Consequences of the Sulphur Directive

October 2012
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Table of contents

1 Introduction 6
  1.1 Background and purpose 6
  1.2 The Sulphur Directive 6
  1.3 The Swedish transport sector 8
  1.4 Maritime activity in SECAs 11
2 Changes in demand for fuel 13
  2.1 The fuel markets and the refinery process 13
  2.2 Increased shortage of middle distillates in Europe 14
  2.3 Road transport in Sweden 16
3 Alternative emission abatement methods 19
  3.1 Alternative fuels (LNG) 19
  3.2 Shipboard exhaust gas treatment - scrubbers 20
  3.3 Additional refinery desulphurisation 22
  3.4 Other uses 24
4 Scenarios 25
  4.1 Baseline scenario 25
  4.2 Sulphur Directive scenario 26
  4.3 Discussion 30
5 Conclusion 32
Summary

Amendments to Directive 1999/32 on sulphur content in marine fuels that will become effective in 2015 are expected to have a significant impact on the transport pattern in SECA's. Hoping to minimize risks and since their ability to invest is limited, many stakeholders have adopted a "wait-and-see" strategy, increasing the risk of a prolonged turbulence in the period between 2015 and 2019.

This analysis points to a total drop in demand for freight transport of 9 % in the years 2014-2015 in Sweden. We expect demand for maritime freight transport to fall by 21 % and for heavy road transports by 8 %, while we expect demand for rail freight transport to increase by 11 %. The total drop in demand for freight transport is dramatic and can be compared to a fall in demand for freight transport of 14 % following the financial crisis and global recession. Our analysis also points to an increased demand and limited supply of compliant marine fuels. We expect demand for compliant marine fuel with a sulphur content of 0.1 % or less to increase by at least 33 % in Sweden between 2014 and 2015. We also expect a sudden demand for distillate products in Europe equivalent to 20 million tons of bunker fuel. Whether this new demand will be met or whether Europe will be left structurally short of diesel is uncertain. A trend that started in 2005 towards a decreasing share of the total amount of crude oil being made available to the markets could mean that demand for diesel will not be met. In addition, tougher regulations for sulphur emissions will also affect maritime transports along the North American coastline leading to increased demand for low sulphur maritime fuel also in North America, a long-time supplier of distillate products to the European market. Diesel is the dominant fuel type in the European car fleet, and the price elasticity of demand for diesel is low. However, new diesel vehicle registrations are expected to go down if the price spread between diesel and gasoline increases. Such a trend would mean reduced efficiency and increased CO₂ emissions.

In 2015, we expect a temporary shift in the market shares of the three modes of freight transport. By 2020 the shares are expected to be back at the starting mix. We expect an increased demand for rail freight transport from Central Europe to Sweden resulting in a reduced ability for hauleries to give discounts for transport in the opposite direction. Hauleries that today are least competitive will have to target shorter routes and products of higher value that are relatively less affected by increased transport costs. Transports to ports outside the SECA are expected to increase.

Despite a significant increase in the cost of maritime transport, shipping is expected to maintain its competitive position and continue to be the most cost-effective mode of transport for bulk goods. The ability of ship operators to pass on increased fuel prices to its customers and the overall economic development will determine the outcome of the shipping sector operating within SECA's.
The price spread between low sulphur fuels (containing max. 0.1% sulphur) and low sulphur fuels (containing max. 1% and 3.5% sulphur) will determine whether the shipping industry will choose to reduce sulphur emissions by installing desulphurisation technology (scrubbers) or by completely switching to higher-priced low sulphur fuels. Our estimate is that the price spread will be over $ 350 per ton in 2015. The spread is widened both ways – by higher prices for low sulphur fuels and lower prices for high sulphur fuel. Based on this larger spread we predict that the price of diesel will increase by 0.8 SEK including tax in 2015 with correspond to roughly 0.72 €. If refiners start moving away from Swedish sulphur free diesel fuel (MK1) in favor of European diesel, a further 0.4 SEK should be added to the price increase. The total increase in the price of diesel is not enough to reduce fuel demand from road transport, other than some long-distance transport of lower value goods.

We expect the use of alternative fuels in shipping to increase to a 2% of the total fuel consumption in 2015. Alternative fuels will remain an expensive choice up to 2020. Refiners in SECA will have difficulties selling high sulphur marine fuel and there is a risk that it will increase market shares at the cost of bioenergy for combined heat and power purposes. The trend towards eliminating oil from sectors other than transport will be broken. Refineries in SECA will have to increase the price of diesel to compensate for decreased demand for heavy fuel oil.
1 Introduction

1.1 Background and purpose

In June 2012, Sweco was commissioned to investigate the impact of a proposed revised Directive as regards the sulphur content of marine fuels. The topic is linked to the development of the oil market, especially the middle distillate fraction.

From a Swedish perspective, assessing the impact of a revised Directive imposing tighter sulphur emissions limits on the shipping industry is crucial. The industry will be faced with the choice of purchasing more expensive low-sulphur compliant fuel, or investing in emission abatement technology. How will higher fuel prices impact Swedish industry? How will road transports cope with an increased competition for diesel? Will there be enough diesel fuel to meet demand, and if so, at what cost? How will the new transport patterns affect the environment?

The purpose of this report is an attempt to answer the above questions by looking at different scenarios and at the different stakeholders’ ability to adapt in the short term. The report was originally published in Swedish in September 20121.

1.2 The Sulphur Directive

Directive 1999/32/EC (hereinafter “the Sulphur Directive”) regulates sulphur emissions from ships by limiting the maximum sulphur content of marine fuel. This Directive was amended by Directive 2005/33/EC that designated the Baltic Sea, the North Sea and the English Channel as sulphur emission control areas (SECAs), and limited the maximum sulphur content of the fuels used by ships operating in these sea areas to 1.5%.

In September 2012, the European Parliament adopted a proposal by the European Commission1 to further amend Directive 99/32/EC by once again reducing the maximum allowed sulphur content of marine fuels. Under the amended Directive,

- the maximum sulphur content of the fuels used by ships operating in the SECAs shall not exceed 1.00% by mass until 31 December 2014, and 0.10% by mass as from January 1st 2015.
- the maximum sulphur content of the fuels used by ships in other sea areas within the EU shall not exceed 0.5 % by mass as from January 1st 2020.

