Volume 3, November 2007

Tran:SIT Update

Transformation towards Sustainable and Integrated Transport

Energy, Climate Change and Transport

The Energy, Climate Change and Transport Nexus

Climate change and the depletion of global oil reserves are two of the key challenges facing the world today, and transport directly impacts on them both. The transport sector is the fastest growing and second largest source of greenhouse gas (GHG) emissions, accounting for 13%. Global energy supply accounts for the largest source of GHG emissions. The transport sector also consumes approximately 20% of global energy reserves and up to 90% of oil reserves. Increased urbanisation and economic development, particularly in developing countries such as India and China and to a lesser extent South Africa, and the resultant increased motorisation will have an added impact on the environment.

It is projected that by 2050 transport emissions will double, particularly if there are no major shifts in the current transport system to a more efficient one. Synthetic fuels from coal and gas have been proposed as a "solution", but are twice as polluting as conventional oil because of emissions released in the production of the fuel.

Three-quarters of the transport sector's greenhouse gas emissions are from road transport, including passenger, freight and public transport vehicles, with air transport emitting 12% and shipping and rail responsible for 10% and 2% respectively. The main emission from road transport is carbon dioxide (CO_2), which is a by-product of the burning of fuels in the internal combustion engine. CO_2 emissions are almost directly proportional to the quantity of fuel consumed. A decrease in fuel consumed will therefore mean a reduction in CO_2 emissions, if everything else remains the same. There are a number of other behavioural changes that could also decrease fuel consumption and therefore CO_2 emissions. These are discussed in more detail at a later stage in the booklet.

The purpose of this booklet is to highlight the transport sector's impact on climate change as well as it's dependence on fossil fuels. We will discuss how a move towards sustainable transport and movement patterns which depend least on non-renewable and polluting energy sources can start addressing these impacts and the need for a drastic change in transport and land-use planning towards sustainable cities.

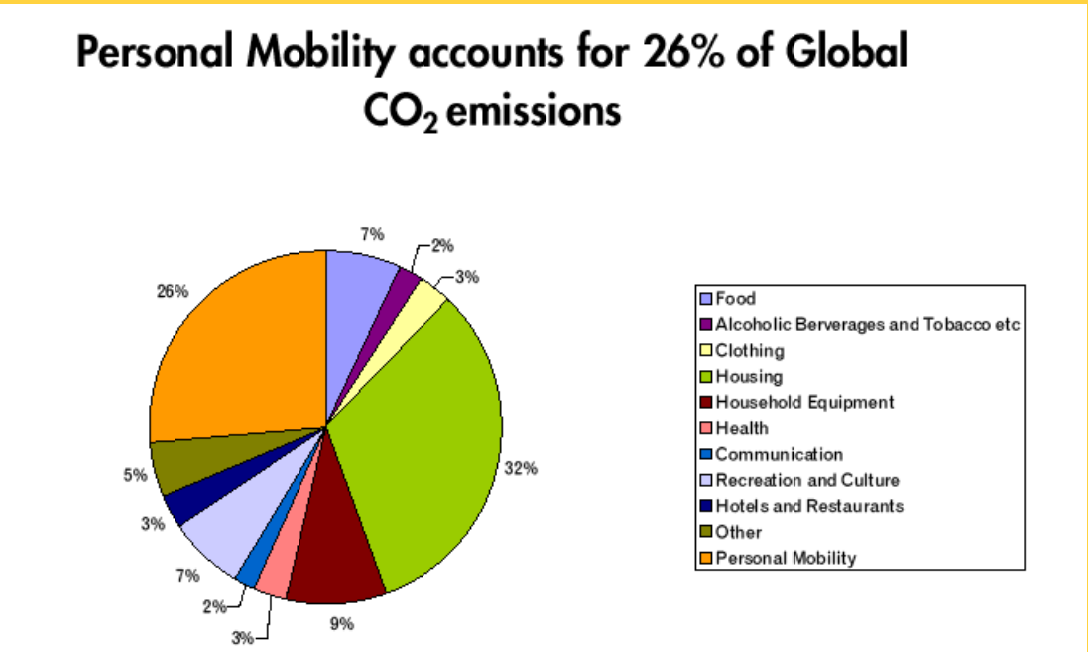
Sustainable Transport promotes a new way of thinking about transport planning. This booklet is part of a series of booklets produced by the Urban Tran:SIT Programme. The Transformation to Sustainable and Integrated Transport for the urban environment (Tran:SIT) Programme focuses on sustainable transport and energy issues related to urban development in South Africa. The programme aims to build capacity of South African cities around sustainable transport.

