Friends of the Earth
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**FRIENDS OF THE EARTH'S SUBMISSION TO
TRANSPORT PANEL AND
ENVIRONMENTAL AFFAIRS PANEL
LEGISLATIVE COUNCIL**

Response on the Proposal to Introduce LPG Taxis

3 November 1998

1. Friends of the Earth (FOE) supports the proposal to introduce the Liquefied Petroleum Gas (LPG) Taxis and encourages Hong Kong SAR government to give LPG fuel a price advantage in order to break into mainstream use and achieve economies of scale. The switch of vehicle fuel from diesel to LPG is a vital step for protection of the community from the notorious air pollution caused by the transport in Hong Kong nowadays. In order to inform the honourable members of Transport and Environmental Affairs Panels on this alternative fuel, FoE has enclosed the **Questions and Answers on Liquefied Petroleum Gas as An Alternative Fuel to Diesel.**

Environmental Impacts of Diesel Vehicles Not Negligible

2. In 1997, the particulate concentrations measured at six out of the nine air quality monitoring stations in Hong Kong breached the Air Quality Objectives (AQOs) and three stations also measured nitrogen dioxide (NO_2) concentrations breaching the AQOs. In fact, contribution of vehicles to particulate emissions increased from 30.5% in 1988 to 51.8% in 1996 and has become the greatest source of particulate emissions. In the same period, vehicular contribution to nitrogen oxides (NO_x) emissions increased from 19.3% to 32.9% (EPD, 1998). **Diesel vehicles are the major sources of particulates, especially respirable suspended particulate (RSP), and NO_2.**

Health Impacts of Diesel Vehicles Not Negligible

3. Many studies in Hong Kong and worldwide have shown significant correlation between air pollution. in particular particulates, with increases in chronic bronchitis. asthma, emphysema, cardio-vascular conditions as well as general death rates. (Committee on Environmental Health, 1993; Dockerey et al, 1989, Dockerey et al 1993; Edwards et al, 1994; Ong et al, 1991; Seaton et al, 1995) **Based on prevailing levels of RSP in Hong Kong** (i.e. 60 microgrammes per cubic metre)**, FoE estimates that additional 1928 people die unnecessarily every year.**

4. Research has also demonstrated a clear relationship between the airborne concentration of RSP with daily mortality from all causes and respiratory morbidity. The data indicates that there is **no totally safe concentration for RSP**.A number of independent studies have suggested that a 10 microgrammes per cubic metre rise in RSP is associated with an approximately 1% increase in mortality from all causes (e.g. Pope et al, 1992)

5. Particulates from diesel exhaust contain significant amounts of carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as benzo(*a*)anthracene and benzo(*a*)pyrene. Extremely carcinogenic compounds, 3-nitrobenzanthrone and 1,8-dinitropyrene has been found by Japanese scientists recently who say that these substances are so toxic that "it is easily understandable that they would contribute considerably to the total mutagenic activity of diesel exhaust particle extracts." (New Scientist, 1997) More important, **these highly toxic substances form more quickly in smoggy air with high concentration of NO_x and ozone; the same atmospheric situation which happens in the winter months in Hong Kong.**

Economic Loss Due To Air Pollution Not Negligible

6. Using overseas studies, FoE estimates that for the exposed urban population of 6.3 million people in Hong Kong, the annual ill health costs associated with the prevailing RSP level could be **HK$12.5 billion**.

7. A survey conducted by the Universal Federation of Travel Agents' Association (UFTAA) showed 81% of people questioned said they would never go twice to a place where the environment was not protected. In 1996, 54% of tourists were repeat visitors who spent HK$44.5 billion. If even only 10% of these repeat visitors choose not to return to Hong Kong due to deteriorating environmental quality this could result in a potential drop in revenue of **HK$4.5 billion**.

