

A REVIEW OF INTERNATIONAL INITIATIVES TO  
ACCELERATE THE REDUCTION OF SULPHUR IN  
LIGHT AND HEAVY FUEL OIL

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## Executive Summary

Environment Canada proposes to develop measures to reduce the level of sulphur in both light and heavy fuel oils used in stationary facilities. It plans to commence studies in 2001 of the benefits to the health of Canadians and the environment as well as the cost of reducing sulphur in fuel oils, with a view to matching the 2008 requirements set by the European Union for sulphur in fuel oils (reduction to 1.0% wt. (10 000 ppm) sulphur in heavy fuel oil by January 1, 2003 and to 0.1% wt. (1000 ppm) sulphur in light fuel oil by January 1, 2008). Complementary measures to Regulations such as economic instruments are to be examined as a means of accelerating the introduction of low-sulphur fuel oils.

Excise taxes on light and heavy fuel oil as a form of revenue generation are common in OECD countries while taxes specifically to accelerate the reduction of sulphur levels are less so. Only one OECD country (Switzerland) has a fiscal measure designed solely to reduce sulphur in light fuel oil. Four OECD countries have introduced a tax differential to accelerate the use of low sulphur heavy fuel oil. Another five OECD countries each have introduced a fiscal instrument that applies the same rate based on sulphur in both light and heavy fuel oil.

In 1988, Italy was the first country to apply an environmental tax on sulphur in heavy fuel oil, which has resulted in nearly a 48% market share for heavy fuel oil of less than 1% sulphur by weight. Switzerland, Sweden and Denmark have also used economic instruments to accelerate the reduction of sulphur in light and/or heavy fuel oil to less than 0.1% weight (Switzerland and Sweden) or less than 0.05% in Denmark. The primary driver cited for reducing sulphur in heavy and light fuel oils was reducing the precursors to acid rain while another benefit cited was improved air quality.

Four case studies (Switzerland, Sweden, Denmark and Italy) on the use of economic instruments in accelerating the reduction of sulphur in light and/or heavy fuel oil are reviewed.

Beginning in 1997, **Switzerland** was motivated by a commitment to improve air quality and reduce precursors to acid rain to introduce a tax of \$0.012 CDN/kg on light fuel oil with a sulphur content of more than 0.1% weight. The market shifted within two months of the fiscal measure coming into effect and this low sulphur light fuel oil was the only fuel quality available on the market within two months. The revenue from the tax is earmarked to reduce personal contributions to the medical health insurance through a per capita reimbursement scheme. This case is unique with its innovation in linking pollutants, such as sulphur in fuels and VOCs, to air quality and health even if the monetary impact is modest.

In 1991, concern for acid rain prompted **Sweden** to introduce a sulphur tax on liquid fuels, including light and heavy fuel oil, at the rate of \$3.96 CDN/m<sup>3</sup> for each tenth of a percent (0.1%) by weight of sulphur content. The determination of the tax rate was based

on the estimated emission abatement costs (price difference for oil with low sulphur levels and costs of technical emission reduction, respectively). This disincentive approach was selected instead of tightening the standards because they expected to reach their ecological goal more quickly and with lower costs. The success of the tax emanates from the fact that the refiners could finance the required investments through the tax incentive.

**Denmark** phased in a fiscal disincentive starting in 1996 and coming into full effect in 2000, as a part of the Danish commitment within the European Union to restrict its sulphur dioxide emissions to 90 000 tonnes until the year 2000. The sulphur tax is levied with choice provided for application either as a product tax or an emission tax on all fuel consumption with a sulphur content of greater than 0.05%, including light and heavy fuel oil. When it is charged as a product tax, the tax is levied on the sulphur content of the fuel at a tax rate of \$3.90 CDN/kg of sulphur in the fuel. When it is charged as an emission tax, the tax is based on the actual sulphur dioxide emissions at a tax rate of \$1.95 CDN/kg of sulphur dioxide. Market penetration was quick for both lower sulphur fuel oils: the sulphur content of light fuel oil was reduced from 0.2% to 0.05% within a few weeks of the tax's introduction and the sulphur content of heavy fuel oil was reduced from 0.2% to 0.05% within a year of its introduction in 1996.

**Italy's** focus on achieving broad environmental benefits such as reducing the precursors to acid rain and the consequent impacts from acid deposition prompted the introduction of its tax incentive for heavy fuel oil with lower than 1.0% sulphur by weight as of January 1988. Tax is 45 LIT/kg (\$0.034 CDN/kg of sulphur in the product) for low sulphur heavy fuel oil and twice that rate (90 LIT/kg or \$0.068 CDN/kg) for heavy fuel oil with a higher sulphur content. The net result is a tax differential of 45 LIT/kg (\$0.034 CDN/kg). This is the only case studied where a small part of the revenue is directed, for example, to the development of renewable energies. Low sulphur heavy fuel oil has achieved nearly a 48% share of the Italian heavy fuel oil market.

The following are concluding observations from the case studies:

**Measure of Choice** – At least 10 OECD member countries have implemented economic instruments to accelerate the reduction of sulphur in heavy and/or light fuel oil. The case studies document how these measures have been successful in prompting market shifts to lower sulphur products.

**Integration of Measures** – In general, these are not stand-alone measures. They are typically introduced as one component in a package of measures. Switzerland pools the revenues from both of the taxes for light fuel oil and volatile organic compounds to redistribute it to Swiss citizens. Sweden and Denmark tax energy products on three bases: energy, carbon dioxide and sulphur. In the case of the sulphur tax, in January 1991 Sweden introduced this tax disincentive for all fuels (including peat and coke) at the same time as part of a comprehensive package for accelerating the reduction of sulphur in all fuels.

**Cost to Government** – In all of the case studies examined, the measures were designed to generate revenue with minimal administrative costs.

**Disposition of Revenue** – In most cases it appears tax revenue goes to general funds. But in the case of Italy, a very small part of the revenue is directed, for example, to the development of renewable energies. In the innovative Swiss example, the revenue is used as an offset to mandatory medical insurance for Swiss citizens.

### **Emission Reductions Reported**

- Switzerland has reported the combined effect of the Ordinance on Air Pollution Control and the Ordinance for “Extra Light” Heating Oil has reduced sulphur emissions from approximately 42 000 tonnes in 1990 to around 26 000 tonnes in 1999 or approximately a 38% reduction. Measurements taken in urban areas show that sulphur dioxide emissions have decreased from approximately 34 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) in 1988 to approximately eight  $\mu\text{g}/\text{m}^3$  in 1999.
- Sweden estimates that annual sulphur emissions from 1989 to 1995 have been reduced by 19 000 tonnes due to the tax. This represents 30% of the total emissions reduction in that period for which the tax is responsible. With reference to the manufacturing industry in the same period, approximately 59% of their reduction in sulphur emissions can be attributed to the Swedish sulphur tax.
- Denmark reports that the total sulphur dioxide emissions decreased by approximately 24% in the years 1995-1997. Denmark has estimated that the total reduction of sulphur emissions will have been reduced by 34 000 tonnes in 2005 as a result of the sulphur tax.

**Global Impacts** – An unintended negative impact may be the “dumping” of polluting products, i.e. higher sulphur, in countries without comparable measures. For example, in Sweden a by-product from the manufacture of low-sulphur heavy fuel oils is a residual oil with a high sulphur content, which is often exported to countries with lower environmental standards.

**Timing** – An economic instrument can produce a rapid market shift in particular when the consultative process leading to its introduction is effective. For three of the four case studies (Switzerland, Sweden and Denmark), the measure was announced well in advance of it coming into effect. This produced a rapid market shift with lower sulphur fuel oils either available immediately on the heel of the announcement, or prior to the measure coming into effect.

**Technology Driver** – Flexibility in implementing economic instruments appears to be of particular importance to large- scale industries and may help drive the adoption of cleaner technology. (Technology adoption rather than technology innovation seems to be a result). According to an article published in *The Energy Journal*, the Swedish sulphur tax has primarily worked via three channels: 1) by inducing technological progress on the demand side, 2) by enhancing technological progress on the supply side, and 3) by

substitution between heavy and light fuel oil, this being the least applicable of the three. According to the Danish Ministry of Taxation, the tax has had a positive impact on the development of desulphurisation plants and technology.

**Impact on End Consumers (Citizens)** – Two cases have interesting innovations for making the initiative more transparent. In the Swiss case, the revenue from the tax is earmarked to reduce personal contributions to medical health insurance through a per capita reimbursement scheme. In Denmark, consumers ultimately pay the tax and many companies voluntarily specify the sulphur tax as a separate item on the bill of sale. Thus, consumers are able to consciously choose lower sulphur fuel oils that incur a lower tax burden.

**Public Awareness** – While a great deal of media coverage seems to occur during the debate and introduction of the measure, ongoing public awareness seems limited.

## **1. Introduction**

As announced in the Federal Agenda on Cleaner Vehicles, Engines and Fuels in the Canada Gazette, February 17, 2001, Environment Canada proposes to develop measures to reduce the level of sulphur in both light and heavy fuel oils used in stationary facilities. Environment Canada plans to commence studies in 2001 of the benefits to the health of Canadians and the environment as well as the cost of reducing sulphur in fuel oils, with a view to matching the 2008 requirements set by the European Union for sulphur in fuel oils (reduction to 1.0% wt. (10 000 ppm) sulphur in heavy fuel oil by January 1, 2003 and to 0.1% wt. (1000 ppm) sulphur in light fuel oil by January 1 2008). Complementary measures to Regulations such as economic instruments are to be examined as a means of accelerating the introduction of low-sulphur fuel oils.

In Canada for the year 2000, sulphur levels in light and heavy fuel averaged 2030 ppm and 17 610 ppm respectively.

This report is intended to serve as background to the aforementioned work. It compiles regulations, voluntary initiatives and economic instruments as they are applied to light and heavy fuel oil in OECD countries. Cases studies of four countries' use of economic instruments are reviewed to gain insight from their experiences in applying measures to accelerate the reduction of sulphur in light and heavy fuel oils. Based on this work, a series of observations is put forward to consider as Canadian initiatives are developed.

## **2. An Overview of Measures in OECD Countries Applied to Reduce Sulphur in Light and Heavy Fuel Oil**

This section provides an overview of three kinds of measures used in OECD countries to reduce sulphur in light and heavy fuel oil: regulations, industry voluntary initiatives and economic instruments. See the Appendices for the charts summarizing measures by country.

### **2.1 Regulations**

Members of the **European Union** are committed to reductions to 1% wt. sulphur for heavy fuel oil by January 1, 2003 and to 0.1%wt. sulphur for light fuel oil by January 1, 2008. (See Appendices A and B) Currently, in OECD countries, sulphur in light fuel oil is regulated in the range from 0.2% wt. at the high end to 0.1% wt at the low end. Heavy fuel oil is regulated in OECD countries from 4.0% wt. at the high end to 0.7% wt. at the low end. Currently, **Canada** and the **United States** have no federal regulations. Voluntary (commercial) standards in Canada administered through the Canadian General Standards Board (CGSB), govern the level of sulphur in light and heavy fuel. The US, at a national level, has similar voluntary standards for sulphur in fuel oils, through the American Society for Testing and Measurements. The CGSB standard (CAN/CGSB-3.2-M89) for sulphur in light fuel oil is 0.20% wt. for type 00 and 0.5% wt. for type 0, 1 and 2. There is no limit specified for heavy fuel oil by the CGSB. However, some provinces and states have enacted their own legislation to regulate sulphur levels in light and heavy fuel oil.

### **2.2 Industry Voluntary Initiatives**

There appears to be only one case to-date of an industry voluntary initiative to reduce sulphur in light fuel oil in advance of requirements. (See Appendix C)

In **Germany** in 2000, Deutsche Shell introduced a light fuel oil with 0.05% weight sulphur reportedly to help enable the introduction of more efficient boilers as part of a voluntary agreement with the government reached in 1996.

### **2.3 Economic Instruments**

Taxation of light and heavy fuel oil is a common focus for revenue generation as seen by the range of excise taxes in the accompanying chart. (See Appendices D and E)

Those taxes explicitly focussed on reducing sulphur are listed briefly below in addition to appearing in Appendices D and E. Only one OECD country (Switzerland) has a fiscal measure designed solely to reduce sulphur in light fuel oil. Four OECD countries have introduced a tax differential to accelerate the use of low sulphur heavy fuel oil. Another



five OECD countries each have introduced a fiscal instrument that applies the same rate based on sulphur in both light and heavy fuel oil.

### 2.3.1 Tax Differentials

Five OECD countries have used tax differentials for accelerating the reduction of sulphur in light and/or heavy fuel oil. The tax differentials range from 0.094 cents/kg of sulphur in the product at the high end to 0.018 cents/kg at the low end. See Appendix F for conversion rates to local currency.

**Table 1: Tax Differentials for Light and/or Heavy Fuel Oil**

Country	Fuel Oil	High Sulphur Level (% wt.) and Rate Applied	Low Sulphur Level (% wt.) and Rate Applied	Resulting Tax Differential (in Canadian dollars) <sup>1</sup>
Belgium	Heavy Fuel Oil	>1 - \$0.027/kg	<1% - \$0.009/kg	\$0.020/kg
France	Heavy Fuel Oil	>2 - \$0.337/kg	<2% - \$0.243/kg	\$0.094/kg net
Italy	Heavy Fuel Oil	>1 - \$0.068/kg	<1% - \$0.034/kg	\$0.034/kg
Luxembourg	Heavy Fuel Oil	>1 - \$0.027/kg	<1% - \$0.009/kg	\$0.018/kg
Portugal	Heavy and Light Fuel Oil	>1 - \$0.0398/L	<1% - \$0.0181/L	\$0.0217/L

### 2.3.2 Tax Disincentives

Five OECD countries have chosen a tax disincentive to promote the introduction of low sulphur light and heavy fuel oils. The tax disincentives range from \$3.96/m<sup>3</sup> of product at the high end to 0.01 cent/kg of sulphur in the product at the low end. See Appendix F for conversion rates to local currency.