The amended Directive has to be approved by the Council before entering into force. After that, Member States will have 18 months to implement the Directive into national law.

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1 Texts adopted 2012-09-11
Figure 1 The European Sulphur Emission Control Area (SECA)

Source: Swedish Forest Industries Federation

Figure 2 The North American Sulphur Emission Control Area (ECA) adopted by the International Maritime Organisation (IMO)

Source: Westwood Shipping Lines
Figure 1 shows the SECA zone. The amended Directive shall apply to all vessels of all flags.

Figure 2 shows the North American emission control area (ECA). Within this area, the sulphur content of fuel oil was limited to 1.0 weight-% from January 2012; falling to 0.1 weight-% on and after 1 January 2015.

1.3 The Swedish transport sector

In Sweden, goods are predominantly transported by sea, road or railroad. In general, maritime transport is considered to be the most energy efficient means of transport, road-based transport the most flexible, and rail-based transport the most CO₂ effective, as Swedish electricity generation is 95% fossil-free. Historically, rail transport was expected to increase market shares at the cost of sea and road transport\(^2\), but this modal shift has not materialised, possibly due to the less flexible nature of rail, a lack of capacity, and the prioritisation of passenger trains over freight trains. At the same time, rail transport companies have failed to increase demand for rail transport for goods going in opposite direction as the major goods flows, resulting in a lot of empty trains “on the way back”. Because of the more flexible nature of road transports, truck companies are more successful at finding goods for “the return trip”.

For a long time, Swedish industry has invested in longer and heavier trains. Theoretically, it is possible to increase the share of freight transported by rail but numerous factors including market conditions, crowding on key lines, topography, and the length of side-tracks have prevented this from happening. In the short term, because steel- and forest industry related products account for a large share of Swedish rail freight, further increasing the share of freight transported by rail is considered close to impossible. One possible way to increase transport work by train would be by filling the trains carrying steel or paper products “on the way back”, where they usually run empty.

From a cost perspective, the following applies for heavy goods.

**Ship < Railroad < Truck**

As mentioned above, trucks can have a cost advantage on certain routes depending on which way the majority of goods is flowing. For groceries for instance, a rule of thumb is that transportation costs from southern or central Europe to Sweden are three times as high as in the opposite direction. In spite of this, the share of the transportation costs in the total price of groceries in stores is very small.

For a long time, there has been a continuous effort to improve technological efficiency in order to reduce the environmental impact of heavy road transports.

\(^2\) TFK TransportForsK AB - Capacity 2015
Unlike passenger cars, trucks are designed to have a low total cost of ownership. Diesel engines have an overall better efficiency than Otto (gasoline) engines. However, the emission gap between diesel and gasoline is decreasing as tougher emissions standards for NO\textsubscript{x} and other particles emitted from diesel engines have been introduced, limiting further improvement of energy efficiency. For long-distance transports, efficiency can be improved by using longer and heavier trailers. At present, lengths of up to 25.25 meters are allowed in Sweden. In general, for most truck transports the limiting factor is volume so further increases in efficiency will have to be achieved through other means like hybridization.

In terms of energy consumption, heavy road transports use approximately 36 TWh per year in Sweden while maritime transports use roughly 20 TWh. Because the volumes transported by road and by sea are similar, it can be argued that maritime transports are twice as energy efficient as heavy road transports.

In 2011, the European Commission commissioned the AEA and Ricardo to assess the greenhouse gas reduction potential of heavy-duty vehicles in the EU\textsuperscript{3}. In order to do this, they defined eight different vehicle categories and estimated their fuel consumption.

<table>
<thead>
<tr>
<th>Vehicle category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service / Delivery (3.5 - 7.5 t)</td>
<td>Urban operation including frequent stop start</td>
</tr>
<tr>
<td>Urban Delivery / Collection</td>
<td>Distribution in cities or suburban areas including frequent stop start driving</td>
</tr>
<tr>
<td>Municipal Utility</td>
<td>Typical duty cycle is low speed urban operation with frequent stop starts, typical vehicle is a refuse truck</td>
</tr>
<tr>
<td>Regional Delivery /Collection</td>
<td>Regional delivery of consumer goods from a central warehouse, includes periods of constant high speed and urban operation</td>
</tr>
<tr>
<td>Long Haul</td>
<td>Long periods of constant high speed travel with very few periods of urban operation</td>
</tr>
<tr>
<td>Construction</td>
<td>Vehicles operating on and off-site both light and heavy duty</td>
</tr>
<tr>
<td>Bus</td>
<td>Low speed travel with frequent stop starts</td>
</tr>
<tr>
<td>Coach</td>
<td>Long periods of constant high speed travel with periods of urban operation</td>
</tr>
</tbody>
</table>

Estimated average annual mileages, average new vehicle fuel consumption (l/100 km) and average annual fuel cost (the average fuel price was assumed to be 1 EUR/liter) for the EU27 are shown in the table below:

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Consequences of the Sulphur Directive

<table>
<thead>
<tr>
<th>Vehicle category</th>
<th>Average annual mileage (km)</th>
<th>Average new vehicle fuel consumption (l/100 km)</th>
<th>Average annual fuel cost (SEK/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service / Delivery (3.5 - 7.5 t)</td>
<td>35 000</td>
<td>16</td>
<td>47 000</td>
</tr>
<tr>
<td>Urban Delivery / Collection</td>
<td>40 000</td>
<td>21</td>
<td>70 000</td>
</tr>
<tr>
<td>Municipal Utility</td>
<td>25 000</td>
<td>55,2</td>
<td>115 000</td>
</tr>
<tr>
<td>Regional Delivery /Collection</td>
<td>60 000</td>
<td>25,3</td>
<td>126 000</td>
</tr>
<tr>
<td>Long Haul</td>
<td>130 000</td>
<td>30,6</td>
<td>31 000</td>
</tr>
<tr>
<td>Construction</td>
<td>50 000</td>
<td>26,8</td>
<td>112 000</td>
</tr>
<tr>
<td>Bus</td>
<td>50 000</td>
<td>36</td>
<td>150 000</td>
</tr>
<tr>
<td>Coach</td>
<td>52 000</td>
<td>27,7</td>
<td>117 000</td>
</tr>
</tbody>
</table>

In 2007, road transports accounted for 21.6% of total CO₂ emissions from all sectors in the EU-27.

