this limited access on a joint basis.

The European Union issued new directives for air quality in 1999. These directives lay down threshold values which require considerable efforts. Even though the number of places at which the threshold values are exceeded are decreasing greatly, drastic measures are still necessary at the remaining problem spots. The extent of this problem is still not completely clear. Measures which have been worked out include reducing speed limits, the establishment of buffer zones along infrastructure, limiting lorry traffic, the conversion of roads into underpasses, influencing the extent and the spread of traffic. The approach opted for will vary depending on the location. The financial consequences still have to be examined. The new EU directives will be evaluated in 2003.

The task regarding the emission of NO_x caused by traffic and transportation (including mobile sources and excluding aviation and ocean shipping) is a reduction from 160 to 150 kiloton per year by 2010, based on the prognoses for economic and mobility development used by the National Plan for Traffic and Transport. The policy is expected to lead to a further reduction beyond 2010, too. The reduction of the sulphur content of fuels for road traffic has been laid down on a European level. This limits the SO_2 emissions by road traffic drastically: from 12.5 kiloton in 1995 to one kiloton by 2010. Ocean shipping is lagging way behind. The rapid ratification of the International Maritime Organisation (IMO) treaties on limiting the sulphur content of fuel oil used by shipping in the North Sea area has been an important step. A reduction of emissions to thirteen kiloton will be possible by 2010 on the basis of these treaties. This is a limited relaxation in comparison with the earlier NEPP objective of twelve kiloton. Further reductions in the sulphur content of fuel oil and enforcement at an international level are necessary in order to be able to meet the objectives for ocean shipping beyond 2010, too. The Netherlands will take the initiative to this end.

The third NEPP indicates an objective of 57 kiloton per year for VOS from 2010. Recent prognoses indicate that with the existing policy a level of 51 kiloton will be achieved. A reduction to 45 kiloton will be possible if stricter emission requirements for mopeds and motorcycles receive international support. Without this support, the policy will lead to a reduction of 49 kiloton. The VOS emissions from inland shipping craft also form a problem. Between 2 and 13 kilotons VOS are released during degassing by tankers.

2.2 NOISE POLLUTION

Traffic is responsible for more than 40% of noise pollution. Noise pollution is, furthermore, the cause of sleep disturbance in a number of cases. The National Institute of Public Health and the Environment (RIVM)'s National Environmental Outlook–5 indicates that without extra measures, in 2010 the percentage of residents exposed to an additional noise load of 65 dB (A) as a result of the road traffic will increase by 40% compared with 1995. For rail traffic, a 25% increase in noise pollution is expected in the same period. The economic and social developments of the coming years will result in considerable growth in traffic, including that during the night. Undoing the negative consequences of this development costs progressively more effort. In the long run, traditional solutions such as noise barriers alone will no longer be adequate. They would have to become more numerous and higher. The existing noise barriers are already often deemed ugly. All those involved will have to make a very great effort in the coming years if this problem is to be tackled. Choices will have to be made, from the financial point of view, too.

The central government will do everything possible in the future to find innovative solutions for the noise problem. There is no single universal panacea. A combination of shrewd measures will have to be used. In adaptation, the authorities actively aim at the application of state-of-the-art technology with regard to quiet technology, for both vehicles and infrastructure. Cost effectiveness is, of course, also an important criterion. This is why in the case of rail traffic, measures concerning the rolling stock are preferable, along with the replacement of the noisiest steel railway bridges.

The central government is dedicated to the rapid laying down of international requirements for vehicles, particularly lorries, cars and goods wagons. In the case of road traffic, the noise produced by tyres is of even greater importance than that produced by engines. In 2000 an EU directive will be issued which sets noise requirements for tyres. The draft directive lays down that the European Commission will be submitting new proposals for tightening up the requirements. A great deal of noise reduction can be achieved with quiet tyres. The Netherlands will do its utmost to realise this. As regards goods wagons, for example, new brake systems offer possibilities. The enforcement of existing vehicle regulations will also be tightened up. This might include the tackling of tuned-up mopeds which are responsible for a lot of noise nuisance and air pollution. Once registration numbers for mopeds have been introduced, inspections can be developed on the basis of these points. Traffic measures such as diversions or speed limits during the night also provide solutions for local areas. Concentrating traffic on the main roads in both urban and rural areas can relieve congestion in other areas.

