Pricing and market regulation issues which influence the success of fuel quality changes

This Module will focus on the impact of pricing, competition and market regulation on the successful implementation of fuel quality policies. It will show how countries that have market and pricing constraints have more difficulties in switching over to cleaner fuels versus countries without these constraints. Economic and other policy issues to consider in developing fuel strategies including the use of tax differentiation and economic instruments to promote the use and facilitate the penetration of cleaner fuels and refinery modification are also discussed. Case studies from outside Asia and one or two from within Asia are included.

Explanatory section—fuel pricing, taxation, and market regulation issues

As indicated under Module 1, one of the key building blocks to a fuel quality strategy is the use of economic instruments. In this regard, tax incentives and price differentials are an important tool in facilitating the penetration of cleaner fuels on the market.

During the drafting of a fuel quality strategy, it is necessary to carry out an in depth analysis of all possible economic issues, which could both hinder and facilitate the implementation of the strategy. For example,

1. Does the country have a liberalised energy market?
2. Is there price fixing?
3. Do energy subsidies or price support exist?
4. Do tax incentives already exist for fuel products or other products e.g. higher tax charges for leaded gasoline or higher sulfur fuels, CO2 taxes on mineral oils versus alternative fuels?

Again this should not be an ominous task as standard material on the use of economic instruments exists and should be used to assess national instruments already in application.
If we look at fuel pricing in detail, there are various factors that have an influence on the price of refined products, some of which cannot be influenced and others that are dependent on government decisions or logistics etc. In general, the price of fuel or a refined product at the pump to the consumer is made up of following parts - production costs (including raw material and related costs), tax and distribution and retailing gross margin (see Figure 3.1.). Subsidies may also play a part in fuel price, but this issue is discussed later:

1. **Production cost including raw material** – the majority of the cost of the fuel is the price of purchasing the raw material i.e. crude oil; also included in this is the cost of refining the raw material into the refined product itself and related transport costs. In the recent years there has been some variation in crude oil price and this obviously has an effect on the price of the refined product. While crude oil prices are very difficult to influence and predict, oil can also be traded on futures markets (but not generally to supply physical volumes of oil) as a mechanism to distribute risk.

2. **Tax** – this can be divided into various taxes, e.g. excise tax, carbon tax and GST (goods and services tax) etc. Not all taxes are levied in all countries. See table below for example on taxes in South Korea.

3. **Distribution and retailing gross margin** - this is the difference between the pump price and the cost (i.e. product cost including tax - the first two parts of the cost). This addition to the price is not profit, but the needed difference to cover costs of distribution and retail from the refinery gate to the refuelling station. In addition, the retailer may add a profit margin on top. The profit margin varies greatly depending on factors like location and time of the week etc.

   Let’s look at South Korea. As can be seen in the table below, South Korea levies various taxes on their refined products. The figures are from May 2002. In total, the taxes make up about 65%, 28%, 28% and 45% of the retail price of gasoline, kerosene, heating oil and diesel respectively. In 1999 the total tax portion for gasoline, heating oil and diesel was 77%, 32% and 49% respectively. The production price (cost of producing the product at the refinery) accounted for 30%, 57%, 58% and 50% of the retail price for gasoline, kerosene, heating oil and diesel respectively in May 2002. These numbers don’t seem to be the same as the table?

   The South Korean example shows that the pump price is based on different taxation factors. It is important to note however that in addition to taxation there are numerous other factors, which could also have an impact on pump price. These range from the overall supply/demand for crude oil or for finished products, freight rates/logistics, crude market to regional as well as domestic market competition. The price at the pump can also be influenced by macroeconomics as well as local and global politics (wars, sanctions etc.).

   Fuel taxation is a simple instrument, which can impact vehicle travel demand and fuel use but has no direct influence on congestion and transport management. To date, the main purpose of fuel taxation has been...
to raise road infrastructure or public transport revenue.

In Europe, fuel taxes are widely used and can amount to more than 75% of the price at the pump (see figure 3.2 below). Comparatively, gasoline taxes in Canada represent approximately 40% of the price at the pump, with variations between provinces and territories. In the U.S. on the other hand, the tax percentage is closer to 10%. The differences in taxation exist due to different goals the various governments want to achieve in the country. Taxes can also be dispersed differently in countries (GST, vehicle taxation, road tax) which all in the end one way or another affect vehicle emissions and the transport sector — e.g. the more you drive, and hence the more fuel you use, the more you pay.

Taxes for fuels can also be levied on certain components in fuel. For example, a country can apply a “sulfur tax”, which means that fuels are taxed based on their sulfur content. This means the higher a fuel’s sulfur content the more taxes producers of that fuel will have to pay. This sort of tax encourages refiners to produce lower sulfur fuels so as to pay less tax. The flip side of the “sulfur tax” is the sulfur tax incentive. Tax incentives can be placed on fuels with certain cleaner properties (e.g. low sulfur fuel, reformulated gasoline etc). This is discussed in more detail in the case studies below on Sweden and Finland. Tax incentives for cleaner fuel properties are used in a variety of ways to stimulate the market penetration of such fuels. For example in Italy, France and the UK a tax incentive is used for emulsified diesel, commonly known as “white diesel”, which is a blend of conventional diesel and water. Not only do producers of this fuel claim large reductions in NO\textsubscript{x} and PM\textsubscript{10} but also the water portion of the fuel is considered a renewable property and thus is not taxed in most countries. This untaxed portion can amount to up to 20% of the fuel depending on the blend.