The graph below shows freight transport volumes and modal split in Sweden during the period 2000-2011. Demand for heavy road transport grew steadily until the financial crisis in the summer of 2008 when the price of road transport fuels reached new records in Sweden. Prices fell later that year.

**Figure 3 Freight transport volumes in Sweden 2000-2011**

![Transportation of Goods in Sweden 2000-2011](image)

*Source: Traffic Analysis (Trafikanalys)*

Demand for freight transport in Sweden dropped by 14% between 2008 and 2009. Demand for road transport fell most, by just over 17%.

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4 IHS Fairplay
In 2011, diesel consumption in Sweden totaled 51 TWh. Road transport was the largest diesel consumer with 44 TWh. International maritime transport uses mostly bunker fuels (in Sweden called eldningsolja 2-5), small amounts of diesel, and some heating oil (MGO with sulphur level below 0.1 %).

Figure 4 Diesel fuel and heating oil consumption per user

During the winter, kerosene is sometimes blended with diesel to lower its freezing point and improve winter operability of diesel. European diesel fuel specifications are broader than specifications for Swedish diesel fuel (MK1), giving refineries more room to adapt the product.

1.4 Maritime activity in SECAs

Approximately 14 000 ships operate in SECAs each day. From this total, approximately 2 200 ships operate daily in SECAs while 2 600 ships enter the SECAs often (every other day)\(^5\). Annual bunker fuel consumption in SECAs is 20 million tonnes, or around 220 TWh\(^6\). In comparison, the Swedish transport sector’s energy consumption was 123,3 TWh in 2011\(^7\), including 21 TWh for international maritime transport.

At present, shipping inside SECAs and ECAs use heavy fuel oil with a maximum sulphur content of 1 %. On January 1\(^{\text{st}}\) 2015 the maximum allowed sulphur content will be reduced to 0.1%. Maritime transport will therefore experience increased fuel costs and stronger competition from road freight transport despite the fact that fuel

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\(^5\) IHS Fairplay  
\(^6\) Density 0.96 kg/dm\(^3\), energy content 38,16 GJ/m\(^3\)  
\(^7\) Swedish Energy Agency
for international maritime transport is exempt from taxation while road fuels are heavily taxed. Below is a graph of fuel prices for 1 % and 3.5 % (international shipping) sulphur content HFO (heavy fuel oil).

**Figure 5 Price development for heavy fuel oils with different sulphur contents**

![Graph showing price development for heavy fuel oils with different sulphur contents](source: Reuters)
2 Changes in demand for fuel

2.1 The fuel markets and the refinery process

Crude oil contains hundreds of different types of hydrocarbons (oil products) mixed together. In order to use crude oil efficiently, the hydrocarbons have to be separated. This is known as oil refining. Sweden has five oil refineries, of which three produce gasoline, diesel and heating oil. Preem’s refinery in Lysekil is one of Europe’s most modern.

An oil refinery is built around the principle that different hydrocarbons have different properties and behaviours. The carbon atoms in crude oil link together in chains of different lengths – shorter chains are lighter and have lower boiling points so the different hydrocarbons can be separated by distillation. Crude oil is heated, and when it boils the vapour is led into a fractional distillation column that is progressively cooler towards the top, so when the vapour reaches the point where the temperature is equal to its boiling point it will start condensing and the liquid fraction is led out of the column for further processing.

Once the different oil fractions have been separated, pollutants – principally sulphur - need to be removed to meet product quality specifications and environmental standards. A rule of thumb is that the sulphur content of crude oil increases with the age of the oil field. This is because lighter, more desirable fractions with shorter chains are extracted early in the field’s life cycle, while the heavier fractions, which pass slower through the rock formation on its way to the pipe, are extracted last and contain more sulphur. Since the rate of discovery of new oil fields is relatively low - in 2010, 5 barrels of oil were consumed for every barrel that was discovered\(^8\) - the average age of oil fields is steadily increasing. This means that the oil being extracted is increasingly sulphurous. Removing sulphur from heavy fuel oil is a very costly process for the refineries.

To reduce the sulphur content of heavy oils, refineries mix the oil with a catalyst under heat and high pressures. Not all oil fractions can be de-sulphured. As the sulphur content increases, higher temperatures and pressures, and more stable catalysts are needed to break the sulphur bonds. Heavy oil divides into many shorter molecules when exposed to heat above 380 degrees Celsius.

The basic division of marine fuel form lightest to heaviest is: Marine gas oil (MGO), Marine diesel oil (MDO), Intermediate fuel oil (IFO), Marine fuel oil (MFO) and Heavy Fuel Oil (HFO). There is also an ISO standard for marine fuel (8217) that describes four qualities of distillate marine fuels and six qualities of residual marine fuels. Heavy fuel oils (HFO)\(^9\) are residual and produced to different sulphur contents and viscosity specifications. Because sulphur removal is expensive marine fuels with lower sulphur content are more expensive. MGO is produced to a

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\(^9\) Heavy fuel oils are also referred to as bunker fuels. The term bunker fuel is sometimes applied to all marine fuels.
maximum of 0.5% sulphur content, and is very similar to the diesel fuel used for road transport. They differ by flashpoint, and sulphur and aromatics content, but current developments indicate that these differences will be reduced by 2020. The diesel market is much larger than the MGO-market and the cost to refineries for reducing sulphur content from 0.1% down to 50 ppm (0.005 %) is low. The Intercontinental Exchange (ICE) will stop trading MGO with sulphur content of 0.1% from January 2015 in favour of diesel.

