Unit 9
Transport and the Natural Environment

TEC711S
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Unit Outline

• On reading this unit, you will learn about:

  – The relationship between the macro economy and the environment
  – The impact which transport has in terms of the environment
  – The main issues surrounding the carriage of freight and its impact on the environment from a balanced perspective
  – How economics can aid in our understanding of how transport affects the environment
  – The economic options which can be considered as a means of addressing environmental issues.
What are externalities?

• Externality is that situation in which the actions of one agent imposes a benefit or lost on another economic agent who is not party to a transaction. It could be Negative or Positive

• Negative Externalities (external dis-benefit) –: it is a cost or benefit incurred by a party`s decision or purchase on another, who neither consents nor is considered in the decision e.g. Pollution (air, water and noise).
What is climate change?

- “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. **UNFCCC (United Nation Framework Convention on climate change)**

- “a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer”. **IPCC (Intergovernmental Panel on Climate Change)**

- Namibia ratified the UNFCCC in 1995

- Namibia acceded to the Kyoto Protocol in 2003

- The Ministry of Environment and Tourism (MET) through the Directorate of Environmental Affairs (DEA) is responsible for overseeing the coordination of climate change issues in Namibia.
• 70% of the population of the southern African countries lives in rural areas where their direct dependence on the natural ecosystem with its goods and services is high thus impacts of climate change are more

• Their livelihood is largely dependent on agriculture

• Most developing countries, including Namibia are categorised as non-Annex 1 countries. According to the UNFCCC

• Non-Annex I Parties are mostly developing countries. Certain groups of developing countries are recognized by the Convention as being especially vulnerable to the adverse impacts of climate change, including countries with low-lying coastal areas and those prone to desertification and drought.

• Namibia’s contribution to greenhouse gas emissions is insignificant. IPCC

• Namibia energy sector produced 2200 Gg CO2-equivalents in 2000, compared to 1905 Gg CO2-equivalents in 1994 of which (50%) was contributed by the transport sector in 1994
# Air pollution

Total transport emissions as % of total emission

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<tr>
<th></th>
<th>North America</th>
<th>OECD states</th>
<th>Japan</th>
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<tbody>
<tr>
<td>Nitrogen oxides (Nox)</td>
<td>47</td>
<td>48</td>
<td>39</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>71</td>
<td>75</td>
<td>na</td>
</tr>
<tr>
<td>Sulphur oxides (Sox)</td>
<td>4</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Particulates</td>
<td>14</td>
<td>13</td>
<td>na</td>
</tr>
<tr>
<td>Hydrocarbons (HC)</td>
<td>39</td>
<td>40</td>
<td>na</td>
</tr>
</tbody>
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## Population exposed to road traffic noise over 65dBA

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<tr>
<th></th>
<th>North America</th>
<th>OECD states</th>
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<tr>
<td></td>
<td>19 million</td>
<td>110 million</td>
<td>36 million</td>
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• **LINKS BETWEEN THE ECONOMY TRANSPORT AND ENVIRONMENT**

• The macroeconomic concept of the circular flow of income relates to the flow of income and expenditure between households and firms and can be used in order to set the scene in terms of transport and the environment.

• With respect to the circular flow of income households receive income for the factor services they have undertaken and with that income they buy goods and services, including transport.

*The macro economy and the environment*
• The environment, transport and the economy can be linked in three ways as illustrated in Figure above:

• **Natural resources**: transport makes use of natural resources most notably oil which is in fact the most dominant source for transportation (Chapman, 2006)

• According to the International Energy Agency (2002) the transport sector accounts for 54 per cent of the primary oil demand in OECD countries.

• **Waste products**: including transport emissions, are generated by both households and firms in the transport activities in which they are engaged.

• The natural environment can be seen as a ‘dumping ground’ for waste products and one that apparently comes at a zero economic cost.

• **Amenity services**: it relates to the natural environment which provides households with benefits such as recreational space and areas of natural beauty such as National Parks, accessed predominately by the private motor vehicle

• These can clearly be affected by economic activity and the related transport decisions made by both households and firms in terms of transport emissions.

• In conclusion we can agree that the link between transport activity and the environment is unsustainable. This brings the question to what is really a sustainable transport?