**Table 2: Tax Disincentives for Light and Heavy Fuel Oil**

Country	Fuel Oil	Sulphur Level Applied (% wt.)	Tax Disincentive (in Canadian dollars) <sup>2</sup>
Denmark	Heavy and Light Fuel Oil	>0.05%	\$3.90/kg
Hungary	Heavy and Light Fuel Oil	>2.0%	\$0.01/kg
Norway	Heavy and Light Fuel Oil	Per 0.25% sulphur content	\$0.013/L
Sweden	Heavy and Light Fuel Oil	Per 0.1% sulphur content	\$3.96/m <sup>3</sup>
Switzerland	Light Fuel Oil	>0.1%	\$0.012

<sup>1</sup>Local currency converted to Canadian dollars

<sup>2</sup>Local currency converted to Canadian dollars

### 3.0 Case Studies

The authors chose to look at four case studies of which three are tax disincentive approaches from Sweden, Denmark (for both light and heavy fuel oil) and Switzerland (for light fuel oil) and a differentiated tax from Italy for heavy fuel oil. All correspondence cited, unless otherwise dated, was exchanged between June and September 2001.

#### 3.1 Switzerland

##### 3.1.1. Status of the Measure

The tax for “extra light”<sup>3</sup> heating oil or light fuel oil, with a sulphur content of more than > 0.1% weight as introduced November 12, 1997, entered into force January 1, 1998 and was first levied on July 1, 1998.<sup>4</sup> The tax rate corresponds to 12 CHF/tonne (\$11.86 CDN/tonne of fuel with sulphur greater than 0.1% wt.) or 10.14 CHF/kL (\$10.02 CDN/kL) of light fuel oil at 15<sup>0</sup>C. The tax is expected to continue indefinitely but may be increased in accordance with actual inflation.<sup>5</sup>

The average sulphur content in light fuel oil prior to the introduction of the measure was 0.13%<sup>6</sup> and was 0.07% in mid-2001.<sup>7</sup>

##### 3.1.2. Attributes of the Measure

###### *3.1.2.1 Purpose of the Measure/Rationale for Initiating the Measure*

The primary purpose for initiating the measure was to improve air quality through reducing the sulphur content of light fuel oil from 0.2% to 0.1% weight. There was also considerable public pressure to introduce measures that would help combat acid rain.

###### *3.1.2.2 Type and Description of the Measure*

This is a tax disincentive<sup>8</sup> for light fuel oil with a sulphur content of more than 0.1% by weight. According to the Ordinance, light fuel oil with a sulphur content of greater than 0.1% weight is allowed to be mixed with heating oil of other qualities but only after the

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<sup>3</sup> “Extra light” refers to the name under which heating oil is commercially sold.

<sup>4</sup> Swiss Federal Council, *Ordinance on the Incentive Tax on “Extra Light” Heating Oil with a Sulphur Content of More Than 0.1 Percent*, November 12, 1997

<sup>5</sup> Personal communication with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>6</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

<sup>7</sup> Correspondence with Andreas Liechti, Swiss Agency for the Environment, Forests and Landscape

<sup>8</sup> In the Ordinance, the measure is referred to as an incentive. However, the measure results in revenue generation and thus will be referred to as a tax disincentive for consistency in this report.

tax has been paid or the demand for payment has been made. Dye is required for higher sulphur (>0.1% by weight) light fuel oil streams to distinguish it from lower sulphur light fuel oil.

### 3.1.2.3 Delivery Agents of the Measure and Operational Finances

The Swiss Agency for the Environment, Forests and Landscape initiated the measure and enforces the regulations concerning the distribution of the tax revenue. It is also responsible for reviewing the effect of the tax on the environment and is obligated to publish the results on a regular basis. The Swiss Federal Customs Administration enforces the Ordinance and administers the measure.

Switzerland also has a tax incentive for reducing volatile organic compounds (VOCs). Since January 1, 2000, VOCs and products containing more than 3% volatile organic compounds are subject to a tax incentive of 2 CHF/kg (\$1.97 CDN/kg).<sup>9</sup> This rate will be increased to 3 CHF/kg (\$2.96 CDN/kg) from 2003 onwards. Switzerland is in the process of introducing a tax incentive (proposed maximum incentive of 0.05 CHF/L (\$0.049 CDN/L)) for sulphur-free (< 10 ppm) gasoline and diesel fuel.<sup>10</sup> It is expected that the tax incentive will be introduced in 2004 with the support of the Swiss Petroleum Association.

The cost of the measure's implementation and administration is minor.<sup>11</sup> The consumer ultimately sees the price difference. Importers and refiners are obliged to pay the disincentive tax to the federal government. The revenue from the tax is earmarked to reduce personal contributions to medical health insurance through a per capita reimbursement scheme.<sup>12</sup>

Swiss citizens pay mandatory health insurance.<sup>13</sup> Health insurance companies are to redistribute the revenue from the tax plus any interest to the Swiss citizens on a per capita basis under the supervision of the Federal Office. Insurance companies will be reimbursed for their administrative expenses. When the tax was introduced, the projected reimbursement was expected to amount to 15 CHF/capita (\$14.81 CDN/capita) in 1999/2000, 25 CHF (\$24.68 CDN) in 2001/2002 and 30 CHF (\$29.61 CDN) in 2003.<sup>14</sup> However, comparatively little revenue has been generated. Only \$200 000 CHF (\$197,400 CDN) has been accumulated to date and so the Agency plans to pool this revenue with that from the revenues of the volatile organic compounds tax

<sup>9</sup> Correspondence with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>10</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

<sup>11</sup> Personal communication with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>12</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm))

<sup>13</sup> Federal Law on Health Insurance SR 832.10

<sup>14</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm) **Error! Bookmark not defined.**)

(approximately 100 million CHF (\$108.6 million CDN)) and redistribute the funds in 2002 and subsequently on a yearly basis.<sup>15</sup>

The minimum length of the consultation process to develop new legislation in Switzerland is a year to a year and a half with another year to year and a half for parliament to debate the proposal. A diverse range of stakeholders was consulted prior to putting a proposal before parliament. Mostly large refiners participated at the consultation stage, though all refiners are subject to the Ordinance. According to the Swiss Agency for the Environment, Forests and Landscape, domestic refiners were hesitant about the new measure, as it required additional investments.<sup>16</sup> The exact costs to the refiners to implement the measure are difficult to determine since other factors necessitated investment at the same time. The estimated cost to the refiners is in the order of several hundred million Swiss Francs (this corresponds to approximately several hundred million Canadian dollars).<sup>17</sup>

#### *3.1.2.4 Environmental Results*

The combined effect of the Ordinance on Air Pollution Control<sup>18</sup> and the Ordinance for “Extra Light” Heating Oil has reduced sulphur emissions from approximately 42 000 tonnes in 1990 to around 26 000 tonnes in 1999 or approximately a 38% reduction.<sup>19</sup> The National Air Pollution Monitoring Network has taken measurements of ambient air quality in urban areas of Switzerland. These measurements show that sulphur dioxide emissions have decreased from approximately 34 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) in 1988 to approximately eight  $\mu\text{g}/\text{m}^3$  in 1999.<sup>20</sup>

The tax can be credited with reducing the sulphur content in light fuel. Only light fuel oil with a sulphur content of less than 0.1% is now sold although the law allows for a maximum sulphur content of 0.2%.

#### *3.1.2.5 Impact of the Measure*

The Agency assesses this as a very effective measure based on its swift implementation.<sup>21</sup>

There are two domestic refiners in Switzerland. In 2000, they produced 1.326 million tonnes of light fuel oil corresponding to 30.7% of the domestic market.<sup>22</sup> Most of the

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<sup>15</sup> Personal communication with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>16</sup> Correspondence with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>17</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

<sup>18</sup> This Ordinance limits sulphur levels in heavy fuel oil to 1% by weight from July 1, 1990 onwards and light fuel oil to 0.2% by weight from July 1, 1987 onwards.

<sup>19</sup> Correspondence with Andreas Liechti, Swiss Agency for the Environment, Forests and Landscape

<sup>20</sup> Swiss Agency for the Environment, Forests and Landscape, National Air Pollution Monitoring Network (NABEL): The Network, Monitoring Stations and Principal Results, 2001

<sup>21</sup> Correspondence with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

<sup>22</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

crude oil that is refined domestically originates from Nigeria, Libya and Algeria. This crude is naturally low in sulphur, typically with a sulphur content of around 0.15%.<sup>23</sup>

In the view of the Swiss Petroleum Agency, refiners and importers reacted differently to the introduction of the measure. In their view, since the two domestic refiners had previously upgraded and were able to produce low sulphur light fuel oil right away, the fiscal measure was an opportunity to pay off part of their investment and the domestic refiners gained a competitive advantage over importers. Importers that had to rely on foreign refineries for their supply were disadvantaged in that they had to obtain low sulphur oil at a higher cost than that incurred by the domestic refiners.<sup>24</sup>

#### *3.1.2.6 Degree of Market Penetration*

The market reacted almost immediately to the tax disincentive. Within two months, the market penetration reached 100% and hence the only light fuel oil available today has a sulphur content that is less than or equal to 0.1% weight.<sup>25</sup>

#### **3.1.3. Level of Public Awareness**

Non-governmental organizations including both health and environmental groups were involved in extensive stakeholder consultations prior to the introduction of the measure. Pressure from the public was mounting for the government to do something about acid rain. The media had been bombarding the public with images of dying lakes and forests. Public awareness of the broader issue of acid rain is high.

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<sup>23</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

<sup>24</sup> Correspondence with Dr. Marco Berg, Swiss Petroleum Agency

<sup>25</sup> Personal communication with Andrea Burkhardt, Swiss Agency for the Environment, Forests and Landscape

## 3.2 Sweden

### 3.2.1. Status of the Measure

On January 1, 1991 Sweden introduced a sulphur tax for all fuels, including light and heavy fuel oil, peat and coal.<sup>27</sup> The sulphur tax for liquid fuels (including gasoline, diesel and light and heavy fuel oil) is at the rate of 27 SEK (\$3.96 CDN) per m<sup>3</sup> oil for each tenth of a percent (0.1%) by weight of sulphur which corresponds to 30 SEK (\$4.40 CDN) per kilogram of sulphur for peat, coal and petroleum coke. (Energy products are taxed with three taxes: energy, carbon dioxide and the sulphur tax).

In July 1997, Sweden was pushing for a stricter sulphur limit for heavy fuel oil during the discussions for the first EU fuel oil proposal.<sup>26</sup> Sweden suggested a sulphur limit of 0.8% wt. for heavy fuel oil, which is lower than the limit of 1% wt. proposed by the EU Commission. At the time of the discussions, Sweden was strongly opposed to the prospect of having to revise its standards to bring them into line with those of the other EU members, given that its standards were more stringent. In fact harmonization slated for the end of 1998 has not occurred.

As of 1995, the average sulphur content in light fuel oil was 0.076% compared to 0.2% in 1990 while the average sulphur content in heavy fuel oil was 0.35% compared to 0.7% in 1990.<sup>28</sup>

### 3.2.2. Attributes of the Measure

#### 3.2.2.1 Purpose of the Measure/Rationale for Initiating the Measure

Sweden has had severe problems with the effects of acid rain on lakes and forests. Two principal contributing factors include long-range transport of acid rain precursors from neighbouring countries and the low buffering capacity of Scandinavian rock. Thus in order to deal with this problem domestically, Sweden has pursued an ambitious policy to combat acid rain. By introducing the sulphur tax, Sweden aimed to reduce critical loads in sulphur

Sweden recently announced its intention to achieve the objective of clean air by reducing sulphur dioxide emissions by “at least” 7000 tonnes/year more than required under either the UN Gothenburg Protocol or the draft European Union national emissions ceilings directive.<sup>29</sup>

<sup>26</sup> ENDS Environment Daily, *First Discussion for EU Fuel Oil Proposal*, July 7, 1997

<sup>27</sup> Swedish Tax Authority, *Information from the Swedish Tax Authority – Excise Duties*, RSV 510, Edition 5, 2001

<sup>28</sup> Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, The Energy Journal, Vol. 22, No.2, 2001

<sup>29</sup> Environment News Service, *Sweden Legislates for Sustainability*, May 4, 2001

deposition. In 1980, Sweden set a goal for reducing sulphur dioxide emissions by 80% and achieved this in 1991 (emissions decreased from a peak level of more than 900 000 tonnes annually to 110 000 tonnes).<sup>30</sup> According to the Swedish Environmental Protection Agency, sulphur emissions from combustion of light and heavy fuel oils have decreased by approximately 8.5 tonnes owing to the sulphur tax.<sup>31</sup>

The tax was aimed to encourage the use of cleaner fuels (to reduce acid rain) and increase desulphurisation technology in the combustion process with the goal of reduced sulphur emissions. This disincentive approach was selected instead of tightening the standards because they expected to reach their ecological goal more quickly and with lower costs.<sup>32</sup>

### 3.2.2.2 Type and Description of the Measure

A tax rate of 27 SEK/m<sup>3</sup> (\$3.96 CDN/m<sup>3</sup>) of oil works as a disincentive tax since the higher the level of sulphur in the fuel oil, the greater the tax burden. The determination of the tax rate was based on the estimated emission abatement costs (price difference for oil with low sulphur levels and costs of technical emission reduction, respectively).<sup>33</sup> The average treatment cost was assumed to be 10-15 SEK/kg (\$1.47-2.20 CDN/kg) of sulphur.<sup>34</sup> A relatively high tax rate had to be set to motivate refiners to deliver even lower sulphur content fuels than those on the market (see *Table 4*). The tax is not levied if the sulphur content in the oil is lower than 0.1% by weight. Dye is required to distinguish the high sulphur content fuel oil streams.