In Sweden, a special kind of diesel (MK1) is almost exclusively used in the road transport sector. The background to this is that Sweden introduced the world’s first sulphur-free (4 ppm) diesel fuel in 1991 as a niche fuel for city use. With time, MK1 became dominant on the market since it was taxed more generously than its competitors (MK3). Taxes are 0.4 SEK lower than for MK3, which is the category in which European diesels fall today. Sweden has been criticized for being the only country in the world that uses MK1. The refinery process is more energy demanding and according to the organization CONCAWE an additional 9.2 million tons of CO$_2$ net would be emitted if all refineries in Europe would start producing MK1 instead of European diesel$^{10}$.

**Figure 6 Global fractioning of crude oil**

![Crude Oil Fractions](image)

*Source: IEA*

The pie chart above shows how crude oil is fractioned on a global scale. “Heavier products” include bituminous residues (asphalt).

### 2.2 Increased shortage of middle distillates in Europe

Europe has had a shortage of diesel and a surplus of gasoline for quite some time. In the beginning of the year 2012, the diesel deficit in Europe amounted to 30-40 million tons per year (corresponding to roughly 300-400 TWh), out of a total diesel
consumption (including MGO) of 250 million tons. So far, imports from the US, where there has been a deficit of gasoline, have bridged the gap. Imports of distillates from the US hit an all time high in April 2012. Because of the shortage situation, European refineries have sought to produce higher yields of the middle distillates that diesel is blended from. Theoretically, refineries could further increase distillate production, but yields will vary according to the characteristics of the crude oil being processed and other fractions that are not easy to sell would have to be produced as by-products.

Figure 7 United States monthly distillate fuel trade balance

![Figure 1. U.S. monthly distillate fuel trade balance](image)

*Source: U.S. Energy Information Administration*

Europe also imports diesel fuel from Russia and India. Tougher environmental regulations in Europe have led oil refineries to relocate to Asia where environmental regulations are less stringent. European refineries are being converted to depots of pre-refined oil products.

Since the global price spike for petroleum in 2008, European refinery profitability has declined. Refineries struggle to adapt to changing demand patterns. In addition, because less crude oil is being made available to world markets, European refineries are also facing becoming redundant.

The United States is a net importer of oil since the 1960s. Domestic production peaked in 1970 and had been declining steadily until 2008 when the trend was reversed as technological advances in drilling and higher prices made the development of shale oil possible. However, a number of technological barriers have to be addressed if the steady growth of US domestic production is to continue. For instance, fracking involves the injection of very large amounts of fresh water and chemicals into the ground and there are signs of increasing competition between water used for irrigation and for fracking purposes. In addition, fields that rely on fracking tend to leak more methane than conventional...
fields. The U.S. Energy Information Administration (EIA) expects that development of tight formations will lead to continuing significant increases in U.S. oil production in the coming years.

**Figure 8 EIA forecast for US domestic oil production - "all liquids"**

Since the financial crisis, the price difference between North Sea Brent and West Texas Intermediate (WTI) crude oils has been increasing, with WTI trading cheaper. This is an important reason why US refineries have been making good profits since the spread started occurring. US refineries are buying crude oil of good quality at a lower price than other refineries, and then sell the refined products to customers that are also buying refined products from refineries buying Brent-oil.

### 2.3 Road transport in Sweden

Sweden accounted for 3 % of the European diesel market in 2008. In 2007, diesel overtook gasoline in sold volumes for the first time. The share of diesel cars continues to increase, probably as a result of higher energy efficiency - a diesel engine has an efficiency of 44 % whereas an engine with spark ignition reaches as an approximate efficiency of 38 %. In 2011, Sweden passed the European average for new diesel car registrations, 62 % compared to the European average of 56 %.

The blending of fossil fuels with biofuels continues to increase. Since Spring 2012, blends consisting of 10% ethanol and 90% gasoline, and 7 % FAME (fatty acid methyl ester) and 93% diesel are allowed. One reason behind this is that it is a cost-effective way to meet the EU target of 10 % renewable energy in the transport sector by 2020. Other renewable fuels such as HVO (hydrogenated vegetable oils)
and Fischer-Tropsch diesel can be blended into fossil fuels in higher shares since they are chemically more similar to fossil fuels.

Renewable fuels are exempt from both CO₂- and energy taxes. This tax exemption may have to disappear if the target of 10 % renewables in the transport sector becomes a binding target, as it is not allowed to subsidize a commodity in order to meet legal obligations.

**Figure 9 Development of cost structure for diesel in Sweden 2007-2012**

![Graph showing the development of cost structure for diesel in Sweden from 2007 to 2012.](source)

In 2011, buses and trucks consumed approximately 36 TWh of the 44 TWh that diesel road transport consumed in Sweden. Passenger cars consumed the remaining 8 TWh. The share used by passenger cars is expected to increase as the trend with a high share of new diesel car registrations continue. In 2011, 17.4% of all cars in Sweden were diesel cars. If the current trend continues, in 2015 29%¹¹ of all personal vehicles will run on diesel and will consume 13 TWh.

¹¹ Assuming a constant number of vehicles and replacement of all cars every 20 years.
Figure 10 Development of GDP and diesel demand 1993-2011

DEVELOPMENT OF GDP AND DIESEL CONSUMPTION 1993-2011
PERIOD 1993-2011

Source: Swedish Petroleum and Biofuels Institute (SPBI) and Statistics Sweden (SCB)

Figure 10 shows the correlation between GDP and diesel fuel demand in Sweden in the period 1993-2011. Between 1950 and 2008 the correlation was 0.98! An explanation is that transport enables trade and thus specialisation and division of labour. This leads to higher efficiency and greater economic activity in society.

The Swedish Association of Road Transport Companies estimates that the cost of fuel is around one third of the total cost of a truck transport. The longer and the heavier the transport, the larger share of the fuel cost.
3 Alternative emission abatement methods

3.1 Alternative fuels (LNG)

Alternative fuels that do not emit sulphur are available to the shipping industry in the form of Liquefied Natural Gas (LNG) and methanol. LNG is considered to have a high potential as a marine fuel, as it has environmental benefits in the form of low emissions of NO\textsubscript{x} and CO\textsubscript{2}. LNG is nearly pure methane and methane has a low energy density, but compared to diesel fuel LNG has about 66\% as much energy on a volume basis and almost 90\% as much energy on a weight basis.