But these measures will not be sufficient. In a large number of places in the Netherlands, extra measures will have to be taken to reduce the noise in the vicinity of roads and railways to the desired level. Buffer zones from 50 to 75 metres next to infrastructure are very important here. These buffer zones are also desirable from the points of view of safety and improvement of local air quality.

The application of quiet road surfaces will also help to solve the problem of noise pollution. New road surface types are under development for main, secondary and urban roads, such as the double-layered highly-porous asphalt concrete, which promises considerable noise reduction. It is expected that this new type of road surface will provide a reduction of approximately two decibel compared with (single-layered) highly-porous asphalt concrete. How these types score in terms of functional and technical life, cost effectiveness and safety aspects (particularly in the presence of frost and black ice) in comparison with single-layered asphalt concrete will have to be demonstrated by practical tests. If the double-layered version scores better, it will be applied as state-of-the-art in noise-sensitive areas, if cost effective, of course. Quieter materials are already being used in the replacement and construction of sections of railway tracks and bridges. Resources have already been reserved in the budget for the period 2002-2010 for the replacement of the noisiest steel railway bridges. New methods, such as grinding and spraying, are used during maintenance to make the tracks quieter. For railway emplacements, a joint noise pollution reduction project has been started by the parties involved, in which both source measures and spatial and traffic engineering measures are under consideration.

The abovementioned measures will require efforts from all the actors involved: industry, municipalities, provinces and the central government. They will form an important step in breaking through the trend towards more individuals suffering from increasingly severe noise pollution. A programme of research and practical experiments is also expected to generate innovative solutions for the noise problem. Anti-noise is, for example, a possibility for the long term.

In the field of aviation, new environmental standards are currently being developed within the framework of the decision making regarding *Schiphol* for the period beyond 2003. A transition will also take place from the existing noise unit (Ke) to a new unit (Lden). The sector will itself be responsible for the use of the environmental thresholds. Enforcement of compliance with these standards will be stricter than in the past and will be based on a number of measuring points. Stricter noise requirements for planes is effective in the long term. International consultations focus on the phasing out of planes with old technology, sharpening noise requirements, operational improvements in the environmental pressure caused by planes, including improvements in starting and approach procedures at airports, and improvements in air traffic control systems regarding a better use of routes. Any further increases in the noise load at the regional airports and smaller airfields will be excluded in the central planning decisions regarding the Structure Plan for Regional Airports and Smaller Airfields.

2.3 CLIMATE CHANGE

Traffic is responsible for approximately 18% of the national emissions of CO_2 and is the sector with the most rapidly growing emissions. The Climate Policy Implementation Memorandum agrees on the measures the Netherlands is to take to realise the tasks regarding CO_2 reduction within the framework of the Kyoto Protocol. This concerns measures to be taken up to 2010. For traffic, these measures will involve the suppression of the expected growth in emissions. Technical measures, such as more economical cars, will be of primary importance here. Secondly, tax measures are to be taken, the most important of them being the

differentiation of the tax on private cars and motorcycles according to their relative CO_2 emissions.

Thirdly, stakes are being placed on influencing driving and purchasing behaviour. Examples of this approach are the enforcement of stricter compliance with speed limits and car labelling. The central government has also set up 'The New Driving Force' platform in cooperation with a large number of social organisations. The progress achieved by the implementation memorandum will be evaluated in 2002 and 2005. If necessary, a package of extra measures, or some of them, will be implemented. This package of extra measures includes an increase in excise duties for the traffic and transportation sector.

It is expected that traffic and transportation will face much more stringent restrictions on greenhouse gases beyond 2010. Given the expected extent of the necessary CO_2 reduction, the period up to 2010 will have to be used for preparing ourselves for this challenge. New policy instruments will be required. The results of research into the possibilities for introducing a system of tradable emission rights (in the long term) may be important for the traffic sector. A committee is currently examining the possibilities regarding tradable emission rights, or an emission ceiling per sector, with a view to the next budget period of the Kyoto protocol. In the short term, the Netherlands will make an effort to get CO_2 standards placed on the agenda of the Environmental Council at EU level.

The authorities expect a great deal from technology in the long term. Now that low-CO_2 technology has become available, policy can be developed to encourage or enforce its application. The Netherlands is currently striving to make international agreements regarding the emissions of motorised traffic and transportation. The price policy will also be essential in stimulating the demand for more economical technologies. The policy focuses on achieving the cleanest, most economical vehicles possible by differentiation of levies and taxes on a national basis but within the international framework.