Large-scale consumers (plants and firms) who restrict their sulphur emissions through desulphurisation technologies are eligible for a refund of the sulphur tax.<sup>35</sup> In 1997, approximately one quarter of these 240 taxpayers had implemented such emission control measures, thereby reducing the tax assessed to them by 70%.<sup>36</sup>

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<sup>30</sup> Swedish Ministry of Environment and Natural Resources, *The Swedish Experience – Taxes and Charges in Environmental Policy*, 1994

<sup>31</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

<sup>32</sup> Cansier, D. and Krumm, R., *Air Pollution Taxation: An Empirical Survey*, Ecological Economics, 23 (1997) 59-70

<sup>33</sup> Cansier, D. and Krumm, R., *Air Pollution Taxation: An Empirical Survey*, Ecological Economics, 23 (1997) 59-70

<sup>34</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

<sup>35</sup> Swedish Tax Authority, *Information from the Swedish Tax Authority – Excise Duties*, RSV 510, Edition 5, 2001

<sup>36</sup> Cansier, D. and Krumm, R., *Air Pollution Taxation: An Empirical Survey*, Ecological Economics, 23 (1997) 59-70

### 3.2.2.3 Delivery Agents of the Measure and Operational Finances

The Tax Agency under the Ministry of Finance is responsible for the administration of the measure while the Swedish Environmental Protection Agency formulated this fiscal disincentive.

Persons subject to the tax include retailers of fuels, who levy the tax at the time of sales, and those large consumers who declare their consumption of the taxable fuel. The resulting net revenues from the tax are not earmarked. There were some initial difficulties with the administration of the sulphur tax. Since 1995, deductions for desulphurisation are entered directly in tax returns instead of being reimbursed

Sweden has an extensive history with environmental taxes and policy and was the first country to implement a tax shift from income taxes to taxes on energy and pollution. In 1988, as part of a major tax reform, the Swedish Commission of Environmental Charges was appointed. Its work resulted in the adoption of a number of environmental taxes (including taxes on fossil fuels, carbon dioxide, sulphur etc.) by the Swedish Parliament in 1991. This adoption resulted in all fuels being taxed with three taxes: energy, carbon dioxide and the sulphur tax. For the sulphur tax, petroleum industry associations represented the interests of the refineries during the negotiations.

through a refund system. This in turn has substantially reduced administrative costs and the annual cost to the state is now estimated at under 100 000 SEK (\$14 700 CDN).<sup>37</sup> If it is assumed that approximately the same amount is involved for the taxpayers, the total administrative costs may be estimated at about 200 000 SEK (\$29 300 CDN) (i.e., the administrative costs of the sulphur tax are less than 1% of revenue).<sup>38</sup> Only the system of monthly declarations combined with deduction possibilities and exemptions causes some additional work to the government and the taxpayers.

### 3.2.2.4 Environmental Results

Sweden's sulphur tax can be credited with reducing sulphur content of fuel in the market place and reducing emissions from combustion plants. The Swedish Environmental Protection Agency estimates that annual sulphur emissions from 1989 to 1995 have been reduced by 19 000 tonnes due to the tax (e.g. 20% of the total emissions in 1995).<sup>39</sup> The tax is responsible for 30% of the total sulphur emissions reduction in that period.<sup>40</sup> With

<sup>37</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

<sup>38</sup> Swedish Environmental Protection Agency, *Evaluation of Green Taxes in Sweden: Large Environmental Impact at Small Cost*, March 13, 1997

<sup>39</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

<sup>40</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000



reference to the manufacturing industry in the same period, approximately 59% of their reduction in sulphur emissions can be attributed to the Swedish sulphur tax on all fuel.<sup>41</sup>

### 3.2.2.5 Impact of the Measure

In 1990, prior to the introduction of the measure, several large municipalities had voluntarily chosen to use cleaner liquid fuels than stipulated by law.<sup>42</sup>

When the measure was first introduced in 1991, refiners purchased low sulphur light fuel oil from Rotterdam to increase the availability of low sulphur light fuel oil.<sup>43</sup>

The Swedish Environmental Protection Agency assesses this as a very successful measure as it appears to have made an effective contribution to the achievement of parliament's target for sulphur emission reductions. However, the actual revenues from the sulphur tax have been considerably lower than was expected based on a more rapid reduction of emissions than projected. According to a Ministry of the Environment and Natural Resources' report, complexities arise when a fiscal instrument is also expected to provide environmental direction – a faster response to the environmental direction results in lower tax revenues.<sup>44</sup>

Sweden has three domestic refining companies. Two thirds of the total crude oil imported in the year 2000 originated from the North Sea, which is naturally low in sulphur. Swedish refiners are net exporters of light fuel oil and export to countries including the UK.<sup>45</sup> In 2000, domestic consumption of all fuel oils totaled 14 million m<sup>3</sup>, which is down by approximately 50% from 28 million m<sup>3</sup> in 1979.<sup>46</sup> In the early 1970's, oil accounted for approximately 75% of Sweden's total energy supply. As this was considered unacceptable from a supply point of view, the Swedish government introduced a number of schemes to reduce oil dependency such as energy conservation, promoting biofuels, building nuclear plants and introducing natural gas, for example, in district heating systems.<sup>47</sup>

A by-product from the manufacture of low-sulphur heavy fuel oils is a residual oil with a high sulphur content, which is often exported to countries with lower environmental standards than Sweden.<sup>48</sup>

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<sup>41</sup> Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, The Energy Journal, Vol. 22, No.2, 2001

<sup>42</sup> Swedish Ministry of Environment and Natural Resources, *The Swedish Experience – Taxes and Charges in Environmental Policy*, 1994

<sup>43</sup> Personal communication with Stefan Nyström, Swedish Environmental Protection Agency

<sup>44</sup> Swedish Ministry of Environment and Natural Resources, *The Swedish Experience – Taxes and Charges in Environmental Policy*, 1994

<sup>45</sup> Personal communication with Stefan Nyström, Swedish Environmental Protection Agency

<sup>46</sup> Swedish Petroleum Institute, 2001 ([http://www.spi.se/main\\_index\\_english\\_new.htm](http://www.spi.se/main_index_english_new.htm)**Error! Bookmark not defined.**)

<sup>47</sup> Correspondence with Sören Olsson, Swedish Petroleum Institute

<sup>48</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

According to an article published in *The Energy Journal*, the Swedish sulphur tax has primarily worked via three channels: 1) by inducing technological progress on the demand side, 2) by enhancing technological progress on the supply side, and 3) by substitution between heavy and light fuel oil, this being the least applicable of the three.<sup>49</sup> Further, these authors concluded that the Swedish sulphur tax has been important in providing an incentive for the reduction of sulphur emissions by the manufacturing industry.

According to the Swedish Petroleum Institute, the success of the tax emanates from the fact that the refiners could finance the required investments through the tax incentive (no other subsidies were granted).<sup>50</sup> A report by the Swedish Environmental Protection Agency notes that the measures taken as a result of the sulphur tax have not led to any extra investments by oil users and hence it is safe to assume that the average treatment cost due to the sulphur tax is not in any case more than 15 SEK/kg (\$2.20 CDN/kg) of sulphur.<sup>51</sup> The Swedish Environmental Protection Agency has attempted to calculate the socio-economic effects of the sulphur tax (see *Table 3*). The sulphur tax level of 30 SEK/kg (\$4.40 CDN/kg) may be regarded as a measure of the minimum value attached by society to one kilogram of sulphur emission reduction. The average treatment cost was assumed to be no more than 15 SEK/kg (\$2.20 CDN/kg) due to the sulphur tax. Therefore, according to this calculation, the sulphur tax yields a socio-economic gain of at least 110 million SEK (\$16 million CDN) in 1997.<sup>52</sup>

**Table 3: Attempted Socio-Economic Calculation of the Effects of the Sulphur Tax**

	Per Kilogram of Sulphur	Total Per Year
Environmental Gain	30 SEK (\$4.40 CDN)	225 million SEK (\$33 million CDN)
Treatment Cost	Approx. 15 SEK (\$2.20 CDN)	115 million SEK (\$17 million CDN)
Net Gain	15 SEK (\$2.20 CDN)	110 million SEK (\$16 million CDN)

Source: Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

### 3.2.2.6 Degree of Market Penetration

For light fuel oil, the average sulphur content decreased below the allowable limit of 0.1% wt. before the introduction of the tax, perhaps due to the “announcement effect”.<sup>53</sup> For heavy fuel oil, sulphur levels had dropped below the regulated limit of 0.8% wt. two years prior to the introduction of the measure. This was also credited to the

<sup>49</sup> Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, *The Energy Journal*, Vol. 22, No.2, 2001

<sup>50</sup> Correspondence with Sören Olsson, Swedish Petroleum Institute

<sup>51</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

<sup>52</sup> Swedish Environmental Protection Agency, *Environmental Taxes in Sweden – Economic Instruments of Environmental Policy*, March 1997

<sup>53</sup> Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, *The Energy Journal*, Vol. 22, No.2, 2001

“announcement effect”.<sup>54</sup> The sulphur level dropped considerably more when the tax came into effect, and then decreased progressively to less than half of the former level (see *Table 4*).

**Table 4: Actual Sulphur Content in Light and Heavy Fuel Oil**

Year	Light Fuel Oil (% sulphur by weight)	Heavy Fuel Oil (% sulphur by weight)
1976-1988	0.2 <sup>55</sup>	0.8 <sup>56</sup>
1989	0.2	0.7 <sup>57</sup>
1990 <sup>58</sup>	0.2	0.7
1991	0.08	0.5
1992	0.076	0.45
1993	0.056	0.45
1994	0.058	0.45
1995	0.076	0.35

Source: Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, *The Energy Journal*, Vol. 22, No.2, 2001

Industry strategies for achieving reductions of sulphur in fuel oils included:<sup>59</sup>

- the use of lower sulphur crude oils,
- “indirect reduction” of sulphur content by adding fractions of crude oil with low sulphur content to oils containing more sulphur.

### 3.2.3. Level of Public Awareness

The Swedish Environmental Protection Agency stated that there was a high level of public awareness when the measure was introduced, but now the level of awareness is low. The initial high level of awareness was attributed to frequent news coverage of the work of the Swedish Commission of Environmental Charges and the debate spurred by the Rio Summit in 1992.

When the measure was introduced, refiners such as Shell launched large marketing campaigns advertising their low sulphur light fuel oil.<sup>60</sup>

<sup>54</sup> Hammar, H. and Löfgren, A, *The Determinants of Sulfur Emissions from Oil Consumption in Swedish Manufacturing Industry, 1976-1995*, *The Energy Journal*, Vol. 22, No.2, 2001

<sup>55</sup> Note: Sulphur in light fuel oil was regulated at the following levels: 1976-80: 0.5% wt. After 1980: 0.3% wt. After 1987: 0.2% (the current regulated limit).

<sup>56</sup> Note: Sulphur in heavy fuel oil was regulated at the following levels: 1976-1984: 2.5% - 1% wt. in the entire country by 1984.

<sup>57</sup> Note: The now current regulated limit for sulphur in heavy fuel oil came into effect (0.8% wt.).

<sup>58</sup> These are uncertain estimates from the Swedish Environmental Protection Agency (1997).

<sup>59</sup> Swedish Ministry of Environment and Natural Resources, *The Swedish Experience – Taxes and Charges in Environmental Policy*, 1994

<sup>60</sup> Personal communication with Stefan Nyström, Swedish Environmental Protection Agency

### 3.3 Denmark

#### 3.3.1. Status of the Measure

A sulphur tax on all fuel consumption, including light and heavy fuel oil, was introduced on the June 14, 1995, and came into effect on January 1, 1996. The tax was phased in and came into full effect in 2000. The sulphur tax is levied with choice provided to the taxpayer for application either as a product tax or an emission tax. (Energy products are taxed with three taxes: energy, carbon dioxide and the sulphur tax).

When it is charged as a product tax, the tax is levied on the sulphur content of the fuel at a tax rate of 20 DKK/kg (\$3.90 CDN/kg) of sulphur in the fuel.<sup>63</sup> When it is charged as an emission tax, the tax is based on the actual sulphur dioxide emissions at a tax rate of 10 DKK/kg (\$1.95 CDN/kg) of sulphur dioxide.<sup>64</sup> These two rates are equivalent based on sulphur content. The tax is applicable for fuel with a sulphur content of greater than 0.05%.