Current barriers to a rapid expansion of LNG as a marine fuel are hampered by lack of infrastructure to handle bunkering and safety of the fuel. Ships that run on LNG in SECAs have custom solutions for bunkering and safety. At present, only a small number of ships operating in SECAs run on LNG: a total of 23 ships of which 22 are flagged in Norway. From January 2013, Viking Grace, a large passenger ferry, will start to traffic Stockholm-Åland-Åbo\textsuperscript{12}. Construction cost amount to 2 billion SEK of which 250 million are support for innovative technology from the Finnish government\textsuperscript{13}.

How fast LNG-ships can be introduced in SECA is unclear. An estimate from Swedegas is that construction costs for LNG ships are between 5-50\% higher than for conventional ships. At present costs are probably closer to 50\% and falling steadily the closer to 2020 we get\textsuperscript{14}. Figure 11 shows an assessment of Germischer Lloyd of demand for LNG in the Baltic Sea in the period 2015-2020.

Figure 11 Expected LNG demand from Baltic shipping

<table>
<thead>
<tr>
<th>Year</th>
<th>Standard replacement</th>
<th>accelerated phase-out (30-year vessels)</th>
<th>accelerated phase-out (20-to-30 year old vessels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>50,000</td>
<td>100,000</td>
<td>150,000</td>
</tr>
<tr>
<td>2016</td>
<td>50,000</td>
<td>100,000</td>
<td>150,000</td>
</tr>
<tr>
<td>2017</td>
<td>50,000</td>
<td>100,000</td>
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<tr>
<td>2018</td>
<td>50,000</td>
<td>100,000</td>
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<tr>
<td>2019</td>
<td>50,000</td>
<td>100,000</td>
<td>150,000</td>
</tr>
<tr>
<td>2020</td>
<td>50,000</td>
<td>100,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

Source: Germanischer Lloyd, 2010.

\textsuperscript{12} http://www.sjofartstidningen.se/tidningen/nummer/2012/3/artikel3.php
\textsuperscript{13} http://svenska.yle.fi/artikel/2012/04/27/viking-lines-nybygge-far-lysvikliqt-stod
\textsuperscript{14} Rapport SGC 235, s 13.
Germanischer Lloyds estimates are based on the assumption that LNG-fueled vessels replace vessels that retire because of high age. In the low demand scenario, demand for LNG is 0.4 TWh in 2015 and around 0.7 TWh in 2016 in the Baltic Sea region. In the high demand scenario, LNG demand is 1.34 TWh in 2015.

In our analysis, we assume that LNG’s market share in the SECA is 2 % (4.4 TWh) in 2015. This is a very optimistic assumption considering the that lead times to build new ships generally range from 3 years and up, nonetheless LNG looks very attractive as a marine fuel and LNG supplies are growing as a result of the shale gas boom in North America.

### 3.2 Shipboard exhaust gas treatment - scrubbers

A significant uncertainty is the potential deployment of scrubber technology for direct use on ships to reduce sulphur emissions from exhaust fumes. While promising, the technology is not yet fully proven and cannot be considered commercially mature in a marine environment. Scrubber manufacturers will not guarantee that the equipment will be fully functional during ship operations. Currently there are two main types of scrubbers, wet scrubbers and dry scrubbers. Both technologies have been tested on several ships in the Baltic Sea region.

Dry scrubbers use a dry chemical as the scrubbing medium. Fitting dry scrubbers in ships requires extra stabilising measures, such as placing extra dead weights below the water line to compensate for the high location and weight of the scrubber system. This reduces the carrying capacity of the ship and increases fuel consumption even when no cargo is being carried. An advantage of dry scrubbers is that the technology works in any type of water (salt or fresh) and does not require much extra equipment other than electricity and some measuring instruments. Handling of the waste from dry scrubbers in harbours is an unsolved question.

Wet scrubbers use water as the scrubbing medium. There are two main types of wet scrubbers: one type uses fresh water mixed with caustic soda in a closed loop to clean the exhaust fumes while the other type uses only salt water. The closed loop system gradually emits water and has to refill caustic soda on a regular basis. The handling of caustic soda on board requires special safety equipment and training. Salt-water scrubbers take in salt water continuously, use it to clean the exhaust gas, and then discharge it back into the sea. The salt-water system also needs to empty the waste (sludge) on a regular basis. Both systems require extra maintenance when in harbor increasing costs. Wet scrubbers are more expensive in this regard, not clear how much.

According to STENA, the following factors should be considered when considering the installation of scrubber technology.

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15 LNG is assumed to have an energy content of 228 800 MJ per m³.
Consequences of the Sulphur Directive

- Scrubber type, planned route and other arrangements.
- Installation costs including personnel costs.
- Maintenance and operation costs.
- Reduced income due to less cargo capacity after installation.
- Age of vessel at time of scrubber installation. For ships older than 20 years scrubber installation will likely not be profitable.
- Expected price spread between maritime fuels of 3.5 % and 0.1 % sulphur content.
- Shipboard scrubber technology is not mature so fitting scrubbers involves a considerable risk.

**Figure 12 Cost structure of installing shipboard scrubber technology**

![Cost Structure Diagram](image)

Source: Stena

The price spread between low and high sulphur maritime fuel is an important parameter when considering scrubber installation. Shipping company STENA has estimates that the spread increases pay back times by 6-13 years. The spread between futures for marine fuels containing a maximum of 0.1 % and 1 % sulphur for delivery in 2015 is currently around $290 per ton\textsuperscript{16}. The spread for 2015 has been relatively stable during the summer of 2012. A rough estimate of the price difference between 0.1 % and 50 ppm is $ 35 per ton and between 3.5 % and 1 % about $75 per ton. If the shipping lines expect the spread to widen, a scrubber might be a good investment, even though the technology risks remain significant. Important to remember is that shipping lines inside SECA's will be facing higher costs starting in 2015 even if they make the correct decision regarding scrubber installation. Many shipping lines are not making profits today, making investments difficult. Our assumption is therefore that most shipping lines will delay installing scrubber technology until there are more certain indicators of the cost difference.