8. Other estimates of air pollution costs for Europe and the USA range from 0.03 to 3% of GDP with a mean of 0.504%. Adopting the lower of these estimates (0.03% of GDP) and the mean (0.504%), gives. a possible range of annual costs for Hong Kong of **HK$0.2 billion**, the lower estimate, to **HK$3.7 billion**.

Urgent Actions To Abate Diesel Pollution Not Deferrable

9. FoE has pointed out the problems of diesel pollution and the associated health impacts on the public since 1992 with over five submissions to the Administration. FoE is frustrated that the Administration was reluctant to take immediate action. In 1995, the Government proposed a Diesel-to-Petrol Scheme aiming at replacement of all small diesel vehicles with petrol engines that could reduce half of the total RSP emission. However, the scheme failed and possibly 2897 lives were lost in these three years time. **FoE calls for early introduction of LPG taxis**.

10. FoE is also disappointed with Government's biased way of calculating the cost of operating diesel vehicles. In the Consultation Paper of the Proposal to Introduce LPG Taxis, the operation cost of each LPG taxi is $7300 per annum lower than that of diesel taxi. However, if the external costs are considered, **phasing out diesel taxis can save 578 lives and up to 3.7**

billion in term of GDP (i.e. $61700 for each taxi) each year.

11. FoE also considers the introduction of LPG taxisas an integral step towards the cfurther switching of other vehicle from diesel to cleaner alternatives such as LPG.

Conclusion

12. FoE believes that to breathe clean air is a basic right for the public and the maintenance of an acceptable standard of air quality should be a fundamental priority of government and the community in general. As a first step in the goal towards achieving better air quality the introduction of LPG taxis appears to be a reliable and practical way to bring about immediate and significant reductions in RSP and NO_x.

Questions and Answers on Liquefied Petroleum Gas (LPG)
as An Alternative Fuel to Diesel

November 1997

1.Why do we need to replace diesel with an alternative fuel?
It is estimated that diesel vehicles account for 50% of Respirable Suspended Particulates (RSP) in Hong Kong. Not only do RSP contribute towards chronic bronchitis, asthma, emphysema and cardio-vascular conditions, but have also been shown to lead to an increase in general mortality. The surest and safest way to reduce RSP emissions in Hong Kong is to replace diesel with an alternative cleaner fuel. Originally the government proposed replacing small diesel engines (less than 4 tonnes) with petrol but that move was rejected by the transport trade and the Legislative Council due to concerns over costs. Now other alternative fuels are being considered.

2.What alternatives are there?
There are several alternative fuels to gasoline which are in use overseas, including Compressed Natural Gas (CNG), Liquified Natural Gas (LNG), Liquified Petroleum Gas (LPG), ethanol and methanol. Both CNG and LPG would be possible for use in Hong Kong. However the only source of CNG would be from excess natural gas supplied to China Light & Power's Black Point Power Station. The loss of vehicle pay-load may limit the use of CNG in smaller vehicles. LPG therefore seems a more feasible alternative at present.

3.What is LPG
LPG consists of a mixture of propane and butane that forms a colourless gas. It is a naturally occurring material and is also produced through the refining process for petroleum and diesel (World LPG Association, 1986). If refrigerated it can be stored as a liquid or at ambient temperatures as a liquid under pressure, It is primarily paraffinic hydrocarbons but may contain olefinic hydrocarbons such as propylene. Automotive products contain a Motor Octane Rating specification.

4.Is LPG used elsewhere?
LPG is the world's most important fuel alternative to gasoline and diesel for automotive use, with around 4 million LPG vehicles in more than 30 countries (World LPG Association, 1996). Italy and the Netherlands have been using LPG for over 40 years.

5.How does it work?
In vehicles the LPG is pumped under pressure from a storage tank on a service station into a small storage tank under the same pressure within the vehicle. The pressured product is heated to vaporise it and then mixed with air and introduced to the engine in a similar process to petrol (World LPG Association, 1996).