During the discussions for the first EU fuel oil proposal, Denmark was negotiating for a stricter sulphur limit for heavy fuel oil.<sup>61</sup> Denmark proposed a sulphur limit of 0.8% wt. for heavy fuel oil which is lower than the limit of 1% wt. proposed by the EU Commission and wanted to bring forward the requirement for compliance with sulphur limits on light fuel oil to 2003. When the final EU directive was passed, Denmark remained opposed to the limits on the sulphur content of heavy fuel oil of 1% wt. by 2003 and that of light fuel oil to 0.1% wt. by 2008, on the grounds that they were not stringent enough.<sup>62</sup>

The average sulphur content in both light and heavy fuel oils in mid-2001 is 0.034% by weight.<sup>65</sup>

#### 3.3.2. Attributes of the Measure

##### 3.3.2.1 Purpose of the Measure/Rationale for Initiating the Measure

The sulphur tax is part of ecological tax reform and was connected with the Danish commitment within the European Union to restrict its sulphur dioxide emissions to 90 000 tonnes until the year 2000 (i.e., an 80% reduction from 1980 levels).<sup>66</sup>

<sup>61</sup> ENDS Environment Daily, *First Discussion for EU Fuel Oil Proposal*, July 7, 1997

<sup>62</sup> ENDS Environment Daily, *EU Ministers Set to Pass Sulphur in Fuels Law*, June 10, 1998

<sup>63</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm)**Error! Bookmark not defined.**)

<sup>64</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm)**Error! Bookmark not defined.**)

<sup>65</sup> Personal communication with Thomas Sørensen, Danish Environmental Protection Agency

<sup>66</sup> The Danish Government, *The Danish Energy Package – Green Taxes*, May 19, 1995

### 3.3.2.2 Type and Description of the Measure

Since the introduction of the sulphur tax in 1996, the tax has applied to light fuel with a sulphur content of greater than 0.05%. However, the sulphur tax for heavy fuel oil has been applied to increasingly lower sulphur contents starting in 1996 (see *Table 5*).

**Table 5: Phase-In of Sulphur Tax for Heavy Fuel Oil**

Year	Tax Applied on Sulphur Content (% weight)
1996	> 0.4
1997	> 0.3
1998	> 0.2
1999	>0.1
2000	>0.05

*Source: Correspondence with Jens Holger Heblo Hansen, Danish Ministry of Taxation*

Whether the sulphur tax is applied as a product or an emission tax, it works as a disincentive since the higher the level of sulphur in the fuel oil, the greater the tax burden. The sulphur product tax is levied on the sulphur content of fuels delivered from refineries and importers. Of the 350 companies that report or receive compensation for energy taxes, approximately 300 companies pay taxes on the sulphur content of the fuel. These companies must take regular samples of their fuels to determine the sulphur content.<sup>68</sup>

Denmark has a history of using tax differentiations as an explicit means of attaining an environmental improvement. Tax differentials have been used for low sulphur diesel fuel, for gasoline according to benzene content, and for installations of vapour recovery systems at gas stations. Denmark also gives a rebate of 10 000 DKK (\$1949CDN) per truck on new EURO 3 trucks purchased between January 1, 1999 and September 30, 2001, before the EURO 3 standard became mandatory.<sup>67</sup>

Those who have invested in desulphurisation technology (such as larger industries including cement, sugar and power stations) have an option to register as a sulphur taxpayer. In this case, they are exempt from the sulphur tax on the fuel. Instead, they must measure and pay the tax on the basis of sulphur dioxide emissions to the atmosphere (Approximately 20 companies use this method). These companies also metered emissions prior to the passage of the Energy Package legislation. The electricity-generating sector originally paid a reduced sulphur dioxide emissions tax, but as of 2000 pays the same rate as other industries.

<sup>67</sup> Correspondence with Erik Iversen, Danish Environmental Protection Agency, November 15, 2000

<sup>68</sup> Companies were required to take samples of their fuels prior to the passage of the sulphur tax law.

A further option is available to register to pay the sulphur product tax on the fuel, but to generate a tax refund based on the measured sulphur content in the ashes as a result of the combustion process. (Approximately 30 companies use this method). Companies may choose between computing the sulphur content of the ashes according to stipulations laid down in the law, or may take samples. If the sulphur content in the ashes is not measured, companies can receive a standard refund which is normally lower than what it would have been if measured.

### 3.3.2.3 Delivery Agents of the Measure and Operational Finances

The Danish Environmental Protection Agency and the Ministry of Taxation deliver this measure while the Danish Energy Agency acts as a technical resource. According to the Danish Environmental Protection Agency, there was no cost to the government to implement or maintain this measure.<sup>69</sup> This is a revenue-raising tax whereby any revenues generated go into the general tax system and into the state budget. Revenue raised from the sulphur tax totaled around 200 million DKK (\$39 million CDN) net in 2000 (out of a total revenue of 650 billion DKK (\$127 billion CDN) for taxes).<sup>70</sup>

Companies that import or manufacture fuel oils are obligated to remit the tax to the Ministry of Taxation. Many companies voluntarily specify the sulphur tax as a separate item on the bill of sale therefore showing how the tax is ultimately passed on to the consumer. Thus, consumers are able to consciously choose lower sulphur fuel oils that incur a lower tax burden.

Table 6 outlines estimated administrative costs of the sulphur tax.

**Table 6: Estimated Annual Administrative Sulphur Tax Costs**

Method of Reporting	Number of Companies Using this Method	Estimated Annual Administrative Costs (DKK)
Sulphur Content of the Fuels	300	1 million <sup>71</sup> (\$195 000 CDN)
Sulphur Emissions	20	100 000 (\$19 500 CDN)
Sulphur Content of the Fuels with a refund based on sulphur concentration determined from ashes	30	0.5-1 million (\$97 500-195 000 CDN)

Source: The Danish Energy Agency, Green Taxes for Trade and Industry: Description and Evaluation, June 2000

Consultations with the refiners and other stakeholders took place prior to the introduction of the measure. A draft of the measure was sent to all interested parties for their review and comment over a one-month period. Many comments were added to the draft

<sup>69</sup> Personal communication with Thomas Sørensen, Danish Environmental Protection Agency

<sup>70</sup> Correspondence with Thomas Sørensen, Danish Environmental Protection Agency

<sup>71</sup> This amount includes the computation of the sulphur tax and possible invoicing of the sulphur tax, as well as reporting to the Central Customs and the Tax Administration.

document before being sent to parliament for approval. The general reaction of the oil companies to the measure was negative, however most of the internationally based refiners were quick to take the lead in implementing the measure.<sup>72</sup>

#### *3.3.2.4 Environmental Results*

According to the Danish Government, the total sulphur dioxide emissions decreased by approximately 24% in the years 1995-1997.<sup>73</sup> It is estimated that the total reduction of sulphur emissions will be reduced by 34 000 tonnes in 2005 as a result of the sulphur tax on all fuels.<sup>74</sup>

The sulphur tax can be credited with dramatically reducing the sulphur content of fuel oils and reducing emissions from combustion plants. Only light and heavy fuel oil with a sulphur content of less than 0.05% are now sold.

#### *3.3.2.5 Impact of the Measure*

In Denmark, Statoil and Shell produce heavy and light fuel oil. Denmark's crude oil supply mainly originates from the Danish part of the North Sea and is naturally low in sulphur. Denmark is a net exporter of crude oil.<sup>75</sup>

According to the Danish Ministry of Taxation, the tax has had a positive impact on the development of desulphurisation plants and technology.<sup>76</sup>

The Danish Environmental Protection Agency has noted that it is too early to know whether the measure has been a success as it was only fully implemented last year.

#### *3.3.2.6 Degree of Market Penetration*

The Ministry of Taxation did a market survey on pricing with regard to sulphur content prior to setting the tax rate. They found that there was no market distinction regarding sulphur levels and hence expected, upon the introduction of the tax, an immediate shift to low sulphur fuels. This in fact did happen. The sulphur content of light fuel oil was reduced from 0.2% to 0.05% within a few weeks of the tax's introduction.<sup>77</sup> The sulphur content of heavy fuel oil was reduced from 0.2% to 0.05% the first year the measure was

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<sup>72</sup> Personal communication with Thomas Sørensen, Danish Environmental Protection Agency

<sup>73</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

<sup>74</sup> The Danish Energy Agency, *Green Taxes for Trade and Industry: Description and Evaluation*, June 2000

<sup>75</sup> Correspondence with Uffe Strandkjaer, Danish Energy Agency

<sup>76</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

<sup>77</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

introduced in 1996, despite a five year phasing before the full effect was scheduled in 2000.<sup>78</sup>

### 3.3.3. Level of Public Awareness

Denmark has had a great deal of public and political pressure to enact “green” legislation and complementary taxes. Many consumer groups, including environmental groups, were involved in the consultations for this measure. While environmental groups were positive about the measure, most other consumer groups held neutral opinions about the measure. When the measure was introduced, the Danish Environmental Protection Agency wrote numerous articles and newsletters about this new tax for fuel oils.

## 3.4 Italy

### 3.4.1. Status of the Measure

In January 1988, a differential tax structure was introduced for heavy fuel oil, with:

- 45 LIT/kg (\$0.034 CDN/kg) for HFO with a sulphur content below 1% wt. and
- 90 LIT/kg (\$0.068 CDN/kg) for HFO sulphur content above 1% wt.<sup>80</sup>

For five years, commencing in 1999, the Italian government will continue to raise excise taxes on gasoline, diesel, coal and mineral oils as part of a plan to reduce greenhouse gas emissions.<sup>79</sup> Italy has thus become the first country among the Mediterranean EU member states, which uses energy taxes systematically as an instrument to combat climate change.

While this tax is expected to continue, it may change over time to harmonize with taxation of other European Union countries. Each year the amount of the tax is confirmed or revised but the tax for high sulphur heavy fuel oil (>1% wt.) will always remain twice that for low sulphur heavy fuel oil (<1% wt.).<sup>81</sup>

In 1988, the average sulphur content in heavy fuel oil was approximately 3.3% weight while the average sulphur content in heavy fuel oil in mid-2001 is about 1.9% weight.<sup>82</sup>

<sup>78</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

<sup>79</sup> European Environment Agency, *Environmental Taxes: Recent Developments in Tools for Integration*, Environmental Issues Series No. 18, November, 2000

<sup>80</sup> Personal communication with Nicolo Verdina, Italian Ministry of Finance

<sup>81</sup> Correspondence with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>82</sup> Correspondence with Franco del Manso, Unione Petrolifera (Italian Oil Union)



### 3.4.2. Attributes of the Measure

#### 3.4.2.1 Purpose of the Measure/Rational for Initiating the Measure

The primary purpose behind the measure was to encourage the use of low sulphur heavy fuel oil to achieve broad environmental benefits such as reducing the precursors to acid rain and the consequent impacts from acid deposition.<sup>83</sup>

#### 3.4.2.2 Type and Description of the Measure

Tax is 45 LIT/kg (\$0.034 CDN/kg of sulphur in the product) for low sulphur heavy fuel oil and twice that rate (90 LIT/kg or \$0.068 CDN/kg) for heavy fuel oil with a higher sulphur content. The net result is a tax differential of 45 LIT/kg (\$0.034 CDN/kg).

The key sectors targeted by the tax are the industrial and heating sectors. Small combustion plants (<50 MW) use low sulphur heavy fuel oil (<1% wt.) because of the cost differential and large combustion plants (>50 MW) are obliged to respect an emission limit of 1700 mg/m<sup>3</sup> of sulphur dioxide (within this limit, large combustion plants can use high sulphur heavy fuel oil with sulphur of up to 3% wt.)<sup>85</sup>

Refineries are exempted from the tax in respect of fuels self-produced and internally used. Electricity generators, the largest consumers of high sulphur heavy fuel oil (50-60% of total consumption),<sup>86</sup> are not obliged to pay the tax. See *Table 7* for a list of reduced tax rates for heavy fuel oil used for industrial heating purposes.

In January 1998, Italy introduced two environmental tax incentives: for measured or estimated NO<sub>x</sub> and for SO<sub>2</sub> emissions for producers operating large combustion plants (nominal power of over 50 MW).<sup>84</sup> Therefore, since 1998 two tax incentives regarding sulphur content apply to users of heavy fuel oil.

**Table 7: Reduced Tax Rates for Heavy Fuel Oil Used for Industrial Heating**

Type of Use	Reduced Rate (\$CDN)
Industrial Use (high sulphur)	123 LIT (\$0.092)
Industrial Use (low sulphur)	60 LIT (\$0.045)
Electricity Generation	30 LIT (\$0.022)
Refinery Use	1 LIT (\$0.0007)
Civil (non-industrial) heating (low sulphur)	124 LIT (\$0.093)

Source: Correspondence with Franco del Manso, Unione Petrolifera

<sup>83</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm)**Error! Bookmark not defined.**)

<sup>84</sup> European Commission, *A Database of Environmental Taxes and Charges*, 2000 ([http://europa.eu.int/comm/environment/enveco/env\\_database/database.htm](http://europa.eu.int/comm/environment/enveco/env_database/database.htm)**Error! Bookmark not defined.**)

<sup>85</sup> Correspondence with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>86</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

### *3.4.2.3 Delivery Agents of the Measure and Operational Finances*

The Ministry of Finance administers the tax. Users are obligated to pay the tax when the heavy fuel oil is consumed, but operatively the amount of the tax is transferred to the Government Fiscal Bureau by the producers/manufacturers.

There are ongoing, administrative costs associated with the measure as well as costs to implement the tax differential.<sup>87</sup> Revenue from the tax goes into the general budget although a very small part of the revenue is directed, for example, to the development of renewable energies.<sup>88</sup>

Refiners incurred no costs to implement this measure, as they did not have to amend their approach to refining heavy fuel oils. To produce low sulphur heavy fuel oil, refiners chose naturally low sulphur crude.<sup>89</sup>

### *3.4.2.4 Environmental Results*

The tax incentive can be credited with reducing the sulphur content in heavy fuel oils from an approximate average sulphur content of 3.3 % wt. in 1988 to 1.9% wt. in 2001.