\textsuperscript{16} ICE 1 % NWE FOB, ICE 3.5 % ARA FOB Barges, ICE Diesel 10 ppm Swap FOB Barges 1M
between the use of low sulphur fuel and the installation of scrubbers to achieve the same reduction of SO$_2$ emissions.

According to STENA, the time from order to delivery of scrubber technology is, on average, 8 months. The actual fitting of the scrubbers takes 3 weeks during which the ship cannot operate. Since delivery lead-time is relatively short, it is reasonable to delay the scrubber investment decision until as close to January 2015 as possible. Firstly, the price spread between low and high sulphur fuel is not likely to increase before 2015, and secondly scrubber technology is likely to improve in the time remaining up to 2015.

We expect that out of the 2 200 ships that operate in SECA daily, 10% will have installed scrubbers by January 2015. We further expect that 5% of the 2 600 ships that operate regularly in SECA will have installed scrubbers by January 2015. This means that we expect that a total of 220 + 130 ships or 2.5% of all ships that operate in SECA daily will achieve compliance with the Directive by installing scrubbers. These ships consume approximately 0.5 million tons of fuel per year (5.5 TWh). This might seem like a bold estimate from the shipping industry's perspective but the fuel industry expects the number of ships installing scrubber technology to be considerably higher.

The cost effectiveness of measures to comply with the Directive will become clearer closer to January 2015. We expect that the pace of scrubber installation will increase between 2015 and 2020, at least for the ships that operate in SECA every day. Whether or not diesel supply can adjust to the new demand will have a big impact on the pace of scrubber installation.

3.3 Additional refinery desulphurisation

The pressure on refiners will increase the closer we get to the date of entry into force for the new sulphur standards mandated by the amended Directive. There is a risk that refineries in SECA will have difficulties selling high sulphur fuels while demand for low sulphur fuels will outstrip supply. Investing in additional refinery processing to deliver large quantities of marine fuel containing less than 1% sulphur and ultimately less than 0.1% could be risky: what happens if shipping companies decide to comply with the Directive by installing scrubbers? The lead-time for upgrading a refinery with equipment to remove sulphur or transform heavy fuel oils into lighter products is 3-4 years, not counting the process to get the proper permits. Which refineries will be able to deliver large quantities of compliant fuel in 2015 can be considered known.

A technology available to refineries to convert the heaviest residual fuels into lighter distillate products and remove sulphur is the so-called Coker. Coke use high temperatures to break the hydrocarbon chains. With cokers, refineries could increase diesel, kerosene and gasoline production, the latter is often used as a fuel to run the process. Preem had plans to add a coker to their refinery in Lysekil but after clearance was given from the environmental study in 2008, economic
circumstances changed along with the financial crisis and the project was put on ice.

An estimate by Purvin & Gertz\textsuperscript{17} is that investment costs for a coker lie between 0.5-1 billion USD, per refinery. The Swedish Petroleum and Biofuels Institute (SPBI) estimates that investing in a coker would cost a refinery between 8-10 billion SEK. It should be noted that SPBI does not consider cokers to be a fully commercially mature technology.

Ever since the financial crisis European refineries have not been operating under full capacity, and profits have fallen to very low levels. This means that refineries are less willing to assume the risk of additional investment. In our scenario, we assume that refineries continue their efforts to expand the diesel share without major investments in additional conversion capacity. This can be done by blending more lighter and heavier fractions into the diesel mix and is already done under certain circumstances in Sweden, such as blending kerosene in diesel during the winter to avoid solidification at low temperatures. However, this could endanger MK1 specifications compliance.

Biofuels for blending is an alternative that might expand the diesel pool. However, increasing demand for bio-oils is likely to result in escalating prices for certain food products as food and fuels compete for crops. This may lead the EU to limit the use of bio-oils.

Figure 13 shows our estimate of what the relative percentages of each of the fractions resulting from the separation of crude oil could be in 2015.

**Figure 13 Scenario for a re-fractioning of output in refineries**

\textbf{CRUDE OIL FRACTIONS}

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{crude_oil_fractions.png}
\caption{Potential future conditions of crude oil fractions.}
\end{figure}

\textit{Source: Sweco}

\textsuperscript{17} http://www.purvingertz.com/
For Sweden, we estimate that the diesel fraction increases by 3%, or from 44 TWh per year in 2011 to 48 TWh per year in 2015. This happens solely through the efforts of the refining industry, i.e. no more crude oil is used. The cost to the refineries should not be high, and if refineries are able to charge the same price per liter diesel in spite of the new diesel having a lower energy content (due to blending kerosene), profits could increase. A risk that must be handled by the refineries is that they must sell all fractions they produce. The rule of thumb is that “nothing can be left over”, so hard to sell fractions may have to be discounted by the more attractive fractions. For instance 9 200 out of 14 000 ships operate in SECAs infrequently so these ships might find the price of low sulphur fuel too expensive and revert to bunkering heavy fuel unless they can buy cheaper fuel in SECAs. Exporting heavy oil to markets with less stringent environmental requirements is possible but ships entering SECAs must still use low sulphur fuel making this cost higher than usual.

3.4 Other uses

In 2011, demand for heating oil in Sweden (including marine gas oil) amounted to 13 TWh, 14% of which was used for shipping. The use of oil for heating purposes has been declining steadily for a long time as electrically powered heat pumps and district heating are well-established alternatives throughout the country. The price elasticity for oil as a heating resource is therefore relatively high. Land-based scrubbers for sulphur removal are an established technology so it is possible for those using oil for heating or electricity generation to use high sulphur fuel if the premium to be paid for low sulphur fuel would increase.
4 Scenarios

4.1 Baseline scenario

In this scenario we assume that the Directive’s requirement for a reduction from 1.0% by weight of the sulphur content of all marine fuels used in SECAs to 0.10% from 1 January 2015 is not enforced. We assume business as usual until 2020.