Fuel taxes also have other advantages. They smooth out the fluctuations of prices at the pump. With a higher tax share, the high price fluctuations on world markets have less impact. For example the recent surge in crude oil prices affected Europe much less in the short term than North America. A doubling of the before-tax price increases the after-tax price by 70% in the U.S., compared to only 25% in

<table>
<thead>
<tr>
<th></th>
<th>Petrol</th>
<th>Kerosene</th>
<th>Heating Oil</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery Price</td>
<td>390.91</td>
<td>340.89</td>
<td>340.07</td>
<td>326.13</td>
</tr>
<tr>
<td>(% of retail price)</td>
<td>(30%)</td>
<td>(58%)</td>
<td>(58%)</td>
<td>(50%)</td>
</tr>
<tr>
<td>Tax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Excise</td>
<td>588.00</td>
<td>82.00</td>
<td>82.00</td>
<td>185.00</td>
</tr>
<tr>
<td>Educational</td>
<td>88.20</td>
<td>12.30</td>
<td>12.30</td>
<td>27.75</td>
</tr>
<tr>
<td>Value Added</td>
<td>181.09</td>
<td>69.72</td>
<td>68.74</td>
<td>77.29</td>
</tr>
<tr>
<td>Total Tax</td>
<td>857.29</td>
<td>164.02</td>
<td>163.04</td>
<td>290.04</td>
</tr>
<tr>
<td>(% of refinery price)</td>
<td>(219%)</td>
<td>(48%)</td>
<td>(48%)</td>
<td>(89%)</td>
</tr>
<tr>
<td>(% of retail price)</td>
<td>(65%)</td>
<td>(28%)</td>
<td>(28%)</td>
<td>(45%)</td>
</tr>
<tr>
<td>Shipment Price</td>
<td>1,248.20</td>
<td>513.91</td>
<td>503.11</td>
<td>616.17</td>
</tr>
<tr>
<td>Whole Sale</td>
<td>1,258.97</td>
<td>530.63</td>
<td>519.32</td>
<td>620.72</td>
</tr>
<tr>
<td>Retail Price</td>
<td>1,301.90</td>
<td>592.36</td>
<td>586.95</td>
<td>649.97</td>
</tr>
</tbody>
</table>

Table 3.1 Taxation of petroleum products in South Korea as at May 2002; (Unit Won/L; 100 Won ≈ 8.7 US cents)

Source: Korean Petroleum Quality Inspection Institute (KPQII).
England. For environmental purposes there is a valid case to tax both gasoline and diesel fuel use. Policies on fuel taxation need to be evaluated carefully to avoid the possible price distortion and as higher fuel prices lead to less fuel consumption, foreign dependence is reduced in the long term.

Taxes vary from country to country. Generally speaking, however, the average tax per litre in higher-income countries is two and a half times that of developing countries for both gasoline and diesel. This difference is also reflected in the higher gross prices of OECD (Organisation for Economic Cooperation and Development) countries, see Table 3.2.

According to a World Bank paper (Bacon, Rober. 2001), the tax as share of the final price of gasoline and automotive diesel was 67% and 59% in OECD countries (in 1999). In non-OECD countries the percentages were 44% and 40% respectively. Additionally, kerosene was taxed in non-OECD countries (23%).

In industrialized countries with a highly sophisticated tax system, fuel taxes play an increasingly important role. In developing countries, the collection of taxes (income and sales) as the main sources of state revenue is quite difficult and much in arrears. For example, in the sub-Saharan Africa, fuel taxes on petroleum products accounted for 35% of the government’s total tax revenues for 1990.2

Nonetheless, policymakers in developing countries need to be mindful of how taxes (or subsidies) affect the relative prices of fuel, since too large a difference in prices between products can lead to fuel switching and adulteration, adversely affecting both the government tax take and pollution levels. In other cases, however, these instruments may encourage the use of cleaner fuels and speed up the market penetration of certain fuels. Thus to avert these complications any taxation policy should be well prepared; possible socio economic impacts as well as the adverse effects of inter-fuel substitution, misuse and the adulteration of fuels should also be addressed.

From the point of view of national revenue growth, goods that have the highest value should bear the highest tax rates. In India for example this means that products, which are regarded as a luxury goods like (regular and premium grade) gasoline are taxed higher. Automotive diesel on the other hand is taxed less severely due to its importance in the mining, agricultural, and

| Table 3.2 Average petroleum product taxes and prices in OECD and non-OECD countries, 1999 |
|-----------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| Fuel and country group                        | Tax as share of final price (%) | Tax (US cents/L) | Net price (US cents/L) | Gross price (US cents/L) |
| Gasoline                                       |                              |                 |                           |                             |
| OECD countries                                 | 67.0                         | 44.0            | 58.1                      | 22.9                        |
| Non-OECD countries                             | 25.2                         | 26.9            | 83.3                      | 49.7                        |
| Diesel                                         |                              |                 |                           |                             |
| OECD countries                                 | 59.0                         | 40.0            | 42.4                      | 16.6                        |
| Non-OECD countries                             | 25.0                         | 22.8            | 67.4                      | 39.4                        |
| Kerosene                                       |                              |                 |                           |                             |
| Non-OECD countries                             | 23.0                         | 5.1             | 12.3                      | 17.4                        |

OECD = Organisation for Economic Cooperation and Development
Note: The table shows data from 22 OECD countries (excluding the Czech Republic, Hungary, Mexico, Poland and Turkey) and 37 non-OECD (mostly developing) countries.
goods transport industry. Fuel oil, heavy diesel oil and also LPG are mainly used for electricity production and other industry purposes and therefore taxes are even less than for automotive diesel. Furthermore, kerosene, which is often used by low-income groups for cooking for example, remains untaxed for social as well as environmental reasons (to help prevent deforestation). In some countries kerosene may even be subsidized. More often than not lower taxes are set on kerosene (in some cases even subsidies may be given) as a way to reduce its cost and assist its primary users; lower income households. This however can erode the total tax collected, as when kerosene is substituted for or mixed into gasoline or diesel, the tax collected from the
latter two is ultimately less. On the other hand, higher taxes on kerosene can also hurt lower income households, which tend to spend larger share of their budgets on this fuel than better-off households. Therefore, in this particular instance, if governments wish to offset the effect of higher kerosene taxes on poor households, they can do so through targeted assistance rather than across-the-board kerosene subsidies.

How do governments use fuel taxation as an environmental instrument?

Environmental taxes are used to stimulate the use of more environmentally sound products or processes and/or penalise the use of “dirtier” products. In order to replace dirtier fuels with cleaner fuels set out by environmental policies, it is necessary to make the producer and the consumer substitute the dirty fuels with environmentally friendlier fuels e.g. unleaded gasoline for leaded gasoline and low sulfur gasoline/diesel for high sulfur gasoline/diesel.

As explained under Module 1, there are a variety of different legislative and non-legislative instruments, which can be used to implement a fuel quality strategy. In this regard, there are two specific sets of instruments that can be used to influence changes in fuel quality and fuel production processes:

- **Economic instruments or market based instruments** (emission fees, differential vehicle taxation, fuel taxation, parking charges etc.)
- **Command and control regulations** (fuel specifications, voluntary agreements (self regulation), emissions standards, inspection and maintenance systems, fuel quality monitoring systems etc)

This chapter will concentrate on economic instruments such as fuel taxation and related issues such as subsidies and price distortion. Other economic instruments such as emission fees, permits, parking charges etc are not the focus of this manual, but should be considered when developing a fuel quality strategy.