Most of the 4 million vehicles running on LPG in the world are retrofitted to run on propane (Myers, 1994) but now manufacturers in the US, Japan and Canada are producing dedicated LPG vehicles (World LPG Association, 1996).

LPG can be used in heavy duty diesel engines in either a mixed diesel/LPG fuel or as a single fuel LPG. In the mixed fuel vehicle the engine is not modified and the diesel combustion principle is maintained but a 2nd fuel system is mounted on the engine. Alternatively they can be converted to a spark ignition engine in which case the use of diesel is no longer possible.

Vienna has several hundreds of buses running on LPG and in the Netherlands and the USA buses are converted to LPG and CNG (World LPG Association, 1996). In the UK Midland Red South are using LPG buses (ETSU, 1996).

In Japan the large vehicle manufacturers all produce mono-fuel LPG taxis and 90% are LPG powered.

6.What are the environmental benefits of LPG compared to other fuels?
Several studies have compared the pollutant emissions and energy efficiency of various liquid and gaseous fuels. A preliminary life-cycle analysis on alternative road transport fuels, conducted by ETSU, UK (ETSU, 1996) found that:

- particulates and NOx emissions - lower than diesel
- hydrocarbon emissions - similar to diesel and lower than petrol
- energy use, carbon dioxide and carbon monoxide - intermediate between petrol and diesel

Note the difference between this study and other emission measurements is that this considers the emissions over the whole life cycle of the fuel including production and transportation.

The Alternative Fuel Vehicle Training Program at the West Virginia University reported (AFVTP):

- reduced ozone potential compared to petrol
- emissions of carbon monoxide and carbon dioxide lower than petroleum
- NOx emissions slightly higher than with petrol due to the fact that there is a higher combustion temperature with propane (which enters the engine as a vapour) compared to petrol.

The World LPG Association compared the environmental factors of the various viable alternative fuels to petrol thus:

	Petrol	Propane	CNG	Methanol	Ethanol

Global warming potential	Base	lower	lower	similar	higher
smog producing ozone reactive	Base	lower	lower	lower	higher
air toxic/benzene	base	lower	lower	lower	lower
air toxic/formaldehyde	base	lower	lower	higher	lower
air toxic/ butadiene	base	lower	lower	lower	higher
particulates in relation to distillates	lower	lower	lower	lower	lower
soil & water contamination/potential impact of spill	base	lower	lower	similar	similar

7.What is the efficiency of an LPG engine?
Although propane has 5% more energy/unit mass than petrol, since the density is lower it results in an overall energy reduction of 28% per litre. The fact that it is a gaseous fuel also means that it displace s more air when entering the engine resulting in a power loss. Typically LPG users will require 5% more fuel than petrol users. Power tests by General Motors found that LPG produced 8% less power than petrol. One method of reducing this problem is by using a supercharger or turbocharger to increase the air flowrate.

8.What are the concerns about the safety of LPG?
LPG when stored or handled is fully contained and is consequently as safe, or safer than petrol. The latter has the danger of spillage or vapour escape (World LPG Association, 1996). In collisions LPG is safer than petrol (AFTP Review).

Since propane is denser than air it will disperse very slowly. There is also a tendency to form a combustible mixture during accidental discharge.

It is considered non-toxic but can be an asphyxiant if large leaks occur in a confined space (World LPG Association, 1996).

9.What infrastructure is needed?
The minimum items for an LPG dispensing facility are:
- tank - for LPG storage (under or over ground)
- pump - to pump LPG from storage tank to customer
- dispenser/metering unit - to control dispensing to customer

Safety items such as fire extinguishers, gas detectors would also be needed.

Infrastructure costs are estimated to be approximately US$65,000 (HK$500,500) for an LPG installation (World LPG Association, 1996).

In Hong Kong the present service stations can be utilised but some new sites may have to be built in addition to modification. Government has set up a Working Committee to study this. One oil company estimates it will take at least 6 months for installation, inclusive of the necessary approvals from government. For new stations the timing will depend on the allocation of land and granting of land leases.