Despite the Directive not being enforced, we predict that European demand for diesel products will grow, and that Europe will be short on diesel, pushing prices upwards. In addition, growing domestic demand for crude oil in oil exporting countries has resulted in less oil being traded on open markets. During the period 2005-2010, crude oil consumption in the OECD fell by 15 % or 4 million barrels a day. This trend is expected to continue.

Figure 14 Imports and exports of crude oil by region /organisation

Source: EIA including Lease condensate, excluding off shore.

The Danish Energy Agency has stated that Denmark will become a net importer of oil in 2015. Norwegian oil production has also peaked and is declining (10% in 2011). This means that Sweden, who historically has imported a large share of the crude oil it consumes from Denmark (20%) and Norway, will have to find new sources of crude oil.

We are assuming no major changes in the price of crude oil in the period up to 2015. We expect that the price of crude oil will fluctuate around USD 100. We are also expecting a slowly but steadily increasing diesel deficit in the EU, with European refineries producing diesel at almost full capacity. Trade with the US, India, the Middle East and Russia prevents shortages but tightness of supply together with inelastic demand will result in diesel prices that are more volatile. The
price of other oil fractions is expected to follow world economic development with a slight downward trend for European gasoline as some countries increase blending of ethanol to meet EU renewables targets in the transport sector. The price differential between 1 % and 0.1 % sulphur fuels is expected to remain below $300 per ton.

4.2 Sulphur Directive scenario

In this scenario we assume that the Directive’s requirement for a reduction from 1.0% by weight of the sulphur content of all marine fuels used in SECAs to 0.10% from 1 January 2015 is enforced.

We also assume an unchanged demand for transport (passenger and freight transport). Energy consumption in the shipping industry is assumed to be 220 TWh in 2015. We also assume that the shipping industry will comply with the Directive in the following way:

- 2 % of all ships with daily operations (14 000) in SECAs start using alternative fuels (primarily LNG but also methanol).
- 10% of all ships with daily operations (2 200) in SECAs will install scrubbers.
- 5 % of all ships with regular operations in SECAs (2 600) will install scrubbers.

This would mean a demand for shipping fuel equivalent to:

\[ 220 - \left( 0.02 \times 220 + \left( 0.1 \times 220 \times \frac{2200}{14000} \right) + \left( 0.05 \times 220 \times \frac{2600}{14000} \right) \right) = 210 \text{ TWh} \]

This means that 4.5 % of demand for maritime transport is covered by alternative fuels and high sulphur fuels, with the remainder being covered by ships using low sulphur fuels, modal shifts or a change in either supply or demand.

We assume that the situation in SECAs can be scaled down to Swedish conditions by dividing energy use by 10. This gives a demand for maritime fuels of 20 TWh in Sweden (original 21 TWh for shipping reduced by 4.5 %).

We also assume that Swedish refineries can increase diesel fuel production by 4 TWh through by increasing blending with kerosene, gas oil and biofuels. This means that the market is likely to move away from MK1 towards MK3, as MK3 benefits from a less strict product specification. Part of this additional production will not qualify as a road transport fuel but will be compliant with specifications for maritime fuel with a sulphur content of less than 0.1 %.

A shift from heating oil to heavier oil is assumed to take place for heat and electricity production. Scrubbers can be built on land using existing technology and will be cost-effective depending on the price difference between 1 % and 0.1 % sulphur content fuel. For heating purposes, heat pumps will continue to gain
market shares. From the current use of heating oil in Sweden of 13 TWh in 2011, an additional 2 TWh is assumed to be available as shipping fuel.

We are now left with a demand for **14 TWh of maritime transport** that must be solved by increased supply, adapted demand or a modal shift. It is not clear whether the US will be able to increase its diesel production and if so, whether there will be diesel left to be exported to Europe. The North American coastline will also implement tighter sulphur regulations from 2015, so we expect demand for diesel in North America to increase substantially. The US will need more crude oil to be able to produce more diesel fuel but with less oil being sold on the open markets this might not be an option, unless the growth in US domestic production continues.

By 2015, we predict increased competition between road, sea and rail transport. However, because each mode of transport has specific advantages that are unique, it is likely that current modal shares will prevail longer term. The energy efficiency of ships is hard to ignore, as is the flexibility of trucks and the low CO₂ footprint of rail.

Figure 15 shows our forecast of modal shares in Swedish transport (dotted line).

**Figure 15 Possible shift in modal shares in Swedish transport**

![Forecasted transportation pattern of goods in Sweden](image)

Source: Sweco

We predict that rail transport will increase by 2.5 billion ton-kilometres, or 11 %, between the years 2014 to 2015. Many rail routes are already crowded but demand for transport to harbours outside SECAs increases as shipping in SECAs becomes more expensive. Trondheim in Norway is an example of a port outside SECA were 3.5 % sulphur fuel would still be permitted. Because prices for non-compliant fuels are expected to decline, shipping lines from ports outside SECAs will be able to offer lower prices.
We expect an increasing shift from road transport to rail transport as demand for diesel fuels pushed prices upwards. Even though the amount of freight shifting from trucks to trains will be small the economic implications for truck companies will be considerable. Truck companies will not be able to subsidize transport in the opposite direction as the major goods flows to the same extent as it used to. This will further strengthen the position of rail transport but is dependent upon rail companies making the required transport capacity available. Rail transport will also have to become better at delivering goods at competitive speeds and without delays. In Sweden many terminals where goods can be transferred between trains and trucks are planned or have recently been built, increasing rail's flexibility and making it more likely that rail transport will increase its market share.