So, apart from control measures such as bans or standards or voluntary agreements, which also in a way anticipate quota-enforcement (as seen above under Table 3.3.), the main tools for changing production and consumption patterns are market based or economic instruments such as taxes and subsidies. With these tools, governments can modify the price of goods based on their

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>Emission fee</td>
<td>Tradable permits</td>
<td>Compulsory inspection and maintenance of emissions control systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Differential vehicle standard taxation</td>
<td>Mandatory use of low polluting vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tax allowances for new vehicles</td>
<td>Compulsory scrappage of old vehicles</td>
</tr>
<tr>
<td>Fuel</td>
<td>—</td>
<td>Differential fuel taxation</td>
<td>Fuel economy standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High fuel taxes</td>
<td>Speed limits</td>
</tr>
<tr>
<td>Traffic</td>
<td>—</td>
<td>Congestion charges</td>
<td>Restraint on vehicle use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parking charges</td>
<td>Bus lanes and other priorities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subsidies for less polluting modes</td>
<td></td>
</tr>
</tbody>
</table>

environmental credentials. This in turn will modify consumer behaviour and towards the purchase of cleaner goods thus increasing the ratio of clean versus dirty product output.

At best there are only limited applications of economic instruments in the design of pollution control strategies. Generally speaking, economic instruments are applied according to the principle of lowest political and consumer resistance. There are also fiscal biases in the use of economic instruments as there is a larger focus on revenue generation than on environmental effectiveness. In fact if a tax or a subsidy has a beneficial environmental impact, it could be incidental and not pre-planned. For even though the benefits of taxation on altering consumer behaviour towards more environmentally friendly products are becoming increasingly understood, most fiscal legislation today still does not make this direct link.

**Tax incentives and subsidies**

Economic instruments can also be used to offset the cost of refinery upgrades to enable clean fuel production as well as price distortions as mentioned above. There are three economic instruments that can assist in reaching market objectives and increasing the ratio between improved and non-improved fuels. These are:

- Taxes on the non-improved fuel
- Tax incentives on the improved fuel
- Subsidies for pro-active market players.

In Northern Europe (e.g. Finland, Norway, Sweden), where fuel prices are generally high due to high taxes (refer Figure 3.2.), there is more manoeuvrability between the actual cost and the pump price. As indicated before, this therefore allows for greater flexibility in the use of tax incentives. Sweden is a case in point. Sweden developed its tax incentive program to create price differentials between clean and dirty fuels as well as pump price flexibility to offset investment costs to refineries. This allowed refiners to produce and sell both highly taxed dirty fuels and clean fuels eligible for a tax incentive at the same time, and created a greater price differential between the clean fuel and the dirty fuel, which drove the user towards the cheaper greener alternative, in this case the cleaner fuel (due to tax incentives). This is discussed in more detail in the case study below.

Tax incentives have been widely used in Europe to introduce cleaner fuels before the mandated deadline. The current maximum limit for sulfur in gasoline and diesel in the EU is 150 ppm and 350 ppm respectively. Starting January 1 2005, the maximum limit for both fuels will be 50 ppm. At the same time, however, EU Member States have to ensure that gasoline and diesel fuels with a sulfur content of max 10 ppm are available on a balanced geographic basis and that these fuels comply in all other respects with the other fuel quality requirements (as set out in Annex III, IV of Directive 98/70/EEC). Not until 2009 will complete market coverage of max 10-ppm sulfur fuels be required in the EU.

Interestingly, due to the use of tax incentives (see Figure 3.3 below) in several European countries market penetration of cleaner fuels has been much swifter than the mandated regulatory deadline. For example, today there is basically full penetration of 10-ppm sulfur diesel in Germany, even though the tax incentive for 10 ppm was only put in place in January 2003. In fact what has been observed is that the use of tax incentives has facilitated the introduction of low sulfur fuels, especially in the countries that have higher tax margins. As Belgium and The Netherlands are not in this category and they have lower tax margins, it is currently more profitable for their refiners to export their low sulfur products to Germany, where the tax margins are a lot higher. This is also in part why Germany has been able to virtually penetrate its market with zero sulfur fuel already now.

While providing tax incentives is one option to influence the introduction of improved fuel grades, subsidies is another option. Subsidies are usually a set sum per year or a percentage of the investments provided by the government used to upgrade the refinery. So whereas tax incentives are market mechanisms that push
for the introduction of cleaner fuels, subsidies are not market oriented but assistance driven to promote the introduction of cleaner fuels. It is important to note that traditionally subsidies are more commonly used in developing countries, whereas developed countries are more inclined to use tax incentives.

**Price distortion**

Price distortion is most commonly found in developing countries and can be seen in the relative price difference between gasoline and diesel. In India for example, the price of gasoline compared to diesel is kept high through the use of taxes. It could be assumed that the reasoning behind the price difference is that gasoline vehicles are presumed to be more prestigious and therefore owners of such vehicles are seen to have higher incomes and a higher buying power to pay even though the external costs of gasoline vehicles are lower than those of diesel vehicles. Price distortions can also be observed for other fuels such as kerosene (used for cooking purposes).

In most countries the gross price for gasoline is much higher than that for diesel. This reflects a general tendency to encourage the use of diesel, as is the case in Europe and also in Asia. In the case of many Asian countries, however the old car fleet and thus prevailing outdated engine technology coupled with poor fuel quality increases diesel emissions in mega cities. This therefore justifies the need to equalize gasoline and diesel prices.

In India for example, customs tax for petroleum fuel ranges from 10 to 20 %, excise tax between 16 to 32 % and state tax between 4 to 40 % depending on fuels. The lowest tax is levied on CNG and kerosene and the...
highest on diesel and gasoline. The latter two are also subjected to additional excise taxes of Rs. 1/L and Rs. 7/L respectively. The taxation of different fuels in India continues to be distorted which leads to adulteration, e.g. mixing of lowered priced fuel with costlier fuels and diversion of fuels to other uses etc. Still, encouraging the use of diesel fuel for mass transit (public transport) may be desirable as a way of relieving congestion.