### *3.4.2.5 Impact of the Measure*

The Ministry of Finance notes that this measure was successful in reducing the sulphur content in heavy fuel oil.<sup>90</sup>

Italy has seventeen refineries of which eleven are domestic refiners and the other six are foreign-owned. Italy produces approximately 15 million tonnes of heavy fuel oil domestically and imports about 10 million tonnes, mainly for the purpose of electricity generation.<sup>91</sup> 60% of the crude oil originates from the Middle East, 30% from North Africa and the remaining 10% comes from Russia and the North Sea.<sup>92</sup> The average sulphur content of the crude oils is 1.1% wt.<sup>93</sup>

The Ministry of Finance decided there was no need to conduct negotiations or consultations with refiners prior to the introduction of the measure.<sup>94</sup> According to the Italian Oil Union, this tax was implemented in order to “balance the budget”. Taxation of petroleum products is one of the highest in Europe with refiners advocating that tax rates

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<sup>87</sup> Personal communication with Nicolo Verdina, Italian Ministry of Finance

<sup>88</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>89</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>90</sup> Personal communication with Nicolo Verdina, Italian Ministry of Finance

<sup>91</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>92</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>93</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>94</sup> Personal communication with Nicolo Verdina, Italian Ministry of Finance

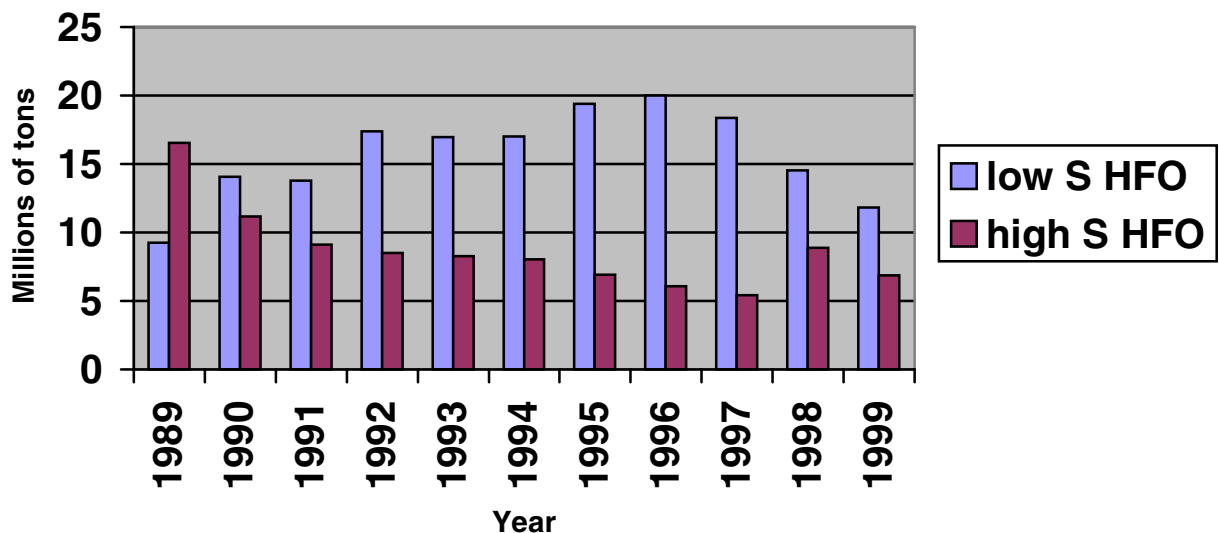
for all oil products be harmonized with other European nations. (The taxation of diesel and gasoline is already aligned with most EU members, however the taxes for light and heavy fuel oil is far higher.)

Electricity generators will occasionally use low sulphur heavy fuel oil, however this action is discouraged by the Italian Industry Ministry as it is seen as an irrational use of energy as low sulphur crude is better used to produce gasoline and diesel.<sup>95</sup>

#### 3.4.2.6 Degree of Market Penetration

Ten years ago, little to no low sulphur heavy fuel oil was available on the market. Once small combustion plants began using low sulphur heavy fuel oil<sup>96</sup>, a larger market share ensued for this higher quality fuel.<sup>97</sup> The 1999 consumption data show that, of the 19 million tonnes of heavy fuel oil used, approximately 12 million tonnes were low sulphur heavy fuel oil (see Figure 1).<sup>98</sup> However, heavy fuel oil for internal use at refineries and that consumed in petrochemical plants is not included in these figures. (Internal consumption by refineries amounts to nearly 4 million tonnes of high sulphur heavy fuel oil (>1% wt.) and petrochemical use amounts to nearly 2 million tonnes of high sulphur heavy fuel oil (>1% wt.)). Hence, low sulphur heavy fuel oil has achieved nearly a 48% share of the Italian heavy fuel oil market.

**Figure 1: Heavy Fuel Oil Consumption from 1989 to 1999**



Source: Correspondence with Franco del Manso, Unione Petrolifera

<sup>95</sup> Correspondence with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>96</sup> Small combustion plants are obliged by the Italian environmental legislation on air emissions to use low sulphur heavy fuel oil.

<sup>97</sup> Personal communication with Franco del Manso, Unione Petrolifera (Italian Oil Union)

<sup>98</sup> Correspondence with Franco del Manso, Unione Petrolifera (Italian Oil Union)

### 3.4.3. Level of Public Awareness

The level of public awareness was high at the introduction of the measure as both the general and specialized media covered its introduction in the news. Continuing public awareness of the measure appears to be low since mainly large consumers such as electricity generators, industry and the refiners themselves use heavy fuel oil.

## 4. Concluding Observations from the Case Studies

**Measure of Choice** – At least 10 OECD member countries have implemented economic instruments to accelerate the reduction of sulphur in heavy and/or light fuel oil. The case studies document how these measures have been successful in prompting market shifts to lower sulphur products.

**Integration of Measures** – In general, these are not stand-alone measures. They are typically introduced as one component in a package of measures. Switzerland pools the revenues from both of the taxes for light fuel oil and volatile organic compounds to redistribute it to Swiss citizens. Sweden and Denmark tax energy products on three bases: energy, carbon dioxide and sulphur. In the case of the sulphur tax, in January 1991 Sweden introduced this tax disincentive for all fuels (including peat and coke) at the same time as part of a comprehensive package for accelerating the reduction of sulphur in all fuels.

**Cost to Government** – In all of the case studies examined, the measures were designed to generate revenue with minimal administrative costs.

**Disposition of Revenue** – In most cases it appears tax revenue goes to general funds. But in the case of Italy, a very small part of the revenue is directed, for example, to the development of renewable energies. In the innovative Swiss example, the revenue is used as an offset to mandatory medical insurance for Swiss citizens.

### Emission Reductions Reported

- Switzerland has reported the combined effect of the Ordinance on Air Pollution Control and the Ordinance for “Extra Light” Heating Oil has reduced sulphur emissions from approximately 42 000 tonnes in 1990 to around 26 000 tonnes in 1999 or approximately a 38% reduction. Measurements taken in urban areas show that sulphur dioxide emissions have decreased from approximately 34 micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ) in 1988 to approximately eight  $\mu\text{g}/\text{m}^3$  in 1999.
- Sweden estimates that annual sulphur emissions from 1989 to 1995 have been reduced by 19 000 tonnes due to the tax. This represents 30% of the total emissions reduction in that period for which the tax is responsible. With reference to the manufacturing industry in the same period, approximately 59% of their reduction in sulphur emissions can be attributed to the Swedish sulphur tax.

- Denmark reports that the total sulphur dioxide emissions decreased by approximately 24% in the years 1995-1997. Denmark has estimated that the total reduction of sulphur emissions will have been reduced by 34 000 tonnes in 2005 as a result of the sulphur tax.

**Global Impacts** – An unintended negative impact may be the “dumping” of polluting products, i.e. higher sulphur, in countries without comparable measures. For example, in Sweden a by-product from the manufacture of low-sulphur heavy fuel oils is a residual oil with a high sulphur content, which is often exported to countries with lower environmental standards.

**Timing** – An economic instrument can produce a rapid market shift in particular when the consultative process leading to its introduction is effective. For three of the four case studies (Switzerland, Sweden and Denmark), the measure was announced well in advance of it coming into effect. This produced a rapid market shift with lower sulphur fuel oils either available immediately on the heel of the announcement, or prior to the measure coming into effect.

**Technology Driver** – Flexibility in implementing economic instruments appears to be of particular importance to large- scale industries and may help drive the adoption of cleaner technology. (Technology adoption rather than technology innovation seems to be a result). According to an article published in *The Energy Journal*, the Swedish sulphur tax has primarily worked via three channels: 1) by inducing technological progress on the demand side, 2) by enhancing technological progress on the supply side, and 3) by substitution between heavy and light fuel oil, this being the least applicable of the three. According to the Danish Ministry of Taxation, the tax has had a positive impact on the development of desulphurisation plants and technology.

**Impact on End Consumers (Citizens)** – Two cases have interesting innovations for making the initiative more transparent. In the Swiss case, the revenue from the tax is earmarked to reduce personal contributions to medical health insurance through a per capita reimbursement scheme. In Denmark, consumers ultimately pay the tax and many companies voluntarily specify the sulphur tax as a separate item on the bill of sale. Thus, consumers are able to consciously choose lower sulphur fuel oils that incur a lower tax burden.

**Public Awareness** – While a great deal of media coverage seems to occur during the debate and introduction of the measure, ongoing public awareness seems limited.

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**Appendix A - Summary of Regulations for Sulphur in Light Fuel Oil in OECD Countries**

SUMMARY OF REGULATIONS FOR SULPHUR IN LIGHT FUEL OIL IN OECD COUNTRIES

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>Canada</i>	0.5 voluntary standard: Type 0=0.3; Type 1&2=0.5 (0.203%) [CAN/CGSB-3.2-M99]	Proposing to develop measures to reduce the level of sulphur in light fuel oils used for residential heating	Not known	Not proposed
<i>Canada – New Brunswick</i>	0.5 (Atlantic 0.132%) [Air Quality Regulations (83-208) amended 1995]			
<i>Canada - Ontario</i>	0.5 (0.223%) [Sulphur Content of Fuels Regulation (361-90) 1990 amended in 1999 to O. Reg. 522/99]			
<i>Canada – Quebec</i>	0.5: Type 0=0.2 (0.252%) [Petroleum Products Regulation (753-91)]			
<i>Czech Republic</i>	1.0: for large (> 5MW) and medium (0.2-5 MW) and 0.2 for small sources (<0.2 MW) [Decree of the Ministry of the Environment of the Czech Republic No. 117/97 Coll.]			
<i>EU Wide</i>	0.2 (0.1-0.2% in 1998) [Sulphur Content of Certain Liquid Fuels (93/12/EEC) October 1,1994]	Sulphur Content of Certain Liquid Fuels (1999/32/EC) Directive	0.1	January 1, 2008; option for 0.2% for Spain, Portugal and Greece
<i>EU Wide - Austria</i>	0.1 [National Legislation for Light Fuel Oil]			
<i>EU Wide - Finland</i>	0.1 [National Legislation for Light Fuel Oil]			

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>EU Wide - Germany</i>	0.2 (0.15%) [National Legislation for Light Fuel Oil, 1975]			
<i>EU Wide - Ireland</i>	0.2 (0.08%) [Regulation of Sulphur Content in Different Oil Products, June, 1995]			
<i>EU Wide - Norway</i>	0.2 (0.08%) [National Legislation for Light Fuel Oil]			
<i>EU Wide - UK</i>	0.2 [Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000, June 2000]	Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000	0.1	
<i>USA – Connecticut</i>	0.3 [State Legislation (Section 16a-21a)]			
<i>USA – Delaware</i>	0.3 [SO <sub>2</sub> Emissions from Fuel Burning Equipment Regulations (8)]			
<i>USA – Massachusetts</i>	0.3 [State Legislation (310 CMR 7.05)]			
<i>USA – New Hampshire</i>	0.4 [State Legislation (Chapter Env – A 401)]			
<i>USA – New York</i>	0.2-1.5 [Fuel Composition and Use Regulation (ch. III, subpart 225.1)]			
<i>USA - Texas</i>	0.3 [Environmental Quality Regulation (30 part I, ss.112.9) 1993]			



**Appendix B - Summary of Regulations for Sulphur in Heavy Fuel Oil in OCED  
Countries**

SUMMARY OF REGULATIONS FOR SULPHUR IN HEAVY FUEL OIL IN OECD COUNTRIES

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>Canada</i>	No limit (1.761%)	Proposing to develop measures to reduce the level of sulphur in heavy fuel oils used by industrial facilities	Not known	Not proposed
<i>Canada - British Columbia</i>	1.1 (1.726%) [Sulphur Content of Fuels Regulations (BC Reg 64/89) 1989]			
<i>Canada – New Brunswick</i>	Ranging from 1.5-3.0: Type 4=1.5; Type 5=2.0 (Atlantic 2.2%) [Air Quality Regulations (83-208) amended in 1995]			
<i>Canada – Ontario</i>	1.5 (1.919%) [Sulphur Content of Fuels Regulations (361-90) 1990 amended in 1999 to O. Reg. 522/99] only applies in Metro Toronto			
	1.0 [Boilers Regulations (338-90), 1990 amended in 1999 to O. Reg. 521/99] only for boiler fuel and exempts Ontario Hydro			
<i>Canada – Quebec</i>	2.0 (1.249%) [Règlement sur la qualité de l'atmosphère]			
<i>Canada – Montreal Urban Community</i>	Ranging from 1.0-1.5 [By-Law # 90 1987]			

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>Czech Republic</i>	1.0: for large (> 5MW) and medium (0.2-5 MW) and 0.2 for small sources (<0.2 MW) [Decree of the Ministry of the Environment of the Czech Republic No. 117/97 Coll.]			
<i>EU Wide</i>	No limit – voluntary standards range from 0.1-3.5 (3.0-5.0% in 1998)	[1999/32/EC, April 1999 amended 93/12/EEC] A Member State may authorize heavy fuel oils with a sulphur content between 1.0 and 3.0% mass to be used in part or the whole of its territory	1.0 sulphur	January 1, 2003
<i>EU Wide - Austria</i>	1.0 [National Legislation for Heavy Fuel Oil] more severe restrictions (0.2-0.6%) on heating plants depending on their age and capacity			
<i>EU Wide – Belgium</i>	3.0 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Denmark</i>	1.0 (0.034%) [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Finland</i>	1.0 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - France</i>	4.0 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Germany</i>	1.0 [Industry Standard for Heavy Fuel Oil]			
<i>EU Wide - Greece</i>	Ranging from 0.7-3.2; 0.7 in Athens [National Legislation for Heavy Fuel Oil]			

