



Department of Economic and Social Affairs

**Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York**

**THE ROLE OF THE TRANSPORT SECTOR
IN ENVIRONMENTAL PROTECTION**

BACKGROUND PAPER NO. 15

Prepared by the
United Nations Environment Programme

**Submission to
the ninth session of the Commission on Sustainable Development**

The Role of the Transport Sector in Environmental Protection





The transport sector has fundamental environmental impacts while greatly contributing to the socio-economic development worldwide. Therefore, all players in the transport sector have an important role to play in making sure that the transport services necessary to economy and quality of life are provided in the most sustainable manner.

Socio-economic development

Transportation means personal mobility as well as access to goods, services and information. It is an essential human activity that makes a critical input to social development, and national and global economies.

The transport sector, comprising the automotive industry, aircraft construction and operation industry, train construction and railway operation and the ship building and operation industry and their suppliers, is probably the largest sector in the world, in terms of financial turnover, workforce, and resource use. The direct value added by the transport sector to the global GDP is at 3 – 5%, and transport directly provides 5 – 8 % of a “typical” country’s total paid employment. Indirect value added and employment in related sectors is much higher. The turnover of the largest three automotive manufacturers alone exceeds the GNP of the whole African continent.

Historically, the development of a country’s transport sector has been an indicator for its economic welfare and success, and ownership of a car and leisure travel are even status symbols.

Over the past 50 years, the transport sector was the most growing one in industrialised countries. Freight transport, especially, has been growing rapidly; overall freight transport has increased by an average of 2-3% annually in OECD countries since the 1970s, and road freight has even increased by 3.7% annually. Although complete figures for developing countries are not available, the World Energy Council estimates that growth in truck transport between 1995 and 2020 will be 3-4% in Asia and almost 5% in Sub-Saharan Africa.

This growth, which is still increasing, is due to:

- population growth;
- rising living standards, which tend to bring about an increase in the frequency and length of personal travel and in the volume of goods transported;
- increased urbanisation - for the first time, a majority of people will live in urban areas – and particular the expansion of big cities creates new needs for urban transport;
- increased access to transport, also in countries with economies in transition and developing countries; and
- evolutions in industrial practices increase the demand for goods transport (flexible stocks, express deliveries, etc.).

At the same time, increased access to goods, services and information greatly furthers social development.

A third layer of the contribution of the transport sector to the socio-economic development, is through mainly multi-national companies. They are often aiming at improving quality of

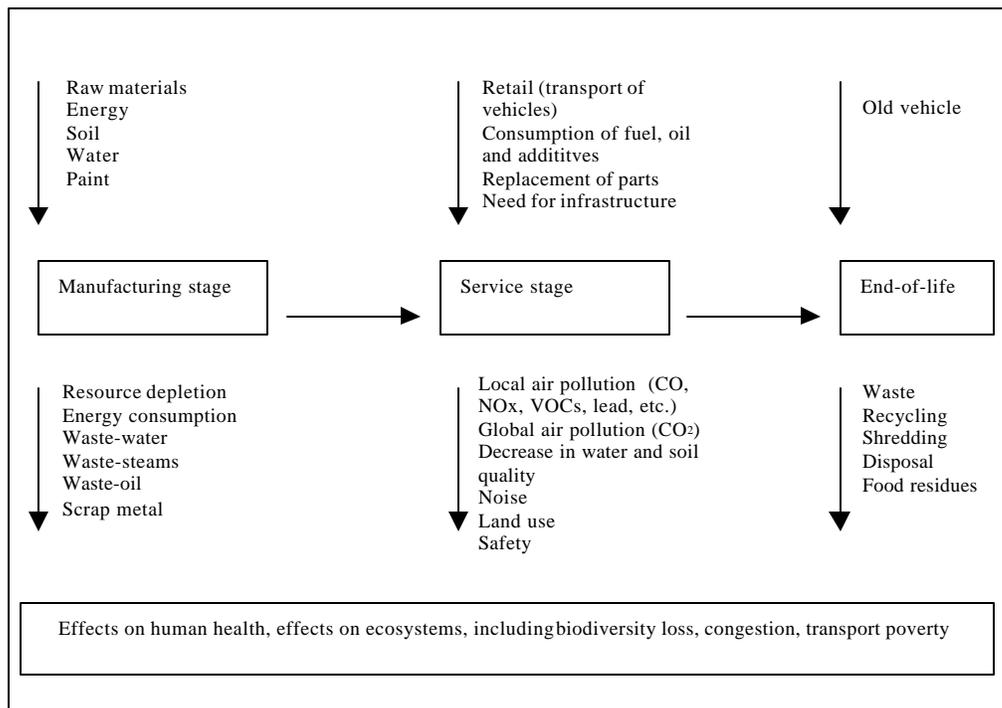


life of those who live in communities where these companies operate through sponsoring of education systems, cultural events, labour practices, etc.

Environmental impacts

However, transportation does have fundamental environmental impacts on air, land, water, ecosystems and human health. These impacts occur at all levels of the life-cycle, i.e., production of passenger cars, busses, trucks, airplanes, ships and trains, the operation of these products and their end-of life. Different modes of transport do have different environmental impacts. Figure 1 illustrates environmental impacts of the life-cycle of automobiles.

Figure 1 – Life-cycle of vehicle production and use



Major environmental impacts of transport arise from use of energy, and transport is responsible for about a quarter of the world's current energy use. Heavily dependent on fossil fuels, it accounts for about half of world oil demand. Since 1970, transportation energy demand has grown by 110% or 18 million barrels of oil per day, and according to projections by the US Department of Energy, it will grow another 77%, or 27 million barrels oil per day, by 2020.

Through burning fossil fuels in combustion engines, cars, buses, trucks, motorcycles, ships, trains (of course, the issue is different for electric-powered systems, whose impacts depend



on the power source) and planes (environmental impacts of aviation are even more complex than those of other modes of transport, therefore, they will be further explained in Box 1 at the end of this chapter) emit significant quantities of carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides and fine particles. These emissions are responsible for air, soil and water pollution at the local, regional and global levels, and cause serious health problems:

Local air pollution

Carbon monoxide (CO) causes short-term toxicity, blocking the uptake of oxygen by haemoglobin. It aggravates and causes – depending on the level of exposure - cardiovascular diseases, especially angina and peripheral vascular diseases. Exposure to elevated levels is even associated with impairment of visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks.

Nitrogen dioxides (NO₂) can irritate the lungs and lower resistance to respiratory infection

Nitrogen oxides (NO_x) are an important precursor to acid rain and may affect both terrestrial and aquatic ecosystems.

SO₂ causes cell destruction.

Volatile organic compound (VOC) emissions contribute to ambient ozone, and some fractions of VOCs emitted from motor vehicles are toxic compounds as well. At elevated concentrations and exposures, human health effects can range from respiratory effects to cancer, as well as neurological, developmental and reproductive effects.

Particulate matter mechanically overloads the lungs.

Aldehydes irritate the bronchi and other mucous membranes, and are acute toxics.

Benzene, a haematotoxic, is suspected carcinogen.

Each of the Polycyclic Aromatic /hydrocarbons in exhaust gases has some mutagenic and carcinogenic activity.

Lead in gasoline can cause major health effects. Low level lead exposure in children, for instance, has adverse effects on the development and function of the central nervous system, leading to various behavioral disorders, including distraction, inability to follow simple directions, and lower scores on IQ tests. On adults, increases in both systolic and diastolic blood pressure and cardiovascular effects have been noted.

Regional air pollution

Ground-level ozone, formed by volatile organic compounds (VOC) and NO_x in the presence of heat and sunlight, is the prime ingredient of smog. Short-term exposure to high ambient ozone concentrations causes increased respiratory problems and can lead to decreases in lung function. Long-term exposure may cause irreversible changes in the lungs which can lead to chronic respiratory diseases.

Sulfur oxides contribute to acid rain, responsible for fauna degradation and in combination with nitrogen compounds and photochemical oxidants, generates material damage.

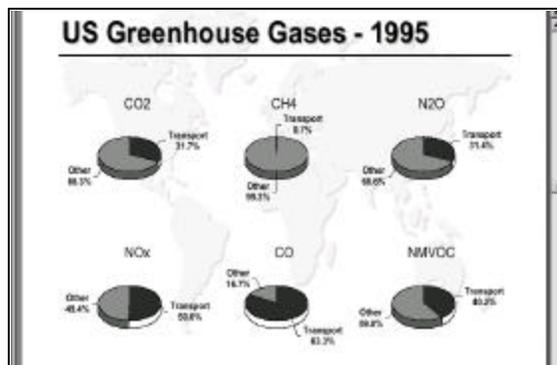


Such local and regional pollution is linked to an estimated 500,000 deaths, 4-5 million new cases of chronic bronchitis as well as millions of cases of other serious illnesses each year. The economic burden of this pollution is estimated at US\$150-750 billion a year.

Climate Change

The transport sector is responsible for the emission of more than a quarter of carbon dioxide (CO₂) emissions from human activity world-wide, as well as considerable shares of methane (CH₄), and nitrous oxide (N₂O) emissions, and is thereby one of the largest single contributors to global climate change. Figure two illustrates the share of the transport sector of greenhouse gas/gases influencing the greenhouse effect emissions in the US.

Figure 2



Source: Michael Walsh

In its latest report, the UN Intergovernmental Panel on Climate Change, a scientific body established in 1988 by the World Meteorological Organization and the United Nations Environment Programme to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change, says that climate change due to human influences has almost certainly begun. It predicts that by the year 2100, global mean surface temperatures will rise by 1.4 - 5.8 degrees Celsius and sea-levels will rise by 15 to 95 cm.

Such changes will create unprecedented environmental, economic, and social pressures from:

- sea-level rise,
- more severe droughts, storms and floods;
- increasing desertification,
- changing mountain ecosystems,
- pressure on food production and water resources,
- migration of tropical diseases, and increase of cardio-respiratory, and infectious diseases.

All regions of the world are likely to experience adverse effects of climate change. However, some regions are particularly vulnerable because of their physical exposure to climate change hazards and/or their limited adaptive capacity, such as small island states and low-



lying coastal areas, which are particularly vulnerable to increases in sea level and storms. Climate change impacts in polar regions are expected to be large and rapid, including reduction in sea-ice extent and thickness and degradation of permafrost. Further, it will be people in the poorest countries who suffer the worst impacts of global climate change. Adverse changes in seasonal river flows, floods and droughts, food security, health effects, etc. will be highest in Africa, Latin America and Asia.

Resource Use and Waste generation

Furthermore, transport has significant impacts on resource use and waste generation.

Box 1 - Environmental impacts of Aviation

Aircraft emit gases and particles directly into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of atmospheric greenhouse gases; trigger formation of condensation trails (contrails); and may increase cirrus cloudiness – all of which contribute to climate change.

The principal emissions of aircraft include carbon dioxide (about 10 % of carbon dioxide emissions from all transport sources) and water vapour. Other major emissions are nitric oxide (NO) and nitrogen dioxide (NO₂), sulfur oxides (SO_x) and soot. Contrary to CO₂, the other gases have shorter atmospheric residence times, and therefore remain concentrated to flight routes. These emissions can lead to radiative forcing that is regionally located near the flight routes for some components (e.g. ozone and contrails). The direct radiative forcing of sulfate and soot aerosols from aircraft is small compared to those of other aircraft emissions. Aircraft emitted NO_x, for example, participates in ozone chemistry, and are more effective at producing ozone in the upper troposphere than an equivalent amount of emission at the surface.

Aircraft contrails, which tend to warm the Earth's surface similar to thin high clouds, are estimated to cover about 0,1% of the Earth's surface on an annual averaged basis.

Extensive cirrus clouds, which tend to warm the surface of the Earth, have been observed to develop after the formation of persistent contrails. Increases in cirrus clouds cover beyond those identified as line-shaped contrails are found to be positively correlated with aircraft emissions.

Land use

With regard to land-use, automotive transport in particular presents some of the most pressing challenges: The competition for land between cars and crops is a major threat to the food security of countries such as India and China. In the US, the area dedicated to roads and car parking covers an estimated 16 million hectares – just slightly less than the 21 million hectares planted in wheat. If China obtains the same level of car ownership as Japan - in 1995, China had 23 motor vehicles registered per 1000 persons, compared to over 550 in Japan - and creates roads at the same ratio the country would need to pave 13 million hectares. This represents half the amount of land used for crops in a country already struggling to attain food security for its 1.2 billion people.

Mega-cities

Negative environmental impacts of transport are concentrated in mega-cities, and with the growing level of urbanization, pressure on urban areas will increase. The situation is



particularly dramatic in major developing country cities, where the separation of working, living and moving spaces is inadequate, a highly mixed traffic composition prevails, and where a low proportion of urban space is devoted to roads (e.g. 11% in Bangkok, compared to 30% in Los Angeles). The result is high congestion, causing higher pollution levels and longer exposure of people in the street to pollution.

Developing-countries

In addition, in developing countries, access to both public and private transport is insufficient, but existing transport means are often inefficient and highly polluting. Vehicle stocks, for instance, are by far older than in the developed world – vehicles at their end of life in developed countries are often transferred to developing countries, without ensuring appropriate retrofit and maintenance measures. Furthermore, in many cases fuel quality is poor, and gasoline still contains lead, causing serious health problems.

Safety

Transport accidents cause a significant number of injuries. In the European Union alone, about 44,000 deaths go back to traffic accidents per year.

Improvements in the past

In the past decades, improvements were made with regard to legal frameworks and technical innovation.

Legal Frameworks

Most of the environmental legislation relevant to the transport sector passed so far is based on emission standards related to air pollution and noise.

International legislation addresses visible smoke, carbon monoxide, hydrocarbons and oxides of nitrogen. Phase out of lead in gasoline and reduction of sulfur in diesel fuel received increased attention. In addition, limits on emissions of respirable particulate matter from diesel-fueled vehicles were gradually tightened.

Vehicle emission standards, for example, are in effect in all industrialised countries, and have also been adopted in many developing countries, especially in those where rapid economic growth has led to increased vehicular traffic and air pollution, as in Brazil, Chile, Mexico, the Republic of Korea and Thailand. However, standards differ from country to country. In some countries, such as the US, differentiated emission standards for heavily used vehicles in highly-polluted areas and the clean fuel vehicle programme (requiring vehicles certified to lower emissions standards) have been introduced.

Emission standards can be a very effective means of limiting emissions when the maximum allowed emission standards set are stringent enough, and when compliance with these standards is sufficiently monitored and enforced. In addition to such emission standards, which sometimes lack flexibility and therefore often result in higher costs for industry, a number of other methods have been introduced, such as voluntary agreements, information and labeling schemes as well as fiscal measures. In the US, for example, programs for emissions averaging, trading and banking have been introduced. Some countries, notably



Germany, have made effective use of tax incentives to encourage buyers to choose vehicles certified to more stringent emissions standards than the minimum requirements.

Box 2 – International Legal Framework Relevant to Transport

- *Geneva Convention, 20 March 1958* (international harmonisation of measures preventing pollution from automotive vehicles)
- *Vienna Convention, 9 November 1968* (prohibition of excessive emissions of harmful gases, smoke, odors and noise)
- *Geneva Convention on the Long-range Transboundary Air Pollution, 13 November 1979*

This was the first multilateral Convention relating to environmental protection, which involved almost all nations of Eastern and Western Europe, the USA and the USSR. It was also the first to deal specifically with the problem of long-range transboundary air pollution where it is not possible to distinguish the contribution of individual emission sources. The Convention sets out the general obligation to limit, reduce and prevent air pollution. The definition of “air pollution” is wide and therefore brings many substances within the scope of the Convention. The obligations are limited to what is economically feasible and refer to the best available technology. The Convention obliges States to exchange information, consult and undertake research.

- *Protocol to the 1979 Convention on Long-range Transboundary Air Pollution Concerning on the Reduction of Sulfur Emissions or their Transboundary Fluxes by at least 30%, 08. July 1985, Helsinki.*

The Protocol sets specific emission targets and timetables. It requires that by 1993 at latest, Parties reduce their annual sulfur emissions on their transboundary fluxes by at least 30%, using 1980 levels as a basis. The Protocol requires Parties to report annually on both their emission levels and the basis of their calculations.

- *Protocol to the 1979 Convention on Long-range Transboundary Air Pollution Concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes, 31. October 1988, Sofia*

The Protocol sets out targets and timetables for the annual emissions of nitrogen oxide or their transboundary fluxes. It requires that by 31 December 1994 at latest, Parties limit their emissions to the levels emitted during any previous year before 1987. The Protocol also requires Parties to implement national emission standards to major new stationary and mobile sources based on best available technologies, which are economically feasible. In addition, the Protocol requires Parties to commence negotiations within 6 months of entry into force on further ways to reduce nitrogen oxide emissions.

- *Protocol to the 1979 Convention on Long-range Transboundary Air Pollution Concerning the Control of Emissions of Emissions of Volatile Organic Compounds or their Transboundary Fluxes, 18 November 1991, Geneva*

The Protocol applies to all anthropogenic compounds that are capable of producing photochemical oxidants by reactions with nitrogen oxides in the presence of sunlight with the exception of methane. The Protocol sets an emissions or transboundary flux reduction target for VOCs of at least 30 % by 1999, based on 1988 levels or the levels of any year between 1984 and 1990. Furthermore, this Protocol takes a more sophisticated approach than the other Protocols (details available, if needed). The Protocol requires Parties to monitor compliance. A Party that suspects another Party of non-compliance with the Protocol may notify the Executive Body and have the matter discussed. Parties are also required to conduct future negotiations on further reductions and to regularly review the adequacy of the Protocol in the light of scientific and technological developments.

- *UN Framework Convention on Climate Change, 9 May 1992, New York*

The ultimate objective of the UNFCCC is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Developed country parties and countries of Central and Eastern Europe are required to take measures to limit their greenhouse gas emissions with the aim of returning individually or jointly to their 1990 levels by the end of 2000. Parties are required to cooperate in developing, applying and transferring technology that reduces or prevents emissions of



Technological Innovation

Over the past two decades, environmental impacts of production processes have been steadily reduced through the introduction of cleaner production methods. This comprises the drastic reduction of energy consumption, use of more efficient use of raw materials, use of filters, closed water-cycles, water-solvable paint, etc., and use of renewable and recycled materials. Moreover, many auto manufacturers, for example, have introduced environmental guidelines for their production plants and developed environmental management systems, often with third-party certification.

Furthermore, the products themselves have been improved. Through new designs and new engines, cars, buses, trucks, trains, ships and airplanes operate more fuel-efficiently. Filters decrease particulate emissions, and the introduction of catalytic converters in vehicles have successfully reduced emissions of local air pollutants. Fuels used in conventional combustion engines are more environmentally friendly (unleaded gasoline, fuel additives, low sulfur fuel, natural gas, etc.), and new engine systems running on alternative fuels are under development (fuel cell, biomass, etc.).

Finally, already in the conception stage, recyclability of end of life vehicles is more and more being taken into consideration. This comprises reuse of parts and components, use of more easily recyclable materials, use of recycled materials, the and the marking of different parts in the construction phase allowing for easy dismantling and recycling.

UNEP's experience with the transport sector

... Reporting...

Reporting is an important tool to both increase awareness of consumers and ensure accountability and transparency of industry operations.

Together with SustainAbility, UNEP has published a series of sectoral reports (Oil Sector Report, Life-sciences Report), examining how industry sectors address the expanding environmental and social reporting agenda. A report on the automotive sector is underway.

Some automotive manufacturers are actively involved in the Global Reporting Initiative (GRI), aiming to design globally applicable guidelines for enterprise-level sustainability reports, and to elevate corporate sustainability reporting practices to a level equivalent to financial reporting.

...Sharing Information...

UNEP has issued different publications on transport issues, such as a joint OECD/UNEP/Austrian Federal Ministry for Environment, Youth and Family publication *Towards Sustainable Transport in the CEI Countries*, two joint UNEP/OECD publications *Phasing Lead out of Gasoline* and *Older Gasoline Vehicles*, showing best practice



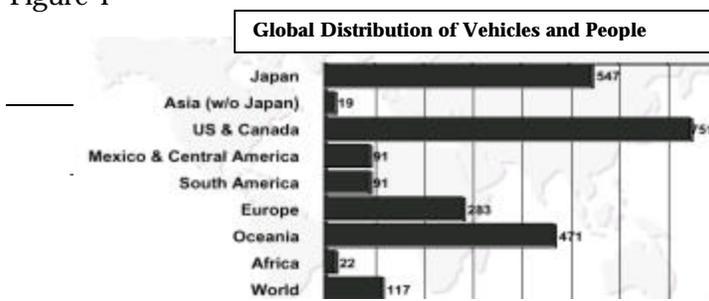
Challenges for the future

The issue of sustainable mobility is more pressing than ever: Environmental impacts of the transport sector continue to rise! The improvements in reducing environmental impacts of production processes and products have been outweighed by an enormous growth of transport demand in developed and lately also in developing countries. Vehicle and aircraft fleets as well as kilometers driven and flown have been increasing. Use of railways remained stable, which means with regard to the enormous increase in other transport modes, considerable decrease of the share of rail transport.