### Competition and market regulation

The motivation for Finland (and Sweden) to introduce improved fuel qualities was to reduce vehicle emissions that have a

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**Background** Hong Kong has no oil production or refining capacity or vehicle production capacity but imports both vehicles and fuels from abroad. By the mid to late 1980’s, it was apparent that motor vehicles were the dominant pollution source with NO2 and PM the major concerns. In an effort to address the problem initially with gasoline-fueled vehicles, Hong Kong decided that it needed to introduce tighter standards for new vehicles. However, it became apparent that before it could do so, it would need to improve gasoline quality since the major producers of cars coming into the country were installing catalytic converters on all new vehicles and these systems required the use of unleaded gasoline. As a very small market, Hong Kong concluded that it would be very difficult to mandate a switch to unleaded gasoline. One concern was that many stations had only one gasoline pump and so could only sell one grade of the fuel; requiring the installation of an additional pump in a very congested and highly developed urban area. On the other hand, there was strong resistance by some vehicle owners that their vehicles would experience mechanical problems if forced to use lead free gasoline.

To solve this problem, Hong Kong decided to introduce a tax incentive scheme that resulted in the price at the pump being cheaper for lead-free fuel than for leaded. Within one month of the introduction of this tax scheme, approximately 70% of the fuel being sold in Hong Kong was unleaded and the introduction of stringent new vehicle standards proceeded without difficulty. On April 1, 1999, the sale of leaded gasoline was banned completely in Hong Kong. In order to assure that benzene levels would not rise with the introduction of lead free fuel, on April 1, 2000, the benzene content of gasoline was set at a maximum of 1%.

**Issue focus** By the late 1990’s it became clear that the most difficult remaining problem is to reduce emissions, especially PM, from diesel vehicles. While diesels are only 30% of the vehicle population, they drive 58% of the mileage and emit 75% of the NOx and 98% of the vehicle related PM. It also became clear that the key to reducing both new and in use diesels was fuel quality. Therefore the government focused on two principle fuel related measures:

1. Shifting diesel taxicabs to LPG fuel instead of diesel fuel, and
2. Encouraging the introduction of ultra low sulfur (<50 PPM) diesel fuel, to enable further tightening of new vehicle standards and retrofit of existing vehicles

With regard to low sulfur diesel fuel, the authorities looked to their experience with lead free gasoline and decided to introduce tax incentives. On July 7, 2000, the following incentive scheme was introduced.

<table>
<thead>
<tr>
<th>US$/gallon</th>
<th>500 ppm S</th>
<th>50 ppm S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Duty</td>
<td>1.04</td>
<td>0.56</td>
</tr>
<tr>
<td>Pump Price</td>
<td>3.32</td>
<td>3.24</td>
</tr>
</tbody>
</table>

Not surprisingly, since the retail price of low sulfur fuel was lower than the retail price of high sulfur fuel, by August 1, 2000, the Hong Kong domestic market was 100% low sulfur fuel. In 2002, to assure that there would be no backsliding, the government made the use of ultra low sulfur fuel mandatory.

**Analysis/lessons learned** Hong Kong demonstrates the important role that fuel pricing and taxation policy can play in stimulating the introduction of clean fuels. This has enabled the introduction of stringent standards for new vehicles; Euro III was introduced in 2002 and a major retrofit program involving over 40,000 diesel trucks and buses is underway.

Source: ADB, 2003
Background  Fuel specifications stipulated in Directive 98/70/EEC for 2000 have been implemented in EU Member States. Interestingly, some countries have already gone beyond the 2005 specifications by deciding to phase-in even cleaner fuels via tax incentives. Interestingly Member State has opted to do so differently. This case study will show how Sweden used its tax incentive program and price differentials for clean and dirty fuels, and related pump price flexibility to offset investment costs to refineries.

Sweden as one of the fore runners in introducing clean fuels in Europe has had clean fuel programs in place since the early 1990s. With the help of tax differentials Swedish environmentally classified diesel qualities (MK1 and MK2) were first introduced in 1991 and Swedish MK2 gasoline was introduced in 1994.

The government of Sweden has supported the introduction by differentiating taxes so that cleaner fuel grades have lower taxes than standard quality fuel. Through these tax differentials refiners could invest and pro-actively introduce the improved fuels to the market. In effect the complete market was transformed in which cleaner fuels dominated.

Issue focus  In the 1990’s it was thought that the majority of consumers would not switch to cleaner fuels if these were priced higher and that in industry would not invest beyond legal requirements to produce clean fuels. To create market incentives, taxes were differentiated so that more polluting fuels were taxed more. Therefore the introduction of cleaner fuels was facilitated through the following tax incentives scheme: MK1 diesel (10 ppm) has a tax incentive versus MK3 (350 ppm) diesel of SEK 524/m3 (ECU 59.94/m3).

The aim was to (1) eliminate the cost advantage of lower quality fuels in consumer pricing since improved fuels in general cost more to produce, (2) catalyze refinery investments so that the fuels could be produced on a large scale even before the mandatory legal requirements and (3) offset increased refinery costs associated with improved fuel grades.

Generally oil companies in Sweden did not take the lead in introducing improved fuel qualities before tax differentials were in place. But following the introduction and further widening of tax differentials the refiners invested to manufacture improved quality fuels.

The following are the differentiated taxes on diesel:

<table>
<thead>
<tr>
<th>Year</th>
<th>Grade</th>
<th>Tax Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Standard</td>
<td>ECU 127 / m3</td>
</tr>
<tr>
<td>1991</td>
<td>MK1 (10 ppm)</td>
<td>ECU 107 / m3 (tax decreased by ECU 20 / m3)</td>
</tr>
<tr>
<td></td>
<td>MK2 (50 ppm)</td>
<td>ECU 131 / m3 (tax increased by ECU 4 / m3)</td>
</tr>
<tr>
<td></td>
<td>MK3 (350 ppm)</td>
<td>ECU 148 / m3 (tax increased by ECU 21 / m3)</td>
</tr>
</tbody>
</table>

January 1, 1991 tax differentials were introduced by the Swedish government, which lead to the increase of the market share of MK1 diesel to 85%. Then in December 1, 1994 the Swedish government introduced tax differential on gasoline after which in June 1995, Swedish petroleum companies voluntarily agreed to only sell MK2 gasoline. MK1 diesel virtually replaced MK2 (50 ppm) through tax incentives and now has 94% of the market whereas MK3 predominantly used by HDVs has 6% of the market. The tax incentive between MK1 (50 ppm) MK2 (1250 ppm) gasoline is SEK 0.03/L (ECU 0.01/ L). In most instances the tax differential is a fraction of the normal annual price fluctuation caused by world markets, i.e. tax differential for gasoline was ECU 0.007/L – the price variation during 1996 was ECU 0.07/L

The tax differentials in Sweden were large enough to motivate the industry to invest without increasing the price to the consumer for the improved fuels. In effect, higher sales volumes of improved fuels covered the extra cost and investment for the refiner.