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>EU Wide - Italy</i>	3.0 (1.9%) [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Netherlands</i>	1.0 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Norway</i>	1.0 (except for the northern part of the country) (0.64%) [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Portugal</i>	3.5 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Spain</i>	3.5 [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - Sweden</i>	0.8 (0.35% in 1995) [National Legislation for Heavy Fuel Oil]			
<i>EU Wide - UK</i>	No limit (2.5%)	Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000, June 2000	1.0	January 1, 2003
<i>Slovakia</i>	<1.0 for sources <0.2 MW [National Legislation for Heavy Fuel Oil]			
<i>USA – Connecticut</i>	1.0 [State Legislation (Section 22a-174-19)]			
<i>USA – Delaware</i>	1.0 [SO <sub>2</sub> Emissions from Fuel Burning Equipment Regulations (8)] only in New Castle County			
<i>USA – Idaho</i>	1.75 [State Legislation]			

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>USA – Maine</i>	Ranging from 1.0-2.0: In Portland=1.0 and rest of state=2.0 [Low Sulphur Fuel Regulation (Chapter 106), 1991]			
<i>USA – Maryland</i>	Ranging from 1.0-2.0: Urban areas=1.0, Rural areas=2.0 [State Legislation]			
<i>USA – Massachusetts</i>	Ranging from 0.5-2.2: sale or use in excess of following limits prohibited: Metro Boston – 0.5; Berkshire District – 2.2; Other parts of the state – 1.0-2.2 [State Legislation (310 CMR 7.05)]			
<i>USA – Michigan</i>	Ranging from 1.0-1.5: Small boilers=1.5; Large boilers=1.0 [Emission Limitations and Prohibitions Regulation (R336.1401) 1978]			
<i>USA – New Hampshire</i>	Ranging from 1.0-2.0: No. 4=1.0, No. 5&6=2.0 [State Legislation (Chapter Env – A 401)]			
<i>USA – New York</i>	Ranging from 0.3-1.5: dependent on region; 0.3 in New York City [Fuel Composition and Use Regulation (ch. III, subpart 225.1)]			
<i>USA – Rhode Island</i>	1.0 [Regulation No. 8]			

Country	Current fuel limit - % wt. (average content) [measure and effective date]	Additional Planned Measures		
		Instrument	Sulphur Limit (% wt.)	Effective Date
<i>USA - Texas</i>	0.3 [Environmental Quality Regulation (30 part I, ss.112.9) 1993] only Harrison and Jefferson counties			
<i>USA – Vermont</i>	2.0 [State Legislation] for the entire state unless another limit is stated in the “bubble” rule			

**Appendix C - Summary of Industry Voluntary Initiatives for Light Fuel Oil in  
OECD Countries**

**SUMMARY OF INDUSTRY VOLUNTARY INITIATIVES FOR LIGHT FUEL OIL IN OECD COUNTRIES**

<b>Country</b>	<b>Current fuel limit - % wt. (average content)</b>	<b>Measure</b>	<b>Low S fuel (% wt.)</b>	<b>Effective Date</b>	<b>Comment</b>
<i>Germany</i>	0.2 (0.15%)	Deutsche Shell's Thermo Eco-Ultra	0.05	Sept., 2000	In 1996, the German oil industry reached a voluntary agreement with the government to improve the efficiency of oil-fired space heating by 25% by 2005 from 1990 levels. Deutsche Shell stated its new low-sulphur grade should help to achieve this goal. The low-sulphur heating oil will enable the introduction of more efficient boilers that could cut energy consumption by 40% in buildings that adopt the technology.



**Appendix D - Summary of Economic Instruments Applied to Light Fuel Oil in  
OECD Countries**

SUMMARY OF ECONOMIC INSTRUMENTS APPLIED TO LIGHT FUEL OIL IN OECD COUNTRIES

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Australia</i>	No limit	Excise on Fuels for heating oil (Excise Tariff Act 1921)		Currently in effect	Tax rate of \$0.07552 AUS/L (\$ 0.0586 CAD/L)	
<i>Austria</i> <sup>99</sup>	0.1	Excise Tax on Light Fuel Oil for industrial/commercial uses		Currently in effect	Tax rate of 3890 OS/kL (\$409.19 CAD/kL)	The use of light fuel oil cogeneration plants (combined heat and power) is subject to a reduced tax rate of 950 OS/kL (\$99.93 CAD/kL)
	0.1	Mineral Oil Tax on Light Fuel Oil		Currently in effect	Tax rate of 0.5 OS/kg (\$0.05 CAD/kg)	Mineral oil used by refineries for their own purposes (not for motor fuel) is exempt from the tax.
	0.1	Excise Tax on Light Fuel Oil for heating purposes – Extra Light Fuel Oil		Currently in effect	Tax rate of 0.95 OS/L (\$0.10 CAD/L)	The use of light fuel oil cogeneration plants (combined heat and power) is subject to a reduced tax rate of 950 OS/kL (\$99.93 CAD/kL)

<sup>99</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Belgium</i> <sup>100</sup>	0.2	Excise Duty on Light Fuel Oil – for Industrial/Commercial Use		January 1, 1989	Tax rate of 750 BEF/kL (\$26.92 CAD/kL)	Mineral oils used for horticulture, agriculture and silviculture are exempt from the tax.
	0.2	Excise Duty on Light Fuel Oil – for Heating purposes		Currently in effect	Tax rate of 210 BEF/kL (\$7.54 CAD/kL)	Heating oil for domestic use is subject to an inspection fee. The taxation of light fuel oil for heating purposes in Belgium is lower than the minimum excise duty adopted by the Council because Belgium has applied no excise duty on 1-1-1991 on the consumption of light fuel oil. According to Article 5.3 of Directive 92/82/EEC member states may continue with a zero tax rate if they levy a 5 EUR/kL (\$7.24 CAD/kL) monitoring charge.
	0.2	Energy Tax on Light Fuel Oil – for heating purposes		Currently in effect	Tax rate of 340 BEF/kL (\$12.20 CAD/kL)	Heating oil can be exempt from the energy tax when used for certain commercial applications
<i>Canada</i>	No limit (0.203%)	Proposing to develop measures to promote the early introduction of cleaner fuels		Not known	Not proposed	

<sup>100</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<b>Czech Republic</b>	1.0 for greater than or equal to 0.2 MW and 0.2 for <0.2 MW	Excises on hydrocarbon fuels and lubricants (Light Fuel Oil)		Currently in effect	Tax rate of 8150 CZK/kL (\$345.27 CAD/kL)	When the products are used for the production of heat, the tax is refunded to the heat producer.
<b>Denmark<sup>101</sup></b>	0.2 (0.034%)	Excise Tax on Light Fuel Oil		Currently in effect	Tax rate of 1.66 DKK/kg (\$0.32 CAD/kg)	If energy is used by industry for other functions than space heating, then taxes are largely refunded. The following is a list of exemptions from the tax: 1) products made and consumed at refineries; 2) goods used by diplomatic services and international organisations and 3) registered businesses' exports.
	0.2 (0.034%)	CO <sub>2</sub> Tax for Light Fuel Oil for Industrial/ Commercial use		Currently in effect	Tax rate of 0.27 DKK per litre (\$0.053 CAD/litre)	Levied according to energy content in fuel in 1998. The following is a list of exemptions from the tax: 1) energy products used for production of electricity in a power station; 2) energy products produced and consumed at refineries; and 3) energy products delivered to diplomats and international organisations.
	0.2 (0.034%)	CO <sub>2</sub> Tax for Light Fuel Oil for Heating purposes		Currently in effect	Tax rate of 0.27 DKK per litre (\$0.053 CAD/litre)	Levied according to energy content in fuel in 1998.

<sup>101</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Denmark</i>	0.2 (0.034%)	Sulphur Tax (for Light Fuel Oil)	For fuel oil with a sulphur content >0.05	1996	Product tax rate of 20 DKK/kg (\$3.90 CAD/kg) sulphur or emission tax rate of 10 DKK/kg (\$1.95 CAD/kg) of sulphur dioxide	The sulphur tax was introduced in 1995, but did not come into effect until 1996. It was phased in over the 1996-2000 period by gradually reducing a basic allowance and took full effect in 2000. It is levied either as a product or and emission tax. There is no duty on mineral oils used for technical purposes by businesses. Goods delivered to diplomatic services and international organisations are exempt from the tax.
<i>Finland</i> <sup>102</sup>	0.1	Excise Duty for Light Fuel Oil		Currently in effect	Tax rate of 0.109 FIM/L (\$0.027 CAD/L) Strategic Stockpile fee is 0.021 FIM/L (\$0.005 CAD/L)	Revenues from the strategic stockpile fees are allocated to special funds. The following is a list of exemptions for this tax: 1) fuels used as a source of energy in an oil refining process; 2) fuels which are sold, delivered or imported for the purposes of emergency supply; 3) fuels used in industrial production as a raw material or auxiliary material or consumed as immediate inputs in manufacturing of goods; and 4) with some exceptions, fuels used in electricity generation. Greenhouse cultivators may apply for a refund of 0.2 FIM/L (\$0.049 CAD/L) for light fuel oil used.
	0.1	Carbon/energy tax (additional duty for Light Fuel Oil for both residential and industrial use)		Currently in effect	Tax rate of 279 FIM/kL (\$68.05 CAD/L)	

<sup>102</sup> Taxes on light fuel oil are cumulative.

<b>Country</b>	<b>Current fuel limit - % wt. (average content)</b>	<b>Measure</b>	<b>Low S fuel (% wt.)</b>	<b>Effective Date</b>	<b>Tax</b>	<b>Comment</b>
<b>France</b>	0.2	Tax on Light Fuel Oil		Currently in effect	Tax rate of 0.5173 FF/L (\$0.1144 CAD/L)	
<b>Germany</b>	0.2 (0.15%)	Duty on mineral oils (Light Fuel Oil for industrial/commercial use)		Currently in effect	Tax rate of 0.12 DM/L (\$0.09 CAD/L)	Revenue from taxes on both industrial and light fuel oil used for heating purposes is earmarked for building or maintenance of roads and for other traffic purposes, such as railways and other public traffic. There is a refund for mineral oils used for tests with biofuels.
	0.2 (0.15%)	Duty on mineral oils (Light Fuel Oil for heating purposes)		Currently in effect	Tax rate of 88 DM/kL (\$65.22 CAD/kL)	
<b>Greece</b>	0.2	Mineral Oil Tax for Light Fuel Oil for heating purposes		Currently in effect	Tax rate of 6.1 DRAL (\$0.03 CAD/L) and 42 DRAL (\$0.18 CAD/L) during the winter period	
	0.2	Mineral Oil Tax for Light Fuel Oil for industrial/commercial use		Currently in effect	Tax rate of 83 DRAL (\$0.35 CAD/L)	
<b>Hungary</b>	Not known	Excise Tax on Diesel (Light Fuel Oil)		Currently in effect	Tax rate of 67.6 HUF/L (\$0.38 CAD/L)	For light fuel oil not fulfilling the Hungarian standard.

<b>Country</b>	<b>Current fuel limit - % wt. (average content)</b>	<b>Measure</b>	<b>Low S fuel (% wt.)</b>	<b>Effective Date</b>	<b>Tax</b>	<b>Comment</b>
<i>Hungary</i>	Not known	Product charge on other oils (Light Fuel Oil)	>2	Currently in effect	Tax rate of 2.00 HUF/kg (\$0.01 CAD/kg)	For fuel fulfilling the Hungarian standard but with more than 2% sulphur content.
<i>Ireland</i>	0.2	Duty on Light Fuel Oil		Currently in effect	Tax rate of 37.3 IEP/kL (\$68.64 CAD /kL)	Light fuel oil used in horticulture production and mushroom tunnels are levied with a reduced tax rate. Oils exported are exempt from the tax.
<i>Italy</i>	0.2	Mineral Oil Tax for Light Fuel Oil for commercial use		Currently in effect	Tax rate of 224.2 LIT/L (\$0.17 CAD/L)	
	0.2	Mineral Oil Tax for Light Fuel Oil for heating purposes		Currently in effect	Tax rate of 747.5 LIT/L (\$0.60 CAD/L)	
<i>Japan</i>	Not known	Light Oil Delivery Tax		Currently in effect	Tax rate of 32.1 JPY/litre (\$0.43 CAD/litre)	All revenues are allocated to prefectural governments' expenses for construction and maintenance of roads
<i>Luxembourg</i>	0.2	Mineral Oil Tax for Light Fuel Oil for heating purposes		Currently in effect	Tax rate of 0.21 LFR/L (\$0.008 CAD/L)	
	0.2	Mineral Oil Tax for Light Fuel Oil for commercial/ industrial use		Currently in effect	Tax rate of 0.75 LFR/L (\$0.027 CAD/L)	

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Netherlands</i> <sup>103</sup>	0.2	Excise Duty on Mineral Oil (Light Fuel Oil)		Currently in effect	Tax rate of 0.1026 NLG/L (\$0.0675 CAD/L) and a Stockpile Fee of 11 NGL/kL (\$7.24 CAD/kL)	
	0.2	Fuel tax payable under Environment Protection Act		Currently in effect	Tax rate of 28.56 NLG/kL (\$18.79 CAD/kL)	
	0.2	Tax in connection with petroleum stocks		Currently in effect	Tax rate of 0.011 NLG/L (\$0.007 CAD/L)	Refunds might be given if oil products are exported or delivered in another EU member state. The purpose of the tax is to finance the costs of compulsory oil stockholding by the Dutch National Petroleum Stockpiling Agency.
<i>Norway</i> <sup>104</sup>	0.2 (0.08%)	Basic tax on fuel oil (Light Fuel Oil)		2000	Tax rate of 0.382 NOK per litre (\$0.069 CAD/litre)	The excise tax on light fuel oil was abolished in 1993. Fuels used as raw material in manufacturing processes if the fuels are incorporated and remains contained in the final product are exempt from the tax.
	0.2 (0.08%)	CO <sub>2</sub> Tax on Light Fuel Oil – ordinary rate		1991	Tax rate of 0.47 NOK/L (\$0.08 CAD/L) per tonne of CO <sub>2</sub>	Both mineral products exported and those used as raw materials in industrial activities in such a way that no CO <sub>2</sub> emissions are caused, or when the emissions are much lower than the quantity used would normally indicate are exempt from the tax.