A partnership project between the City of Cape Town and Sustainable Energy Africa. This Programme is funded by the British High Commission.

Sustainable Energy Africa

THIS CITY WORKS FOR YOU

British High Commission South Africa



Personal Mobility is the second largest contributor to personal GHG emissions for the average person.

Source: WWF One Planet Business Global Evidence Base, 2006 .

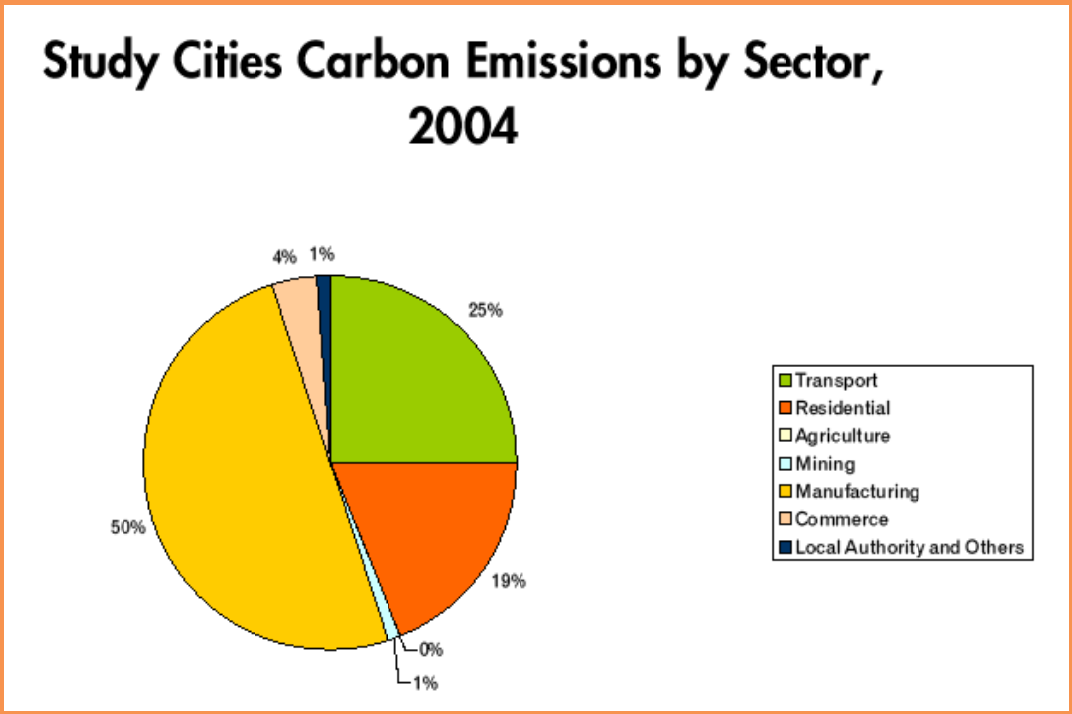
The Impact of Climate Change in South Africa

South Africa is extremely vulnerable to the impacts of climate change. It is expected that climate change will affect agricultural production, biodiversity, water resources and urban air quality in South Africa due to changes in temperature and rainfall patterns. South Africa is the largest emitter of GHG emissions in Africa, and is therefore morally obliged to play a key role in the mitigation of these impacts.

The transport sector is the second largest emitter of CO_2 in South African cities, accounting for 25% of emissions. These emissions are predominantly from road transport including private, freight and public transport vehicles. The improved economic development in the country is leading to increased urbanisation and motorisation, which means that people generally buy a car once they can afford to, because the alternatives are not suitable.

The impact of the transport sector has been noted and the need for mitigation measures has been identified. The Department of Minerals and Energy in their 2005 Energy Efficiency Strategy have set a target of 9% reduction in energy demand for the transport sector by 2015. In the implementation of energy efficiency interventions to meet the target, CO_2 reductions could also be realised.