In 1991-1996 the value of differentials due to the use of improved fuel qualities (tax reductions) was ECU 0.6 billion and the value of differentials due to he use of poorer fuel qualities (tax revenues) was ECU 0.5 billion. Therefore, the revenue excluding differentials was ECU 18.5 billion. The oil industries response to the tax differentiating policy was to invest approximately ECU 540 million over this period.

Analysis/lessons learned  Tax differentiation is a quick and effective method to change market conditions so that improved fuel qualities for road transport can be introduced.

Continues next page
They should, however not be considered as a tax revenue gain or loss.

If consumers are not willing to pay a higher price for less polluting fuels, then the tax differentials need to be large enough to cover extra investment and net increased operating costs in order to encourage refiners to produce the improved fuels. The differentials will then need to sufficiently cover both investments and net increased operating costs.

After the new fuels have been introduced and the appropriate investments have been made a new steady state” has been achieved – tax differentials can then be altered to reflect new market conditions. The important thing to remember is that for the most part the size of the tax differential needed to change market conditions is small.

Source: IFQC, 2003

negative effect on human health and the environment. The market drivers for this were created by differentiating taxes on gasoline and diesel grades, where more polluting fuels were given higher taxes. While fuel tax differentiation was the main market driver for introducing improved fuel qualities, different grades were brought onto the market in different ways depending on refinery configuration and gasoline versus diesel production capacity.

The deregulation of the Finnish market made refineries responsive to environmental challenges and higher value added products. But one of the key motivators for Fortum Oy Finland previously Neste to introduce a cleaner fuel grade in Finland was to protect its market share from dirtier fuel imports from neighbouring Russia. Additionally this enabled Fortum to be a front-runner in the production of clean fuels in Europe but also in other parts of the world that in turn helped them gain market share and promote themselves with a “clean image”. For example, Fortum was one of the first European producers to be able to provide reformulated gasoline to the California market according to their strict CARB requirements.

A closed market with a state energy supplier will not facilitate the production and market penetration of cleaner fuels unless the government clearly mandates a switch to cleaner fuels and finds ways to assist the state energy suppliers. Fortum is a good example of government and state oil company cooperation in the production and market penetration of cleaner fuels with mandatory legislation and tax incentives for swifter market penetration. The deregulation of the Finnish market resulted in the introduction of improved fuels (e.g. oxygenated gasoline) before tax differences were even put in place. The Finnish refineries were therefore able to protect their domestic market share whilst penetrating other markets with their cleaner fuels such as the Swedish and California markets. The case study of Finland is discussed in more detail below.

Also Japan has set a timeline to introduce 10-ppm sulfur fuels in the future. Although 10 ppm sulfur gasoline and diesel will not be required (mandated) until January 2008 and January 2007 respectively, the introduction of these fuels to the market will already be started earlier, possibly around 2005. To achieve early market penetration of these fuels, the Ministry of Economy, Trade and Industry (METI) is studying the possibility of providing a fiscal scheme to support the local oil industry in their marketing efforts in introducing zero sulfur fuels.

How can I use tax incentives as a fuel quality strategy tool?

Tax differentials are a quick and effective method to change market conditions so that improved fuel qualities for road transport can be introduced. They change the market conditions in a way that improved fuels can be rapidly introduced. If consumers are not willing to pay a higher price for less polluting fuels (as is often the
case), then tax differentials need to be large enough to cover extra investments and net increased operating costs, the associated extra costs for producing improved qualities less general productivity improvements due to investments associated with improved qualities in order to encourage refiners to produce the improved fuels. The principal behind the tax differential is that the consumer of the lower quality fuels contributes to tax revenue, i.e. “polluter pays” principle. All in all, the tax differentials on transport fuels gave the refiners in Europe an incentive to invest and in some instances provided positive effects on operations, i.e. more productivity and flexibility.

In addition to that, if tax differentials are carefully planned the loss of tax revenue to the government can be minimized or even neglected. This principle is shown in the case study on Fortum below, where the overall tax increase on gasoline in Finland sponsored the diesel tax incentive that enabled the quick introduction of reformulated diesel. This means that the tax on gasoline was purposefully raised by the government to cover revenue loss from the tax decrease on reformulated diesel. This is a “zero sum” gain as no tax revenue loss has occurred due to the equal distribution between revenue loss from the tax incentive and revenue gained from the higher priced gasoline. This process is encouraged in developing countries where tax revenue is essential and any loss of such revenue cannot be justified.

### Case study 10 Fortum Oy (previously Neste)

**Background**  Fortum Oy Finland previously Neste is a good example of government and state oil company cooperation in the production and market penetration of cleaner fuels with mandatory legislation and tax incentives for swifter market penetration and offsetting investment costs. Typically, a closed market with a state energy supplier will not facilitate the production and market penetration of cleaner fuels unless the government clearly mandates a switch to cleaner fuels and finds ways to assist the state energy suppliers.

**Issue focus**  The motivation of Finland for introducing improved fuel qualities was to reduce vehicle emissions that have a negative effect on human health and the environment. At the same time it opened the opportunity to protect its market share as Russia was not able to produce the improved fuel grade. To create the market drivers, taxes were differentiated on gasoline and diesel grades. Compared to Sweden however, Finland brought the fuels into the market in quite a different way.

The deregulation of the Finnish market made refineries responsive to environmental challenges and higher value added products. This resulted in the introduction of improved fuels before tax differences were in place (for oxygenated gasoline). Oxygenated gasoline “City Gasoline” was introduced to the market in 1991. It was marketed by Neste and purchased by consumers ahead of the introduction of the EU requirements. The marketing companies absorbed the higher production costs at this time.