<sup>103</sup> Taxes on light fuel oil are cumulative.

<sup>104</sup> Taxes on light fuel oil are cumulative.



Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Norway</i>	0.2 (0.08%)	CO <sub>2</sub> Tax on Mineral Oil Products – other fuels for stationary purposes		1991	Tax rate of 0.47 NOK/L (\$0.08 CAD/L) per tonne of CO <sub>2</sub>	For any oil which may be used as a fuel oil.
	0.2 (0.08%)	CO <sub>2</sub> Tax on Light Fuel Oil – reduced rate		1991	Tax rate of 0.26 NOK/L (\$0.05 CAD/L) per tonne of CO <sub>2</sub>	
	0.2 (0.08%)	CO <sub>2</sub> Tax on Light Fuel Oil – used in the pulp and paper and the fishmeal industries		1991	Tax rate of 0.235 NOK/L (\$0.042 CAD/L) per tonne of CO <sub>2</sub>	The paper and pulp industry and production of fishmeal (from herrings) pay half the ordinary rates.
	0.2 (0.08%)	Sulphur Tax – normal rate (Light Fuel Oil)		1970	Tax rate of 0.07 NOK/L (\$0.013 CAD/L) per 0.25% weight share sulphur content	Sulphur tax is reimbursed depending on abated emissions by means of technical measures (clean technology). For example reimbursement of the tax amount corresponds to the quantity of sulphur that is not emitted into the air. Both oils with a sulphur content of 0.05 weight percentage or less and mineral products exported are exempt from the tax.
	0.2 (0.08%)	Sulphur Tax – SO <sub>2</sub> emissions from oil refineries		1970	Tax rate of 3 NOK/kg SO <sub>2</sub> (\$0.54 CAD/kg SO <sub>2</sub> )	

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Norway</i>	0.2 (0.08%)	Sulphur Tax – reduced rate (Light Fuel Oil)		Currently in effect	Tax rate of 0.013 NOK/L (\$0.002 CAD/L) per 0.25% weight share sulphur content	
<i>Portugal</i> <sup>105</sup>	0.2	Tax on petroleum products (Light Fuel Oil)	>1	Currently in effect	Tax rate of 5500 ESC/kL (\$39.76 CAD/kL)	Fuel oils used for the production of town gas, electricity and co-generation is exempt from the tax.
	0.2	Tax on petroleum products (Light Fuel Oil)	<1	Currently in effect	Tax rate of 2500 ESC/kL (\$18.07 CAD/kL)	
	0.2	Tax on petroleum products (Light Fuel Oil for other fuels for stationary purposes)		Currently in effect	Tax rate of 18000 ESC/kL (\$130.10 CAD/kL)	Mineral oils used as inputs for electricity generation or for town gas production are exempt from the excise tax. Light fuel oil for heating purposes does not exist in Portugal; therefore, light fuel oil for heating purposes can be classified as domestic fuel.

<sup>105</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Spain</i> <sup>106</sup>	0.2	Excise tax on Light Fuel Oil		Currently in effect	Tax rate of 13097 PTA/kL (\$114.05 CAD/kL)	The following is a list of exemptions from the tax: 1) products used in production of electricity, including co-generation of electricity and heat; 3) Canary Islands, Ceuta and Melilla (However, the regional governments of the Canary Islands and the local governments of Ceuta and Melilla levy a local tax on the same products as the national tax); and 4) hydrocarbons supplied to diplomatic representatives, international organisations, armies of countries belonging to the NATO, different from Spain.
	0.2	Sulphur Tax (regional)		Currently in effect	Tax rate: 0-1000 tonnes/yr is 0 PTA/tonne 1001-50 000 tonnes/yr is 5000 PTA/tonne (\$43.54 CAD/tonne) >50 001 tonnes/yr is 5500 PTA/tonne (\$47.89 CAD/tonne)	Tax base is the sum of the amount of each one of the polluting substances (SO <sub>2</sub> and NO <sub>x</sub> ). The owner of the industrial activity is the tax payer and only major emitters are taxed.
	0.2	Excise tax on Light Fuel Oil		Currently in effect	Tax rate of 2235 PTA/tonne (\$19.46 CAD/tonne)	

<sup>106</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Sweden</i> <sup>107</sup>	0.2 (0.076 in 1995)	Excise Tax (CO <sub>2</sub> tax) on Light Fuel Oil		Currently in effect	Tax rate of 1058 SEK/kL (\$155.26 CAD/kL)	Refunds from the energy and CO <sub>2</sub> taxes are given to manufacturing and commercial greenhouse cultivation. If heat has been delivered for use in industrial manufacturing processes for commercial, agricultural, forestry or fish cultivation practices, the heat producer may apply for a refund of all the energy tax and 65% of the CO <sub>2</sub> tax.
	0.2 (0.076 in 1995)	Tax on sulphur in Light Fuel Oil	0.1	Currently in effect	Tax rate of 27 SEK (\$3.96 CAD) per m <sup>3</sup> per 0.1% sulphur content by weight	Sulphur tax promotes the use of cleaner light fuel oil and provides incentives for investments in technology because of reimbursement schemes for reduction of sulphur emissions; users can be reimbursed with 30 SEK/kg sulphur (\$4.40 CAD/kg sulphur). Refineries are eligible for tax relief. Tax refunds are given when SO <sub>2</sub> emissions are reduced by treatment or absorption in any product or in ash. The following is a list of exemptions from the tax: 1) oils with a sulphur content below 0.1%; 2) fuels used for the production of mineral oils carbon fuels and petroleum coke; and 3) if sulphur is not emitted to the atmosphere through binding in the process or in the ashes.

<sup>107</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Sweden</i>	0.2 (0.076 in 1995)	Excise Tax (Energy tax) on Light Fuel Oil		Currently in effect	Tax rate of 743 SEK/kL (\$109.02 CAD/kL)	From the income of the energy tax, a small portion (called "Special tax against acidification") corresponding to 9 SEK (\$1.32 CAD) per m3 heating oil, is used to add limestone to rivers and lakes to raise the pH value. Fuels used for the production of electricity are exempt from the energy tax and the carbon dioxide tax – an energy tax is levied on electricity. The following is a list of exemptions from both the energy and CO <sub>2</sub> taxes: 1) fuels used for the production of heat in a combined heat and power plant for the proportion related to the heat generation; 2) fuels used for the production of mineral oils, carbon fuels and petroleum coke; and 3) fuels delivered to another member state within EU for use by diplomats and the like as well as such consumption in Sweden.
<i>Switzerland</i> <sup>108</sup>	0.2 (0.07%)	Energy Contribution Tax – Light Fuel Oil for heating purposes		Currently in effect	Tax rate of 0.34 CHF/L (\$0.34 CAD/L)	Certain industrial and commercial activities (in circumstances when excise duties are earmarked for mineral oils) are exempt from the tax.

<sup>108</sup> Taxes on light fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Switzerland</i>	0.2 (0.07%)	Tax on Light Fuel Oil/Sulphur	>0.1	Currently in effect	Tax rate of 12 CHF/tonne (\$11.86 CAD/tonne)	The objective of the tax is to reduce sulphur content from 0.2% to 0.1%. Revenue is earmarked to reduce the contribution to the medical health insurance (per capita reimbursement). Increase of the tax rate will be in accordance with actual inflation.
	0.2 (0.07%)	Tax on Mineral oils – Light Fuel Oil		Currently in effect	Tax rate of 3.0 CHF/kL (\$2.96 CAD/kL)	Fuels used as a source of energy in the refining process are exempt from the tax.
	0.2 (0.07%)	Tax on Mineral oils – Light Oil for other fuels for stationary purposes		Currently in effect	Tax rate of 1.1 CHF/kL (\$1.09 CAD/kL) at 15°C	
	0.2 (0.07%)	Emergency Fund		Currently in effect	Cost-covering charges of 10.6 CHF/tonne (\$10.48 CAD/tonne)	Revenues are distributed to a private institute (CARBURA) which administers the emergency fund.

<b>Country</b>	<b>Current fuel limit - % wt. (average content)</b>	<b>Measure</b>	<b>Low S fuel (% wt.)</b>	<b>Effective Date</b>	<b>Tax</b>	<b>Comment</b>
<b>UK</b>	0.2	Excise Tax on Light Fuel Oil		Currently in effect	Tax rate of 31.3 GBP/kL (\$72.20 CAD/kL) and a tax rate of 27.4 GBP/kL (\$63.21 CAD/kL) for fuel oil delivered for use as a furnace fuel	
<b>USA - Wisconsin</b>	Unknown	Wisconsin -- Petroleum Inspection Fee for Light Fuel Oil		Currently in effect	Tax rate of 0.03 USD/gallon (\$0.047 CAD/gallon)	The following is a list of exemptions from the tax: 1) fuel exported from Wisconsin; 2) fuel transferred to tax-free terminal storage; and 3) fuel sold to the US government and its agencies.

**Appendix E - Summary of Economic Instruments Applied to Heavy Fuel Oil in  
OECD Countries**



SUMMARY OF ECONOMIC INSTRUMENTS APPLIED TO HEAVY FUEL OIL IN OECD COUNTRIES

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Australia</i>	No limit	Excise on Fuels (Excise Tariff Act 1921)		Currently in effect	Tax rate of \$0.3812 AUS/L (\$0.2958 CAD/L)	
<i>Austria</i>	1.0	Excise Tax on Heavy Fuel Oil		Currently in effect	Tax rate of 500 OS/tonne (\$52.60 CAD/tonne)	Heavy fuel oil used for the production of electricity, mineral oil used in blast furnaces and mineral oil used by refineries for their own purposes (not for motor fuel) are exempt from the tax.
<i>Belgium</i>	3.0	Excise Duty on Heavy Fuel Oil	<1.0	Currently in effect	Tax rate of 250 BEF/tonne (\$8.97 CAD/tonne)	Mineral oils used for horticulture, agriculture and silviculture are exempt from the tax.
	3.0	Excise Duty on Heavy Fuel Oil	>1.0	Currently in effect	Tax rate of 750 BEF/tonne (\$26.92 CAD/tonne)	
<i>Canada</i>	No limit (1.761%)	Proposing to develop measures to promote the early introduction of cleaner fuels		Not known	Not proposed	

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Denmark</i> <sup>109</sup>	1.0 (0.034%)	Excise tax on Heavy Fuel Oil used for Industrial/ Commercial Use		Currently in effect	Tax rate of 1910 DKK/tonne (\$372.45 CAD/tonne)	
	1.0 (0.034%)	CO <sub>2</sub> Tax for Heavy Fuel Oil		Currently in effect	Tax rate of 320 DKK/tonne (\$62.40 CAD/tonne)	Levied according to energy content in fuel in 1998.
	1.0 (0.034%)	Sulphur Tax (for Heavy Fuel Oil)	For fuel oil with a sulphur content >0.05	1996	Product tax rate of 20 DKK/kg (\$3.90 CAD/kg) sulphur or emission tax rate of 10 DKK/kg (\$1.95 CAD/kg) of sulphur dioxide	The sulphur tax was introduced in 1995, but did not come into effect until 1996. It was phased in over the 1996-2000 period by gradually reducing a basic allowance and took full effect in 2000. It is levied either as a product or and emission tax. There is no duty on mineral oils used for technical purposes by businesses. Goods delivered to diplomatic services and international organisations are exempt from the tax.

<sup>109</sup> Taxes on heavy fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Finland</i>	1.0	Excise Duty (Carbon/Energy Tax) for Heavy Fuel Oil		Currently in effect	Tax rate of 321 FIM/tonne (\$78.29 CAD/tonne) Strategic Stockpile fee is 17 FIM/tonne (\$4.15 CAD/tonne)	Revenues from the strategic stockpile fees are allocated to special funds. The following is a list of exemptions for this tax: 1) fuels used as a source of energy in an oil refining process; 2) fuels which are sold, delivered or imported for the purposes of emergency supply; 3) fuels used in industrial production as a raw material or auxiliary material or consumed as immediate inputs in manufacturing of goods; and 4) with some exceptions, fuels used in electricity generation. Greenhouse cultivators may apply for a refund of 0.08 FIM (\$0.02 CAD) for heavy fuel oil used.
<i>France</i> <sup>110</sup>	4.0	National Tax/Stockpile Tax on Heavy Fuel Oil		Currently in effect	Tax rate of 11.7 FF/tonne (\$2.59 CAD/tonne)	Tax on heavy fuel oil benefits the 'Institut francais du petrole'.
	4.0	Tax on Heavy Fuel Oil	>2.0	Currently in effect	Tax rate of 1.523 FF/kg (\$0.337 CAD/kg) net	
	4.0	Tax on Heavy Fuel Oil	<2.0	Currently in effect	Tax rate of 1.101 FF/kg (\$0.243 CAD/kg) net	The reduced tax rate for heavy fuel oil with low sulphur content led to a loss of 70 million FF (\$15.5 million CAD).