Most transport mitigation measures are long-term measures and will require major shifts in the current transport system. The National Climate Change Response Strategy has identified a transport sector mitigation programme which combines energy efficiency and emissions reduction programmes for road-going vehicles. The mitigation options include public transport initiatives, particularly focusing on upgrades and service efficiency in order to encourage modal shifts, fuel efficiency in private vehicles, including a move away from SUVs to smaller, lighter more efficient vehicles and improved uptake and acceptance of alternative fuels and technologies including hybrids, electric cars and hydrogen fuel cells.



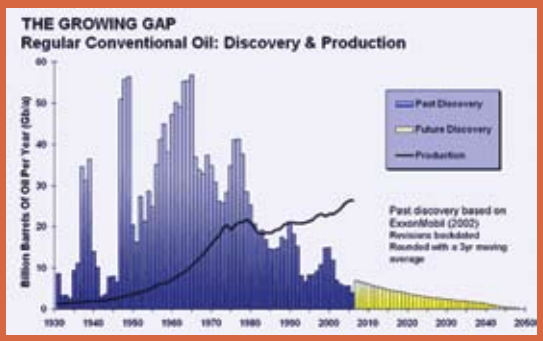
Transport is the second largest emitter of carbon emissions in South African cities, taking into account both private vehicles and public transport.

Source: State of Energy in South African Cities 2006.

Implication of Peak Oil for South Africa

Peak Oil refers to the peak of the planet's oil production, which is defined by the point where the rate of available oil starts a decline. There is currently much debate around when oil production is expected to peak. Most estimates show that world peak could lie in the next 5 – 10 years, although some predictions are more optimistic. As oil becomes scarcer the oil prices are expected to rise. The oil reserves remaining are increasingly difficult and expensive to extract, adding to the expected production cost and associated fuel price increases so the fuel price is expected to increase as some of these costs are passed on to the consumer. In tandem, economic growth is on a continuing long-term upward trend. This economic growth demands energy and over time there will be an exponentially increasing gap between economic growth expectations and energy availability from oil.

Imported oil makes up about 65% of South Africa's annual petroleum consumption. The remainder



This graph shows the decreasing discoveries of new oil reserves compared to the growing demand globally for oil.

Source: ASPO Ireland

comes from domestic production of oil (5%) and the synthetic fuel industry (30%). Three-quarters of petroleum products are used for road transport. Peak Oil therefore represents a threat to liquid fuel prices as well as availability in South Africa. South Africa could also experience various indirect effects of Peak Oil via its impacts on the global political economy.

In general, those sectors that use oil most intensively will suffer the greatest impact of declining oil production. The heavy reliance of road freight for the retail sector in South Africa will mean increases in goods prices as the oil price increases. The tourism sector could shrink as international transport becomes more expensive, particularly considering South Africa's distance from the wealthier nations, including the United States, European Union and Japan. Local tourism could also be affected due to the higher transport costs. Agriculture and food security could also be affected as increasing scarcity and cost of oil would impact the cost of food production. Government's decision to promote biofuels as an alternative to conventional liquid fuels could also add to further competition for maize and other food crops. Finally, diminishing availability leading to liquid fuel price rises presents an enormous structural challenge to cities. Urban areas would have to densify and the infrastructure, including public transport would need to be upgraded.

Public Transport and CDM: The TransMilenio Example

The Clean Development Mechanism (CDM) was established through the Kyoto Protocol and allows industrialised countries with greenhouse gas reduction commitments to invest in emissions reducing projects in developing countries as an alternative to more costly emission reductions in their own countries. It also assists developing countries to move towards sustainable development.

TransMilenio is the Bus-Rapid Transit (BRT) system operating in Bogotá, Columbia. The BRT system makes use of dedicated bus ways, pre-board ticketing and elevated bus stations that allow for a comfortable and efficient public transport service.

Source: Andrés Ramirez

The first large-scale transport project to be registered for CDM was the TransMilenio Bus-Rapid Transit (BRT) system in Bogotá, Columbia. TransMilenio includes new infrastructure consisting of dedicated lanes, large capacity buses and elevated bus stations that allow pre-board ticketing and fast boarding. Smaller units offering feeder services to main stations are integrated in the system. It includes a new integrated fare system allowing for free transfer as well as centralised coordinated fleet control providing monitoring and communications schedule services and real-time response. In order to ensure the efficiency of the system, 9 000 of the oldest conventional buses were scrapped and replaced with larger capacity, new buses.