**Taxation in Finland in 1992 and 1993**

<table>
<thead>
<tr>
<th></th>
<th>Taxation in 1992</th>
<th>Taxation in 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard gasoline</td>
<td>300 ECU/m</td>
<td>300 ECU/m</td>
</tr>
<tr>
<td>Standard diesel</td>
<td>174 ECU/m</td>
<td>174 ECU/m</td>
</tr>
<tr>
<td>Oxygenated gasoline</td>
<td>367 ECU/m</td>
<td>375 ECU/m</td>
</tr>
<tr>
<td>Oxygenated diesel</td>
<td>149 ECU/m</td>
<td>149 ECU/m</td>
</tr>
<tr>
<td>Standard gasoline</td>
<td>174 ECU/m</td>
<td>174 ECU/m</td>
</tr>
</tbody>
</table>


Two years later, in 1993, specifications on improved fuel qualities were introduced in Finland together with tax differentials. To support consumer demand for diesel; the Finnish government policy was to increase gasoline taxes to compensate for tax incentive on diesel (see Figure 4.4).

Continues next page
So, compared to the taxation in 1992, tax on gasoline was further increased and tax on reformulated diesel was reduced.

Finland’s final taxation program in 1993 was based on the following:

- general tax for gasoline was increased by ECU 67/m3 (from ECU 300/m3)
- standard gasoline tax was further increased by ECU 8.3/m3 compared to reformulated gasoline
- ECU 3.3/m3 of the overall tax raise on gasoline sponsored the diesel tax differentiation
- reformulated diesel tax was reduced by ECU 25/m3 compared to standard diesel

The tax differentiation strategy was to promote the use of reformulated gasoline and low-sulfur diesel through tax differentiation by levying lower excise duty rate on these products compared to the "old" qualities of gasoline and diesel. In order to permit the same retail price to new and old qualities of these products and to compensate the difference in production costs between them, the amount of the duty graduation was equal to this difference. The idea was to carry out the strategy without any tax revenue losses. Therefore the excise duty rates on old qualities were raised whereas the new qualities could benefit from the duty rates applied on the old qualities before. It is important to note that the tax differential in most cases was a fraction of the normal annual price fluctuation caused by world markets.

The graduation strategy succeeded well - in the short period of two years almost 100 % of all motor gasoline sold in Finland appeared to be reformulated unleaded gasoline, refer Figure 4.5. Similar results were reached in the market share of low-sulfur diesel.

The total value of tax differentials to introduce improved fuel grades in Finland for the years 1993 to 1996 were approximately ECU 0.25 billion, representing about 5% of the total revenues from transport fuels. The use of more polluting fuels provided an additional tax revenues of ECU 0.10 billion (3%).

Analysis/lessons learned Tax differentiation is a quick and effective method to change market conditions so that improved fuel qualities for road transport to be introduced. If consumers are not willing to pay a higher price for less polluting fuels, then the tax differentials need to be large enough to encourage refiners to produce the improved fuels. The differentials will then need to sufficiently cover both investments and net increased operating costs.

The tax differential policies gave Finnish (and Swedish) refiners an incentive to invest. Additionally, in Finland, the refiner was able to reduce his initial investment by switching to a sweet crude slate; in other countries this may not be possible as major global crude oil reserves are located in the Middle East and are sour.

Additionally, the Finnish refiner responded not only to tax differentials signaled by their government but also by Swedish tax differentials already in place. In comparison, the Swedish oil companies only started investing when the tax differentials were widened.

Source: ADL and IFQC

Classroom material

One of the key issues with respect to cleaner fuels is the pricing issue. Pricing, taxation and incentives are important instruments to encourage refiners to produce cleaner fuels and also to encourage consumers to buy cleaner fuels. Experience shows that different countries have taken different approaches in this respect. The objective of this exercise is to brainstorm about what could be possible approaches in your country.
Current incentives and subsidies

As first step please list any current pricing incentive/subsidy/tax incentive you have in place in your country and describe whether they were put in place for environmental or other reasons.

Future incentives and subsidies

As a second step in this exercise please think deeply what possible incentives and subsidy schemes can be applied in your country with the specific aim to promote the production and the adoption of cleaner fuels in your country. In this case you need to explain in the description column whether this is a temporary measure or whether it is permanent, also is it industry wide or only for early adopters. In the column on affordability please summarize what the implications of the proposed incentive or subsidy will be for the treasury.

Please select a person who will present this to the plenary and good luck!!!

<table>
<thead>
<tr>
<th>Proposed pricing incentive/subsidy/tax incentive</th>
<th>Description – temporary – for all or for few etc.</th>
<th>Affordability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import crude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refining equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel end product</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline end product</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For further reading

MTBE Supply and Demand <http://www.efoa.org/fr/what_mtleSupply_demand.htm>
The Auto-Oil II Cost-Effectiveness Study (using TREMOVE model) with base case scenarios for various EU countries <http://europa.eu.int/comm/environment/enveco/auto-oil/index.htm>
Why Tax Fuels

- REVENUE
- Income redistribution
- Influencing choice of fuels
- Influencing distance traveled
- Influencing mode of transport

### Fuel Tax as Revenue

<table>
<thead>
<tr>
<th>Year</th>
<th>Excise Collections ($ mil)</th>
<th>Share of Commonwealth Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>6,642</td>
<td>6.8%</td>
</tr>
<tr>
<td>1994-95</td>
<td>9,406</td>
<td>8.6%</td>
</tr>
<tr>
<td>1996-97</td>
<td>10,543</td>
<td>8.1%</td>
</tr>
<tr>
<td>2001-02</td>
<td>12190</td>
<td>7.5%</td>
</tr>
</tbody>
</table>
Fuel tax can not meet all policy objectives

- Environmental impacts are dependant on:
  - vehicle age and technology
  - location (eg country vs city driving)
  - driver behaviour
- Taxing fuel is not the ideal way to achieve environmental outcomes
- But it is simple

Incentives for Cleaner Fuels

- Supporting transition to cleaner fuels
- Providing consumers with price signals
  - Supply side incentives
- Recognising significant refinery investment
  - Demand side incentives
- Money for nothing?
**Australian Example: Leaded Petrol**

- 1994 – introduced a 2 cents per litre tax on leaded petrol
- Consumers were encouraged to shift to cheaper lead replacement petrol
- Significant reduction in sales of leaded petrol before the phase-out

**Australian Example: ULSD**

- In 1999 Government announced it would introduce an incentive to encourage the move to ultra low sulfur diesel (50ppm)
- Directed at refiners – pay less excise on ULSD
- Deferred for 6 months because of impacts on farmers – effected refinery confidence
- Commenced 1 July 2003
Future Incentives for Clean Fuels