Figure 3



Figure 4





Source: Michel Walsh

Against this background, it is evident that technological solutions alone are not sufficient. They need to be complemented by a whole rethinking and restructuring of current transport patterns. The focus of attention must be switched from particular modes of transport to the wider question of how to organise access to personal mobility, goods, services and information most efficiently. This involves change of land use and infrastructure planning, change of consumption patterns, including intermodal transport, avoidance of unnecessary travel, and support for non-motorised forms of transport, and switch to alternative fuels.

Making sustainable mobility happen is a highly complex task and therefore requires a coordinated approach by all players: governments on the national and local level, industry, NGOs, consumers and international organisations. Dialogue of the various players is a first step. Also the Global Compact, by which the UN Secretary-General, Kofi Annan, invited business leaders to “embrace and enact” Human Rights, International Labour Standards and the Rio Principles both in their corporate practices and by supporting appropriate public policies, will play an important role.

Measures that could be taken...

... by governments...

The role of governments in the challenge of sustainable mobility is to create an enabling environment. This comprises the setting up of an appropriate regulatory framework coupled with sustainable transport planning and the use of economic instruments. In the following, several possible measures will be mentioned, the list is not exhaustive.

© Short-term measures that could be taken comprise policies to accelerate the rate of capital stock turnover in automobile and aircraft fleets to reduce the rate of emissions growth. This is particularly relevant for developing countries, where large fleets with many older vehicles are in place, and where air travel will experience a major uptake. Furthermore, measures for retrofitting and maintenance of vehicles, trains and aircraft could be particularly helpful. A third pillar would be the promotion of cleaner, lead and sulfur free fuel.



UNEP, together with the OECD, has recently released two publications to support governmental measures regarding such measures. Replication of measures included in both publications can help address environmental impacts from transportation:

- *Phasing Lead out of Gasoline* An Examination of Policy Approaches in Different Countries. This publication includes successful programmes to phase-out lead completely in some countries as well as co-ordinated action of the lead industry.
- *Older Gasoline Vehicles* Information included in this publication comprises inspection maintenance programmes, retrofit programmes, accelerated retirement of older vehicles, switching to cleaner fuels, and other measures that have been undertaken by governments.

© In many countries, external costs of transport are not reflected in the costs of the different modes of transport. Putting in place environmental taxes, abolishing fossil fuel subsidies and creating incentives for promoting environmentally friendly transport systems are measures that can help internalise environmental externalities in the cost of transport. This could also include the facilitation of setting up alternative fuel infrastructures.

To support governments in finding ways to reduce GHG emissions from transport and particularly to internalise externalities, the UNEP Collaborating Center on Energy and Environment has prepared for the World Bank Climate Change Global Overlays for the transport sector. The Global Overlays Guideline document, which will be released later this year, includes a number of conceptual issues relating to GHG externalities including baseline definitions and cost-effective GHG abatement policy options. Specific policy options under consideration include new technologies, economic instruments and infrastructure planning.

© Transport planning is particularly important in congested and heavily polluted urban areas, especially since in the coming years, more than half of the world's population will live in cities. As a general motto, sensible land use should be emphasised over physical mobility.

Intelligent city planning, provision of safe and efficient public transport systems, the use of IT ("virtual city" programmes), road and parking pricing, traffic calming and other similar measures have already successfully been used by some governments to reduce congestion and thereby save emissions and costs. As a general statement, non-motorised transport, such as walking and cycling, needs to be strengthened. This is particularly true for developing countries, where in many cases the poorest cannot afford public transportation and where many different modes of transport co-exist on the roads, causing injuries and congestion. Governments could be a facilitator of introducing non-motorised options.

Policies and measures, of course, will vary from city to city as they need to be adapted to the city's specific needs.

UNEP is preparing a project that will gather case studies on sound practices in urban transport management and on energy efficient urban transport systems. Furthermore, together with Habitat's Sustainable Cities Programme, IETC is preparing an Air Quality Management Toolkit for Cities.



© Furthermore, the individual user of transport systems needs to be addressed. In the US, for example, there are more licensed drivers than voters. Education and awareness raising are steps that could be taken by governments to promote the necessary change in consumption patterns.

Together with automotive manufacturers, UNEP is planning an awareness raising campaign on more environmentally friendly driving behaviour. Governments could possibly help to disseminate the lessons learned by for example translating them into official programmes of driving schools.

... by industry...

Along the lines of responsibility, accountability, and transparency, industry should integrate environmental and social concerns into core-decision making. In the production stage, ideally a cradle-to-cradle approach needs to be taken, and as to the products, efforts to develop innovative technology rendering operations more efficient and cleaner need to be enhanced. This new technology should also to be transferred to less developed countries.

Furthermore, through voluntary initiatives and a partnership approach, industry should work with national and local governments and exchange information with consumer groups, environmental NGOs and consumers. Transportation issues have received increased attention in recent years because of the heightened concern at all levels of society about global climate change and local air pollution, as well as greater recognition of the critical role that transport plays in sustainable economic and social development. This means that consumers will be more receptive to sustainable transport solutions. To use this awareness to change consumer behaviour, consumers need to be better informed to be able to make the right transport choice. Reporting on environmental policies and measures will be an important tool to share information, but also to ensure compliance with regulation and voluntary initiatives.

Moreover, the challenge of sustainable mobility presents an opportunity for this industry sector to restructure and develop into proactive mobility service providers.

© The rail transport sector could use a three-pillar approach:

The first pillar could be technological innovation, comprising:

- Development of retrofit systems to render the existing locomotive fleet more efficient, more efficient new diesel engines and new locomotive engines, such as liquid gas and fuel cell;
- Use of renewable raw materials and recycled materials (“cradle-to-cradle approach”), and increase of recyclability of old material; and
- Reduction of noise and vibration levels.

The second pillar could be management measures to:

- Make international rails fungible to allow for easier and quicker freight transport;
- Allow for intermodal shift. The railway sector could work with other industry using rail transport, with air carriers (“fly and ride”, bringing country-internal traffic on rail), car rental companies (“ride and drive”), with local governments (“park and ride”) and taxi operators (“ride and be driven”);



- Purchase green electricity.

A third pillar could be relationship with other stakeholders, especially consumers. Rail is often the most environmentally friendly means of transport. The sector should use the increased public awareness for environmental issues to promote this more environmentally friendly means of transport. An example for such an approach is the interactive internet tool developed by Deutsche Bahn, which indicates to the interested traveler the most environmentally friendly and the most efficient means of transport to a given destination.

© The automotive sector could also use a three-pillar approach:

Similarly, the first pillar could draw on technological improvement:

- Production process: environmental management best practice/ ISO14001 and/or EMAS third-party certification; savings of natural resources, energy, air and water pollution; enforcement of EM and industrial best practice on suppliers;
- Product: reduction of fuel consumption and thereby reduction of GHG and pollutants emissions; development of new fuel technologies/engines (biofuel, fuel cell, etc.); use of and efficiency in renewable materials, take back and recycling of old vehicles.

The second pillar could be so called non-product or non-technical measures, covering the promotion of use of unleaded gasoline in old cars, the promotion of education and training on environmentally friendly driving, the promotion of regular and systematic maintenance of vehicles, car-pooling or short-term rental; multi-modal/regional transport schemes, integrated freight schemes, cooperation with the IT sector.

The third pillar could also consist in relationship with other stakeholders, especially consumers. Most auto manufacturers complain that consumers would like to have a more environmentally friendly car, but that they are not willing to pay more for it, and that therefore, there is no market for “green cars”. Automotive manufacturers have always found ways to market their new invention that made cars more expensive, therefore, advertising could concentrate on creating a demand for environmentally friendly vehicles. Reporting would, of course, be a means of communicating efforts undertaken.

© Also, the aviation sector could use a three-pillar approach:

Again, the first pillar could draw on technological improvement:

- Due to engine improvements and airframe design improvement, subsonic aircraft being produced today are 70% more fuel efficient per passenger-km than 40 years ago. Further increase of fuel efficiency is needed. Thereby, a balance of considerations among many factors (CO₂, NO_x, water vapour, etc.) will have to be made;
- Reduction of sulfur content of kerosene to reduce SO_x emissions and sulfate particle formation;
- Research on new fuels, such as hydrogen;
- Reduction of noise emission, especially in areas surrounding airports.

The second pillar could draw on operational measures:



-
- Air traffic management systems for guidance, separation, coordination and control of aircraft movements need to be improved to avoid aircraft flying in a fixed pattern waiting for permission to land; and to avoid inefficient routings, sub-optimal flight profiles and taxiing;
 - Increase of load factors (carrying more passengers or freight on a given aircraft), elimination of non-essential weight, optimisation of aircraft speed and limitation of the use of auxiliary power (e.g. for heating and ventilation).

The third pillar could consist in policy options:

- Conclude voluntary agreements with national governments and international organisations to reduce environmental impacts;
- Work with the rail sector to set up intermodal travel; especially for short-distance travel, high-speed trains are the most efficient option;
- Increase transparency with stakeholders through environmental reporting.

As to maritime transport, it appears that the most pressing environmental issues are safety of vessels, dumping at sea and other issues related to compliance. With regard to a changed mix of transport modes, in certain areas short distance travel by ships make ecological sense – if the technical equipment, especially engines, is up to modern standards.

...by the international community...

- Raise awareness of decision-makers within governments and industry;
- Promote the integration of sustainability considerations into transport provision and planning;
- Promote a coherent and coordinated approach among environmental instruments and regions;
- Disseminate best practice examples;
- Strengthen capacity-building;
- Support and empower civil society;
- Encourage private-private and public-private partnerships.



Department of Economic and Social Affairs

Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York

**THE ROLE OF URBAN TRANSPORT IN
SUSTAINABLE HUMAN SETTLEMENTS DEVELOPMENT**

BACKGROUND PAPER NO. 7

Prepared by:
UNCHS (HABITAT)



Urban Transport, Human Settlements and Social Development



A. The Role of Urban Transport in Sustainable Human Settlements Development

The rapid urbanization occurring across much of the globe means that not only that more people than ever before will be living and working in cities but also that more people and more goods will be making more trips in urban areas, often over longer and longer distances. How cities, and especially, how rapidly growing cities in developing countries meet the increased demand for urban transport has profound implications for the global environment and the economic productivity of human settlements.

Cities represent a spatial organization of functions to meet human needs. The value of this spatial organization depends, to a large extent, on the capacity to facilitate interactions, by arranging effective patterns of physical development and by providing for the efficient movement of goods and people. By allowing access to employment opportunities, housing quarters and services, the transport sector meets basic human needs and, by affecting the exchange of raw materials and finished products, it supports diversification and strengthens the economy. However, meeting the demand for transport involves high costs which bear heavily on public spending, business expenditures and family budgets, competing for resources needed for the achievement of other developmental objectives. Expenditures on transport affect, in particular, low-income-family budgets, adding the poverty burden.

Additionally, transport has substantial impacts on global life-support systems, non-renewable resource consumption, sustainability of production of renewable resources, living conditions and human health and safety:

- (a) Global life-support systems can be significantly affected by transport-related emission of carbon dioxide and methane which contribute to the "greenhouse" effect. Vehicle emissions of carbon monoxide, hydrocarbons and nitrogen oxides reduce oxidation, i.e. the cleansing efficiency of the atmosphere.
- (b) Transport consumes about 40 per cent of commercial energy in the developed countries mainly responsible for the world's total energy use in transport. In developing countries, with low levels of industrial development, the share of transport in commercial energy consumption is, often even higher, reaching 80 to 90 per cent.
- (c) Transport exerts a demand on land for the construction of infrastructure; and the production of vehicles and the construction of transport infrastructure require significant quantities of mineral and other natural resources with limited possibility of re-use.

- (d) Transport affects sustainability of renewable-resource production because emissions of nitrogen and sulfur oxides lead to atmospheric acidity which cause water and soil pollution, degradation of vegetation and a decrease in agricultural and forestry outputs. Furthermore, there is an impact of transport -related emissions through corrosion damage to building materials.
- (e) Gaseous and particulate emissions from vehicles, using fossil fuels, create smog and excessive concentrations of carbon monoxide, nitrogen oxides and lead. The movement of vehicles is also the main source of noise pollution. These phenomena affect, directly or indirectly, physical and mental health of all urban residents.
- (f) Construction of the transport infrastructure often disrupts neighborhoods; it relocates urban residents to the periphery increasing their travel distances and expenditures; it decreases safety; it degrades the amenity of public open spaces and creates visual intrusions. Yet inadequate or unaffordable transport leads to excessive building and population densities, causing deterioration of the living environment.

In the context of sustainable urban development, the crucial transport issue is how to make social and economic progress possible with the least damage to the natural and built environments, while saving non-renewable resources and ensuring equity in distribution of transport costs and benefits.

B. Transport strategies which enhance social and economic development

To be managed and developed in compliance with the principles of sustainable development, appropriate transport planning requires the adoption of long-range strategies which should be established on an inter-sectoral basis as the issues involved pertain not only to regional-development but also to land-use, industrial, energy and fiscal planning. This planning must be carried out at sub-national and local scales and linked to national policies to provide the most appropriate framework for devising such strategies. Only in this framework is it possible to reconcile requirements for transport and the standards against the adverse effects of transport-infrastructure installation and operation. Indeed, the demand for transport and the ways in which it can be met depend to a large extent on how human settlements are managed.

When devising transport strategies compatible with the objectives of sustainable development within human settlements, it is necessary to consider three issues simultaneously:

- (a) The indispensable level of transport provision to meet required social-economic development objectives. This analysis should include clearly establishing exactly what kind of transport facilities and services should be provided to bring about this development within the desired limits of resource use.
- (b) Developing and managing the transport sector while not simultaneously undermining the sustainability of other sectors of the economy.
- (c) Organizing and planning for the human settlements system and patterns of individual settlement development to sustain transport and reduce its costs; its impacts on human health; and its demand for non-renewable resources.

Such an integrated approach to devising transport strategies has not typically been a common practice. Overall policies on transport in human settlements are usually completely lacking, and transport planning at local levels tends to adopt, for the sake of simplicity, a strictly sectoral approach. Transport plans attempt to respond to the predicted demand for travel if possible in its entirety, but

this future travel demand is derived from models which transpose, into the future, present travel behavior and accepted tendencies in settlement development. Broad social, economic and environmental objectives which are often beyond the concern of transport planning, are not normally taken into account.

The integrated approach significantly increases the complexity of planning in technical and decision-making aspects. However, it opens great possibilities for guiding development in a more sustainable way. Nevertheless, to be effective, integrated planning needs close interagency co-operation and strong urban management in general. This will be extremely difficult to achieve in developing countries where institutions tend to be very weak. Considerable efforts will have to be made to upgrade skills and improve management systems.

Ready-made strategies cannot be proposed, owing to the diversity of conditions and problems in developed and developing countries, but the following lines of action deserve to be considered:

- (a) Modifying and managing the demand for transport, including making changes in travel behavior;
- (b) Making modal composition in transport supportive of sustainable development;
- (c) Improving vehicles and fuel technologies
- (d) Controlling the impacts of investment projects in transport on the quality of life;
- (e) Increasing the efficiency of existing transport operations;
- (f) Improving the maintenance of existing infrastructure and of vehicle in use.

These lines of action can be fully effective only if they are well coordinated and undertaken simultaneously. The optimum combination of options is essential, as they usually have synergistic links. For example, where each individual action on its own might have modest impact at best, joint actions might achieve considerable benefits. To be implemented, strategies must have the support of the general public, which make public participation in their formulation essential and requires the raising of public awareness of the ecological impacts of transport. At the same time, substantial international co-operation is needed in promoting environmentally-friendly transport technologies. Any program designed to improve transport must identify measures of improvement and establish a means for monitoring progress. This requires the development of a means of monitoring impacts on resource use, social conditions and human health more sensitively than is currently achieved by simple economic analyses of transport programs.

C. Reducing the demand for transport

Transport represents an imperfect market in which the costs borne by users of transport services and infrastructure neither reflect fully social, economic and, in particular, ecological costs of transport nor distribute these cost among users in an equitable way. This results in individual travel behavior and location decisions which increase the demand for transport above real needs and lead to an inefficient use of limited natural resources and to inevitable adverse ecological impacts. Therefore, there is a need to manage the demand for transport by applying policies which will create conditions for the users of transport such that their behaviors becomes compatible with principles of sustainability.

Transport needs can be reduced and satisfied by lower costs and with lessened impact on the environment by applying strategies which result in a spatial distribution of activities which shortens travel distances and prevents excessive concentration of the demand for transport. In this context, the importance of subnational development planning and local land-use planning should be fully

recognized. This particularly pertains to developing countries wherein planning tools can be potentially effective if they are geared realistically to the current processes of structural transformation which subnational areas and settlements are undergoing due to globalization.

Subnational development planning should aim at the distribution of population and economic activities which prevents spatial concentration of the demand for transport to the point where the level of loading of the environment by transport-related pollution will endanger ecological sustainability. In the use of settlement land, single-purpose zoning patterns should be avoided, and, instead, urban areas should be structured in the form of medium-sized, relatively self-contained modules which will meet the needs of different social-economic groups and allow people's homes and places of work to be within walking distance. However, to achieve this, a substantial improvement in urban management institutions is indispensable.

Unlimited mobility and unrestrained choice of mode of travel cannot be ensured in any but the smallest settlements. Therefore, transport networks should be developed for the benefit of all sections of the community in such a way that indispensable access to employment opportunities, housing opportunities and services is ensured for all, while freedom of choice in route and mode of travel can be restrained for the sake of sustainability. Freedom of car traffic should be restrained, in particular, in the centers of large cities, in recreation zones and in other environmentally sensitive areas.

The complexities of transport development and operation and the imperfection of transport markets lead to costs and benefits of transport being unequally distributed. This is particularly the case with people who have access to private cars at the expense of others. Therefore, fiscal policies and other economic measures should enhance efficiency in transport, discourage excessive use of cars and make car-users pay the economic and environmental costs of their travel. At the same time, environmental-friendly travel behavior should be encouraged by raising awareness of transport-related environmental impacts and providing education on energy-efficient driving habits.

D. Reducing the Overuse of the Private Automobile to Meet Future Travel Needs

The detrimental effects of the activities of the transport sector on the biosphere, including consumption of energy resources, are mainly related to road transport. The economic efficiency and environmental quality of large cities are particularly affected by transport based on the massive use of cars and more recently, also by the use of motorcycles. Although individual transport has numerous advantages in flexibility, speed, privacy and comfort of travel, these advantages should be weighed against their impact on energy consumption and land use, including the role of individual transport plays in encouraging land-absorbing and energy-inefficient physical development patterns. In the conditions of large cities, the need for passenger accessibility and mobility should be largely met by public-transport, and non-motorized transport modes which consume less energy and emit fewer pollutants per passenger-kilometer than private modes. Additionally, these modes are more economical in their use of travel-way space and support higher urban-development densities.

Development of public transport should lead to the establishment of transport networks made up of a diversity of modes that are compatible with travel needs and affordable by the entire population. Progress will require flexible transport-development strategies, particularly in the conditions of uncertainty concerning development prospects prevailing in cities in developing countries. Travel-way space for exclusive use of public transport should be created or reallocated from automobiles to public transport, whenever the latter solution is feasible. The use of this space, i.e. the choice of a public-transport mode or mix of modes, should be appropriate to local conditions, reflecting, *inter alia*, financial affordability of mode installation and operation, its economic viability, its expected

impact on the transport network, the sustainability of the urban structure and any socially distributive effects.

Buses are likely to retain an essential share in public transport; thus, there is the need to improve the operation, maintenance and management practices of bus transport and reduce its contaminant effects and, where feasible, promote the use of electric trolleybuses and trams. Also, paratransit should retain a substantial role in public transport, in particular in developing countries. Regulation of paratransit by governments should focus on safety and on environmental requirements, while not impeding paratransit operation or limiting entry to the market, with the exception of transport corridors heavily loaded and well served by buses. Rail-bound high-capacity public-transport modes might become indispensable in very large cities with strong and intensively developed centers: these modes are also preferable for environmental reasons. Capital operating costs are, however, usually restrictive, and such modes can only be developed if high economic and environmental benefits can be achieved: in this connection, innovative methods of environmental cost/benefit analysis should be developed to capture all the facts involved in decision-making on these modes.

In the pursuit of transport policies reflecting sustainable development, the promotion of walking and cycling can be important. The bicycle is by far the most energy-effective means of passenger transport and most affordable for the urban and rural poor. Adequate attention should be given to the provision of safe cycle routes and parking spaces. Likewise, policies must support walking as a prime mode of transport, thorough the provision and maintenance of walkways.

E. Reduce costs by enhancing transport efficiency

The objective of sustainability calls for making the best use of existing transport networks. Traffic-management measures have brought significant although, often, short-lasting effects. Attention should be directed, therefore, to improvements in public-transport operation. Providing for priority in traffic of public-transport vehicles, at the expense of the free movement of individual transport, is fully justified by principles of equity and sustainability. Special attention should be given to the segregation of public transport from general traffic, and the provision of busways is one promising option.

The objective of a public-transport development strategy is to optimize the effectiveness and efficiency of a multimodal public-transport network. This can be achieved by enhancing modal integration and by ensuring the co-operation of all transport operators. However, this should be done without introducing transport operators. However, this should be done without introducing impediments to competitiveness and the initiative of operators.