TransMilenio aims to provide a more resource efficient transport option for the commuters of Bogotá, focussing on reduced emissions per passenger trip as the key indicator. This is realised through improved efficiency due to new and larger buses that have improved fuel efficiency per passenger, through increased use of the new public transport system as it provides a more attractive,

reliable and comfortable service and the centrally managed system, which ensures that the vehicles occupancy is used efficiently. .

The project contributes to improved sustainability of the system through reduced GHG and other air pollution emissions. The system impacts on improved social well-being as a result of less time lost in congestion, less respiratory disease due to decreased particulate matter pollution, less noise pollution as well as fewer accidents per passenger transport. Bogota has also improved its competitive position by offering an attractive and modern public transport system and is reducing the cost of congestion.

TransMilenio Phase 1 was prepared as a Voluntary Emission Reduction (VER) project, selling the emissions reductions from 2001 – 2012 on the voluntary market, without the project having to go through the CDM approval process. Phase II onwards was registered as a CDM project. The first monitoring period covered 2006 and the delivery of the first Certified Emission Reductions (CERs) took place in mid-2007. The money received through the selling of CERs will assist with further upgrades of the public transport system.

The future success of the TransMilenio CDM project depends on the continued expansion of the project, which may be affected by changes in the political leadership of the city as well as the future demand for Carbon Emission Reduction projects after 2012, when the current phase of the Kyoto Protocol comes to an end.

Item	GHG Reductions until 2012	Expected income from sale of emission reductions till 2012	GHG reductions until 2026	Expected income from sale of emissions reductions till 2026
CERs	1 700 000	$ 20 000 000	8 500 000	$ 100 – 300 million
VERs	2 100 000	$ 10 000 000	5 000 000	$ 30 – 50 million
Total	3 800 000	$ 30 000 000	13 500 000	$ 130 – 350 million

Source: calculation by Grütter based on expansion projections of TransMilenio and calculated GHG offsets: price ranges from 2012 onwards are based on constant prices as currently given (low level and price increase based on an increasing world market price due to increased marginal cost of offset).

How the CDM Process Works

An industrialised country that wishes to get credits from a CDM project must obtain the consent of the developing country hosting the project that it will contribute to sustainable development. Then, using methodologies approved by the CDM Executive Board (EB), the applicant must make the case that the project would not have happened or should not happen without CDM, and must establish a baseline estimating the future emissions in absence of the registered project. The case is then validated by a third party agency, a so-called Designated Operational Entity to ensure the project results in real, measurable, and long-term emission reductions. The EB then decides whether or not to register (approve) the project. If a project is registered and implemented, the EB issues credits, so-called Certified Emission Reductions; CERs (one CER being equivalent to one metric tonne of CO_2 reduction), to project participants based on the monitored difference between the baseline and the actual emissions, verified by an external party.

Tackling the problem – sustainable transport interventions

In addressing the impacts of climate change through sustainable transport interventions, cities also benefit from a range of benefits, including improved air quality, reduced noise from traffic, increased road safety and other social and economic benefits.

One of the key aspects of a sustainable transport system is to limit emissions, increasing the use of renewable resources and minimising the use of non-renewable resources, particularly when suitable renewable substitutes are not yet available. In order to move away from a dependence on private vehicles, an integrated transportation planning approach should be taken. A sustainable transport system supports lifestyles and movement patterns which depend least on non-renewable and polluting energy resources. It encourages walking, cycling and public transport over private vehicle use and it supports integrated planning approaches which move towards sustainable cities.

The focus of these interventions will be on reducing greenhouse gas emissions through a move away from private vehicles and an increased use of public transport and non-motorised transport. There are three primary strategy responses to reduce greenhouse gas emissions from vehicle travel: avoiding or reducing travel or the need to travel, shifting to more environmentally friendly modes and improving the efficiency of transport modes and vehicle technology.

There are a number of sustainable transport interventions that can be implemented. They can be categorised into planning, regulatory, economic, information and technology interventions. The effect on carbon emissions through the implementation of these interventions can be measured according to four outcomes. The outcomes include:

- **Travel does not take place** – as a result of sustainable transport measures implemented, the decision is taken not to travel for certain trips. In this case, emissions for a trip that would have been made previously are reduced to zero. This is achieved through the 'avoid' strategy.
- **Non-motorised transport is increased** – strategies to encourage mode-shift can result in a higher proportion of trips being made by walking or cycling, which produce zero GHG emissions.
- **Public motorised transport is increased and / or made more efficient** – a second outcome of mode-shift strategies is to achieve a shift to public transport vehicles, such as buses or rail. Although there are emissions associated with both bus and rail, the high occupancy levels that can be achieved means that the emissions of greenhouse gases per passenger km is less than being the sole occupant of a private vehicle. Strategies to improve the energy efficiency and technology of vehicles also apply to public transport vehicles, so emissions can be reduced further.
- **Individual motorised transport is made more efficient** – where private cars and other low occupancy vehicles continue to be used,

Some sustainable transport interventions include the promotion of public transport and the allocation of non-motorised transport infrastructure.