<sup>110</sup> Taxes on heavy fuel oil are cumulative.

<b>Country</b>	<b>Current fuel limit - % wt. (average content)</b>	<b>Measure</b>	<b>Low S fuel (% wt.)</b>	<b>Effective Date</b>	<b>Tax</b>	<b>Comment</b>
<b>Germany</b>	1.0	Duty on mineral oils (Heavy Fuel Oil)		Currently in effect	Tax rate of 35 DM/tonne (\$25.94 CAD/tonne) and an additional Stockpile Fee of 7.9 DM/tonne (\$5.85 CAD/tonne)	Heavy fuel oil used for the generation of electricity is subject to a tax of 55 DM/tonne (\$40.76 CAD/tonne). Revenue is earmarked for building or maintenance of roads and for other traffic purposes, such as railways and other public traffic. There is a refund for mineral oils used for tests with biofuels.
<b>Greece</b>	Ranging from 0.7-3.2	Mineral Oil Tax for Heavy Fuel Oil		Currently in effect	Tax rate of 13 DRA/kg (\$ 0.06 CAD/kg)	
<b>Hungary</b>	Not known	Product charge on other oils (Heavy Fuel Oil)	>2	Currently in effect	Tax rate of 2.00 HUF/kg (\$0.01 CAD/kg)	For fuel fulfilling the Hungarian standard but with more than 2% sulphur content.
	Not known	Product charge on other oils (Heavy Fuel Oil)		Currently in effect	Tax rate of 60.8 HUF/kg (\$0.34 CAD/kg)	For fuel not fulfilling the Hungarian standard.
<b>Ireland</b>	Not known	Duty on Heavy Fuel Oil		Currently in effect	Tax rate of 10.6 IEP/kL (\$19.51 CAD/kL)	Heavy fuel oil used in horticulture production and mushroom tunnels are levied with a reduced tax rate. Heavy fuel oil used in the manufacture of alumina and oils exported are exempt from the tax.
<b>Italy</b>	3.0 (1.9%)	Mineral Oil Tax for Heavy Fuel Oil	<1.0	January 1988	Tax rate of 45 LIT/kg (\$0.034 CAD/kg)	This is a tax incentive to encourage the use of low sulphur heavy fuel oil (<1% wt.). Refineries are exempt from the tax for heavy fuel oil used for internal use. Heavy fuel oil for electricity generation is exempt from this tax.
	3.0 (1.9%)	Mineral Oil Tax for Heavy Fuel Oil	>1.0	January 1988	Tax rate of 90 LIT/kg (\$0.068 CAD/kg)	

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Italy</i>	3.0 (1.9%)	Sulphur Tax for Heavy Fuel Oil		January 1998	Tax rate of 102 740 LIT/tonne (\$76.92 CAD/tonne) polluting emissions of SO <sub>2</sub> per annum	Producers operating large combustion plants are subject to the tax (nominal power of over 50 MW). Revenue generated from the tax is used for projects aimed to reduce environmental impact.
<i>Japan</i>	Not known	Petroleum Tax for crude and imported petroleum used for stationary purposes (Heavy Fuel Oil)		Currently in effect	Tax rate of 2.04 JYP/L (\$0.027 CAD/L)	Both imported heavy fuel oil to be used in agriculture, forestry or fishery and exports of fuels are exempt from the tax. All revenues are allocated to the central government's expenses for various programs to secure a stable supply of petroleum and to develop and introduce alternative energy sources.
<i>Luxembourg</i>	Not known	Mineral Oil Tax for Heavy Fuel Oil	<1.0	Currently in effect	Tax rate of 0.25 LFR/kg (\$0.009 CAD/kg)	
	Not known	Mineral Oil Tax for Heavy Fuel Oil	>1.0	Currently in effect	Tax rate of 0.75 LFR/kg (\$0.027 CAD/kg)	
<i>Netherlands</i> <sup>111</sup>	1.0	Excise Duty on Mineral Oil (Heavy Fuel Oil)		Currently in effect	Tax rate of 0.03 NLG/kg (\$0.020 CAD/kg)	

<sup>111</sup> Taxes on heavy fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Netherlands</i>	1.0	Tax in connection with petroleum stocks		Currently in effect	Tax rate of 0.011 NLG/kg (\$0.007 CAD/kg)	Refunds might be given if oil products are exported or delivered in another EU member state. The purpose of the tax is to finance the costs of compulsory oil stockholding by the Dutch National Petroleum Stockpiling Agency.
	1.0	Fuel tax payable under Environment Protection Act		Currently in effect	Tax rate of 33.57 NLG/tonne (\$22.09 CAD/tonne)	
<i>Norway</i> <sup>112</sup>	1.0 (except for the northern part of the country) (0.64%)	Basic tax on fuel oil (Heavy Fuel Oil)		Currently in effect	Tax rate of 0.19 NOK per litre (\$0.03 CAD/litre)	Fuels used as raw material in manufacturing processes if the fuels are incorporated and remains contained in the final product are exempt from the tax.
	1.0 (except for the northern part of the country) (0.64%)	CO <sub>2</sub> Tax on Heavy Fuel Oil – ordinary rate		1991	Tax rate of 0.48 NOK/L (\$0.09 CAD/L) per tonne of CO <sub>2</sub>	Mineral products exported, those used as raw materials in industrial activities in such a way that no CO <sub>2</sub> emissions are caused, or when the emissions are much lower than the quantity used would normally indicate, are exempt from the tax.
	1.0 (except for the northern part of the country) (0.64%)	CO <sub>2</sub> Tax on Heavy Fuel Oil – reduced rate		1991	Tax rate of 0.26 NOK/l (\$0.05 CAD/litre) per tonne of CO <sub>2</sub>	

<sup>112</sup> Taxes on heavy fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Norway</i>	1.0 (except for the northern part of the country) (0.64%)	CO <sub>2</sub> Tax on Mineral Oil Products – other fuels for stationary purposes		1991	Tax rate of 0.47 NOK/L (\$0.08 CAD/L) per tonne of CO <sub>2</sub>	For any oil which may be used as a fuel oil.
	1.0 (except for the northern part of the country) (0.64%)	CO <sub>2</sub> Tax on Heavy Fuel Oil – used in the pulp and paper and the fishmeal industries		1991	Tax rate of 0.235 NOK/L (\$0.042 CAD/L) per tonne of CO <sub>2</sub>	The paper and pulp industry and production of fishmeal (from herrings) pay half the ordinary rates.
	1.0 (except for the northern part of the country) (0.64%)	Sulphur Tax – normal rate (Heavy Fuel Oil)		1970	Tax rate of 0.07 NOK/L (\$0.013 CAD/L) per 0.25% weight share sulphur content	Sulphur tax is reimbursed depending on abated emissions by means of technical measures (clean technology). For example reimbursement of the tax amount corresponds to the quantity of sulphur that is not emitted into the air. Both oils, with a sulphur content of 0.05 weight percentage or less and mineral products exported are exempt from the tax.
	1.0 (except for the northern part of the country) (0.64%)	Sulphur Tax – reduced rate (Heavy Fuel Oil)		1970	Tax rate of 0.013 NOK/L (\$0.002 CAD/L) per 0.25% weight share sulphur content	

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Norway</i>	1.0 (except for the northern part of the country) (0.64%)	Sulphur Tax – SO <sub>2</sub> emissions from oil refineries		1970	Tax rate of 3 NOK/kg SO <sub>2</sub> (\$0.54 CAD/kg SO <sub>2</sub> )	
<i>Portugal</i> <sup>113</sup>	3.5	Tax on petroleum products (Heavy Fuel Oil)	> 1	Currently in effect	Tax rate of 5500 ESC/kL (\$39.76 CAD/kL)	There is a tax differentiation on heavy fuel oil according to sulphur content. Market share of low sulphur fuel is still low (31.5% in 1998) because the electricity companies are exempt from the tax and are consuming the majority of heavy fuel oil. Fuel oils used for the production of town gas, electricity and co-generation are exempt from the tax.
	3.5	Tax on petroleum products (Heavy Fuel Oil)	<1	Currently in effect	Tax rate of 2500 ESC/kl (\$18.07 CAD/kl)	
	3.5	Excise Tax on Heavy Fuel Oil		Currently in effect	Tax rate of 15000 ESC/kL (\$108.42 CAD/kL)	Mineral oils used as inputs for electricity generation or for town gas production are exempt from the excise tax.

<sup>113</sup> Taxes on heavy fuel oil are cumulative.



Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Spain</i>	3.5	Excise tax on Heavy Fuel Oil		Currently in effect	Tax rate of 13097 PT/kL (\$114.05 CAD/kL)	The following is a list of exemptions from the tax: 1) products used in production of electricity, including co-generation of electricity and heat; 2) Canary Islands, Ceuta and Melilla (However, the regional governments of the Canary Islands and the local governments of Ceuta and Melilla levy a local tax on the same products as the national tax); and 3) hydrocarbons supplied to diplomatic representatives, international organisations, armies of countries belonging to the NATO, different from Spain.
<i>Sweden</i> <sup>114</sup>	0.8 (0.35% in 1995)	Excise Tax (CO <sub>2</sub> tax) on Heavy Fuel Oil		Currently in effect	Tax rate of 743 SEK/kL (\$109.02 CAD/kL)	Refunds from the energy and CO <sub>2</sub> taxes are given to manufacturing and commercial greenhouse cultivation. Fuels used for the production of electricity are exempt from the energy tax and the carbon dioxide tax – an energy tax is levied on electricity. The following is a list of exemptions from both the energy and CO <sub>2</sub> taxes: 1) fuels used for the production of heat in a combined heat and power plant for the proportion related to the heat generation; 2) fuels used for the production of mineral oils, carbon fuels and petroleum coke; and 3) fuels delivered to another member state within EU for use by diplomats and the like as well as such consumption in Sweden.
	0.8 (0.35% in 1995)	Excise Tax (Energy tax) on Heavy Fuel Oil		Currently in effect	Tax rate of 787 SEK/tonne (\$115.47 CAD/tonne)	

<sup>114</sup> Taxes on heavy fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Sweden</i>	0.8 (0.35% in 1995)	Tax on sulphur in Heavy Fuel Oil		Currently in effect	Tax rate of 27 SEK (\$3.96 CAD) per m <sup>3</sup> per 0.1% sulphur content by weight	Sulphur tax promotes the use of cleaner heavy fuel oil and provides incentives for investments in technology because of reimbursement schemes for reduction of sulphur emissions; users can be reimbursed with 30 SEK/kg sulphur (\$4.40 CAD/kg sulphur). Refineries are eligible for tax relief. Tax refunds are given when sulphur emissions dioxide are reduced by treatment or absorption in any product or in ash. The following is a list of exemptions from the tax: 1) oils with a sulphur content below 0.1%; 2) fuels used for the production of mineral oils carbon fuels and petroleum coke 3) if sulphur is not emitted to the atmosphere through binding in the process or in the ashes; and 4) fuels used in metallurgical processes or for the production of goods from other mineral compounds than metals or used in soda recovery boilers.
<i>Switzerland</i> 115	Not known (0.7%)	Tax on Mineral oils – Heavy Fuel Oil		Currently in effect	Tax rate of 3.6 CHF/tonne (\$3.56 CAD/tonne)	

115 Taxes on heavy fuel oil are cumulative.

Country	Current fuel limit - % wt. (average content)	Measure	Low S fuel (% wt.)	Effective Date	Tax	Comment
<i>Switzerland</i>	Not known (0.7%)	Emergency Fund		Currently in effect	Cost-covering charges of 8.95 CHF/tonne (\$8.85 CAD/tonne)	Revenues are distributed to a private institute (CARBURA) which administers the emergency fund.
	Not known (0.7%)	Tax on Mineral oils – Heavy Fuel Oil for other fuels for stationary purposes		Currently in effect	Tax rate of 1.1 CHF/kL at 15°C (\$1.09 CAD/kL)	
<i>UK</i>	No limit	Excise Tax on Heavy Fuel Oil		Currently in effect	Tax rate of 27.8 GBP/tonne (\$64.13 CAD/tonne)	

## **Appendix F - Currency Conversion Table**

Currency Conversion Table<sup>116</sup>

<b>Country</b>	<b>1 Canadian Dollar (CAD) = X in Local Currency</b>
Australia	1 CAD = 1.28867 AUS
Austria	1 CAD = 9.50650 OS
Belgium	1 CAD = 27.8618 BEF
Czech Republic	1 CAD = 23.6046 CZK
Denmark	1 CAD = 5.13003 DKK
Europe	1 CAD = 0.690568 EUR
Finland	1 CAD = 4.10040 FIM
France	1 CAD = 4.52374 FF
Germany	1 CAD = 1.34929 DM
Greece	1 CAD = 235.096 DRA
Hungary	1 CAD = 178.865 HUF
Ireland	1 CAD = 0.543415 IEP
Italy	1 CAD = 1,335.84 LIT
Japan	1 CAD = 74.9150 JPY
Luxembourg	1 CAD = 27.8254 LFR
Netherlands	1 CAD = 1.51982 NLG
Norway	1 CAD = 5.53127 NOK
Portugal	1 CAD = 138.333 ESC
Spain	1 CAD = 114.834 PTA
Sweden	1 CAD = 6.81444 SEK
Switzerland	1 CAD = 1.01164 CHF
UK	1 CAD = 0.433492 GBP
USA	1 CAD = 0.636772 USD

<sup>116</sup> Note: This table is current as of September 25, 2001