F. Urban Transport-Related Human Settlements Policy Recommendations

Policies aimed at bringing transport in human settlements into harmony with principles of sustainable development should respond to national local development objectives and reflect specific local conditions. At the same time, they should contribute to sustainability of development in global dimensions. The following set of recommendations may be of help in devising such policies in both developed and developing countries:

- (a) Subnational development planning and local land-use planning should be deeply concerned with the implications of transport and of transport-related environmental effects; they should be effectively used for decreasing the demand for transport,

preventing its excessive concentration and mitigating its ecological impacts, e.g. by encouraging compact rather than dispersed development patterns.

- (b) Fiscal policies and other economic instruments should increase the share within the transport modes with high energy-efficiency and low emissions.
- (c) The role of public transport in making urban transport compatible with the requirements of sustainable development should be fully recognized and be adequately reflected in urban transport plans and development programs. High-occupancy public-transport vehicles should be given preferential treatment in traffic-management policies.
- (d) Cycling and walking should be recognized as important components of urban traffic: safe cycleways and footways should be provided, while the attractiveness of these modes of travel should be enhanced by ensuring proximity of work-places and services to residential quarters.
- (e) Appropriate national emission standards of new vehicles and ceilings for emissions from vehicles in use should be established, and systematic control of emission levels by vehicles in use should be introduced.
- (f) Monitoring of the environmental impact of transport should be improved, and studies on the quantitative evaluation of this impact, with regard to various transport modes, should be promoted.
- (g) Research and development on new vehicles and new energy sources, able to replace petroleum fuels, reduce the level of pollutant emissions and increase energy efficiency in transport, should be expended.
- (h) Measures to promote public awareness of the transport-related environmental impact should be undertaken, so as to enhance the development of environment-friendly travel behaviour: education of drivers in vehicle maintenance and operation should be given attention, since it has proved to result insignificant energy savings and lessened pollution.

The transport sector in developed countries bears particular responsibility for the depletion of non-renewable energy resources and damage to the biosphere. Travel behavior and urban development patterns prevailing in these countries are evidently incompatible with the objectives of sustainable development. However, it would be unrealistic to aim at their radical change. To reconcile urban transport with objectives of sustainability, it is recommended that:

- (a) The efficiency of public transport should be increased, and new public-transport systems, able to attract car users, should be developed.
- (b) Users of motorized individual transport modes should pay the full economic and environmental costs of their travel, and appropriate pollution and congestion pricing should be developed for this purpose.
- (c) The use of energy-efficient and low-polluting vehicles and fuels should be encouraged by taxation policies, regulatory and other economic incentive instruments.

- (d) Introduction of emission standards for carbon dioxide and for other not-yet-controlled toxic emissions should be considered. Transport-related noise should be reduced and appropriate noise-reduction standards for the construction of vehicles and infrastructure should be introduced.
- (e) In line with the improvement in public transport, restrictions on car traffic should be imposed in congested and environmentally-sensitive areas.
- (f) Research should be carried out on environmentally sensitive cost/benefit analysis techniques for transport infrastructure investments.

In developing countries, policies on urban transport should respond to the basic needs of the present generation while preserving sustainable options for the future. Recommendations addressed to developing countries are:

- (a) Human settlements management should be strengthened, so as to be able to steer physical development in a way which reduces the demand for transport and prevents damage to the environment. Properly located and well-timed investment in transport infrastructure might be a guiding force to induce development in defined directions.
- (b) Transport modes based on animated energy should be gradually replaced by public-transport modes for long-distance travel.
- (c) Development of affordable, reliable and efficient public transport should be given top priority in urban transport plans and development programs. Coordinated transport and land-use planning should make provision for gradual improvements to public-transport systems, so as to enable them to respond to a fast-growing demand for transport.
- (d) Travelway space should be allocated to public transport and segregation of public transport from general traffic should be promoted in heavily loaded traffic corridors.
- (e) The development of efficient, environment-compatible, high-capacity public-transport modes deserves governmental support which should be granted if it does not undermine the achievement of other important social and economic objectives.
- (f) Wide public/private partnership in the provision of public-transport services should be encouraged.
- (g) Particular attention should be attached to effective traffic management, to efficient operation of public transport and to proper maintenance of the transport infrastructure.
- (h) The growth of car and motorcycle ownership should not be directly or indirectly subsidized. Import tariffs, taxation policies and fuel-pricing policies should be used to prevent, in particular, growth in the number of energy-inefficient, highly polluting types of vehicles.
- (i) Emphasis should be given to training in transport-management skills, so as to build up planning and operating capacities.

International co-operation can be influential in making transport in human settlements compatible with the sustainability goal. It should encompass the following:

- (a) Control of transboundary air pollution resulting from transport.
- (b) Consolidation of environment-protecting standards for production of transport
- (c) Facilitation of environment-friendly transport technologies.
- (d) Establishment of financial mechanisms enabling developing countries to build environmentally friendly public-transport systems on fair financial terms



Department of Economic and Social Affairs

Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York

**TRANSPORT AND SUSTAINABLE DEVELOPMENT
IN THE ESCWA REGION**

BACKGROUND PAPER NO. 8

Prepared by the
Economic and Social Commission for Western Asia (ESCWA)

TRANSPORT AND SUSTAINABLE DEVELOPMENT

**Contribution of ESCWA Secretariat
to The EGM organized by DESA**

**in preparation for
Secretary-General's Report
CSD9-April 2001
16-17 October 2000**



New York

CONTENTS

Page

INTRODUCTION

I. TRANSPORT AND SUSTAINABLE DEVELOPMENT: AN ESCWA REGION PROFILE

1. VEHICLE OWNERSHIP
2. RESOURCES CONSUMPTION
3. EMISSION OF TRAFFIC GASES
4. NOISE POLLUTION
5. ACCIDENTS
6. AUTOMOTIVE INDUSTRY

II. TRANSPORT TECHNOLOGIES

1. CLEANER FUEL TECHNOLOGIES
2. TECHNOLOGY TRANSFER AND DEVELOPMENT

III. TRANSPORT SYSTEMS AND NETWORK

1. INTEGRATED TRANSPORT SYSTEM IN ARAB MASHREQ:
ITSAM-NETWORK
2. TRANSPORT FACILITATION

IV. POLICY OPTIONS

1. USE OF VEHICLES WITH IMPROVED TECHNOLOGY
2. USE OF ALTERNATE FUELS
3. CLEAN FUEL TECHNOLOGY
4. PROMOTING PUBLIC TRANSPORT
5. MANAGEMENT OF VEHICLE OWNERSHIP
6. IMPROVING TRAFFIC CONDITIONS
7. INTEGRATING LAND USE PLANNING
8. USE OF INFORMATION TECHNOLOGY
9. SAFE MOBILITY

V. REGIONAL, INTERREGIONAL AND INTERNATIONAL COOPERATION

COOPERATION AMONG UN-REGIONAL COMMISSIONS IN THE FIELD OF TRANSPORT

REFERENCES

ANNEXES

- A. STATISTICAL TABLES
- B. ITSAM-NETWORK

INTRODUCTION

Transport plays a major role in the development of the ESCWA region. It was observed that most of the countries in the region witnessed a greater increase in transport demand than their respective GDP. The main reason for this is the continuing movements of people from rural areas to the newly developing urban areas. It is well established that economic activities rely on transportation. The socioeconomic benefits extended by the various transport projects include such elements as increased access to markets for local products, access to new employment centers, passage to health and recreation centers, etc. In general transport is considered as a means for strengthening local economies.

Roads are considered the prevailing mode of transport. Motor vehicles will continue to be the most convenient form of door-to-door, fast, and private transport since its evolution. It has been the main criterion on which modern land use and transport planning was based. But, by virtue of the principles of Rio Declaration, the automobile, as it is now, is not a sustainable form of transport for a number of reasons, including its direct contribution to: a) death and injury, deterioration of public health, b) millions of people who die or become chronically ill as a result of air and noise pollution, c) the social disintegration of millions of families throughout the world, d) the disruption of the ecosystems and city environment - pressure on land, e) the climate change, f) extravagant consumption and depletion of non-renewable natural resources, and g) the huge economic and social losses as a result of the aforementioned impacts. In the case of OECD countries the cost of transport externalities ranges between 4-8 per cent of the GDP. Such losses are certainly damaging the economic, social, and environmental fabrics of all countries, particularly developing ones. Experiments to ban the use of private cars implemented in Rome, Italy, and Bogota, Columbia, are examples of the beginning of the change taking place in the field of human behaviour and transport governance .

Growth in transport demand poses several implications on sustainable development. For instance, alternative fuels to the traditional sources of energy have to be sought. Public transport should be the key point within a well planned system adopted to local sustainability needs. Rational policies for vehicle ownership have to be in place. Improving traffic flows together with an integrated land-use urban planning is imperative for a successful sustainable development and mitigation of air pollution. Marketing efforts by vehicle manufacturers should emphasize improved technology of vehicles through improved performance, speed, and safety in addition to fuel economy.

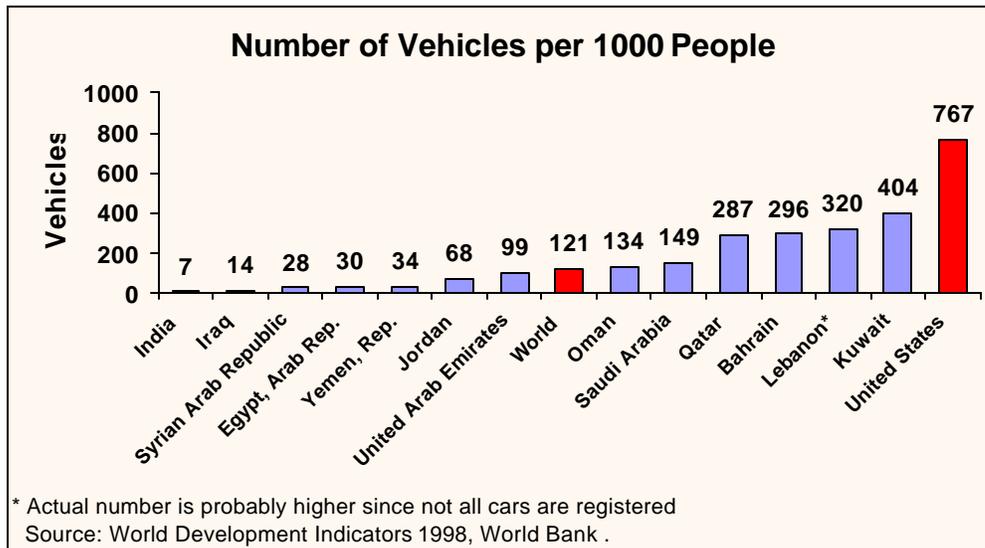
I. TRANSPORT AND SUSTAINABLE DEVELOPMENT: AN ESCWA REGION PROFILE

1. VEHICLE OWNERSHIP

It has been estimated that the number of cars (commercial and passenger) in the world will reach a staggering 1 billion in the year 2015, compared with only 550 million cars in the year 1990. ESCWA member countries have experienced similar trends. There was a sizable increase in the number of registered vehicles in ESCWA region. For instance, in the period between 1985 and 1997 the number of vehicles in Egypt and Jordan has almost doubled. On the other hand, and in a shorter period from 1989 to 1997, the number of vehicles in the Yemen Republic has approximately increased by a factor of 2.7.⁷

Figure 1 shows the number of vehicles per 1000 capita in the ESCWA member states. The figure clearly indicates a large variation in the ownership of vehicles. The world's average for the year 1998 was 121 vehicles per 1000 capita. Definitely a major factor that affects this ratio is the average income per capita. However other factors contribute also such as the tax laws and the limitation on the number of vehicles that one person can own. It is to be noted here, however, that the environmental impacts that are experienced in one country can hardly be based on this indicator alone. For instance it is well recognized that air pollution in Egypt, where the average number of vehicles per 1000 capita is 30, is much more than that of Bahrain where the corresponding number is 296⁷. It is more appropriate to measure the traffic volumes at a certain location and other related factors such as the volume to capacity ratio, the operating speeds, and the average distance of a trip.

Fig. 1. Number of vehicles per 1000 capita in the ESCWA region



In ESCWA region, as shown in Table 1 the rate of growth of the number of vehicles indicates clearly that there is a continuous rise with various rates. Some countries like Yemen are still witnessing very high increasing rates. On the average the rate of increase is high indicating that more impacts will be encountered over time which calls for appropriate strategies to be formulated.

2. RESOURCES CONSUMPTION

It is well known that the consumption of energy, raw materials, and labor resources by the transportation sector in both construction and operation results in economic impacts. The most important issue is energy consumption. It has impacts on national economy as well as individuals' expenditure. Moreover, it is well known that burning fossil fuels will result in producing pollutants that are harmful to human beings, plants, and infrastructures.

Transport sector in the ESCWA region, similar to all other regions in the world, continues to be almost 100 percent oil dependent. The only exception in the region relates to the very limited use of natural gas in Egypt and to a lesser extent in Syria.

The consumption of gasoline in the ESCWA region, which is the main fuel for vehicles, witnessed a large increase in the last years. This is mainly attributed to the sharp increase in the

number of vehicles. Table 2 indicates the total gasoline consumption (estimated in barrels/day) for the countries in the ESCWA region.

The transport sector is a major consumer of energy in the ESCWA region. This is also a phenomenon that is prevailing worldwide. However the amount of energy consumption in the transport sector as a ratio of the total energy consumption varies and ranges from as low as 29 percent in Egypt to remarkably high 74.3 percent in Qatar, as shown in Table 3.

3. EMISSION OF TRAFFIC GASES

There is a rising concern in the major cities, like Cairo and Damascus, that pollution levels from traffic operations are reaching unacceptable limits. However, in ESCWA region the issue of land transport pollution has not yet received sufficient attention. Findings of studies funded by the World Bank indicate that there is a potential for significant health problems to be associated with poor air quality and that most of the emissions are attributed to mobile sources.⁷

The yearly NO₂ emissions from the transport sector in selected countries in the ESCWA region are presented in Table 4.

The above table indicates that nearly NO₂ emissions from the transport sector in Egypt is about one third of the total NO₂ emissions while this ratio is much lower for both Jordan and Syria. Compared with the USA where the transport sector accounts for more than 70 percent of the total NO₂ emissions, it is concluded that the transport sector is not a major contributor for this emission in the region. However, it is of prime importance to avoid such occurrences.⁷

The CO₂ emissions from transport sector in selected countries in the ESCWA region are presented in Table 5. In 1980 Jordan 's transport sector accounted for about half of the CO₂ emitted but since then there has been a gradual decrease until it reached only 20 percent in 1996. Similar trends are indicated for Syria (approximately 10 percent in 1996 compared to 38 percent in 1980). Overall it is clearly indicated that the emissions of the CO₂ in the ESCWA region by the transport sector is being controlled and reduced gradually.

The emissions of other gas pollutants were also established for some ESCWA countries. For instance, the emission of SO₂ in Jordan and Syria from transport sources as indicated in Table 6 is minimal compared to USA. In fact the percentage for Jordan was even reduced from 2% in 1992 to 1% in 1996.

4. NOISE POLLUTION

In ESCWA region, noise from traffic has not yet been considered as a major environmental problem that warrants strict measures. However, with the increasing reliance on road transportation over the years and the subsequent rise in the number of operating vehicles, noise pollution will definitely require more attention and regulatory steps.

The effects of transport noise are not well understood yet. Also there are no fully satisfactory measurements of noise and nuisance it causes. Several regulations and standards were set. However, in ESCWA member states Lebanon and Egypt have limited noise intensity in different Zones⁷, as indicated in Tables 7 and 8.

5. ACCIDENTS

There is a growing concern in the ESCWA region about the socio-economic, environmental, and health impacts of road crashes on sustainable development, and the need to address this potential problem in its totality in order to reduce the human suffering and the drastic economic losses to the national economies. Total external costs of road crashes are not considered in the traditional transportation planning methodologies and evaluation. For example the loss of working power and salient costs related to human suffering, the related effects on poor communities, particularly women, are not included. The externalities of road crashes are directly related to the Agenda 21's polluters' pay principle. The European Union has taken a number of actions in the previous years. Some of the findings show that road crashes represented the larger share of the transportation externalities (4.6 percent of the GDP of 17 European countries).

The number of accidents that occurred in the ESCWA countries, depicted in Table 9 indicates that there is a varying trend in the rate of increase in the number of fatalities and injuries. Some countries like Bahrain are showing positive trends. The number of both fatalities and injuries is decreasing with time indicating that the proposed safety schemes are satisfactory. On the other hand, Jordan is witnessing a dismal situation with respect to accidents. From 1994 until 1997 (about four years) there was an increase of about 40 percent in the number of fatalities.

6. AUTOMOTIVE INDUSTRY

Only a few countries in the ESCWA member countries are in possession of automotive assembly plants. The most remarkable are those set up in Egypt during the past decade. Thus, the number of local vehicle assembly facilities in Egypt now stands at eleven plants, only one of which is in the public sector. In 1997, these companies produced 14,500 passenger cars, 13,100 trucks, 2,350 heavy-duty cars, 1,000 mini and minibuses, 450 standard buses and 320 tourist buses¹. This industry is estimated to employ 20,000 workers.

The benefits of establishing assembly plants in the ESCWA member countries are multifaceted but conditional for the most part upon contractual terms and the availability of supportive policy regimes. Thus, the erection of assembly facilities may lead to effective renovation of automotive fleets with consequent technology dissemination and commensurate positive results throughout the economy. Naturally, a good deal of these benefits will depend upon the terms adopted in the agreements underlying the establishment of the assembly facilities. Furthermore, by virtue of their presence in the region, such facilities may significantly contribute to considerable environmental consequences. However, this too will be contingent upon the level of innovation and sensitivity to environmental factors allowed by technology transfer clauses in the above-mentioned contracts.

II. TRANSPORT TECHNOLOGIES

1. CLEANER FUEL TECHNOLOGIES

Fossil fuel operated internal combustion engines are the predominant, indeed the sole, source of automotive power in the ESCWA member countries. Vehicles in use, mostly passenger cars, busses and trucks, rely on two principal oil derivatives, gasoline and fuel oil.

Natural gas is increasingly being used in the transport sector throughout the world. The fact that it constitutes a cleaner fuel source is at least partly responsible for its preferability. On the other

hand the need to introduce considerable engine design changes and modify fuel distribution facilities are believed to have encumbered its proliferation. Thus, the transport share of worldwide gas consumption stood at a mere 3.9% in 1997². Additionally, natural gas constituted only 2.5% of total fuel consumption by the transport sector in the same year.

Available reports indicate that natural gas was introduced as an automotive fuel in only one ESCWA member country, namely Egypt. Thus, in 1992, the Egyptian Ministry of Petroleum launched a programme aimed at replacing gasoline in the transport sector with natural gas. However, only around 19,000 vehicles, including passenger cars, and public transport vehicles, were in fact converted to natural gas³.

The fact that the use of this alternative fuel has so far been the subject of positive feedback, in terms of its economic and environmental impact, is likely to contribute to its expanded utilization with time. It may also be assumed that the programme launched by Egypt has contributed to the accumulation of local technological expertise, regarding engine design modification and maintenance procedures as well as improved knowledge in the organization of supply and distribution networks allowing further expansion in the dissemination of natural gas as an automotive fuel in Egypt as well as the region. The fact that the countries of the Middle East account for a significant proportion, 7.6%, of the world's natural gas output, should provide further impetus for such expansion.

With respect to the use of unleaded fuel, the ESCWA member countries have only recently joined global efforts aimed at phasing out lead additives in gasoline with a view to reducing human exposure to lead poisoning. Thus, Egypt, the most populous among the ESCWA member countries, introduced unleaded gasoline as recently as in 1996. Nevertheless, a plan being implemented with assistance from the US Agency for International Development (USAID) assisted Egypt in its plan to phase out lead by 1999⁴.

In Kuwait, unleaded gasoline was introduced as late as October 1998. The Kuwaiti government has been reported as planning to phase out leaded gasoline by October 1999. In order to facilitate its replacement by unleaded gasoline, plans have been made to double its cost to the consumer.⁴ Saudi Arabia is also reported as planning to convert to unleaded gasoline by 2002-2003⁵.

2. TECHNOLOGY TRANSFER AND DEVELOPMENT

Several countries in the region, including principally Saudi Arabia and Egypt have active research programmes aimed at the development of alternative energy sources. Very few of such programmes appear to target the transport sector, however.

In essence, there is an urgent need to acquire a much higher rate of technology transfer and local technology development of a variety of areas with impact upon the transport sector's economic and environmental performance. In particular technologies essential for enforcing improved safety, fuel consumption and emission standards are urgently needed. Furthermore, there is a need to acquire modern means that facilitate the use of common transport systems, including subway systems in urban centres. The onus for initiating action along these lines will naturally have to fall on the shoulders of governmental and public sector institutions. There is also a need to acquire technological capabilities for modern maintenance and continuous improvement of current vehicle fleets.

In general, the trend towards liberalization of ESCWA economies highlights the role of the private sector in such endeavours. Moves in the ESCWA member countries towards privatization auger well for an enhanced role by the private sector in solving the sector's problems. On the other hand, it is not expected that this role will develop much further in the absence of relevant environmental regulations and enforcement measures.

Many developments in the transportation sector in the developed countries have come as a result of incorporating a variety of inputs from fields of technologies that are extraneous though supportive to the sector. Some of the more prominent developments in transport infrastructures as well as actual improvements in transport equipment are indebted to the application of advanced information and communications technologies (ICTs) in the field of transport, for example.