Source: City of Cape Town

the strategy to improve energy efficiency and technology of vehicles can help to reduce emissions. Increasing vehicle occupancy can also play a role by reducing the emissions per person.

The outcomes are also dependent on the number of vehicles affected; the level of congestion before and after the intervention has been put in place, general driver behaviour, vehicle conditions and the common fuel type used.

Sustainable transport instruments and potential contribution to the reduction of greenhouse gas emissions

Instruments	Detail of instrument	Potential Contribution
Planning Interventions	Land use planning (master planning)	Planning can reduce the need to travel through bringing people and the activities they need to access closer together. Planning can also enable the implementation of new transport infrastructure (road, rail, other public transport, cycling and walking)
Regulatory Interventions	Standards (emissions limits, safety), traffic organisation (speed limits, parking, road space allocation) ,production processes	Regulatory measures can be used to restrict the use of certain motorised vehicles, but also influence the types of vehicles used and standards that they should adhere to (both in terms of vehicle performance and road regulations).
Economic Interventions	Fuel taxes, road pricing, subsidies, purchase taxes, fees and levies, emissions trading	Economic instruments can be used to discourage the use of motorised vehicles, which will encourage the use of alternative modes, or reduce the need to travel. Instruments can also improve accessibility and mobility for those without a private vehicle, through investment in transport infrastructure.
Information Interventions	Public Awareness Campaigns, mobility management and marketing schemes, co-operative agreements, eco-driving schemes	The provision of information in easily accessible formats can increase the awareness of alternative modes, leading to a mode shift to walking or cycling. Information can also be provided to improve driver behaviour, resulting in reduced fuel consumption.
Technological Interventions	Fuel improvements, cleaner technologies, end-of-pipe control devices, cleaner production	Where travel by motorised transport is necessary, technology can be used to reduce the impact of carbon emissions, through developing cleaner fuels and improving vehicle efficiency.

Source: Sustainable Transport: Sourcebook for Policy Makers in Developing Countries. Module 5e – Transport and Climate Change (GTZ)

The City of Cape Town has recently implemented a dedicated bus mini-bus taxi lane along the N2. This lane is operational during the peak morning period and can only be used by public transport vehicles during this period.

Source: City of Cape Town

London introduced a congestion charge in the centre of town as an economic intervention to discourage people from using private vehicles. Funds from this system go towards the upgrade of public transport services in the area.

Source: Lisa Kane

Survey of Low-Carbon Cars in the South African market

The motor vehicle industry is experiencing increased pressure to make environmental protection a priority in the manufacture and design of their vehicles. The availability of green vehicles in South Africa is currently extremely limited and generally not affordable to the average consumer. For the time being the best option is to look at fuel efficiency and CO_2 emissions in order to decide on the most environmentally friendly option.

SEA has developed a list of the top performers in terms of fuel consumption and CO_2 emissions based on four vehicle categories, namely: mini-cars, hatchbacks, sedans and 4x4s/SUVs.

The Toyota Prius is currently the only hydrid electric vehicle available in South Africa. It uses a combination of petrol and electric motors to run the vehicle. This results in a reduction in fuel consumption as well as CO_2 emissions

Source: Toyota South Africa

BMW x5 (BMW South Africa)

CorsaLite (Opel South Africa)

Citroen C1 (Citroen South Africa)

VW Jetta (Volkswagen South Africa)

This is a selection of the top performers in terms of fuel consumption and CO_2 emissions in each of the categories.