• Sustainable transport can be defined as ‘the ability to meet society’s need to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or eco-

• logical values, today or in the future’ (WBCSD, 2002).
Transport emissions

- **Carbon dioxide**: is combustion of fossil fuels and in terms of domestic transport accounts for 23 per cent of carbon dioxide emissions.
- **Carbon monoxide**: is the product of internal combustion engines, and domestic transport accounts for approximately 50 per cent of carbon monoxide emissions.
- **Nitrogen oxide**: is caused by combustion engines and other industrial, residential and commercial sources that burn fuels. It can impact on the environment in a number of ways, once emitted it can be transported many miles before being deposited as acid rain impacting on forests, lakes, wildlife, crops and buildings.
- **Particulates (PM10)**: also impact on health including effects on both the respiratory and cardiovascular systems. It particularly impacts on asthma sufferers.
- Both **benzene** and **1,3-butadiene** emitted from car exhausts are seen to be a human carcinogen, which means it is an agent that is directly involved in the promotion of cancer.
- **Lead** has historically been a major source of emission from motor vehicles and industry.
- Lead has an impact on health in terms of damage to the kidneys, liver, brain and nerves. Exposure to lead can also lead to osteoporosis and reproductive disorders.
AN ECONOMIC MODEL OF TRANSPORT AND POLLUTION

- The vertical axis measures the costs and benefits, both to transport and society.
- The horizontal axis measures the level of transport activity and its related pollution, which is assumed to be directly related to the level of transport activity.
- The marginal external cost curve (MEC) measures the additional environmental cost of transport activity, in terms of air pollution, noise and so on.
- Marginal private benefit (MPB) measures the additional benefits, in terms of satisfaction received by the road user or airline passenger from undertaking journeys, or road haulier or cargo handler in terms of profitable activity.
AN ECONOMIC MODEL OF TRANSPORT AND POLLUTION

- If the transport user/sector is not constrained in terms of their level of activity then they will consume or provide an amount equal to TA1.
- This means that the area under the MPB curve, represented by A + B + C will be maximised.
- At that level of activity (TA1) however there are external costs in terms of the impact of the emissions detailed above of B + C + D.
- The optimum level of pollution, therefore, is achieved at a scale of transport activity TA2, where the MPB = MEC.
- If the transport user operated at a level of activity above TA2 then the additional environmental costs would be greater than the additional benefits accrued from undertaking the transport activity.
- This represents what is termed a ‘welfare loss’ to society, whereas at a level of transport activity below TA2 the opposite is true. Here the MPB is greater than the MEC and as such, activity should be allowed to increase to TA2, in order to take account of these additional benefits. Note further, however, that continuous production above level TA2 will result in a significant negative impact upon the environment.
AN ECONOMIC MODEL OF TRANSPORT AND POLLUTION

• The costs (MEC) in terms of airport pollution and so on are not incurred by the same group.

• For example, aviation activity is likely to lead to profit for the airport operator, but the costs are incurred by those who live in the vicinity of the airport and who suffer, in particular from the noise and air pollution, not simply from aircraft but also the surface access traffic.

• These can be viewed as **external costs** since transport users or organisations do not normally include them in their decisions as to what output level to produce.

• The costs are actually incurred by third parties who are not involved in the transport activity but who suffer from the ‘spill over effects’.

• In terms of our airport example, the first two parties are the airport operator (the producer) and the airline and airline passengers (the consumers).
Means of addressing the issue of the environmental impact associated with road and air transport.

- **Bargaining** - The basis of this particular approach is that if property rights are assigned then bargaining will occur naturally between the various parties that suffer from or are the source of external cost, the externality, and the optimum level of pollution will be the result.
- The notion of bargaining is based on the idea that if property rights are assigned to either of the two parties, thus giving the airline operators or airport the right to pollute or to those who are affected by the pollution to clean air, then via bargaining agreement will be reached so that pollution is reduced.
- If the property rights were assigned to the airline/airport operator then in terms the level of transport activity would be TA1, with profit maximised and no account given to those affected by emissions.
- It would however be in the interest of those suffering from the emissions to pay the polluter if they agree to reduce their level of activity and thus their level of pollution. In this situation the sufferers would pay as long as it was less than the value of the pollution from which they would otherwise suffer.
- In terms of the Figure above therefore the sufferers may be willing to offer the polluters a maximum amount of C+D, which represents the total external cost incurred by the sufferer as a result of the transport activity TA2–TA1.
- The airline/airport operator would have been prepared to reduce their scale of activity from TA1 to TA2 for an amount no less than C, an amount which
• If on the other hand the ‘property rights’ were to be assigned to the sufferers, who therefore have a right not to be affected by aviation pollution, that is a right to clean air or no noise, then the airline operators and thus the airport would have to cease operation, thus being at point 0 in the figure, with no airline or airport activity or related pollution
A tax-based solution