Greenhouse gases are also emitted as a result of international aviation and ocean shipping. International policy development is needed to tackle this. The Kyoto Protocol lays down that the reduction or limiting of greenhouse gases resulting from aviation and ocean shipping must be brought about via the International Civil Aviation Organisation (ICAO) and the IMO. For aviation, the ICAO envisages technological and operational improvements. In parallel with these, ICAO is giving priority to work on options for measures which are in line with market conditions, including levies and tradable emission rights, with the purpose of reducing the emission of greenhouse gases. The Netherlands is actively participating in research into these market measures and is using the Dutch policy analysis model, AERO, to this end. Alternatives are being looked at with regard to the possible introduction of an emissions ceiling with linked emission rights, trading in rights within and outside the sector being possible. The initiative here is emphatically with the central government in cooperation with international partners and the business community. The IMO is currently researching the possibilities for CO_2 reduction in ocean shipping.

3 QUALITY OF LIFE AND INFRASTRUCTURE

Technologies and methods for improving the infrastructure from the point of view of the quality of life have undergone rapid developments during recent years. This trend will continue. The objective is to optimise the living environment of people, flora and fauna. The same measures will not be opted for everywhere. De *Veluwe* requires other ambitions and measures than an urban area. It is difficult, and not useful, to formulate objective criteria and objectives for the many types of areas. It is better to weigh up the interests specifically for each area in question. In addition to ecological value, historico-cultural value is also of importance, as indicated in the Belvédère Policy Document. Incidentally, the NEN and its carry-over to provincial ecological networks are significant points here. These areas and corridors are of vital importance to Dutch countryside. A "no, unless" approach applies here too, when it comes to the possibility of damage. The quality of the infrastructure concerns not only the blending of these structures into the landscape. Infrastructure can also be attractive, both for users and non-users. Extra attention will be paid to this in the coming years. Furthermore, the road itself will also become more sustainable and environmentally friendly through structural and environmental optimisation.

SUSTAINABLE ENERGY FROM INFRASTRUCTURE

Environmental technology plays a progressively greater role in the field of infrastructure. There are, for example, experiments with solar collectors on noise barriers on the A27 near *De Bilt*, and on the A9 near *Ouderkerk aan de Amstel*. By using collectors, the noise barriers did not have to be so high and the costs were the same. Experiments are also being carried out on extracting heat energy from the road surface: the asphalt as solar collector. The heat in the road is collected and stored and used for heating the road in the winter months, when there is snow and black ice. Two experiments, on the N57 on the *Haringvlietsluizen* (*Haringvliet* locks) and on the N34 close to *Zuidlaren* have shown that in the summer substantially more heat is collected than is needed for heating in the winter. The energy can therefore also be used for heating of (tap water in) houses or buildings. The question is still to what extent these systems can be profitably exploited, economically speaking. The concept of the low-energy, low-emission road is to be further elaborated in the Roads to the Future programme.

3.1 EXISTING INFRASTRUCTURE

The realisation of the NEN is part of the Nature Policy and it includes various types of measures, such as increasing the surface area of nature conservation areas by acquisition and improving the quality of habitats of these areas. The removal or neutralisation of barriers between areas is, however, also important. Infrastructure often forms a barrier, particularly in the case of main roads, the underlying road network, railways and waterways. The aim is to neutralise the most significant barriers formed by railways, (main) roads and canals with regard to the NEN by 2020. Ninety percent of the inventoried problem areas in which the intersection

can only be solved by means of an infrastructural measure, will have been solved by 2010. All road managers are drawing up programmes to prevent fragmentation by infrastructure.

The prioritisation in the "Nature for People, People for Nature" Policy Document is being used as the guiding principle here. Research is being carried out into the means by which the quality of these ecological corridors can be optimised. In view of the green connections to be realised, an integrated design approach will be worked out for several crossings in 2000. This will indicate what is necessary for a good landscape design and the profits to be booked by the simultaneous realisation of 'grey' and 'green'. The central government will work out a continuous long-range de-fragmentation plan early in 2001, indicating the locations at which grey and green corridors can reinforce one another. Provinces and municipalities will look at the bottlenecks which exist in the ecological networks area by area. The quality of rural areas will be promoted by pushing back motorised traffic in favour of slow traffic in the NEN. The motorised traffic will be concentrated on area access roads and main roads. The significance of verges along roads, railways and waterways will be enhanced by ecological verge management.