The ESCWA member countries will need to enhance the influx of similar developments if their transport systems are to achieve the standards required by the trend towards globalization. Some of these developments will necessarily need to be closely related to manufacturing and maintenance technologies as applied to automotive vehicles and to systems dedicated to measuring their environmental impact and fuel economies. Inputs provided by new materials technologies possess a prominent position in this arena. Other equally, if not more important, developments, however, will need to target transport infrastructures and operations, in general. It is the latter set of developments that are expected to benefit greatly in the following few years from greater emphasis on the acquisition of modern ICTs including geographic information systems (GIS) and remote sensing. Mastery of a variety of electronic data transmission and analysis systems including Internet related modes of information networking, will also need to receive much greater attention.

III. TRANSPORT SYSTEMS AND NETWORK

1. INTEGRATED TRANSPORT SYSTEM FOR ARAB MASHREQ : ITSAM-NETWORK

ESCWA is currently undertaking a long-term plan to develop an integrated transport system in the region, known as the Integrated Transport System in the Arab Mashreq (ITSAM), which was endorsed upon the recommendation of the Committee on Transport, in a statement issued at the twentieth session of ESCWA in May 1999.

The Committee on Transport was formed pursuant to a resolution adopted at the nineteenth session of ESCWA in 1997. It serves as a regional institution enjoying legislative competency and its secretariat is represented by the Transport Section of the Sectoral Issues and Policies Division of ESCWA, which is responsible for the execution of the programmes of action recommended by the Committee.

The concept of ITSAM is based on the recognition of the strategic importance of the transport sector – including land, sea and air transport networks – in promoting and supporting sustainable development activities in the ESCWA region. The working framework of the System consists of three principal components, namely:

- (i) An integrated transport network (ITSAM-NETWORK) comprising the principal modes of transport in the ESCWA region;
- (ii) An associated information system (ITSAM-INFOSYS) to serve as a regional database facility for use by ESCWA member countries;

- (iii) An analytical framework (ITSAM-FRAMEWORK) for issue analysis and policy formation.

The development of ITSAM will require sustained and deliberate efforts in order to make the system viable. Defining the issues pertinent to transport integration and sustainability arriving at policy recommendations at the regional level will require addressing the many concerns related to infrastructure, traffic flows, harmonization of regulations, the impact of regional and international agreements and operational efficiency, among others.

It was in its preliminary endeavours to initiate work on ITSAM that ESCWA in its 1998/1999 biennium work programme, convened three expert group meetings on the subject.

Published reports on those meetings, as well as the “Report on the first session of the Committee on Transport” (E/ESCWA/C.1/20/7/Add.6) and the regional transport network map produced by ESCWA in June 1999, are available from ESCWA upon request. The ITSAM regional transport network comprises the major international road and railway (north-south and east-west oriented) routes, seaports and airports in the region. ESCWA is presently proposing a multilateral regional agreement on the international road network of ITSAM to be adopted by its member countries. The proposed agreement specifies the adopted road network and its unified technical specifications, signs and signals.

As recommended by the Committee on Transport, an action plan is to be prepared that will include defining priorities and the distribution of roles among the regional organizations concerned, such as the League of Arab States, the Gulf Cooperation Council (GCC) and those regional organizations and associations involved with the transport sector. The plan is expected to provide a framework for the mobilization of coordinated efforts and the formulation of strategies and mechanisms geared to the development of an integrated transport system that will facilitate the flow of intra-regional and international transport of freight and passengers throughout the ESCWA region and at its land, sea and air border crossing points.

2. TRANSPORT FACILITATION

Trade facilitation and liberalization as a result of the globalization trends have imposed special requirements on transport. Transport facilitation is the physical expression of trade.

In this respect ESCWA has already completed in 1999 a study on the applications of Electronic Data Interchange (EDI) and the United Nations EDI standards for the facilitation of administration, commerce and transport (UNEDIFACT) in the ESCWA region. The study reviewed existing applications within and outside the region and made recommendations for the enhancement of such applications. ESCWA is currently undertaking a more comprehensive study on transport facilitation in the region. The study involves a detailed review and comparative analysis of existing practices and procedures for imports, exports, transit and re-export processes of international freight movements within and between selected countries in the region. The study would recommend a more simplified and harmonized international trade transaction model for future practice in countries of the region. 

IV. POLICY OPTIONS

1. USE OF VEHICLES WITH IMPROVED TECHNOLOGY

Replacement of old vehicles with fleet that uses improved technologies is a matter of controlling sustainability at the source. Some experts noted that marketing efforts by many manufacturers now emphasize power, speed, acceleration, and accessories (such as air-conditioning and radios) in contrast to the emphasis on fuel economy in the 1970s. This situation undermines improved levels of fuel economy and emissions, and efforts are required from national and international authorities to counter this trend.

Different options are available to increase engine efficiency and flexibility of use and to decrease fuel consumption, weight and maximum power, while maintaining sufficient performance, in accordance with limits prevalent in the industrialized countries. For example, combining the use of high-power density engines, turbo and supercharging, electronic control of fuel injection and engine regulation, and electronically controlled continuously variable transmissions, can maximize engine power where needed, while retaining the fuel economy characteristics of a lighter and less powerful engine. Other interesting engine developments include manufacturing compact and efficient two-stroke engines with electronic fuel injection, efficient and clean "lean burn" engines, for which problems of catalyst durability under poor maintenance conditions could be overcome. Beyond the year 2000, the experts consider that the implementation of the best available technologies, together with increased consumer demand for highly efficient and clean automobiles, could lead to further improvement in the fuel efficiency of cars on the order of 50-60% above today's levels.⁷

Since ESCWA member countries import most of their vehicles, it will be necessary to modify their specifications in order to introduce vehicles of better quality and with cleaner engine to replace older ones with inferior technology. However, this would have a major economic cost for developing countries, which would find this very difficult to implement. Table 10 gives an example of the problem associated with the age of the operating vehicle fleet in Syria. The number of passenger cars that are operating in the streets are 24 years old and more. In Egypt about 65 percent of the vehicles are 10 years old or more and about 25 percent of these vehicles are more than 20 years old. Jordan has taken a positive step to replace the old fleet of taxis operating in its major cities. The Government has granted taxi owners an exclusive exemption from taxes if they opt to replace their old vehicles with new ones.

2. USE OF ALTERNATE FUELS

The use of alternative fuels including natural gas, methanol, ethanol, electricity, and differing qualities of petroleum-based fuels should be considered. Natural gas (whether compressed natural gas CNG or liquefied natural gas LNG) beside its free pollution advantage it has proven to be economically feasible. So, it has witnessed a very large use recently and it is estimated that the total number of vehicles using this fuel exceeds one million⁷. In Egypt the use of natural gas has witnessed a big stride. Currently there are more than 19,000 vehicles that have been converted to use natural gas and the existing number of fueling stations have exceeded 20. Besides, Egypt and USA are jointly implementing the Cairo Air Improvement Project (CAIP). One of the aims of this project is to employ CNG engines in public transportation busses. Rolling chassis are being imported and a local manufacturer is building and integrating the bodies⁶. In Syria serious considerations are being directed towards the use of natural gas fuel.

3. CLEAN FUEL TECHNOLOGIES

Although, developed countries have phased out lead from gasoline pioneered by Japan (1975), and the US (1986), the majority of the developing countries, including those of the ESCWA region, are still using leaded gasoline. Education and policy formulation are the essential elements in the phasing out of lead from gasoline. The overwhelming health gains and maintenance savings associated with the phasing out of lead from gasoline should encourage all the ESCWA government to take a firm action in this respect.

4. PROMOTING PUBLIC TRANSPORT

Public transport should be the key point within a well-planned and integrated transportation system adapted to local needs for sustainable development. Major steps have been taking place or under serious considerations in some major cities in the ESCWA region to promote public transport facilities. For instance, the construction of the underground (metro) system in the city of Cairo has eased traffic congestion considerably. In addition, the city of Alexandria is considering constructing underground (metro). Other examples in the region are the cities of Damascus and Amman which are considering constructing light rail systems. Studies undertaken as early as 1985 and in 1997 call for the construction of a 45-km line (three diagonal routes and one circumferential) with a total of 36 stations in Damascus.⁷

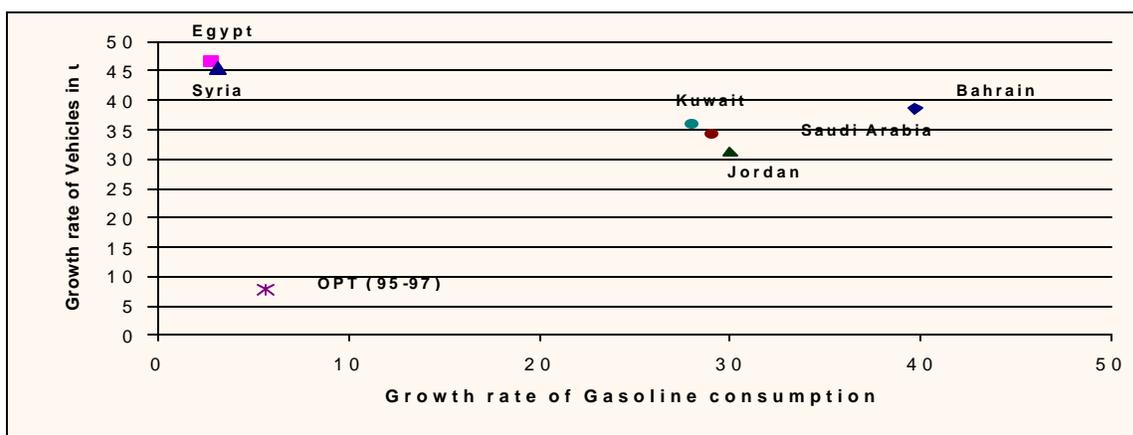
5. MANAGEMENT OF VEHICLE OWNERSHIP

No sustainable transport plan will be successful unless it tackles the problem of controlling the number of registered vehicles. The increase in fuel consumption is mainly attributed to sharp increase in the number of vehicles. Figure 2 shows the relationship between the growth rate of vehicles in use and the growth rate of Gasoline consumption in selected ESCWA member states in the period ranging from 1985 to 1996. It indicates that for these countries, except for Syria and Egypt, the growth rate of vehicles in use increases proportionally with the growth rate of Gasoline consumption as expected. However for Egypt and Syria, the figure indicates that the rate of growth in gasoline consumption was not influenced by the increasing rate of vehicle ownership. This could be explained by the fact that other fuels such as Diesel are being more used as a source of energy for vehicles. In Addition these two countries have witnessed a dependency on public transport more than others. In fact, the average km per passenger car in these two countries has decreased over time and therefore neutralizing the effect of the increase in the vehicle fleet.⁷

6. IMPROVING TRAFFIC CONDITIONS

For ESCWA developing countries in specific, and for others in general, it must be recognized that, for a sustainable transport policy to be successful, it is imperative that it would not be based on technological improvements alone as they cannot compensate for growing demand. Improving traffic flow operations and circulation and providing facilities and transport infrastructures can result in smooth traffic flows. Improving access to, and mobility within, a central area, but at the same time relieving the adverse impacts of heavy automobile use and enhancing the pedestrian environment are only a few examples of improved traffic conditions.

Figure 2. Growth rate of vehicles in use versus growth rate of Gasoline consumption in selected ESCWA member states



Source: Economic and Social Commission for Western Asia, *Harmonization of Environmental Standards in the Transport Sector in ESCWA Member Countries*, E/ESCWA/TRANS/1999/5, 25 October 1999.

It is to be stressed here that improved traffic management in urban areas will provide the most cost-effective technique for reducing transport-related pollution. It has been observed in many large cities of ESCWA countries that simple changes, such as changing two-way streets into one-way streets, and changing direction of traffic of certain major roads during peak hours to provide more lanes in the direction of heavy traffic, has resulted in substantially smoother traffic flows. In some extreme cases where the urban traffic becomes extremely heavy, such as Beirut or Cairo, use of stricter measures might be called for.

7. INTEGRATING LAND USE PLANNING

Urban planning can best be utilized to aid in abating the detrimental effects of transportation on environmental quality. Land-use and transport are closely related parts of the human activity system. Bringing schools, factories, offices, shops, recreational and other facilities into or near activity centers will minimize the need to travel far or frequently for work and other activities. Developing countries have an advantage over developed countries in the sense that they are in the process of building or completing their infrastructures. They therefore have the unique advantage of their urban expansion with appropriate incentives for more efficient and environmentally sound patterns.

8. USE OF INFORMATION TECHNOLOGY

Recent information technology (IT) advances offer a range of modern user services for increasing the efficiency of travel and transportation of freight. Information technology help in many uses as follows:

- Systems giving buses and trams priority at traffic signals, helping to speed up public transport.
- Systems to monitor bus, tram, and train movements, allowing control of services and the provision of real time information.

- Systems to provide up-to-the minute information on routes, timetable, station facilities whether via call centers or direct through the Internet.
- Convenient system-wide ticketing suited to today's electronic cash society.
- Systems for port and customs management, operation, and administration.

Use of IT in most ESCWA countries is still limited. One of the reasons is the inappropriate communication infrastructure. However, Dubai has achieved a great progress in this field. The port of Dubai has used the state-of the-art IT with EDI for container terminal management, port operation, ships' movement control, and customs processes. Moreover, Dubai Transport Corporation (DTC) provides taxi services using an automatic vehicle location (AVL) and tracking system based on Trimble's advanced GPS (Global Positioning System) board technology. Some ESCWA member countries, such as Jordan, Lebanon, Saudi Arabia and Egypt, have also taken steps towards using IT in port and custom operation and management.

9. SAFE MOBILITY

The negative transportation impacts includes, inter alia, road crashes, social disintegration, pain, suffering, and chronicle illnesses. Globally, 1.25 million persons are killed annually in road crashes, and 50 million get seriously injured resulting in millions of disable persons, and several millions of victim(s) families living in misery. It appears that social costs have received less attention. The governments of the region to combat road crashes effective results have to exert continuous efforts. Sustainable Safe Mobility initiatives using the principles of Agenda 21 would have to be formulated in order to ease the collective transportation social impacts facing the ESCWA member countries and their societies.

V. REGIONAL, INTERREGIONAL AND INTERNATIONAL COOPERATION

COOPERATION AMONG UN-REGIONAL COMMISSIONS IN THE FIELD OF TRANSPORT

The first meeting of the Heads of Divisions Responsible for Transport of the United Nations Regional Economic Commissions was held from 7 to 9 December 1999, in Cairo, Egypt, hosted by the Egyptian Ministry of Transport. The purpose of the meeting was to initiate a dialogue among the five secretariats of regional commissions of the United Nations on possible land and land-cum-sea transport linkages and to draw up an action plan in order to assist their member countries to fully participate in the rapidly globalizing economy.

There was general convergence of views and agreement that a coherent, complementary and monitorable action plan was also needed to guide these efforts. This action plan should be regarded as tentative and indicative that needs to be progressively refined, as more information is gathered, studies carried out and consultations made with member States. To implement this action plan, corresponding activities should be reflected in the work programme of each regional economic commission.

It was agreed that the elements of the action plan, based on the various proposals, should respond to the needs of member States for sustainable development. It should provide a rational framework for a consistent and practical programme. The elements of the programme should therefore be conceived as adding value to the projects and policies to be undertaken by these States.

On the other hand, the ongoing processes of globalization, and liberalization of national economies have greatly enhanced the scope for intra-regional and interregional trade and tourism. The developing countries are affected to a varying degree by both these processes, and many of them could not fully participate in it to share the benefits due to inadequate transport infrastructure and services. This has created a great demand for efficient and well integrated transport infrastructure and services to enable those countries to take part in the development processes effectively.

In light of the above background, and in pursuance of a decision taken at the Meeting of the Executive Secretaries of Regional Commissions in September 1999, the meeting of Directors responsible for Transport in the Regional Commissions strongly recommended that a "**programme proposal**" be prepared for mobilizing the funding support, to assist the countries concerned in their capacity building.

The implementation of the programme which is already submitted for funding from the UN Development Account will enable the countries to identify potential interregional transport linkages and their expected impacts on regional and economic development, by undertaking a series of technical studies under a common methodological framework. That would definitely contribute positively to the sustainable development of the respective countries.

REFERENCES

1. US & Foreign Commercial Service and US Department of State, *"Egypt Automotive Feeder Industries"*, Industry sector analysis series, 1998.
2. International Energy Agency, *"Key World Energy Statistics"*, 1999 edition.
3. www.e-petroleum.com, *E-Ptroleum online magazine*, October 1999 issue.
4. World Bank, *"World Bank Support for the Global Phaseout of Lead from Gasoline; Issues, Progress and Challenges"*, 1999.
5. US & Foreign Commercial Service and US Department of State, *"Saudi Arabia Unleaded Gas Trends"*, Industry Sector Analysis Series, 1999.
6. Samir Mouafy, *"Egypt's Strategies to Reduce Emissions from Motor Vehicles"*, International Roundtable on Transportation Energy Efficiency and Sustainable Development, Cairo, Egypt, 5-7 December 1999.
7. Economic and Social Commission for Western Asia, *Harmonization of Environmental Standards in the Transport Sector in ESCWA Member Countries*, E/ESCWA/TRANS/1999/5, 25 October 1999.

ANNEX (A)
STATISTICAL TABLES

ANNEX (A)
STATISTICAL TABLES

Table 1. Rate of annual growth in vehicles in the ESCWA region

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Bahrain	9	7	4	2	4	5	4	3	7	7	6	4	3	...
Egypt	...	...	6	4	2	3	5	3	4	16	7	8	4	5
Iraq	...	9	7	9	9	6	8	-7	2	1	5	...	...	...
Jordan	...	4	4	4	2	0	1	1	6	1	1	6	9	2
Kuwait	...	7	-2	4	4	5	9	4	3	2	4	5	5	
Lebanon	...	...	...	...	...	...	...	...	...	9	9	4	4	4
Oman	...	...	...	...	4	7	9	11	7	7	5	3	5	11
Qatar	...	...	...	6	6	3	4	11	3	6	2	4	6	9
Saudi Arabia	9	5	3	3	3	8	3	4	3	2	5	4	3	...
Syria	1	-4	5	1	3	-3	1	1	6	16	9	11	8	...
U.A.E	5	6	-3	3	6	13	-3	2	11	14	...	...	...	...
Yemen Republic	...	...	...	...	...	...	3	13	11	15	7	12	13	18

Source: Based on data compiled by the Statistics Division of ESCWA.

Table 2. Total gasoline consumption (1000 Barrels/day)

Country Name	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
Bahrain	1.2	2.6	4.1	5.2	5.4	5.8	6.2	6.4	6.5	6.8	10.3
Egypt, Arab Rep.	15.3	27	45.6	50.6	48.5	45.8	43.7	43.7	45.4	46.9	48.5
Iraq	14.6	33	51	74	55	70	68	66	68	71	74.1
Jordan	3.6	6.3	8.4	8.4	8.9	9.8	10.1	10.6	11.4	12	12.6
Kuwait	10.9	20.9	26.2	18.4	14	26.9	29.9	31.8	34.3	36.4	38.4
Lebanon	11.2	13.9	17.2	14	17.5	24.2	28.1	29	30.9	32.6	34.3
Oman	2	4.8	9.2	11.2	12.2	13.1	13.8	13.9	14.4	14.9	15.7
OPT	...	...	...	...	...	...	...	...	5.49	5.82	6.2
Qatar	1.6	3.9	5.4	6.7	6.9	7.3	7.6	7.7	10.5	8.4	9.2
Saudi Arabia	26.6	87.3	142.1	157.5	150.7	169.4	183.1	197.9	178.6	200.5	210.5
Syrian Arab Republic	9.3	12.3	18.4	16.3	16	16.8	17.3	18.4	18.7	19	19.6
United Arab Emirates	5.1	13.6	18	24	26	28	29	31	33	36.6	40.6
Yemen, Rep.	3.2	5.2	5.2	15.3	19.4	21.2	22.2	22.2	24.4	23.2	24

Source: Annual Statistics Report 1998, OAPEC.