- Recent Budget announced further incentives for cleaner fuels
- Incentives will encourage:
  - 10ppm Sulfur diesel from 1 January 2007
  - 50ppm Sulfur PULP from 1 January 2006

Making it Happen

- Good information
- Stakeholder support – in and out of Government
- Linkages within Government
- Balancing impacts on all sectors
  - costs and benefits
Pre-requisites

- Shared vision
- Industry support (auto/oil)
- Legislation
- Technical/legal knowledge

Getting Government Together

<table>
<thead>
<tr>
<th>Department</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Emissions</td>
</tr>
<tr>
<td>Transport</td>
<td>Fuel Quality</td>
</tr>
<tr>
<td>Industry</td>
<td>Vehicle Standards</td>
</tr>
<tr>
<td>Treasury</td>
<td>Timing</td>
</tr>
<tr>
<td>Finance</td>
<td>Competition</td>
</tr>
<tr>
<td>Trade</td>
<td>Price of Fuel</td>
</tr>
<tr>
<td>Prime Minister</td>
<td>Fuel Tax</td>
</tr>
<tr>
<td></td>
<td>Trade</td>
</tr>
</tbody>
</table>
More Information is Available at:

Contact us at:
fuel.quality@deh.gov.au
Comparative Analysis

- Industrialized countries have a highly sophisticated product tax system – excise tax, carbon tax, value added tax (VAT) etc…
- Collection of petroleum product taxes in industrializing countries are often the main source of state revenue
  - Policymakers in industrializing countries need to be mindful of how taxes (or subsidies) affect the relative prices of fuel as it may lead to fuel switching and adulteration
  - Socio economic impacts need to be addressed e.g. kerosene however this can lead to price distortion and adulteration

Price Distortion and Subsidies as an Economic Instrument

- Subsidies and price distortion: Commonly used in developing countries - developed countries are more inclined to use tax incentives.
- Subsidies: lump sum per year or a percentage of investments provided by the government for refinery upgrade.
  - Promote the introduction of cleaner fuels
  - Not market oriented but assistance driven
- Price distortion: Price of one fuel is (kept) higher than that of another (gasoline - diesel, diesel - non-road diesel, gasoline - kerosene)
How to Use Tax Incentives as a Tool

- Tax differentials quick and effective method to change market conditions to enable the introduction of improved fuel qualities
  - need to be large enough to cover extra investment and net increase of operating costs etc..
- “Polluter pays” principle
- Tax revenue loss to the government can be minimized or neglected - one taxed raised enables tax incentive for another fuel = “zero sum”

Summary – Motivation for Tax Differentials

Market drivers were created by differentiating taxes on gasoline and diesel grades - more polluting fuels were given higher taxes

Reasons for differentiating taxes on fuel qualities:

- To eliminate the cost advantage of lower quality fuel in consumer pricing
- To catalyze refinery investments in order that the fuel could be produced
- To offset increased refinery costs associated with improved fuel grades
- The majority of consumers would not switch to cleaner grades if they carried a higher price
- Without anticipated demand the refining industry would not invest in quality beyond mandatory legal requirements
- Improved fuels cost more to produce than normal ungraded fuels

Source: Arthur D. Little.
Environmental benefit has been evaluated in terms of reduced environmental costs:

- **Tax differences**
- **Improved fuel qualities enter the market**
- **Changes in fuel consumption patterns**
- **Reduced emissions**
- **Reduced environmental costs**

**Approach and Methodology – Environmental Benefit**

- **National emission estimates** calculated by reviewing available literature data.
- **External costs of emissions** calculated using European Union ExternE Study.

**Source:** Arthur D. Little.

---

We analyzed the taxation systems to establish how the incentives were provided:

- **Oil Companies**
  - Refinery
  - Wholesale Depot
  - Distributor
  - Retailer
  - Consumer

**Approach and Methodology – Tax Differences and Market Drivers**

**Source:** Arthur D. Little.
How to Use Tax Incentives as a Tool

A tax differential needs to be large enough to motivate the industry to invest without increasing the price to the consumer...

...extra costs and investments are covered by higher sales volumes of improved fuels with increased price per liter for the refiner

Source: Arthur D. Little.

Case study: Sweden

Differentiated diesel taxes were first introduced in 1991...

Source: Arthur D. Little.
Case study: Sweden

...with wider tax differentials in 1992

<table>
<thead>
<tr>
<th>MK1 diesel</th>
<th>MK2 diesel</th>
<th>MK3 diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>107 ECU/m³</td>
<td>131 ECU/m³</td>
<td>148 ECU/m³</td>
</tr>
<tr>
<td>Tax decreased by 12 ECU/m³</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MK1 diesel</th>
<th>MK2 diesel</th>
<th>MK3 diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 ECU/m³</td>
<td>119 ECU/m³</td>
<td>148 ECU/m³</td>
</tr>
<tr>
<td>Tax differential of 24 ECU/m³ compared to MK1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MK1 diesel</th>
<th>MK2 diesel</th>
<th>MK3 diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 5 5 5</td>
<td>107 ECU/m³</td>
<td>131 ECU/m³</td>
</tr>
<tr>
<td>Tax decreased by 12 ECU/m³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax differential of 53 ECU/m³ compared to MK1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Arthur D. Little.

Penetration of ULSD in Sweden

Source: ECMT 2001
Case study: Sweden

The general taxation on gasoline increased in 1995, but MK3 gasoline was raised 7.1 ECU/m³ further than MK2 gasoline.

<table>
<thead>
<tr>
<th>Taxation in 1994</th>
<th>Taxation in 1995</th>
<th>Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>461 ECU/m³</td>
<td>472 ECU/m³</td>
<td></td>
</tr>
<tr>
<td>Standard Gasoline</td>
<td>MK2 Gasoline</td>
<td>MK3 Gasoline</td>
</tr>
<tr>
<td></td>
<td>↑ Tax Increased</td>
<td></td>
</tr>
<tr>
<td></td>
<td>479 ECU/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ Tax Increased</td>
<td></td>
</tr>
</tbody>
</table>

- Gasoline taxation increased by 11 ECU/m³
- Tax differential MK3 (standard gasoline) further increased by 7.1 ECU/m³ compared to MK2
- Swedish oil companies voluntarily agreed to only sell MK2 gasoline after June, 1995

Source: Arthur D. Little.

Case study: Sweden - Finland

While tax differentiation of fuel grades was the main market driver for introducing improved fuel qualities - how the fuels were brought into the market differed...