CROSSROADS BETWEEN GREEN AND GREY: CROSSINGS RATHER THAN INTERSECTIONS

The NEN comes up against roads, railway or waterways in countless places. This leads to the fragmentation of biohabitats, because of which the continued survival of certain species is at risk. In order to allow the ecological (and recreational) flows within the NEN to function, it is essential to breach these barriers wherever possible. Infrastructural measures will have to be taken at locations which yield the highest returns: places at which the spatial cohesion in the NEN is already relatively great and where neutralising the barrier effect produces direct results. In other places, measures in a wide environment will also be necessary, alongside infrastructural measures, to achieve the intended effect. The robust ecological corridors are important main arteries within the NEN. Where these cross the infrastructure (grey-green junctions) de-fragmentation measures yield the greatest returns. By linking investments in grey and green, the fragmentation will be effectively tackled, because "work is made with work". This is certainly the case where a more integrated design approach is followed. In order to learn from examples, several grey-green crossings will be worked out as examples of a more integrated design approach. Subsequently a more definitive form will be given to the activities in the Fifth Policy Document on Physical Planning and the Green Space Structure Plan-2. Two crossings relating to the *Veluwe-Utrechtse Heuvelrug* are also under consideration here.

- NEN in the direction of the river area with the A12-High-speed train (HST)-East and robust corridor with the A12/HST-East
- *Veluwe-Utrechtse Heuvelrug*: NEN with the A1/rail and robust corridor with A1/rail

A specification for crossings with the *Natte As* (an axis of water and swampy countryside running from *Lauwersmeer* to the *Zeeuwse* delta) is also being considered.

3.2 NEW INFRASTRUCTURE

Several large infrastructural projects will be implemented in the next few years. These include the *Betuwelijn*, the Dutch high-speed line and the Rotterdam Mainport Project. These projects will be accompanied by various design problems, such as the blending of these structures into the countryside, dealing with archaeology and monuments, limiting the noise load and the overall design quality of the lines. Better design quality is possible if all the large spatial interventions with which the central government is involved are handled as design problems by using the design quality instruments in the Policy Document on Architecture from the very beginning. The possible application of a grand design will be explored.

A good blending in of infrastructure is important for the improvement of quality of rural areas. The Cabinet's standpoint on the blending aspect provides a good reference point for this improvement in rural quality. Blending, mitigation and compensation, in so far as they are statutory or policy requirements, are inherent components of infrastructural projects. The Green Space Structure Plan contains these policy regulations and protective formulas. Furthermore, the process approach laid down in the standpoint provides guarantees for a responsible blending in of structures. This is given form in the interdepartmental policy project, Multiannual Programme for Infrastructure and Transport Investigation, New Style. An integral problem analysis, an area-specific approach and the involvement of interested parties in the exploratory phase form the overture to the administrative decision making which precedes future plans. In metropolitan areas, the policy focuses on the intensification of land use by compression and multiple use of the space. The pressure to build close to infrastructure or to convert roads etc. to underpasses is increasing. This sets requirements on the blending in and design of infrastructure, based on the desire to be able to deal flexibly with infrastructure in the long term, as well as on the factors, air quality, noise pollution, safety and perceptions of users and those living in the neighbourhood.

In addition to attention for fragmentation, noise, design and the blending in of structures, environmental quality also contributes to the general quality of the infrastructure. This includes, for example, reducing the use of primary materials (sand, gravel) and the application of secondary materials (broken concrete granulates, phosphorus slag). The depletion of the environment and natural raw materials can be reduced by means of recycling and alternative material usage. The reduction of energy consumption and dealing with the waste problem resulting from the exploitation of the infrastructure are, similarly, aspects of environmental engineering quality. Improvement of building technology and environmental gains often go hand in hand, examples being faster, cleaner building technology, the use of cleaner materials and more economical use of materials. The central government has defined policy for sustainable building in which the improvement of the environmental and constructional quality has been elaborated. It is important that attention be paid to sustainable building in the planning and study phase in order to be able to implement it sufficiently in the project phase.