Mini Cars

	Fuel Consumption l/100km			CO2 Emissions
	Urban	Extra Urban	Combined	g/km
Citroën C1	5.5	4.1	4.6	109
Peugeot 107	5.5	4.1	4.6	109
Mini	6.9	4.5	5.4	129
Hyundai Atos	6.7	4.7	4.5	131
Ford Ka 1.3	8.4	4.9	6.2	147
Ford Ka 1.3 ac	8.9	5.1	6.5	154
Nissan Micra	7.9	5.4	6.3	154
Smartcar	6	4.1	4.8	113
VW Beetle	9.4	5.8	7.1	169

Hatch Backs

	Fuel Consumption l/100km			CO2 Emissions
	Urban	Extra Urban	Combined	g/km
Audi A3 1.6	9.6	5.6	7.1	169
BMW 120	8.7	5.1	6.4	152
Citroën C2 1.4	7.9	4.9	6	143
Ford Fiesta	8.7	5.5	6.7	159
Honda Civic 1.8	–	–	6.4	149
Hyundai Getz 1.6	9.1	5.3	6.7	159
Mercedes A170	8.6	5.5	6.6	157
Opel Corsa 1.2	–	–	6.2	139
Peugeot 206 1.6	10.2	5.7	7.4	175
Renault Cleo	10	6	8	179
Toyota Yaris 1.3	–	–	6	141
VW Golf Gti	11	6.2	8	189

Sedans

	Fuel Consumption l/100km			CO2 Emissions
	Urban	Extra Urban	Combined	g/km
BMW 320i	11	6.2	7.9	190
Citroën C5	11.5	6.3	8	190
Ford Focus 2.0	9.8	5.4	7.1	169
Honda Accord 2.4	–	–	8.4	214
Hyundai Sonata	10.4	6.6	8	190
Mercedes E280	13.5	7	8.5	228
Volvo S40 2.0	10.1	5.7	7.4	177
VW Jetta 2.0	7.1	4.8	5.6	148

SUV's and 4X4's

	Fuel Consumption l/100km			CO2 Emissions
	Urban	Extra Urban	Combined	g/km
Audi Q7 3.0 TDI	14.5	8.3	10.5	282
BMW X5	8.7	5.1	6.4	152
Hyundai Tucson 2X4	10.4	6.6	8	190
Nissan X-Trial	7.2	6.8	7.6	203
Renault Espace	12.9	7.5	9.6	223
Subaru Forester	14.7	8.4	10.7	254
Toyota Hilux 2.5 D	10.3	7.1	8.3	219
Toyota Land cruiser	–	–	9.2	243
Volvo XC90	10.7	6.9	8.3	219
VW Touareg 2.5 TDI	13.1	8.3	10.1	267

Disclaimer:

- The data given in the tables is based on information for European made cars, so South African made models may differ slightly.
- All models are petrol burning engines
- The engine size is not the same for all vehicles in the table and is specified for the vehicle. The table should therefore be used as an information provider and should not be used for direct comparison.
- The fuel consumption figures are provided by the manufactures and actual fuel consumption may differ in "real world" situations.

Saving Fuel, Reducing Emissions

There are ways to reduce your fuel consumption without having to buy a new car or a Hybrid vehicle. The way you drive and maintain your vehicles can affect the amount of petrol your car uses on a daily basis. Here are ten simple ways in which to increase the fuel efficiency of your car and reduce your carbon emissions.

1. Efficient driving : The most fuel-efficient speed is between 75 and 90km/h. Driving at speeds more or less than this can result in fewer km traveled for the same amount of fuel burned. Driving at 120km/h consumes up to 20% more fuel than driving at 90km/h.

2. Avoid aggressive driving – aggressive driving (rapid acceleration and heavy braking) can reduce your fuel efficiency as well as place unnecessary wear and tear on your vehicle. Avoid over-revving the engine as this too increases fuel consumption.

3. Less idle time – idling in traffic wastes fuel and produces excess emissions. Try to switch off your vehicle when stuck in traffic. When traffic starts moving again simply restart your car and move on.

4. Think aerodynamics – try to remove roof-racks, bicycle racks etc when they are not in use in order to keep the car's aerodynamic shape. Equipment on the roof of the car causes extra drag and can thus reduce your fuel efficiency.

5. Maintain your vehicle – a poorly maintained car can significantly increase your fuel consumption. Consult your service manual and

By planning trips, you can avoid getting stuck in traffic and drive in a more efficient manner

Source: City of Cape Town

follow the recommended service schedule. A tuned engine is an efficient engine.

6. Change the air filter – if your car's air filter becomes clogged it reduces fuel efficiency. Simply by replacing the air filter you can add kilometres to the tank.