- This would involve setting a price which places a monetary value on the environmental costs of transport using taxation and imposes these upon the polluter. Such a solution is likely to reduce the demand to travel and therefore the environmental impact.
- In terms of the economic model in Figure 9.4, then, if an environmental tax of t (known as a Pigouvian tax, which is a tax imposed upon an externality) is imposed on the transport user/operator/polluter it has the effect of shifting the MPB curve to MPB−t. The tax would be paid on each unit of pollution and the transport operator would now maximise their marginal private benefits at a level of activity equal to TA2.
- If the transport operator undertook a level of activity between TA2 and TA1 then the benefits received (in terms of profit) would be less than the amount of tax paid.
Advantages and disadvantages with the use of an environmental tax on the transport user/operator.

• Advantages
  – With an environmental tax, then, the road or air transport user or airport/airline operator has to pay a price for the pollution caused. As such, the polluter has an incentive to reduce their level of activity to the optimum level of TA2
  – The introduction of an environmental tax allows the transport user/operator to decide how they will respond, unlike the use of a standard which sets a particular limit.
Disadvantages

- There may be difficulties in establishing the optimum tax of $t$, although in reality the aim may be to get as close to the optimum as possible. If the tax is underestimated then it may lead to a problem.
- There are often political difficulties when introducing a new tax, say with a passenger tax on airline users. There may be resistance in that the belief is that the tax will be raised above $t$ in Figure once it is introduced - the tax being seen simply as a revenue-raising measure.
• ** Tradable Permits** The idea behind tradable permits is that polluters are presented with a number of ‘permits’ which allow them to emit a particular level of CO2. The number of permits which exist clearly limits the amount of emissions. The permits are tradable in that they can be bought and sold to other polluters who are participating in the particular tradable permits scheme.

• The basis of such a scheme is that those organisations who are able to achieve a lower level of emissions are then able to sell their superfluous permits to organisations that are not able to meet the emissions target set and are therefore forced to buy permits to emit if they do not want to curtail their activity.
• **The setting of standards**  Polices such as the requirement for an annual vehicle inspection for road trucks and private vehicles and vehicle exhaust emissions tests or limits on noise from aircraft

• Setting a standard of S1 would achieve the optimum level of transport activity TA2 in the Figure. If achieved this would result in the optimum level of pollution.

• Clearly as with taxation it could be the case that the standard has been incorrectly set. It could be too harsh, thus a point to the left of S1, or too lenient, a point to the right of S1.

• Not only does the standard have to be set correctly but the penalty for not meeting the standard has to be established. The optimum penalty will be Penalty 1, for if a penalty such as Penalty 2 were to be set then the polluter would be tempted to pollute up to TA3 because the penalty (if ever administered) would be less than the level of additional satisfaction obtained between TA2 and TA3.
Technological change

- This can take a number of forms. First, transport emissions of carbon monoxide have been reduced through technology-related initiatives such as cleaner fuels with reduced carbon content, cleaner, more efficient car engines and electrified public transport. Catalytic converters fitted to petrol-driven cars have reduced emissions in pollutants such as nitrogen oxide and benzene and in the UK new cars are 10 per cent more fuel efficient, on average, than they were 10 years ago.

- Second, technological advances have improved the ways in which individuals can make choices about transport modes, through in-car information and real-time information at public transport stops.

- Third, through video conferencing meetings can be undertaken without the need to travel. This is also another aspect of technological change which leads to a reduction in transport emissions.
Promotion of alternative modes of transport

• This policy option involves encouraging alternative modes such as public transport, walking, cycling, rail freight and shipping. The private car has the advantage of convenience and flexibility whereas public transport tends to be confined to fixed routes.

• Trams are in many respects a more environmentally-friendly, although expensive, alternative to the private car.
• Promotion of alternative modes of transport – for examples Trams and cable cars
All this are done to reduce MEC