4. TECHNOLOGY FOR QUALITY OF LIFE

So far, success has come mainly from dealing with problems at source. Vehicles are becoming cleaner and quieter, and there are possibilities for increasing their fuel efficiency in the future. The efficiency of classic combustion engines is being optimised and new motive systems, such as those based on fuel cell technology, are becoming available on a large scale. In addition, weight reduction and ICT applications can make a contribution. These will make it possible, by 2030, to reduce CO2 emissions from cars by 50% per kilometre travelled. In the case of lorries, a reduction of 25% appears feasible. On the other hand, some developments are working in the opposite direction. Vehicles are becoming bigger, faster and more powerful. Government policy is oriented towards accelerating the introduction of fuel-efficient vehicles, with a view to EU standards on CO2 emissions per kilometre relative to the size of cars. These standards are in addition to the agreements with car manufacturers to achieve a 25% reduction in the average CO2 emission per kilometre from cars by 2008 (base year 1995). The government does not itself select the future vehicle technology of the future; it leaves this to the market. In this respect, the government seeks to approach matters in a European context or to cooperate internationally with like-minded countries. The most important means are requirements and conditions pertaining to vehicles. Research, pilot schemes and demonstration projects play an essential role in the formulation of regulations. The Netherlands aspires to act as a testing ground for new technologies.

THE FUEL CELL

It is anticipated that between 2020 and 2030 this technology will attain a price-quality ratio similar to that of the combustion engine. Fuel cell technology will benefit from advantages of scale, some of which will be achieved with stationary applications such as decentralised total energy. It may be assumed that the market in fuel cells for traction will take off through use in high-value niches such as shipping, airport equipment and military applications, and also in urban buses and, later, the more expensive cars.

Experience amassed in the Netherlands – from the Electric Vehicle Practical Experiment and from projects such as the use of hybrid buses in *Leiden*, hybrid lorries in *Groningen* and hybrid High Quality Public Transport in *Eindhoven* – contributes to the knowledge base on electrically-powered motive systems. This knowledge is essential to the successful application at a later stage of fuel cell technology to electrically-powered or hybrid vehicles.

Daimler / Chrysler is preparing an experiment with thirty fuel cell powered buses in ten big European cities. Amsterdam is participating, with two or three buses. The experiment will commence in 2002 and will be partly financed by the participants. A further part of the finance will come from the Fifth Framework Programme of the European Commission. The Ministry of Economic Affairs, The Ministry of Housing, Spatial Planning and the Environment, and the Ministry

of Transport, Public Works and Water Management are considering financial participation.

4.1 Motive Power and Fuels

Alternative forms of motive power are electricity (employed in hybrid applications) and especially the fuel cell powered car. These systems will start to make headway when improvements to the combustion engine produce too little benefit or when mass production enables the new technology to compete in terms of price. The alternative power technologies make it possible to drive without emitting NO_x, VOS and fine particles. Potentially, systems of this sort could produce an increase of 30 to 50% in energy efficiency (fuel cell vehicles running on hydrogen), with at least the same level of performance as conventional motive power systems. Fuel cell technology is based on an electric power source, but unlike battery-powered vehicles it does not have the drawbacks of limited action radius and speed. It should be said that electric vehicles powered by batteries could play a role in the transport of the future if deployed as links in mobility chains. Fuel cell technology is still at the development stage. In the past few years, great progress has been made with respect to technology and costs. A complete switch to hydrogen as a fuel would require different distribution channels. Moreover, any environmental benefits depend on the way in which hydrogen is produced.

4.2 Weight Reduction

Limiting the weight of vehicles is very important if savings in energy are to be achieved. The amount of weight to be moved is reduced and smaller motive power units become a feasible option. In the recent past, some thought has been given to the materials used in vehicles and their components. The government wishes to promote (by using the VAMIL regulation, among other things) the entry into the market of weight-saving materials and technologies, particularly for public transport buses.

4.3 Information and Communication Technology

The rapid developments in information and communications technology constitute a challenge for the traffic and transport sector. Both in passenger and goods transport, the technological possibilities are far from being fully developed and applied. Electronic equipment has already been introduced in vehicle motor management and for the constant monitoring of the traditional exhaust emissions. New petrol-driven cars are now fitted with on-board diagnostics – a system that detects and records excessive emission levels. This makes it possible to establish when the vehicle's environmental protection equipment is not working properly. With periodic maintenance, it is then easier to trace and remedy faults. Cruise control is also an example of electronic equipment in use. ICT can ensure better efficiency for logistical applications in road transport.

4.4 Aviation

The policy on technology as concerns the environmental aspects of aviation is strongly internationally oriented. The tightening of standards imposed on the noise produced by aircraft has an effect in the long term. International consultation is oriented towards reducing the number of aircraft that use old technology, tightening noise regulations and operational improvements in the environmental impact of aircraft, including improvement in airport take-off and approach procedures and improved air traffic control systems for better air lane usage.