Table 3. Percentage of Oil Consumption in the Transport Sector in Selected ESCWA Countries in 1995

Country	Million bl.o.e	Transport % of total energy consumption
Bahrain	5654	30.7
Egypt, Arab Rep.	49456	29
Iraq	45023	32
Jordan	9192	41
Kuwait	14282	39.8
Lebanon	18478	50.6
Oman	8284	64.1
Qatar	4637	74.3
Saudi Arabia	122570	46.9
Syrian Arab Republic	19725	29.3
United Arab Emirates	33215	49.4
Yemen, Rep.	16605	50.66

Source: *Energy Statistics Yearbook for the Middle East and North Africa 1997*, ESCWA/ENR/1997/13

Table 4. NO₂ Yearly emissions in Transport for selected countries (kt)

Country		1980	1990	1992	1993	1994	1995	1996
Egypt	Transport Emissions	0.09	0.15	0.16	0.16	0.16	0.18	0.19
	Total Emissions	0.3	0.52	0.48	0.46	0.48	0.53	0.55
	%	30	28.8	33.3	34.8	33.3	34.0	34.5
Jordan	Transport Emissions			2	2	1.35	1.4	1.45
	Total Emissions			18.4	18.4	22.61	24.53	25.6
	%			10.9	10.9	6.0	5.7	5.7
Syria	Transport Emissions		0.19	0.26	0.3	0.32	0.3	0.28
	Total Emissions		1.25	1.52	1.55	1.44	1.45	1.39
	%		15.2	17.1	19.4	22.2	20.7	20.1
USA	Transport Emissions		132	136				
	Total Emissions		179	179				
	%		73.7	76.0				

Source: World Energy Council; [Http://www.worldenergy.org/wec-geis](http://www.worldenergy.org/wec-geis)

Table 5. Yearly CO₂ emissions in transport in selected ESCWA countries

Country		1980	1990	1992	1993	1994	1995	1996
Egypt	Transport Emissions	10.0	18.0	19.0	19.0	20.0	22.0	22.0
	Total Emissions	39.0	75.0	72.0	70.0	73.0	83.0	85.0
	%	25.6	24.0	26.4	27.1	27.4	26.5	25.9
Jordan	Transport Emissions	2.3	3.8	3.9	4.0	2.7	2.8	2.9
	Total Emissions	5.0	10.2	11.0	11.4	11.7	12.7	13.3
	%	46.4	37.4	35.6	35.2	23.1	22.0	21.7
Saudi Arabia	Transport Emissions	22.3	28.6	29.9	32.8	35.6	35.0	37.1
	Total Emissions	98.1	168.6	213.2	224.0	218.6	225.0	248.7
	%	22.7	17.0	14.0	14.6	16.3	15.5	14.9
Syria	Transport Emissions	5.7	5.0	4.3	4.1	4.1	3.8	3.9
	Total Emissions	15.0	33.3	36.0	35.9	37.3	39.1	40.4
	%	38.2	15.0	11.9	11.4	11.0	9.6	9.6
Yemen	Transport Emissions	2.5	3.9	5.2	4.1	4.3	4.4	4.2
	Total Emissions	3.9	7.6	9.9	7.8	8.3	8.3	8.3
	%	64.1	51.3	52.5	52.6	51.8	53.0	50.6
USA	Transport Emissions	1257.5	1462.8	1468.2	1493.9	1548.0	1583.0	1625.0
	Total Emissions	4785.3	4873.4	4924.6	5095.0	5153.7	5194.5	5324.5
	%	26.3	30.0	50.2	29.3	30.0	30.5	30.5

Source: World Energy Council; [Http://www.worldenergy.org/wec-geis](http://www.worldenergy.org/wec-geis)

Table 6. Yearly SO₂ emissions in transport in selected ESCWA countries

Country		1980	1990	1992	1993	1994	1995	1996
Jordan	Transport Emissions			0.5	0.5	0.3	0.31	0.32
	Total Emissions			24.7	25.9	29.6	30.97	31.92
	%			2.0	1.9	1.0	1.0	1.0
Syria	Transport Emissions	9.71	13.04	14.94	16.01	15.27	13.94	
	Total Emissions	237.58	263.29	262.98	258.51	242.22	222.48	
	%	4.1	5.0	5.7	6.2	6.3	6.3	
USA	Transport Emissions	604	745	756	716			
	Total Emissions	22786	20638	20022	20287			
	%	2.6	3.6	3.8	3.5			

Source: World Energy Council; [Http://www.worldenergy.org/wec-geis](http://www.worldenergy.org/wec-geis)

Table 7. Lebanese Ambient Noise Limits for Intensity in different land use Zones

<i>Receptor</i>	Daytime dB (A)	Evening dB (A)	Night dB (A)
Industrial Areas (heavy industries)	60-70	55-65	50-60
Commercial, administrative and "downtown" areas	55-65	50-60	54-55
Residential areas, including some workshops or commercial businesses or on public roads	50-60	45-55	40-50
Residential areas in the city	45-55	40-50	35-45
Residential suburbs having low traffic	40-50	35-45	30-40
Rural residential areas (hospitals and gardens)	35-45	30-40	25-35

Source: Ministry of Environment, Resolution # 1/52, Official Gazette issue # 45, 12/9/1996

Table 8. Egyptian Ambient Noise Limits for Intensity in different land use Zones

<i>Receptor</i>	Daytime dB (A)	Evening dB (A)	Night dB (A)
Industrial Areas (heavy industries)	60-70	55-65	50-60
Commercial, administrative and "downtown" areas	55-65	50-60	45-55
Residential areas, including some workshops or commercial businesses or on public roads	50-60	45-55	40-50
Residential areas in the city	45-55	40-50	35-45
Residential suburbs having low traffic	40-50	35-45	30-40
Rural residential areas (hospitals and gardens)	35-45	30-40	25-35

Source: The Egyptian experience in applying environmental norms and standards in the areas of Electricity generation, transmission and distribution, Eng. Maher Bedrous. Background paper in the expert group meeting on the Harmonization of environmental standards in energy sector,Cairo,1999.

Table 9. Number of car accidents and fatalities in some selected ESCWA countries

Country	1992		1993		1994		1995		1996		1997	
	# of Acc	# of Fat	# of Acc	# of Fat	# of Acc	# of Fat	# of Acc	# of Fat	# of Acc	# of Fat	# of Acc	# of Fat
Bahrain	28073	69	32004	56	31019	63	29083	53	27899	57	...	...
Jordan	...	...	24799	440	26837	443	28970	469	33784	552	39005	577
Kuwait	...	...	19820	289	21697	289	24045	294	24912	285	26322	356
Lebanon	...	...	...	...	...	...	...	...	...	...	3315	357
Oman	13617	218	11754	372	11754	372	11025	399	9456	413	8444	549
Qatar	41100	116	41615	84	39719	52	41691	99	43263	89	49943	96
Saudi Arabia	...	...	...	...	...	...	...	...	167265	3123	...	...
Syria	...	...	17407	1198	16692	1297	15649	1524	14297	1386	14694	1256
UAE	...	...	...	...	19397	600	18071	563	16610	358	...	...
Yemen	...	...	...	...	...	...	7346	1369	7303	1267	8332	1223

Source: Economic and Social Commission for Western Asia, *Harmonization of Environmental Standards in the Transport Sector in ESCWA Member Countries*, E/ESCWA/TRANS/1999/5, 25 October 1999.

Table 10. Age distribution for vehicles in Syria

Vehicle Type	% Of fleet older than	
	13 years	24 years
Passenger cars	60.5	24
Buses and minibuses	40.4	9.4
Pickups	57.4	6.5
Trucks	68.2	19.2

Source: Economic and Social Commission for Western Asia, *Harmonization of Environmental Standards in the Transport Sector in ESCWA Member Countries*, E/ESCWA/TRANS/1999/5, 25 October 1999.

ANNEX (B)
ITSAM-NETWORK



Department of Economic and Social Affairs

Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York

AVIATION AND SUSTAINABLE DEVELOPMENT

BACKGROUND PAPER NO. 9

Prepared by the
International Civil Aviation Organization



AVIATION AND SUSTAINABLE DEVELOPMENT

(Presented by the International Civil Aviation Organization)

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	BACKGROUND INFORMATION ON AVIATION	1
2.1	Historical Perspective	1
2.2	Traffic Forecasts	2
2.3	Environmental Problems Associated with Aviation – A Brief Overview	3
3.	AIRCRAFT NOISE	4
3.1	Description of the problem	4
3.2	Mitigation measures	5
3.3	Reducing noise at source	5
3.4	Operational measures	7
3.5	Land-use planning	8
4.	AIRCRAFT ENGINE EMISSIONS	8
4.1	Description of the problem	8
	<i>Box</i> — Key findings of the IPCC Report	9
4.2	Mitigation measures	10
4.3	Improved technology and new standards	12
4.4	Operational measures	12
4.5	Market-based options	13
5.	ECONOMIC INSTRUMENTS	13
5.1	Economic instruments to address aircraft noise	13
5.2	Economic instruments to address the impact of aircraft engine emissions	14
	Table 1	17
	Figure 1	18
	Figure 2	18
	Appendix 1	19
	STATEMENTS BY THE COUNCIL	19
	Appendix 2	20
	COUNCIL RESOLUTION ON ENVIRONMENTAL CHARGES AND TAXES	20

1. INTRODUCTION

1.1 This information paper has been prepared by the International Civil Aviation Organization (ICAO) at the request of the United Nations Department of Economic and Social Affairs as part of the documentation being prepared for the ninth session of the Commission on Sustainable Development. Two inputs were originally requested, both in the context of sustainable development, one on air transport, the other on the use of economic instruments for the mitigation of the negative environmental impact of aviation. It was subsequently agreed that these two inputs would be merged into one information paper.

1.2 The paper provides background information on aviation and a brief overview of environmental problems associated with aviation (Section 2). It then focuses on the two principal problems that governments have mandated ICAO to address on a worldwide basis, namely aircraft noise and the impact of aircraft engine emissions (Sections 3 and 4 respectively). Finally, Section 5 explores economic instruments, to address aircraft noise and to address the impact of aircraft engine emissions.

2. BACKGROUND INFORMATION ON AVIATION¹

2.1 Historical Perspective

2.1.1 Air transport has experienced rapid expansion since the second world war as the global economy has grown and the technology of air transport has developed to its present state. The result has been a steady decline in airline operating costs and fares per unit of traffic (measured in passenger-kms) in real terms, which has stimulated traffic growth. Consequently, scheduled domestic and international air traffic has increased from some 9 million passengers in 1945 to over a billion and a half in 1999. On average, passenger traffic has grown at about 10 per cent annually, although the growth rates varied significantly from very high, exceeding 20 per cent a year in the first post-war decade, to quite moderate in recent decades as the air transport market has become more mature (see **Figure 1** at end of this paper).

2.1.2 As an illustration of this growth, the output of air transport (measured in terms of tonne-kilometres performed) has increased by a factor of 30 since 1960. Gross Domestic Product (GDP), which is the broadest available measure of world output, increased by a factor of 3.8 over the same period.

2.1.3 Although growth in world air traffic has been much greater than world economic growth, there is a high correlation between the two. Statistical analyses have shown that growth in GDP now explains about two-thirds of air travel growth, reflecting increasing commercial and business activity and increasing personal income and propensity to travel. Demand for air freight service is also primarily a function of economic growth and international trade. Air travel growth in excess of GDP growth is usually explained by other economic and structural factors:

¹ The data in this Section are largely based on civil aviation statistics collected by ICAO and on civil aviation forecasts developed by ICAO. For more details, see ANSConf-WP/13, a paper presented to the Conference on the Economics of Airports and Air Navigation Services (Montreal, 19–28 June 2000) by the ICAO Secretariat.

- improvement in service offerings as routes, frequencies and infrastructure are added, stimulation from reductions in airline fares as costs decline, and increasing trade and the globalization of business;
- population and income distribution; and
- travel behaviour, including travel time budgets and travel costs.

2.1.4 The airline industry has a long history of improving productivity. As a result, the growth in the output of the industry has been greater than the growth in the various inputs used by the industry; the average annual growth in productivity since 1987 has been about 3.5 per cent. The progressive absorption of new technology aircraft into airline fleets has been a major contributor; in particular, new aircraft are more fuel- and labour-efficient. Improved aircraft utilization has also made an important contribution. **Figure 2** depicts the contributors to declining trend in real yields and unit costs over the 1961–1997 period.

2.2 Traffic Forecasts

2.2.1 In terms of scheduled passenger kilometres performed, the most recent ICAO 10-year forecasts show domestic traffic growing at an average annual rate of 3.5 per cent and international traffic at 5.2 per cent for the period 1999–2010. Overall (domestic plus international) growth is projected at 4.5 per cent per annum, with total traffic by airline region varying from 7.2 per cent per annum for airlines of the Asia/Pacific region to 2.8 per cent per annum for airlines of the North American region.

2.2.2 In the longer term, passenger traffic worldwide, expressed in passenger-kilometres performed, is projected to grow for the period 1997–2020 at an average annual rate of 4.5 per cent, with freight traffic growth expected to be somewhat higher (it should be borne in mind that approximately 70 per cent of freight traffic is carried on bellies of passenger aircraft). The growth rates vary from a high of 6.2 per cent per annum for the transpacific compared with a low of 2.9 per cent for the more mature intra-North American market as illustrated in **Table 1**. The North Atlantic route group which has the highest share in passenger traffic is projected to grow at 3.8 per cent per annum.

2.2.3 These traffic forecasts have been developed with the implicit assumption that sufficient system infrastructure and capacity will be available to handle the demand. This growth will therefore be influenced by the extent to which the industry faces up to major challenges, such as airport and airspace congestion, environmental protection and increasing capital investment requirements. The shape and the size of the air transport system will be also affected by government decisions, notably those determining the nature and extent of economic regulation of airlines.

2.2.4 In some parts of the world, particularly in Europe and North America, the airports and airspaces are operating under constraints that limit their ability to provide efficient service. These constraints are likely to become more acute in the future as air transport continues to expand. Major new airports in most developed countries appear to be unlikely. The ICAO-promoted global Communications, Navigation, Satellite/Air Traffic Management (CNS/ATM) system that is in the process of being implemented promises enhanced system capacity, even higher margins of safety, and environmental benefits. However, airport and airspace capacity will remain finite resources that have to serve the anticipated growth in traffic.

2.2.5 Other system constraints are related to environmental issues. Aircraft noise has become a major issue affecting airport expansion in some countries and there are also concerns regarding the impact of aircraft engine emissions at both the local and global levels. These issues are being studied by ICAO. Meanwhile, some States are calling for greater use of economic instruments as a means of limiting the growth of international air transport.

2.2.6 Finally, air transport is particularly vulnerable to fuel prices. The industry has benefited over the past from relatively low and stable prices of aircraft fuel, but even today fuel represents some 13 per cent of airline operating costs worldwide. Prevailing industry expectations are for no increase in real terms, but a surge in prices (which occurred in 1973–4, 1979, 1990 and, to a lesser extent, in 1999–2000) has a dual impact, increasing air transport costs and reducing demand.

2.3 Environmental Problems Associated with Aviation – A Brief Overview

2.3.1 Civil aviation, like most other economic activities, gives rise to environmental problems of various kinds. In 1999, the ICAO Secretariat compiled an inventory of environmental problems that may be associated with civil aviation, to assist the ICAO Council in identifying future priorities in the environmental field². It was assumed that "the environment" means all those natural and man-made surroundings which may be adversely affected by the presence of civil aviation, but which are not directly involved in the aviation itself. The inventory therefore excluded problems concerning the conditions for passengers and crew, or problems concerning the working conditions of airline or airport employees. It also excluded aircraft-manufacturing processes, because such processes fall outside ICAO's ambit.

2.3.2 Environmental problems associated with aviation include:

- 1) Aircraft noise
- 2) The impact of aircraft engine emissions, at ground level and globally
- 3) Other local problems at airports, including problems arising from construction and expansion of airports and associated infrastructure, water and soil pollution, and management of wastes.

2.3.3 This paper does not attempt to cover all these environmental problems. It focuses on the two principal problems that governments have mandated ICAO to address on a worldwide basis, namely aircraft noise (see Section 3) and the impact of aircraft engine emissions (see Section 4).

2.3.4 ICAO's work on these two problems, noise and emissions, is largely undertaken by the Organization's Committee on Aviation Environmental Protection (CAEP), which reports to and makes recommendations to the Council of ICAO. CAEP consists of experts from States and observers from international organizations, including representatives of industry and environmental interests. CAEP and its predecessor committees have been working on noise matters for some 30 years and on emissions matters for some 20 years.

² Recommendations regarding ICAO's environmental activities. C-WP/9375, 17 October 1991.

3. AIRCRAFT NOISE

3.1 Description of the problem

3.1.1 How people perceive the noisiness of a sound is dependent on such factors as its intensity, its frequency characteristics, and the length of time that they are exposed to it. Whereas road traffic and industrial noise is usually fluctuating but continuous, aircraft noise consists of a series of discrete events corresponding to aircraft movements (take-offs, landings). Consequently, aircraft noise can be described in terms of single events, or in terms of cumulative noise exposure. Many different noise exposure indices have been developed, taking into such factors as the number of aircraft, their individual noise levels, and time (day or night)³.

3.1.2 Exposure to aircraft noise is difficult to quantify on a worldwide basis. However, estimates have recently become available based on a new analytical tool that is being used within ICAO, the Model for Assessing the Global Exposure to the Noise of Transport Aircraft (MAGENTA)⁴. Approximately 30 million people are estimated to be exposed to levels of aircraft noise at which many States formally recognize the existence of noise nuisance, including approximately 3 million people who are exposed to higher levels at which many States make noise insulation provisions⁵.

3.1.3 A summary of the effects of aircraft noise in the United States⁶ identifies annoyance as the most prevalent effect. Within a community, some individuals will be much more and others much less upset or annoyed with the sound in question, making the measurement of “community response” a rather complicated matter. In addition, speech and sleep interference are identified as major concerns of neighbours close to airports, while it is noted that hearing damage is not a common result of aircraft noise exposure.

3.1.4 Aircraft noise is one of the main environmental problems constraining the future growth of air transport. In this connection, Airports Council International, the international body representing airports worldwide, recently stated “The extreme difficulty encountered in the construction of new airports, the expansion of existing airports and the scheduling of aircraft operations, especially at night, is primarily the result of community opposition to aircraft noise at many airports”⁷.

³ For additional information, see “Recommended Method for Computing Noise Contours around Airports”, ICAO Circular 205-AN/1/25.

⁴ Developed by Wyle Laboratories, under contract to the United States Federal Aviation Administration.

⁵ Noise levels of DNL55 and DNL65 respectively. The DNL (Day-Night Sound Level) scale is equivalent to A-weighted Leq, but with a 10dB night penalty applied between 2200 hours and 0700 hours.

⁶ Aviation Noise Effects. Federal Aviation Administration, Report No. FAA-EE-85-2, March 1985.

⁷ Policy Handbook, Third Edition — 2000, Airports Council International.

3.2 Mitigation measures

3.2.1 In very simple terms, mitigation of noise problems usually involves taking action at the source of the noise, or somewhere along the transmission path between the source and those affected, or at the point where they are affected. In the case of aircraft noise, where the source is moving fast in three dimensions, this translates into:

- a) making aircraft quieter or introducing restrictions on the use of noisier aircraft;
- b) operational measures, that is adapting an aircraft's operational procedures at an airport so as to minimize community exposure to noise; and
- c) appropriate use of land-use planning near airports.

3.2.2 There is also some experience with the use of noise charges to address aircraft noise problems. This is described briefly in Section 5.1 on economic instruments.

3.3 Reducing noise at source

3.3.1 Much of the effort that has gone into tackling aircraft noise over the past 30 years has been aimed at reducing noise at source. The aircraft built today are required to meet the environmental standards set by ICAO. In 1971, ICAO adopted the document which constitutes Annex 16 to the Convention on International Civil Aviation⁸. Volume I of Annex 16, entitled *Aircraft Noise*, sets Standards for the noise certification of large subsonic jet and propeller-driven aircraft, small propeller-driven aircraft and helicopters. It also includes descriptions and methods of measurement of aircraft noise.

3.3.2 For jet-powered aircraft, there are two levels of stringency in the Standards. Chapter 2 of the Annex contains the Standards which are essentially applicable to jet aircraft designed before October 1977, and Chapter 3 contains more stringent Standards applicable to those designed after that date. There are also some jet aircraft, which are now no longer in production, that are not subject to noise certification requirements by the Annex and are commonly referred to as non-noise certificated (NNC). The CAEP keeps the noise certification Standards under review and is currently working on a possible new standard more stringent than the present one in Chapter 3, with a view to making recommendations for consideration by the Council of ICAO in 2001.

3.3.3 Although noise levels have declined at many airports as the proportion of total movements which are performed by new quieter aircraft has increased, aircraft noise has continued to be a major problem, particularly in developed countries. Many States have therefore found it necessary to impose operating restrictions on noisier aircraft. Initially, in the 1980s, the focus was on NNC aircraft (for example, Boeing 707 and McDonnell Douglas DC-8). Later, attention turned to those aircraft which meet the Standards in Chapter 2,

⁸ The Standards in Annexes to the Convention on Civil Aviation are considered binding. However, if any Contracting State finds it impossible to comply with them, the State is required to inform ICAO of any differences that exist. The differences notified are then published by ICAO in Supplements to Annexes.

but which exceed the noise levels of the more stringent Standards in Chapter 3 (for example, Boeing 727 and early models of the Boeing 737 and McDonnell Douglas DC-9).

3.3.4 However, operating restrictions can have significant economic implications for the airlines concerned, particularly those from developing countries. Unless they are able to transfer these noisier aircraft to other routes, they have either to replace them with newer aircraft or to retrofit them with quieter engines or noise-muffling equipment known as “hush-kits”. In both cases — NNC aircraft and Chapter 2 aircraft — ICAO played a leading role in developing a worldwide approach to the introduction of operating restrictions.

3.3.5 In the case of Chapter 2 aircraft, an extraordinary session of the ICAO Assembly in October 1990 adopted unanimously a resolution⁹ on a worldwide policy framework on operating restrictions that represented a careful balance between the interests of developing and developed States and took into account the concerns of the airline industry, airports and environmental interests.