7. Check tyre pressure – driving on under-inflated tyres is not only dangerous but it also increases fuel consumption by at least 3%. The correct wheel alignment will also allow you to increase the fuel efficiency of your vehicle.

8. Plan your trip – try to plan your trip in the car so that you do not get lost, take the long way around or get stuck in traffic. A warmed-up engine is more efficient than a cold engine, so taking many short trips with a cold car can double the amount of fuel you use. A well thought-out trip in the car can save not only time but fuel as well.

9. Less air conditioning – the use of the air conditioner increases fuel consumption. Try to limit unnecessary use of the air con in order to save fuel and hence limit emissions.

10. Think outside the box – try to think of alternative means of transport that may be available to you, for example a bicycle, scooter, the bus or the train. If you are just going down the road maybe you could walk there.

Velib – Bicycle Freedom

Paris has recently implemented a low-cost bicycle rental service called Velib, which is aiming to minimise the impact of traffic and congestion, particularly in the city centre. The system allows the hire of a bicycle from one location and its return to another one. The Velib programme was launched on 15 July 2007, with the introduction of 10 000 bicycles at 750 hire points around the city, each with 15 or more bikes. To access the bikes, the riders can select a one-day, weekly or annual card. After the purchase of an access card, riding for the first half hour is free and the cost of the rest of the trip is based on its duration. Current results show that the average journey time is 17 minutes, with distances averaging 3 km. Similar systems have been implemented in other European cities. This system could be used in South African cities, particularly when linked to tourist attractions in the centre of the main cities. The City of Cape Town is currently developing a number of cycle paths within the CBD and bike rental services could work very well with this.

A Velib bike rental station in Paris, includes up to 15 bikes and an automated payment machine that will release the bikes once the token has been inserted.

Source: http://meteogerard.unblog.fr/2157

The Aviation Sector's impact on Climate Change

Aviation contributes to global warming in a number of ways, the most significant of which is the combustion of kerosene in flight. The principal greenhouse gas emission from aircrafts in flight is CO_2, but other emissions include NO_x, water vapour and particulates.

The contribution of civil aircrafts in flight to global CO_2 emissions has been estimated at around 2%. However, when non-CO_2 altitude-sensitive effects are included the total impact on man-made climate change is believed to be significantly higher. This contribution is set to rise for the foreseeable future as increases in the volume of aircraft movement outpaces improvements in fuel efficiency.

The aviation sector currently accounts for 2% of global CO_2 emissions, although this is expected to increase as demand for air travel grows.

Source: TNT Group

The European Union is looking at including aviation in the EU Emissions Trading Scheme (ETS). The EU ETS is a greenhouse gas trading scheme. Under the scheme each participating country has a National Allocation Plan (NAP) specifying caps on GHG emissions for individual power plants and other larger point sources. Each facility gets a maximum amount of EU emission allowances for a particular period. To comply, facilities can either reduce their emissions or purchase allowances from facilities with an excess of allowances. The proposal provides for aviation to be brought into the EU ETS in two stages. From the start of 2011, emissions from all domestic and international flights between EU airports will be covered. At the start of 2012, the scope will be expanded to cover emissions from all international flights that arrive or depart from an EU airport.

British Airways have announced their commitment to increasing the efficiency of their aircrafts as well as their buildings. They are targeting a 30% improvement in aircraft fuel efficiency as well as reduction in the energy consumption of their buildings. Virgin Atlantic is investigating the use of biofuels to power their aeroplanes. They are working with aircraft manufacturers and engine designers to test the use of alternative fuels and are planning to have the first test flight taking place in 2008.

Useful web resources

- The Association for the Study of Peak Oil : South Africa (ASPO : SA) www.aspo.org.za
- The Intergovernmental Panel on Climate Change www.ipcc.ch
- Congestion Charge London www.cclondon.com
- Velib : Paris Self-service Bike rental service www.velib.paris.fr
- VCA New Car Fuel Consumption / CO2 database http://www.vca.gov.uk/fcb/new-car-fuel-consump.asp
- Sustainable Urban Transport Project www.sutp.org – see module 5e of the Sustainable Transport : Sourcebook for Policy Makers in Developing Cities for more information on Transport and Climate Change

This Tran:SIT Update is part of a series. Other updates including Marking the Case for Public Transport and Introduction to Sustainable Transport. For the full list of Tran:SIT Updates, please visit our website www.sustainable.org.za

Tran:SIT

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