Finland
- Deregulation of markets made refineries more responsive to environmental challenges and higher value added products - this resulted in the introduction of improved fuels before tax differentials were in place (e.g. oxygenated gasoline)
- Finnish refineries responded not only to the Swedish differentials, but also in anticipation of tax differentials signaled by their Government

Sweden
- Oil companies in general did not take the lead in introducing improved fuel qualities before tax differentials were in place
- Following the introduction and further widening of tax differentials the refineries invested to manufacture improved quality fuels

Source: Arthur D. Little.
Case study: Sweden - Finland

... along with the timing of their introduction

<table>
<thead>
<tr>
<th>Diesel - Sweden</th>
<th>Diesel &amp; Gasoline - Finland</th>
<th>Gasoline - Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>• January 1, 1991 Swedish legislation included specifications for improved diesel qualities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MK1 diesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MK2 diesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Finnish legislation included specifications for improved:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• gasoline quality - Reformulated gasoline (January 1, 1993)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• diesel quality - Reformulated diesel (July 1, 1993)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• December 1, 1994 Swedish legislation included specifications for improved gasoline qualities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MK2a gasoline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MK2b gasoline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MK2c gasoline</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Neste introduced oxygenated gasoline in Finland
Finland

Source: Arthur D. Little.

Case study: Finland

In 1993 the Finnish government introduced tax differentials based on fuel quality - two years after Sweden and with the benefit of Swedish experiences

Situation 1992:

- Initial refinery configuration favorable
- Produced environmental diesel grades for the Swedish market
- Sweet crude slate opportunity taken to reduce investment requirements

As result:

- The Government signaled that tax differentials would occur
- Refiners invested in anticipation of tax differentials
- Oxygenated gasoline was made available before tax differentials were in place

Source: Arthur D. Little.
Case study: Finland

Oxygenated gasoline was marketed by Neste and purchased by consumers ahead of legislation - marketing companies absorbed the higher production costs.

```
January 1, 1991

"City Gasoline" containing MTBE launched by Neste

Specifications on improved fuel qualities were introduced in Finland

Reformulated New Future Gasoline" oxygenated, less sulfur and benzene, launched by Neste

January 1, 1992

January 1, 1993

January 1, 1994

Relative sales of standard and oxygenated gasoline in Finland

Source: Arthur D. Little.
```

Case study: Lessons Learned

Tax differentials on transport fuels gave refiners an incentive to invest and in some instances provided positive effects on operations.

- Refinery investments for producing improved fuels gave secondary improvements in terms of productivity and flexibility (e.g.):
  - VGO Hydrocrackers
  - MTBE production
  - Hydro-treating
- Availability of sweet crudes were not a prerequisite for introducing improved fuels, but the Finnish refiner was able to reduce his initial investment costs by switching to a sweet crude slate.

Other EU refiners are likely to require higher investments consistent with sour crude supplies.

Even though Swedish MKI diesel requires components which are used in jet fuel, total production of jet fuel has increased in the region as a whole.

```
Source: Arthur D. Little.
```
Case study: Lessons Learned

Tax differentiation is a quick and effective method to change market conditions so that improved fuel qualities for road transport can be introduced.

- Tax differentials change market conditions in order that improved fuels can be rapidly introduced.
- Tax differentials should not be considered as a tax revenue gain or loss.
- If consumers are not willing to pay a higher price for less polluting fuel, then tax differentials need to be large enough to cover extra investments and net increased operating costs* in order to encourage refiners to produce the improved fuels.
- After the new fuels have been introduced and the appropriate investments been made “a new steady state” has been achieved - therefore tax differentials can be altered to reflect new market condition.

*Net increased operating costs - the associated extra costs for producing improved qualities less general productivity improvements due to investments associated with improved qualities.

Source: Arthur D. Little.

---

Case study: Lessons Learned

The policies adopted by the Finnish and Swedish governments in early 1990’s were successful in introducing improved fuels into the market.

- The size of the tax differentials in most instances needed to change market conditions was small:
  - when compared to the total tax on fuels
  - when compared to the annual fluctuations in market price.
- Tax differentials allow the consumer to always choose the lower priced fuel:
  - even if the tax differential is too large, market forces ensure that the price of the improved fuel is lower than the more polluting grade.
  - if the tax differential is too small, the price of the improved grades will be higher and consumers may switch back to the more polluting grade*.
- Consumers of lower quality fuels contribute to tax revenues - i.e. “polluter pays”.
- Once the investments are recovered from the market place it would appear that refiners have become more competitive and are more flexible.

*This has not been observed for transport fuels, but occurred when tax differentials in Sweden were removed from heating oil grades in 1994.

Source: Arthur D. Little.
Problem

- Hong Kong has no oil production or refining capacity
- In late 1980s, NO$_2$ and PM from vehicles was clearly the major problem
- In the 1990s, PM remains to be the problem
- Stricter emissions standards for vehicles was needed, provided cleaner fuels are available
**Solution (1)**

- The key to reducing emissions from new and in-use diesel vehicles is fuel quality
- Fuel related measures by HKG government
  - Shift diesel taxicabs to LPG
  - Tax incentive schemes for unleaded gasoline and ULSD, enabling the introduction of stricter new vehicle standards and the retrofit of existing vehicles

**Solution (2)**

- Fuel incentive scheme for cleaner gasoline
- Cheaper pump price of lead-free gasoline
  - Within 1 month, 70% of fuel sold is unleaded
- In April 1999, leaded gasoline was completely banned
- In April 2000, benzene in gasoline was set a maximum of 1%
Solution (3)

- Fuel Incentive Scheme for cleaner diesel (July 2000)

<table>
<thead>
<tr>
<th></th>
<th>500 ppm S</th>
<th>50 ppm S</th>
</tr>
</thead>
<tbody>
<tr>
<td>US$/gallon</td>
<td>3.24</td>
<td>3.24</td>
</tr>
<tr>
<td>Fuel Duty</td>
<td>1.04</td>
<td>0.56</td>
</tr>
<tr>
<td>Pump Price</td>
<td>3.32</td>
<td>3.24</td>
</tr>
</tbody>
</table>

- In 2002, ULSD was made mandatory to prevent backsliding

Analysis

- Fuel pricing and taxation policy plays a major role in encouraging the use of cleaner fuels
- Cleaner fuels enables the introduction of stringent vehicular emissions standards
- Euro III was introduced in 2002 – retrofit for 40,000 diesel buses and trucks are underway