3.3.6 The resolution allows States to start phasing out operations of Chapter 2 aircraft from 1 April 1995 and to have all of them withdrawn from service by 31 March 2002. However, prior to the latter date, Chapter 2 aircraft are guaranteed 25 years of service after the issue of their first certificate of airworthiness. Thus a Chapter 2 aircraft which has completed less than 25 years of service on 1 April 1995 would not be immediately affected by this requirement. Similarly, wide-body Chapter 2 aircraft and those fitted with quieter (high by-pass ratio) engines would not be immediately affected after 1 April 1995.

3.3.7 The Assembly also urged ICAO to promote, and States to develop, an integrated approach to the problem of noise, including land-use planning procedures around international airports, so as to minimize the adverse effect of aircraft noise on any residential, industrial or other land-use.

3.3.8 Many developed countries have since implemented restrictions on operations of Chapter 2 aircraft at their airports, along the lines of the policy framework agreed in 1990 and this has been successful in reducing noise levels near many airports. For example, in the United States, the Federal Aviation Administration (FAA) calculated that the number of people exposed to levels of aircraft noise that create a significant annoyance would fall from 2.7 million to 1.3 million in the year 2000 by normal attrition of Chapter 2 aircraft, but would fall to 400 000 in the same year under its phase-out plan¹⁰.

3.3.9 In recent years, governments have been turning their attention to the situation that will exist, once operations of Chapter 2 aircraft at their airports have largely been replaced by Chapter 3 aircraft. There are concerns that the rapid growth of air transport could increase noise levels once again. A consensus has yet to emerge in ICAO on how to address these concerns.

3.3.10 In Europe, governments have focussed on preventing an increase in operations of aircraft which have been recertificated to Chapter 3 standards through re-engining or hush-kitting. While this pertains to European airports only, it nevertheless could impact on carriers based elsewhere, and it has raised questions

⁹Adopted as Assembly Resolution A28-3. Subsequently incorporated into Assembly Resolution A32-8: Consolidated statement of continuing ICAO policies and practices related to environmental protection, as its Appendix D.

¹⁰Phase-out of Stage 2 Airplanes Operating in the 48 Contiguous United States and the District of Columbia. Notice of proposed rulemaking by the United States Federal Aviation Administration. Federal Register, Vol. 56, No. 40. February 28, 1991. The figures quoted are based on a DNL of 65 dB.

within ICAO about consistency with the compromise solution of 1990 as well as the possible impact on ICAO's worldwide noise standards. In April 1999, the EU Council adopted a regulation¹¹ on this subject which became applicable on 4 May 2000. This regulation recently became the subject of a complaint filed by the United States with ICAO under the Chicago Convention's provisions for settling disputes (Article 84) and the relevant procedures for dealing with such issues are now under way.

3.3.11 In June 1999, in the light of these developments, the ICAO Council decided to expand the mandate of the CAEP in the noise field. In addition to work already under way concerning a new noise standard more stringent than Chapter 3, CAEP is now exploring the issue of possible operating restrictions on Chapter 3 aircraft from a worldwide perspective, and has been requested to develop technical options, for consideration by the Council in 2001.

3.3.12 CAEP will be making use of the MAGENTA model referred to in paragraph 3.1.3 above. The model will estimate the benefits of policy measures to reduce noise, in terms of changes in the number of people who would be exposed to a given level of noise. While information about the estimated benefits was sometimes available for a particular airport, until now there has been no reliable means for extrapolating this information to cover many airports. Using MAGENTA, it should be possible to estimate the benefits of different options on both a regional and worldwide basis.

3.4 Operational measures

3.4.1 While the primary focus has been to reduce noise at source through certification or through restrictions on noisier aircraft, there is some scope for alleviating impact on neighbouring communities through noise abatement operating measures. There are several methods of achieving noise abatement. The appropriateness of any of these measures depends on the physical lay-out of the airport and its surroundings, but in all cases the procedures must give priority to safety considerations.

3.4.2 ICAO has developed standard operating procedures for take-off and initial climb which are designed to minimize noise on the ground. At many airports, aircraft use these procedures or others specific to the local situation. New take-off noise abatement procedures are currently under consideration by CAEP, following a review by safety experts.

3.4.3 Airlines are often assigned the preferential use of runways and minimum altitudes for take-off and landing when overflying populated areas. Sometimes airport authorities make directional use of certain runways, or use them primarily for take-offs or landings. Rotation of runway use and restrictions on the use of reverse thrust on landing are also in effect at some airports to reduce sideline and other ground noise.

¹¹Council Regulation (EC) No 925/1999 of 29 April 1999 on the registration and operation within the Community of certain types of civil subsonic jet aeroplanes which have been modified and recertificated as meeting the standards of Volume I, Part II, Chapter 3 of Annex 16 to the *Convention on International Civil Aviation*, third edition (July 1993).

3.5 Land-use planning

3.5.1 Land-use planning is an effective means to ensure that the activities nearby airports are compatible with aviation. Its main goal is to minimize the population affected by aircraft noise by introducing land-use zoning around airports. Compatible land-use planning and control is also a vital instrument in ensuring that the gains achieved by the reduced noise of the latest generation of aircraft are not offset by further residential development around airports.

3.5.2 ICAO has developed guidance on land-use planning.¹² This includes guidance on using various tools for the minimization of the impact of aircraft noise in the vicinity of airports and describes the practices adopted for land-use planning and control in several States.

4. AIRCRAFT ENGINE EMISSIONS

4.1 Description of the problem

4.1.1 When aircraft engines burn fuel, they produce emissions that are similar to other emissions resulting from fossil fuel combustion. However, aircraft emissions are unusual in that a significant proportion is emitted at altitude. These emissions give rise to important environmental concerns regarding their global impact and their effect on local air quality.

4.1.2 At a global level, the most comprehensive assessment to date is a *Special Report on Aviation and the Global Atmosphere*¹³, which was produced in 1999 at ICAO's request by the Intergovernmental Panel on Climate Change (IPCC), in collaboration with the Scientific Assessment Panel to the Montreal Protocol. This report assesses the effects of the past, present and potential future fleets of subsonic and supersonic aircraft on climate and atmospheric ozone. The objective of the report is to provide accurate, unbiased, policy-relevant information to serve the aviation industry, environmental experts and policymakers. In describing the current state of knowledge, it also identifies areas where our understanding is inadequate and where further work is urgently required. Consistent with IPCC practice, the report does not make policy recommendations or suggest policy preferences. This is the first IPCC report for a specific industrial subsector and a unique aspect of the report is the integral involvement of technical experts from the aviation industry, including airlines and airframe and engine manufacturers, alongside atmospheric scientists.

4.1.3 With regard to climate change, the IPCC Report estimates that aircraft contribute about 3.5 per cent of the total radiative forcing¹⁴ by all human activities and that this proportion is likely to increase. The emissions from aircraft of relevance for climate change include carbon dioxide (CO₂), water vapour,

¹²Airport Planning Manual (Part 2 — Land-Use and Environmental Control. Document 9084. A revised edition of this manual is currently in preparation.

¹³This report has a *Summary for Policymakers* which is available in six UN languages (Arabic, Chinese, English, French, Russian and Spanish) and is accessible at IPCC's Website (www.ipcc.ch). The report itself (over 300 pages) is published in English only and can be purchased from Cambridge University Press (www.cup.cam.ac.uk).

¹⁴Radiative forcing is a measure of the importance of a potential climate change mechanism.

nitrogen oxides (NO_x), sulphur oxides and soot. For more information on some of the key findings of the IPCC Report insofar as they relate to describing aviation's contribution to climate change, see the Box on page 9.

4.1.4 The IPCC Report also assesses what is known about aviation and depletion of the ozone layer. This does not appear to be an issue insofar as emissions from the present subsonic fleet are concerned, but could possibly become one if there were to be a significant fleet of supersonic civil aircraft.

4.1.5 At ground level, in the immediate vicinity of airports, and regionally, concerns focus on the potential health and environmental effects of emissions such as NO_x, volatile organic compounds and particulates.

4.1.6 Future concerns about aviation's role in both climate change and local air quality are largely due to the projected continued growth. While past technological improvements have reduced the growth rate of emissions and this progress is expected to continue into the future, total emissions will continue to increase. For example, the IPCC Report projects aviation growth of 5 per cent per year between 1990 and 2015 with fuel consumption and CO₂ emissions growing at 3 per cent annually over the same period.

**Key findings of the IPCC Report
concerning aviation's contribution to climate change**

Aircraft Emissions. Aircraft emit gases and particles directly into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of greenhouse gases, including carbon dioxide, ozone, water vapour and methane, trigger the formation of condensation trails (otherwise known as contrails), and may increase cirrus cloudiness — all of which contribute to climate change.

Radiative Forcing. The climate impacts of the gases and particles emitted and formed as a result of aviation can be compared to each other and to climate effects from other sectors by using the concept of radiative forcing. This is a measure of the importance of a potential climate change mechanism and expresses the perturbation or change to the energy balance of the Earth-atmosphere system in watts per square metre (Wm⁻²). Positive values of radiative forcing imply a net warming, while negative values imply cooling. The major contributors from aircraft emissions to the radiative forcing are carbon dioxide, ozone, methane (negative effect) and contrails, with minor contributions from water vapour, sulfate aerosols (negative effect) and soot. The contribution from cirrus clouds is projected to be positive and could be quite significant, but our current lack of scientific understanding precludes a quantitative assessment of its contribution. While the contributions from carbon dioxide, ozone, methane (opposite sign) and contrails are comparable in magnitude, the uncertainties associated with ozone, methane and contrails are much larger than those associated with carbon dioxide.

Current impact of aircraft emissions on climate. The best estimate of the radiative forcing by aircraft is 0.05 Wm^{-2} (0.01 to 0.1 Wm^{-2}) for the year 1992, or about 3.5 per cent of the total radiative forcing by all human activities. These estimates of forcing combine the effects of changes in all greenhouse gas concentrations, aerosols and line-shaped contrails, but do not include possible changes in cirrus.

Projected impact of subsonic aircraft emissions on climate. For the reference scenario used in the IPCC Report, the projected radiative forcing from subsonic aircraft emissions in 2050 is 0.19 Wm^{-2} or 5 per cent of the radiative forcing in the mid-range IS92a scenario (one of a range of scenarios, IS92a-f that IPCC has developed for future emissions from all anthropogenic sources, based on assumptions concerning population and economic growth, land use, technological changes, energy availability, and fuel mix during the period 1990 to 2100). For the full range of scenarios considered in the report, the radiative forcing is projected to grow to 0.13 to 0.56 Wm^{-2} in 2050, which is 2.6 to 11 times the value in 1992, and compares to the mid-range IS92a scenario of 3.8 Wm^{-2} in 2050.

Projected impact of supersonic aircraft emissions on climate. One possibility for the future is the development of a fleet of second-generation supersonic, high speed civil transport aircraft (HSCT)¹⁵. If a fleet of supersonic aircraft were developed to cruise at an altitude of about 19 kilometres, they would emit carbon dioxide, water vapour, oxides of nitrogen and sulfur, and soot directly into the lower stratosphere. Assuming a fleet of supersonic aircraft started operation in 2015, growing to a maximum of 1 000 aircraft by 2040 and displacing a portion of the subsonic fleet in the reference scenario, by 2050 the combined subsonic and supersonic fleet is projected to add a further 0.08 Wm^{-2} to the 0.19 Wm^{-2} radiative forcing projected for the reference scenario. Most of this additional forcing is due to the increased concentration of stratospheric water vapour.

Source: Article by Robert Watson, Chairman of the IPCC. ICAO Journal, September 1999.

4.2 Mitigation measures

4.2.1 In addition to assessing what is known about aviation's contribution to global atmospheric problems, the IPCC Report also explored options to reduce aircraft emissions. It identified a range of options, including changes in aircraft and engine technology, fuel, operational practices, and regulatory and economic measures. However, the IPCC Report noted that a number of factors will govern the rate at which technology advances and policy options related to technology can reduce aviation emissions: safety of operation, operational and environmental performance, cost, and the typical life expectancy of an aircraft of 25 to 35 years.

4.2.2 Whereas mitigating aircraft noise primarily involves ICAO and the aviation community, addressing the impact of aircraft engine emissions is somewhat more complex in that aviation is one of many contributors to emission-related problems. Consequently, responsibility for mitigation is shared among many human activities, each with different scope for taking action and differences in likely costs. There are also

¹⁵ As the IPCC Report notes in the Summary for Policymakers, there is considerable uncertainty whether any such fleet will be developed.

institutional considerations. A number of other UN bodies with mandates in the emissions field have expressed an interest in aircraft engine emissions, including the policy-making bodies of the UN Framework Convention on Climate Change (UNFCCC), the Montreal Protocol on Substances that Deplete the Ozone Layer and, under the auspices of the UN Economic Commission for Europe, the Convention on Long-range Transboundary Air Pollution. In each of these cases, an understanding has been reached based on cooperation and avoidance of unnecessary duplication.

4.2.3 Of primary importance is the UN Framework Convention on Climate Change. Although the Convention does not specifically refer to emissions from aviation, its coverage includes emissions from all sources. One of the commitments in the Convention is that parties compile national inventories of their emissions sources. For domestic flights, emissions are considered to be part of the national inventory of the country within which the flights occur. For international flights, the problem is how to allocate the emissions (referred to as “emissions from international aviation bunker fuels” in UNFCCC terminology, although “international” is not always specified) to national inventories. A similar problem exists for shipping. To date, there has been no agreement among parties to the Convention on how to resolve this problem.

4.2.4 The Kyoto Protocol to the Convention, which was adopted in December 1997 but has not yet entered into force, requires countries listed in Annex I to the Convention (industrialized countries) to reduce their collective emissions of greenhouse gases by approximately 5 per cent by the 2008–12 period compared with 1990 levels, with the reduction varying from country to country. These targets focus on six greenhouse gases, the one most relevant to aviation being CO₂. Since the targets apply to national totals of greenhouse gases, each Annex I country can determine how the various emission-producing sectors in its economy should be called upon to assist in achieving the country’s national target. Because international aviation emissions are not included in national inventories, they are currently excluded from the targets. Instead, Article 2, paragraph 2 of the Kyoto Protocol states that the responsibility for limiting or reducing emissions from aviation bunker fuels shall fall to the Annex I parties, working through ICAO.

4.2.5 The adoption of the Kyoto Protocol has given increased momentum to the work of ICAO’s Committee on Aviation Environmental Protection (CAEP) in the emissions field. The 32nd Session of the ICAO Assembly, in September/October 1998, requested the Council of ICAO, through CAEP, to “study policy options to limit or reduce the greenhouse gas emissions from civil aviation, taking into account the IPCC special report and the requirements of the Kyoto Protocol”, and to report to the next ordinary session of the Assembly in late 2001.¹⁶

4.2.6 In addressing concerns associated with aircraft engine emissions, the work in progress in CAEP is guided by three main principles:

- Measures to address emissions should take into account environmental need, technical feasibility and economic reasonableness.
- Measures to address emissions should also take into account any potential implications for safety, which must not be compromised, and for aircraft noise. Measures aimed at one type of emission (for example, CO₂) or one emission-related problem (for example,

¹⁶Assembly Resolution A32-8, Appendix F.

climate change) should take into account any potential implications for other types of emission or for other emission-related problems.

- Measures to address emissions should be developed on a harmonised worldwide basis, wherever possible.

4.2.7 This work on emissions falls into three categories, namely technology and standards, operational measures, and market-based options, each of which is considered separately below.

4.3 Improved technology and new standards

4.3.1 CAEP has been considering to what extent technology can help, through improved engine or airframe design, to achieve reductions in emissions.

4.3.2 The present ICAO standards for emissions certification of aircraft engines, which are contained in Volume II of Annex 16 to the Convention on International Civil Aviation, were originally designed to respond to concerns regarding air quality in the vicinity of airports. As a consequence, they establish limits for emissions of NO_x, carbon monoxide (CO), unburned hydrocarbons (HC) and smoke, for a reference landing and take-off (LTO) cycle below 915 metres of altitude (3 000 ft). These limits are expressed in terms of mass of emissions per unit of engine thrust.

4.3.3 While these standards are based on an aircraft's LTO cycle, they also help to limit emissions at altitude. Of particular relevance is the standard for NO_x, a precursor for ozone. At ground level, ozone takes part in the smog chemistry, while at altitude it is a greenhouse gas. The standard for NO_x was first adopted in 1981, then made more stringent in 1993, when ICAO reduced the permitted levels by 20 per cent for newly certificated engines, with a production cut-off on 31 December 1999. In 1998, CAEP recommended a further tightening of about 16 per cent on average for engines newly certificated from 31 December 2003, a measure adopted by the ICAO Council in February 1999.

4.3.4 CAEP is now carrying out assessments of technological advances so that ICAO standards can be modified to specifically address emissions of greenhouse gases. In particular, it is studying alternate emissions methodologies that will encompass all phases of flight (climb and cruise emissions as well as the LTO cycle). In addition to considering the types of emissions already covered by ICAO standards, the new methodologies will take into account fuel efficiency and productivity of the whole aircraft, which would have a direct bearing on CO₂ emissions. CAEP will also follow developments in the characterization and measurement of other emissions, such as particulates that could be relevant to contrail production and additional cirrus cloud formation. This is a very complex task, requiring close cooperation with industry and scientific experts, and recommendations for new methodologies are not expected to be completed until 2001. If required, new provisions based on these emissions methodologies will subsequently be developed for inclusion in Annex 16.

4.4 Operational measures

4.4.1 ICAO is considering to what extent operational measures might help to reduce the amount of emissions of greenhouse gases produced. Work is currently focussed on two key deliverables by January 2001.

4.4.2 The first is a quantification of the environmental benefits possible with the implementation of ICAO's satellite-based CNS/ATM (communications, navigation, surveillance/air traffic management) systems. This is a coordinated effort between the Federal Aviation Administration (United States) and the European Organization for Safety of Air Navigation – EUROCONTROL (29 European States). The study methodology and an initial global assessment of the environmental benefits of CNS/ATM have been completed. This initial study quantifies the emissions reductions to be achieved both in Europe and the United States based on planned enhancements to the respective air traffic environments, and provides baseline assessments of the various ICAO regions on which to base future improvements. Next steps will be to work with ICAO's regional planning groups to help them incorporate environmental considerations into their CNS/ATM implementation plans, and to provide an assessment of those benefits.

4.4.3 The second is draft guidance material for States and the wider aviation community on operational opportunities to reduce aircraft engine emissions. The goal of the document is to offer practical information to reduce aircraft engine emissions through changes in operational procedures and practices. The document incorporates a wide variety of inputs from airlines, airports, and air traffic service providers to provide an end-to-end look at practices now in use to reduce emissions. It has sections on technology, maintenance, non-revenue flying, weight reduction, load factor, flight planning, airports, take-off, climb, cruise, descent and landing, infrastructure, etc. The next step will be to finalize the document and to make it publicly available as an ICAO Circular.

4.5 **Market-based options**

4.5.1 CAEP is also considering the use of market-based options as a potentially attractive means of limiting greenhouse gas emissions at the lowest possible cost, with a main emphasis on carbon dioxide. This work is described in greater detail in Section 5 on economic instruments.

5. **ECONOMIC INSTRUMENTS**

5.1 **Economic instruments to address aircraft noise**

5.1.1 ICAO has been addressing the application of economic instruments to reduce or eliminate the adverse environmental consequences of civil aviation for many years. Initially attention was focussed on aircraft noise, which led to the development in 1981 of a specific ICAO policy on noise-related charges¹⁷, reproduced in **Appendix 1**, which is contained in the *Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services* (Doc 9082/5).

5.1.2 Noise-related charges have been effective in encouraging aircraft operators to accelerate the introduction of quieter aircraft. The ICAO policy on noise-related charges has found wide acceptance, and requests for change have not been received from States nor aircraft operators directly or through the CAEP process. Practical advice on determining the cost basis for noise-related charges and their collection is provided

¹⁷As defined by ICAO “charges are levies to defray the costs of providing facilities and services for civil aviation whereas taxes are levies to raise general national and local government revenues that are applied for non-aviation purposes”.

in the ICAO *Airport Economics Manual* (Doc 9562), and information on noise-related charges actually levied is provided in the ICAO *Manual of Airport and Air Navigation Facility Tariffs* (Doc 7100).

5.2 Economic instruments to address the impact of aircraft engine emissions

5.2.1 ICAO first addressed the introduction of emission-related charges at the 1991 Conference on Airport and Route Facility Management. The Conference recommended that a study be undertaken of whether charges could be an effective means of reducing adverse environmental consequences of aircraft engine emissions. It also recommended that in the meantime if charges were to be considered, some basic principles should be taken into account (no fiscal aims, no distortion of competition with other modes of transport, efficient use of aircraft capacity not prevented, and cost relatedness), an approach subsequently endorsed by the 31st Session of the ICAO Assembly in 1995. The Council of ICAO subsequently approved this recommendation and assigned the study to CAEP.

5.2.2 Subsequent to the 31st Session of the Assembly it became apparent that there was a need for a formal indication of ICAO's position with regard to emission-related levies. Underlying this development was the growing interest in the possible application of environmental charges or taxes to civil aviation expressed in other international fora, primarily ones within the United Nations system (for example, the Commission on Sustainable Development and the UN Framework Convention on Climate Change) and also the European Union. The Council noted that delaying a policy statement by ICAO on emission charges until CAEP had completed its work in that area could compromise ICAO's role in protecting the interests of civil aviation since other UN policy-making bodies might take action with regard to emission-related levies, possibly detrimental to civil aviation in the absence of an ICAO policy. At least an interim statement from ICAO was therefore required. The Council also noted in this respect that relevant policy guidance already existed in the Council Statements in Doc 9082/5 and ICAO's *Policies on Taxation in the Field of International Air Transport* (Doc 8632). However, neither emission-related charges nor emission-related taxes were specifically identified in these policy statements and it was desirable to have ICAO's position on this complex subject recorded in a single concise text. On the basis of these and other factors the Council adopted in December 1996 the *Council Resolution on Environmental Charges and Taxes*, reproduced in **Appendix 2**. Although the title of the Resolution refers to environmental charges and taxes, the Resolution in fact focusses only on emission-related charges and taxes. In the resolution the Council "Strongly recommends that any environmental levies on air transport which States may introduce should be in the form of charges rather than taxes..."

5.2.3 In April 1998, CAEP presented a major progress report on emission-related levies, based on a study carried out within the Committee. While initially having intended to focus on emission-related charges, CAEP, in the report considered a number of options that were either charges or taxes as defined by ICAO. Noting that the generic term "levies" covered both charges and taxes, CAEP used this term throughout the report. The report addressed, *inter alia*, specification of the emission levies such as the substance to which a levy would apply (for example CO₂ and NO_x), and the collection and application of the levy. Basically four options were considered, that is a fuel levy, a ticket levy, a route levy and an airport levy; as well as the effectiveness of each in reducing emissions depending on whether a global or local pollution problem is involved. As to levy application the report considered a revenue neutral application, a general taxation application, levy application based on a prevention cost approach, and application involving paying damages suffered by third parties. The report also addressed implementation aspects of environmental levies both as they relate to levy collection as well as to levy application, and the role of ICAO with regard to such levies. Preliminary analysis had shown that with regard to the global problem the route or fuel levy would be most

effective, while an airport levy would be most effective in reducing local emission problems. However, with regard to a fuel levy – in effect tax – option, the report noted that ninety-seven per cent of bilateral air services agreements contained provisions exempting fuel used in international operations from taxes, consistent with well-established and long-standing policies of ICAO. CAEP emphasized the preliminary nature of its report and that much further work needed to be undertaken, including harmonizing the many different views that existed in this area.

5.2.4 In the light of the report prepared by CAEP, the 32nd Session of the ICAO Assembly in September/October 1998 requested the Council of ICAO to further pursue the issue of emission-related levies with a view to reaching conclusions prior to the next Assembly session in late 2001, while requesting States follow the existing Council guidance in the interim and not take unilateral action inconsistent with that guidance.¹⁸

5.2.5 CAEP has subsequently taken up this matter again. It is currently identifying and evaluating the potential role of market-based options, including emission-related levies, emissions trading and voluntary programmes, as a means of limiting greenhouse gas emissions. As the IPCC Special Report has indicated, there are several different emissions from aircraft engines that play a role in climate change. However, this tends to complicate the design and evaluation of market-based options. It has therefore been decided to focus on CO₂ emissions only at this stage, while leaving open the possibility of accommodating other emissions later, if appropriate. Since CO₂ production is proportional to fuel consumption, focussing on CO₂ means focussing on fuel consumption.

5.2.6 The use of market-based options raises a number of important economic, environmental, legal and administrative issues that must be fully evaluated. In order that different types of market-based options can be evaluated on a consistent basis, an initial set of common assumptions has been developed:

- Initially, two targets for emission reductions will be examined. Starting with a business-as-usual scenario, one target would reflect the average emission reduction required in the Kyoto Protocol for the first commitment period (5% below the chosen base year), while a second target would reflect a reduction of half the projected aviation growth rate in that period.
- Two alternatives for geographic scope will be examined, one assuming implementation on a world-wide basis, the other assuming industrialized countries only.

5.2.7 On this basis, an initial set of specifications for the various market-based options have been developed.

5.2.8 As regards **emission-related levies**, the initial options being evaluated include:

- A fuel tax, with revenue going to national treasuries.
- A revenue-neutral charge based on aircraft efficiency, with higher charges on less fuel-efficient aircraft offset by lower charges on more fuel-efficient ones.

¹⁸Assembly Resolution A32-8, Appendix H.

- An en-route emissions charge, with revenues recycled to the aviation sector (for example, to defray the costs of the harmful effects of emissions and to support air traffic modernisation, early retirement of aircraft, and research and development activities).

5.2.9 For **emissions trading**, options include an open system, in which emissions from all aviation sources (domestic and international) are treated identically to other emissions, and trading may take place between the aviation sector and other sectors.

5.2.10 CAEP is also considering the possibilities of voluntary programmes, as well as hybrid options drawing on elements from each of the three approaches under consideration (levies, trading and voluntary programmes).

5.2.11 Following specification of the initial set of market-based options, analysis has begun on the associated economic impacts and environmental benefits. Meanwhile, work continues on refining these options and assessing administrative and legal issues. The assessment and option refinement process will continue over the next several months, leading to the preparation of an assessment report in time for the next full CAEP meeting in early 2001.

Table 1

**ICAO Traffic Forecasts by Route
Group to The Year 2020**

	Passenger-kms (billions)		Average Annual Growth(%) 1997–2020
	1997	2020	
International Routes			
North Atlantic	316.1	753	3.8
South Atlantic	35.6	119	5.4
Mid Atlantic	41.2	140	5.5
Transpacific	178.0	712	6.2
Europe<=>Asia/Pacific	208.4	758	5.8
Europe<=>Africa	76.6	217	4.6
Europe<=>Middle East	38.3	98	4.2
North America<=>South America	39.5	114	4.7
North America<=>Central America/ Caribbean	39.3	125	5.1
Intra Africa	7.1	18	4.1
Intra Asia/Pacific	208.9	701	5.4
Intra Europe	150.5	370	4.0
Intra Latin America	15.1	48	5.1
Intra Middle East	4.7	12	4.2
Intra North America	24.0	46	2.9
Other International Routes	94.8	334	5.6
Total International	1478	4564	5
Domestic Routes			
Africa	9.4	22	3.7
Asia/Pacific	201.1	651	5.2
Europe	111.6	280	4.1
Latin America	42.5	105	4.0
Middle East	11.8	30	4.1
North America	716.5	1428	3
Total Domestic	1092.9	2516	3.7
Global (International + Domestic)	2570.9	7080	4.5

Figure 1

54 Years of Traffic Development

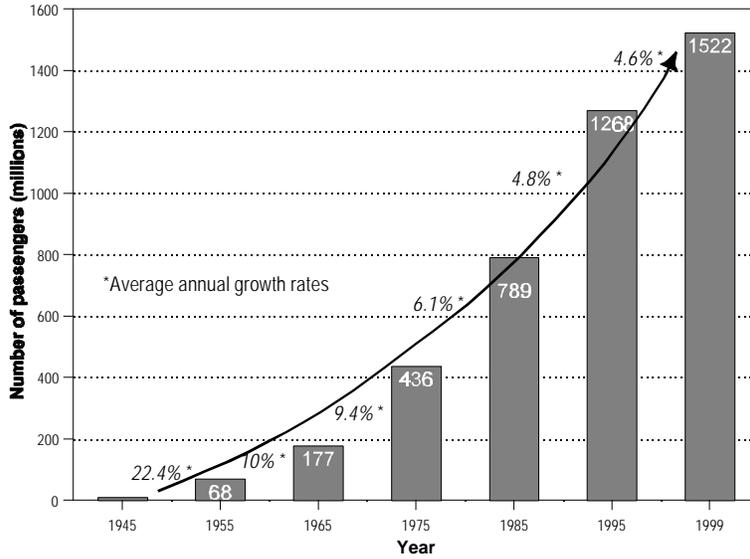
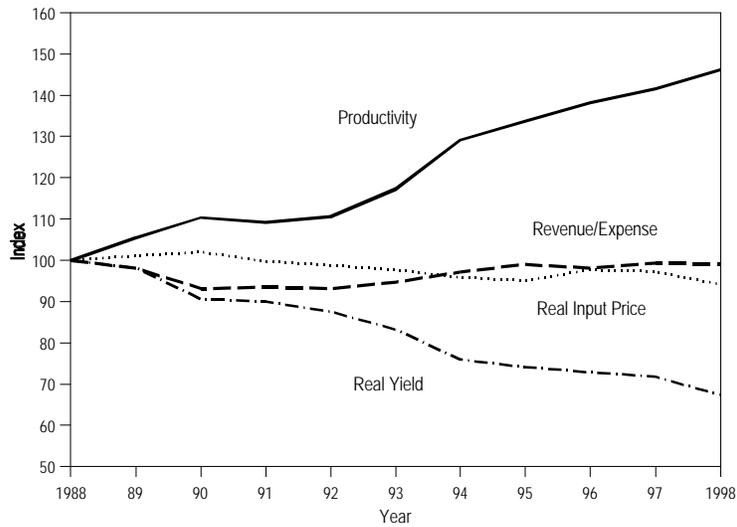


Figure 2

Trends in Performance of the Airline Industry Scheduled Operations



Appendix 1

**EXCERPT FROM THE STATEMENTS BY THE COUNCIL TO CONTRACTING STATES
ON CHARGES FOR AIRPORTS AND AIR NAVIGATION SERVICES (DOC 9082/5)**

“Noise-related charges

21. The Council recognizes that although reductions are being achieved in aircraft noise at source, many airports will need to continue the application of noise alleviation or prevention measures. The Council considers that the costs incurred in implementing such measures may, at the discretion of States, be attributed to airports and recovered from the users and that States have the flexibility to decide on the method of cost recovery and charging to be used in the light of local circumstances. In the event that noise-related charges are to be levied the Council recommends that consultations should take place on any items of expenditure to be recovered from users and that the following principles be applied:

- i) Noise-related charges should be levied only at airports experiencing noise problems and should be designed to recover no more than the costs applied to their alleviation or prevention.
- ii) Any noise-related charges should be associated with the landing fee, possibly by means of surcharges or rebates, and should take into account the noise certification provisions of Annex 16 in respect of aircraft noise levels.
- iii) Noise-related charges should be non-discriminatory between users and not be established at such levels as to be prohibitively high for the operation of certain aircraft.”

Appendix 2

**COUNCIL RESOLUTION
ON ENVIRONMENTAL CHARGES AND TAXES**

Adopted by the Council on 9 December 1996 at the 16th Meeting of its 149th Session

Whereas aircraft engine emissions are contributing to air pollution and to global atmospheric problems such as climate change and depletion of stratospheric ozone, as indicated by recent international scientific assessments, and the scientific community is working towards a better definition of the extent of aviation's impact;

Whereas in recent years there has been increasing recognition by governments of the need for each economic sector to pay the full cost of the environmental damage it causes;

Whereas the 31st Session of the ICAO Assembly in 1995 requested the Council to consider the application of environmental charges or taxes to aviation and report to the next ordinary Session of the Assembly in 1998;

Recognizing that the subject of environmental charges or taxes on air transport has also been raised in other international policy-making bodies, in the context not only of controlling greenhouse gas emissions but also of mobilizing financial resources for sustainable development, and that it is necessary to make clear ICAO's position on environmental charges and taxes at this time;

Noting that ICAO policies make a distinction between a charge and a tax, in that they regard charges as levies to defray the costs of providing facilities and services for civil aviation, whereas taxes are levies to raise general national and local governmental revenues that are applied for non-aviation purposes;

Considering that once aircraft engine emission-related problems are better defined, developments in technology and new approaches to aircraft operations may offer a means of mitigating these problems in the long term;

Having in mind:

- a) that ICAO has established emission standards for new aircraft engines and the work programme of the Council's Committee on Aviation Environmental Protection (CAEP) is aimed at addressing emission-related problems and identifying appropriate solutions, taking into account technical feasibility, economic reasonableness and environmental effectiveness;
- b) that work on emission-related charges is in progress within CAEP, the results so far indicating that the environmental impact of aircraft emissions needs to be understood and quantified before determining the best method for reducing their impact and that both regulatory measures and charges can provide effective instruments in reducing emission levels, but that it is not possible to make any general conclusion at this time as to which of these is preferable;
- c) that Article 15 of the *Convention on International Civil Aviation* contains provisions regarding airport and similar charges, including the principle of non-discrimination, and that

ICAO has developed policy guidance for States regarding charges (*Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services*, Doc 9082/4); and

- d) that ICAO has developed separate policy guidance to States on taxation (*ICAO's Policies on Taxation in the Field of International Air Transport*, Doc 8632), which recommends *inter alia* the reciprocal exemption from all taxes levied on fuel taken on board by aircraft in connection with international air services, a policy implemented in practice through bilateral air services agreements, and also calls on States to the fullest practicable extent to reduce or eliminate taxes related to the sale or use of international air transport;

The Council

1. *Notes* that the use of levies to reflect the environmental costs associated with air transport is considered desirable by a number of States, while other States do not consider it appropriate in the present circumstances;
2. *Considers* that the development of an internationally agreed environmental charge or tax on air transport that all States would be expected to impose would appear not to be practicable at this time, given the differing views of States and the significant organizational and practical implementation problems that would be likely to arise;
3. *Reaffirms* that ICAO is seeking to identify a rational common basis on which States wishing to introduce environmental levies on air transport could do so;
4. *Strongly recommends* that any environmental levies on air transport which States may introduce should be in the form of charges rather than taxes and that the funds collected should be applied in the first instance to mitigating the environmental impact of aircraft engine emissions, for example to:
 - a) addressing the specific damage caused by these emissions, if that can be identified;
 - b) funding scientific research into their environmental impact; or
 - c) funding research aimed at reducing their environmental impact, through developments in technology and new approaches to aircraft operations;
5. *Urges* States that are considering the introduction of emission-related charges to take into account the non-discrimination principle in Article 15 of the *Convention on International Civil Aviation* and the work in progress within ICAO and, in the meantime, to be guided by the general principles in the *Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services* (Doc 9082/4) and the following principles adapted from those agreed by the 31st Session of the ICAO Assembly:
 - a) there should be no fiscal aims behind the charges;
 - b) the charges should be related to costs; and
 - c) the charges should not discriminate against air transport compared with other modes of transport.



Department of Economic and Social Affairs

Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York

**TENDENCIAS Y POLÍTICAS REFERENTE A LOS
SISTEMAS DE TRANSPORTE DE LAS CIUDADES
DE AMERICA LATINA, Y LAS IMPLICANCIAS
PARA SU SOSTENIBILIDAD**

BACKGROUND PAPER NO. 10

Prepared by:

Comisión Económica para América Latina y el Caribe

TENDENCIAS Y POLÍTICAS REFERENTE A LOS SISTEMAS DE TRANSPORTE DE LAS CIUDADES DE AMÉRICA LATINA, Y LAS IMPLICANCIAS PARA SU SOSTENIBILIDAD

Por Ian Thomson

Jefe, Unidad de Transporte

División de Recursos Naturales e Infraestructura

Comisión Económica para América Latina y el
Caribe (CEPAL)

TENDENCIAS Y POLÍTICAS REFERENTE A LOS SISTEMAS DE TRANSPORTE DE LAS CIUDADES DE AMÉRICA LATINA, Y LAS IMPLICANCIAS PARA SU SOSTENIBILIDAD

PRESENTACIÓN

INTRODUCCIÓN

LA DIMENSIÓN DE LOS RECURSOS Y EL MEDIO AMBIENTE

LA SOSTENIBILIDAD FINANCIERA Y SOCIAL

ALGUNAS CONCLUSIONES

INTRODUCCIÓN

- El transporte urbano representa un costo enorme para América Latina y el Caribe. Considerando solamente la operación del transporte en las ciudades de más de 100 000 habitantes, ese transporte consume, aproximadamente, un 3½% del PIB regional.
- Este porcentaje, probablemente, tendería a subir, a raíz, principalmente, del mayor uso del automóvil particular, que normalmente es más costoso de operar por persona-km que los medios colectivos, además de otras consideraciones, como un aumento en la expansión territorial de las ciudades, que trae consigo, entre otras consecuencias, un aumento en el largo de los viajes. Aunque algunas variables independientes, como el mayor uso de internet y otras formas de telecomunicaciones, tirarían el porcentaje para abajo, su influencia sería menor que la de las fuerzas que lo arrastran en el otro sentido.
- El costo social del tiempo de viaje de las personas que se desplazan en esas ciudades equivale a alrededor de un 3% del PIB. Ese costo refleja el consumo de un recurso, es decir, el tiempo personal, que no está reflejado en el PIB.
- Tal como se encuentra actualmente, el transporte urbano latinoamericano no es sostenible en el largo plazo, por su influencia sobre la calidad del aire en algunas ciudades, por su dependencia del petróleo, y quizás por sus consecuencias sociales.
- No podemos descartar la llegada de un **fix** (solución) tecnológico. Los sistemas de transporte en las ciudades de hace un siglo y medio tampoco fueron sostenibles, pero luego aparecieron en el escenario el tren a vapor y el tranvía eléctrico, los que aumentaron su grado de sustentabilidad. Pero nada asegura que el próximo **fix** vaya a llegar a tiempo.
- **La sostenibilidad tiene distintas dimensiones**, entre las cuales se pueden distinguir las siguientes:
 - (i) la dimensión de los recursos no renovables;
 - (ii) la dimensión medioambiental;
 - (iii) la dimensión financiera, y;
 - (iv) la dimensión social.

- No todas esas dimensiones han recibido la atención que merecen. El enfoque de los debates sobre la sostenibilidad ha sido dirigido hacia las primeras dos, pero las últimas son también importantes. Será posible mejorar el desempeño ambiental de los sistemas de transporte urbano mediante, por ejemplo, la conversión de los vehículos a la propulsión eléctrica, de catenaria o de batería, pero el costo financiero sería muy grande. Si ese costo fuera cargado al presupuesto del gobierno, podría desequilibrar las cuentas nacionales, haciéndolos menos sostenibles en el sentido financiero; y si fuera traspasado a los usuarios, para las clases sociales de menores recursos, desplazarse dentro de la ciudad podría exigir la asignación de una proporción importante de sus ingresos, implicando considerables sacrificios, conduciendo posiblemente a desequilibrios o disturbios sociales.

LA DIMENSIÓN DE LOS RECURSOS Y EL MEDIO AMBIENTE

- Conviene considerar estas dos dimensiones juntas, aunque las medidas que reducen el consumo de recursos no renovables, principalmente el petróleo, no necesariamente ayudan a proteger el medio ambiente, y al revés.
- El petróleo proporciona más del 95% de la energía consumida por el sector transporte, a nivel mundial. Ese porcentaje tiende a subir en general (a pesar de que bajó en América Latina, entre 1971 y 1990).
- En las ciudades de la región, otros recursos de importancia crítica referente a la sostenibilidad son: (i) el aire, y, (ii) el espacio, especialmente el dedicado a la vialidad.
- El transporte urbano contribuye grandes cantidades de gases relacionados con el Efecto del Invernadero, especialmente CO₂, que no ha recibido la atención que merece por parte de las autoridades latinoamericanas.
- Las medidas destinadas a reducir el consumo de recursos o mejorar el medio ambiente, pueden actuar sobre:
 - (i) la cantidad de viajes que se hacen;
 - (ii) el largo de los viajes;
 - (iii) el uso de los medios colectivos;
 - (iv) el consumo o emisiones unitarios por vehículo-km, y;

(v) el consumo de recursos renovables, en lugar de los no renovables;

que analizaremos a continuación, enfocando la atención en las materias (i) a (iii).

- **Referente a la cantidad de viajes** (por persona), en general, a nivel mundial, se ha establecido que los mayores ingresos y la propiedad de un auto, aumentan el número de viajes efectuados. Puesto que han subido en los últimos decenios los ingresos personales de muchos de los ciudadanos latinoamericanos, y una parte del alza se ha dedicado a la compra de una mayor cantidad de autos, uno anticiparía que deberían haber subido también las tasas de producción de viajes.
- Sin embargo, esto no aconteció. Véase el cuadro 1.

Cuadro 1. Tasas de producción de viajes mecanizados, por persona y día, en distintas ciudades latinoamericanas, 1967-1997				
Año	SAO	MEX	BUE	SCL
1967	1.05			
1970			1.67	
1977	1.49			0.95
1983		1.42		
1987	1.32			
1991				1.70
1992			1.26	
1994		1.29		
1997	1.22			

Notas: (I) SAO = São Paulo; MEX = México; BUE = Buenos Aires; SCL = Santiago de Chile.

Fuentes: (i) **Encuesta origen-destino de viajes del Gran Santiago**, Ministerio de Planificación y Cooperación, Santiago, 1992, y, (ii) E. Henry y J. Hubert, **Contrastes de la motorización y de la movilidad en las megápolis**, Instituto de Investigación para el Desarrollo, Francia, sin fecha.

- ¿Porqué no sucede? No sabemos con seguridad, pero parece que un análisis de tipo corte transversal da resultados diferentes que otro de serie de tiempo.
- A lo largo del tiempo, la tasa puede bajar porque:
 - (i) el crecimiento espacial de la ciudades aumenta el largo de los viajes y, en particular, hace inviables las vueltas a la casa para almorzar;
 - (ii) la creciente congestión tiene poderes disuasivos sobre los desplazamientos, y;
 - (iii) hay más y mejores programas en la televisión y, a partir de los últimos años, tenemos también el internet en la casa para poder divertirnos.
- Por otra parte, otras influencias tiran en el sentido opuesto, como la reducción en el número medio de residentes por hogar, pero evidentemente no arrastran con una fuerza suficiente para invertir el sentido de la tendencia hacia la baja, excepto en Santiago entre 1977 y 1991 (en que la tasa por hogar subió en un 38%, y la por persona en un 79%). También, la mayor participación de la mujer en la fuerza laboral tira la tasa para arriba hasta llegar al correspondiente punto de saturación.
- Las tasas bajan naturalmente, pero han habido muy pocas medidas gubernamentales para apoyar la tendencia.
- **Referente al largo de los viajes**, sabemos aún menos sobre sus tendencias que sobre las de las tasas de generación de los mismos. Los únicos datos fiables son los de São Paulo. Véase el cuadro 2.

Cuadro 2. Kilometrajes unitarios de los viajes efectuados en São Paulo, 1977, 1987 y 1997				
Específico	Año	1977	1987	1997
Viajes motorizados/persona/día		1.53	1.32	1.23
Kilometraje por persona		11.90	10.80	11.60
Kilometraje por viaje		7.78	8.18	9.43

Fuentes: (i) **PITU 2020**, Governo do Estado de São Paulo, febrero del 2000, y; (ii) E. Henry y J. Hubert, **Contrastes de la motorización y de la movilidad en las megápolis**, Instituto de Investigación para el Desarrollo, Francia, sin fecha.

- La teoría nos enseña, por una parte, que deberá aumentarse, con el pasar de los años, el largo de los viajes (por la mayor extensión de las ciudades, y una mayor especialización de actividades), y por otra, que deberá bajar (inflexibilidad de presupuestos de tiempo en una era de creciente congestión, y mayor densificación de uso de suelo en algunos sectores).
- A lo menos, en São Paulo, el kilometraje por persona fluctúa, sin tendencia evidente, pero el por viaje sube.
- La explicación más probable de eso, es que la separación física entre residencia y lugar de trabajo sube, haciendo infactible volver a casa a mediodía, reforzado por el impacto desincentivador de la mayor congestión.
- Sin embargo, sube el kilometraje en auto por persona, y, por lo tanto, el por persona en las familias de mayores ingresos y más autos. Por lo tanto, a largo plazo, el kilometraje por persona podrá tender a subir.
- El tiempo asignado a los viajes, por persona, tendió a bajar (echando dudas sobre la teoría de la inflexibilidad de los presupuestos de tiempo), implicando que las velocidades han tendido a subir.
- Uno no pensaría, naturalmente, que las velocidades de los viajes efectuados en São Paulo tienden a subir. La explicación de esto tiene que ser una transferencia de los desplazamientos desde medios lentos, como el bus sin vía segregada, hacia medios menos lentos, como el auto, el bus sobre vía segregada, o el metro.
- Los gobiernos de los países latinoamericanos, a nivel nacional o municipal, han tomado pocas medidas a favor de un acortamiento en el largo de los viajes (entre ellas, se incluyen: los centros satélites en Córdoba, el repoblamiento del centro de Santiago, los limitantes sobre el crecimiento de La Habana, y la integración de uso de suelo y sistema de transporte en Curitiba), pero no han habido muchas iniciativas importantes en esa área.
- **Referente al mayor uso de medios colectivos**, la tendencia es claramente negativa. Véase el cuadro 3.

<p align="center">Cuadro 3. La tendencia en la partición modal de viajes motorizados (porcentaje en transporte público), en Santiago y São Paulo, 1967 a 1997</p>
--

Ciudad	Año	1967	1977	1987	1991	1997
Santiago		68.1%	61.0%	55.8%		50.8%
São Paulo			83.4%		70.0%	

Fuentes: (i) **PITU 2020**, Governo do Estado de São Paulo, febrero del 2000, y; (ii) **Encuesta origen-destino de viajes del Gran Santiago**, Ministerio de Planificación y Cooperación, Santiago, 1992.

- El transporte colectivo no es necesariamente un mayor consumidor de combustible que el transporte colectivo (el auto consume menos que un bus, por persona, si el bus lleva menos de 7½ personas, que ocurre frecuente en horas valle y de fin de semana), o más contaminante que un auto (especialmente de partículas).
- Pero sí, casi siempre ocupa el bus menos espacio vial por persona-km, especialmente en las horas de punta. Por lo tanto, para evitar: (i) una congestión intolerable, o; (ii) una consecuente excesiva dispersión espacial de la ciudad (que comería áreas verdes y haría financieramente inviable la operación del transporte colectivo), es de importancia crítica promover el uso de éste transporte.
- Esto exige la toma de acciones duras por parte de los gobiernos, que no se muestran dispuestos a hacer, salvo en casos contados, como, a partir del año 2000, el de Santafé de Bogotá y Santiago de Chile. Medidas para mejorar el transporte público sirven principalmente para beneficiar a quienes ya lo usan, y normalmente tienen un impacto muy limitado sobre la partición modal.
- Normalmente, para lograr un mayor uso del transporte colectivo, las medidas para mejorarlo deberían ir acompañadas por otras de disuasión, físicas o monetarias, sobre el uso del auto. Es decir, hay que usar tanto la zanahoria como el palo.
- En México, Santafé de Bogotá, Santiago y São Paulo, las autoridades han aplicado medidas de restricción vehicular, a veces con el fin de rebajar la contaminación, más bien que reducir la congestión, y fomentar el uso del transporte colectivo. Su eficacia es decreciente con el tiempo, pero constituye una de las pocas medidas duras que se han tomado.

- La tarificación vial ha sido propuesta, especialmente en Chile, pero parece política y socialmente inaceptable.
- Referente al control sobre el estacionamiento, básicamente, las acciones han sido limitadas a meramente prohibirlo sobre las vías principales y sobre la mayor parte de las en las zonas céntricas. Respecto a los estacionamientos en otros sitios, en general, no se imponen restricciones.
- Por esto, sin un cambio drástico en las actitudes: (i) la partición modal del transporte colectivo seguirá bajando; (ii) la congestión seguirá aumentando; (iii) el desarrollo comercial tratará de reubicarse en sectores actualmente de baja densidad, y; (iv) las dificultades de operar en forma rentable servicios de transporte colectivo en estos sectores reforzará el declive en su uso.
- Veo esto como el problema más importante que deberemos resolver. La solución involucra no solamente un mayor control sobre el uso del automóvil, especialmente en zonas comerciales de buena accesibilidad por el transporte público, sino también: (i) mejor transporte público, y; (ii) una buena planificación, regulación y fiscalización del uso de suelo.

LA SOSTENIBILIDAD FINANCIERA Y SOCIAL

- En general, con contadas excepciones, la subvención directa a la operación del transporte colectivo urbano en la región, ha desaparecido, aunque en Brasil, el sistema **vale transporte**, de subvención a los desplazamientos efectuados por los trabajadores de bajos salarios, es bien establecido.
- Además, los gobiernos se han dado cuenta de las consecuencias ingratas de la fijación de tarifas en valores inferiores a los costos de largo plazo de proporcionar el servicio.
- En gran parte como consecuencia de estos dos fenómenos, las tarifas han subido desde, alrededor de USD 0.10 a fines de la década 1980, hasta USD 0.35 diez años más tarde, y en ciudades como Buenos Aires, Santiago y varias de Brasil, alcanzan al rango de USD 0.50 a USD 0.60.
- Por lo tanto, en muchos casos, aunque no en todos, las empresas y otras operadoras de transporte colectivo se pueden considerar financieramente

sostenibles, a costo de generar una situación de posible insostenibilidad social, por la alta incidencia del costo de los pasajes pagados por usuarios de bajos ingresos.

- Un ejemplo de esto ocurrió en Guatemala, en abril del año 2000. Por un congelamiento de la tarifa, durante una serie de años de inflación significativa, la situación de los empresarios se volvió financieramente insostenible. El gobierno municipal trató de resolver su problema autorizando un alza de tarifas, generando, de esta manera, una insostenibilidad social. A lo menos cinco personas perdieron la vida en las manifestaciones populares resultantes.
- La congestión es causada básicamente por las personas de altos ingresos que manejan sus automóviles en zonas centrales y comerciales en períodos de punta. Estos también sufren mayores demoras como consecuencia, pero no les es cobrado ningún castigo monetario.
- Pero la congestión creada por los automóviles también atrasa los buses, y a sus pasajeros, que frecuentemente son de menores ingresos (ganando típicamente montos equivalentes a una tercera parte, o menos, que los automovilistas).
- La congestión no tiene costos financieros para los automovilistas ricos, pero sí para los pasajeros pobres de los buses, puesto que implica aumentar el número de vehículos y choferes que hay que tener para atender la demanda.
- En 1982, la CEPAL estimó ese mayor costo en un 2% a 5%, en el caso de Santiago. En 1998, la ANTP y el IPEA lo calcularon en valores comparables para la mayoría de las regiones metropolitanas brasileras, con índices superiores para algunas de las más grandes y más congestionadas, como Río (10%) y São Paulo (16%).

ALGUNAS CONCLUSIONES

1. Es primordial tomar acciones para detener y, en lo posible invertir, la tendencia hacia un mayor uso del automóvil para viajes en horas punta a zonas con buena accesibilidad por transporte público.
2. El uso de suelo deberá ser regulado de una manera que haga económicamente viable al transporte colectivo.
3. Corregir la partición modal exige la toma de medidas tanto de tipo “palo”, como la imposición de mayores restricciones sobre los estacionamientos, como “zanahoria”, por ejemplo la introducción de mejoras al transporte público.
4. Se justifican, a veces, la concesión de subvenciones al transporte colectivo, por razones de eficiencia y de equidad.
5. La concesión de estas subvenciones debería enmarcarse dentro de un sistema de licitaciones competitivas.



Department of Economic and Social Affairs

Commission on Sustainable Development
Ninth Session
16 - 27 April 2001, New York

**TRANSPORT AND SUSTAINABLE DEVELOPMENT
IN THE ECE REGION**

BACKGROUND PAPER NO. 11

Prepared by the
Economic Commission for Europe (ECE)

TRANSPORT AND SUSTAINABLE DEVELOPMENT IN THE ECE REGION

I. Introduction

During the past decades, ECE member countries, particularly in Western Europe, have experienced an economic growth which has led to unprecedented levels of prosperity and welfare but also to environmental and health problems. The transport sector has substantially contributed to both effects. In Central and Eastern European ECE member countries, after decades of economic stagnation and environmental neglect, the transition process initiated a decade ago has led to a healthier economic situation and to an increased awareness of environmental problems. However, the evolution of the transport sector towards a substantial shift to road transport in these countries, while important for economic development, may aggravate environmental problems if appropriate measures are not taken.

II. Transport and sustainable development in the ECE region

1. Transport and socio-economic development

Transport is indispensable for the well functioning and development of economic activities, for the production and distribution of goods and services as well as for trade. Transport has, therefore, been at the very basis of the economic development in western European ECE member countries in the past decades, contributing to the economic prosperity and social well-being of their citizens. In particular, it has played a most strategic role in the opening up of peripheral and isolated ECE countries and regions and in their integration into the national, European and/or global economy. The transport sector has itself become an important sector of the economic activity in western European ECE countries where it accounts on average for about 7% of GDP and for more than 10% of employment. Furthermore, the transport equipment industry, in particular the motor vehicle industry, is one of the most important and dynamic industrial sectors in many ECE countries.

For these reasons, transport has always been a strategic area of responsibility of ECE Governments, which have played a major role in facilitating mobility and accessibility, including through the supply of transport services. ECE Governments are more recently limiting their role to the planning of infrastructures and the establishment of a regulatory framework within which mobility and transport services can become safer, more efficient and more environmentally sound. With the growing concern of the long-term sustainability of transport developments, ECE Governments are also committed to strengthen their integrated efforts to this end.

Transport has also played a major role in the economic development and integration of the ECE region as a whole through the facilitation of international transport. The notion of international transport is particularly relevant in Europe, which, in contrast to other continents, is divided into numerous countries and where the movement of persons and goods often implies the crossing of one or more borders.

Road transport is, of all modes of inland transport, the one which has increased the most in the ECE countries in recent times, at both national and international level, while other more sustainable modes of inland transport, such as rail, public and inland water transport, have stagnated if not declined. Current transport deregulation policies in ECE member countries and the still widely felt aspirations of populations, particularly in Central and Eastern European countries, to personal mobility after decades of lack of alternatives in transport are expected to lead to a continuous growth in road transport in the years to come.

2. Environmental impact of transport systems

In the ECE region, transport has also led to environmental and health concerns. Indeed, transport consumes energy and causes air, water, soil and sea pollution as well as noise and vibrations. With regard to air pollution, transport is responsible for emissions of CO₂, NO_x, VOCs, HC, CO, lead, particulates and SO_x. Road congestion, particularly in large urban areas and along main transport corridors in ECE countries, aggravates the situation. Noise in the vicinity of airports also raises concerns. In the ECE region, transport accounts for a large share, and an increasing one, of the total final energy consumption. Transport infrastructures, while badly needed in Central and Eastern European and in peripheral ECE countries for development, adversely affect the environment through land taking and visual intrusion, and in some other ECE countries the construction of new infrastructures faces increasing opposition.

Of all modes of inland transport, road transport is clearly the mode which has the biggest environmental impact in terms of energy consumption and air pollution. Road transport is responsible for important shares of CO₂, CO, NO_x, VOC, HC, lead, particulates and a smaller share of SO_x. A large part of all pollutants from road transport is released in urban areas. Although, rail and inland transport account for comparatively less environmental externalities, railways cause noise and vibrations but also pollution, both directly (diesel traction) and indirectly (electric traction). Inland navigation causes water and air pollution. Air transport causes noise and vibrations, but also gaseous emissions which, for being released at high altitude, are considered to be particularly harmful. Additionally, air transport presents the highest specific energy consumption of all transport modes. Maritime transport causes sea pollution through accidents and discharges as well as air pollution. Finally, the transport of dangerous goods represents a potential risk for the environment through accidents.

ECE Governments are aware that, if they want transport to continue to play, both at national and regional level, its economic and social role in future, they must promote a development of the transport system which is compatible with sustainable development.

III. The role of the ECE

The Plan of Action recently adopted by the ECE has confirmed that, in the field of transport, the ECE is a forum for cooperation among member Governments, with the overall objective to facilitate and develop international transport while improving its safety and environmental performance. Since its creation in 1947, the ECE has provided a major contribution to this endeavour. It has done so mainly through the development and continuous updating of a set of international legally binding Agreements and Conventions covering a broad

range of transport issues. These ECE legal instruments have defined coherent pan-European infrastructure networks for the various modes of inland transport, simplified border-crossing procedures and established commonly agreed transport safety and environmental regulations.

The ECE has played and continues to play a key role, in particular, in the improvement of the safety and environmental performance of newly manufactured motor vehicles. In the framework of the ECE Inland Transport Committee, the Working Party on the Construction of Vehicles (WP.29) has developed a number of ECE Regulations annexed to the so-called 1958 Agreement, which set up specific emission limits for the various gaseous pollutants and noise as well as requirements on energy consumption. Motor vehicles manufactured in countries Parties to the 1958 Agreement and applying those Regulations comply with those limits and requirements. These ECE Regulations are constantly updated to keep pace with the best available technology and respond to demands from society for increased environmental protection. The emission limits for CO, HC, NO_x, VOC and particulates established in the latest ECE Vehicle Regulations in force are considerably lower than those in force thirty years ago. Also lower is the level of noise, measured in acoustic power, and fuel consumption, directly linked to CO₂ emissions. The impact of these abatements in the improvement of air quality will be more noticeable as old, highly polluting vehicles are replaced progressively with the new, much cleaner ones. WP.29, which has recently become the World Forum for Harmonization of Vehicle Regulations, will in future develop global regulations, which may be expected to further reduce emission limits of motor vehicles and introduce new less polluting fuels.

The ECE has also played a role in promoting the development of more environmentally sound transport modes such as rail, inland water and combined transport and has developed a number of related legal instruments to this end, including the AGC, the AGN and the AGTC respectively.

It is widely admitted that the full and effective implementation of these ECE legal instruments on transport in Central and Eastern European as well as Caucasus and Central Asian member countries would make transport systems in those countries more efficient, safer and more environmentally sound.

ECE governments, in the framework of the Convention on the Long-Range Transboundary Air Pollution and its related eight Protocols, have established requirements and limits for the overall emissions of gaseous pollutants produced by all kinds of sources and sectors, including transport. The Protocol to Abate Acidification, Eutrophication and Ground-level Ozone adopted in Gothenburg (Sweden) in 1999, sets differentiated emission ceilings for 2010 for sulphur, Nox, VOCs and ammonia, which were negotiated on the basis of assessments of pollution effects and abatement options. Once the Protocol is fully implemented, Europe's sulphur emissions should be cut by at least 63%, its Nox emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990. The Protocol also sets tight limit values for specific emission sources (including cars and lorries) and requires best available techniques to be used to keep emissions down. Guidance documents adopted together with the Protocol provide a wide range of abatement techniques and economic instruments for the reduction of emissions in the relevant sectors, including transport. Scientific work has started to

prepare for incorporating also fine particulate matter pollution into the Gothenburg Protocol, when it is up for its new review, scheduled for 2004.

The ECE Convention on Environmental Impact Assessment in a Transboundary Context (1991, Espoo Convention) prescribes measures and procedures to prevent, control or reduce any significant adverse effect on the environment, which may be caused by a proposed activity e.g. in the field of transport. Furthermore, in order to integrate environment and health issues into policies, plans and programmes of the economic sectors including transport, the ECE is in the process of developing a legally binding instrument on Strategic Environmental Assessment.

More recently, in 1997, the ECE organized in Vienna a Regional Conference on Transport and Environment, where Ministers and high level officials of both the transport and environment sectors sat together for the first time in an international forum. The Conference adopted a Declaration by which ECE Governments committed themselves to «undertake to reduce the negative impact of transport on the environment and human health by promoting measures to reach volumes and patterns of transport which are compatible with sustainable development». To this end, the Declaration set up a comprehensive strategy, which included : promotion of less polluting vehicles and fuels ; promotion of transport efficiency ; protection of sensitive areas ; promotion of sustainable urban transport ; safe transport of dangerous goods ; and prevention of water pollution. It also included improved land use planning. The Conference also adopted a Programme of Joint Action and endorsed two new legal instruments, one aimed at adopting uniform norms for periodical technical inspections of vehicles, and another to promote combined transport on inland waterways. In addition, the Conference endorsed amendments which will oblige heavy commercial vehicles in international traffic in Europe as from 2002 to comply with the emission standards in force at the date of their manufacture and/or to have passed periodical technical inspections. A network of national Focal Points has been established and a number of Lead Actors volunteered to undertake specific elements of the Programme of Joint Action. A Joint Meeting on Transport and Environment, comprised mainly of the members of the Bureaux of the Inland Transport Committee and the Committee on Environmental Policy, is steering the follow up to the Vienna Conference. An Ad hoc Group of Experts has been created to assist in this task. A mid-term review meeting is foreseen in 2002.

The Third Ministerial Conference on Environment and Health (London, June 1999) adopted a Charter on Transport, Environment and Health, in which member countries of the WHO's European region confirmed their commitment to making transport sustainable for health and the environment. The ECE is also participating in the follow up and monitoring of the implementation of the Charter's Plan of Action, which requests for a number of specific transport, environment and health related "products" to be delivered by the Fourth Environment and Health conference to be held in Budapest in 2003. In this context, ECE and WHO have provided jointly a report which reviews the relevant international response to date in priority areas for the transport sustainable for environment and health and contains recommendations for further action in these fields. The recommendations include developing of a new legal instrument focusing on integration of environment and health concerns into transport policies and decision making and urban areas, further development of existing international instruments as well as closer cooperation with other organizations and projects. Decisions on further steps are expected

to be taken at a High-level meeting of ministers of transport, environment and health or their representatives, which will be held in Geneva on 4 May 2001.

While these efforts have already produced noticeable results and progress is continuously made, a number of causes of concern remain. First and foremost, the reduction in energy consumption of new vehicles achieved through technology and regulation has been largely offset in the ECE region by a sharp increase in the number and engine power of vehicles in recent years. This problem will require further technological research, including on new less polluting fuels and engines, but also economic incentives to encourage the use of low-consumption vehicles and wider transport and urban planning decisions. Second, the latest vehicle emission limits adopted are not mandatory in all ECE countries. Third, these emission limits concern newly manufactured or yet to be manufactured vehicles, while a large part of the existing vehicle park, particularly in Central and Eastern European ECE member countries, is comprised of older, more polluting vehicles. The transfer of part of road traffic of goods to other modes of inland transport appears to be less easy than desirable and will require considerable improvement in the efficiency and reliability of these modes, including in their infrastructures.

Coherent, integrated and long-term solutions, which assure the commitment and involvement of all the relevant actors at the international, national, regional and local levels are crucial for assuring in future an efficient transport sustainable for health and the environment. Such an approach is currently being considered by ECE Governments. It involves reinforcing of the implementation of existing legislation and the development of relevant monitoring mechanisms. It also requires better transport demand management as well as land-use- and urban planning. Finally, development of the necessary mechanisms at the national level to achieve the desired level of cross-sectoral integration might be facilitated by an overarching integration strategy common of all ECE member countries.