We predict that in 2015, road transport in Sweden will consume 44 TWh of diesel fuels, including 13 TWh by personal cars. It should be noted that this estimate is low. Government agencies have estimated that passenger cars used close to 12 TWh diesel in 2011. Short-term price elasticity for this segment is low so heavy road transport could be facing more competition for diesel than we are assuming and will probably be passing on these costs to their customers. The transport of low valued goods, especially over longer distances will be the most affected. The transport of higher valued goods over shorter distances, for example of groceries, are less price sensitive as the chances of passing on costs to customers are deemed good. Still, European transport of groceries may shift to rail if demand for diesel pushed prices up to very high levels. Our estimate is that the price premium to be paid for low sulphur fuels (mainly diesel) in the SECA will be more than USD 350 per ton in 2015. We believe that the spread will widen in both direction, i.e. the price of low sulphur fuels will go up while the price of high sulphur fuels will go down. When the price of heavy fuel oils is pushed down due to lower demand, refineries will have to improve margins on diesel. Since the spread is currently around USD 290, we expect that the price of diesel will climb to USD 1030 per ton in 2015, corresponding to a 4 % pre-tax price increase. About 40 % of the total price of diesel at fuel stations is the actual fuel price (including profit for gas companies) while the remaining 60 % are various taxes. In the baseline scenario, we expect the price of diesel to be 15 SEK per litre in 2015. A 4 % increase would mean:

\[
\frac{15 \times 0.4 \times 1.04}{0.4} = 15.6 \text{ SEK}
\]

To this we add 0.2 SEK as margin for fuel companies and refineries, bringing our price estimate for one litre of (taxed) diesel to 15.8 SEK in 2015.

If MK1 were to be abandoned in favour of MK3, an additional 0.4 SEK should be added as taxes on MK3 are higher. Crucial for the development of the price of diesel will the SECA-refineries ability to sell the heavier oil without major subsidies.

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We expect a dip in heavy road transport of 3 billion ton-kilometres (roughly 3.5 TWh) reflecting higher diesel fuel prices, but we expect road transport to recover by 2020. This decline in road transport will be absorbed by maritime transport.

On the other hand, if the price differential between low and high sulphur fuels remains below USD 300, we expect trucking companies to take market share from shipping since road transport would not have any cost increases as opposed to the shipping industry. Passenger cars run on diesel already on the road will not consume less fuel in 2015, but if the price differential between diesel and gasoline widens we expect a decline in new diesel car registrations. This would mean that diesel consumption would decline in the years until 2020, and it would benefit heavy road transports. A growing share of gasoline cars would reduce efficiency in the car fleet and increase CO2 emissions.

We expect rail transport to increase by about 2.5 billion ton-kilometres, equivalent to 1.5 TWh of maritime fuel. Maritime transport will reduce its fuel consumption by 4.4 TWh (21 %) between 2014-2015. About half of this reduction will be the result of rationalization (less transports), while the other half will come from increased efficiency (lower speed etc.). From the 14 TWh demanded for maritime transport we assume an increased supply of diesel corresponding to:

\[
14 - 3.5 - 1.5 - 4.4 = 4.6 \, TWh
\]

Moving from a Swedish perspective to the SECA (using a factor of 10), we get 46 TWh of increased diesel imports or about 5.7 million tons per annum. All estimates above are made under optimistic assumptions! This amount should be added to the current deficit in the EU-27 of 30-40 million tons of diesel fuel. We should also keep in mind that similar environmental requirements will be introduced along the North American coastline, so one of Europe’s most important diesel suppliers will be faced with increased domestic demand.

Maritime transport will decline by 21 % between 2014-2015. This is a significant decline that can be compared to the decline following the financial crisis of 2008 when maritime transport dropped by with 13 %. Another way to look at it is to say that the shipping industry’s demand for diesel fuels will climb from almost zero to 4+2+3.5+4.6 = 14.1 TWh in a single year, and still manage to deliver 79 % of the goods transport work from 2014.

Starting in 2015, maritime transport will increase, and by 2020 the market share of maritime, road and railroad transport will look almost the same as in 2011. Many stakeholders are waiting to see where the price differential between low and high sulphur fuel will land. We expect investment decisions, to start picking pace as we get closer to 2015. From 2020, the tougher sulphur regulation will affect more markets so market distortions will start to disappear. If the price spread widens in...
both directions it could benefit the heavy oils industry as if high sulphur fuels drop in price, there are better incentives to install scrubber technology.

The trend that has seen European refineries closing down and instead becoming depots for pre-refined oil products will strengthen under the amended Directive. We expect that the situation will worsen for European refineries that have not invested in cokers or desulphering technology operational from 2020. Ships that rarely operate in SECAs (9 200 out of 14 000) will determine a floor for the price of heavy oil, but this floor will decrease in 2020 as more geographical regions adopt tighter sulphur requirements and demand for heavy oil decreases. The following factors will be decisive for the price spread between low and high sulphur fuel:

- The refineries’ ability to find buyers for high sulphur fuel.
- If diesel supply to Europe can increase.
- The refineries’ investment plans to meet new sulphur regulation starting in 2020.

A decline in maritime transport in SECAs will affect companies with most of its fleet operating in SECAs more severely. Low valued goods like wood chips will be the most seriously affected. Paper- and pulp mills transporting wood products from the Baltic region to the north of Sweden for processing and then exporting the processed products to Southern Europe will face considerable cost increases.

Organisations financed by taxes - municipalities, public transportation and governmental organizations - could be facing a difficult situation if diesel prices climb as it is hard and takes time for them to increase their income. Public transportation in Sweden is often financed only partially through ticket fees.

Another group with low financial margins is the agriculture sector. Subsidies are depended upon and higher diesel prices are hard to forward to the next part of the chain.

4.3 Discussion

There are many uncertainties linked with the enforcement of the Sulphur Directive. Will scrubber technology improve? What will the price spread between low and high sulphur fuel be in 2015? How fast can LNG or methanol take market share as a shipping fuel? Will refineries in SECAs be able to sell high sulphur fuel without incurring big losses?

Current uncertainty is a strong incitement for involved stakeholders to adopt a "wait-and-see" strategy. Installing scrubber technology could also make more sense closer to 2015 as the technology is not yet fully mature and installation times are relatively short.

A key factor that will determine whether the US will be able to increase exports of diesel to Europe is that domestic demand for gasoline remains high. Otherwise
Europe might have a hard time finding buyers for its gasoline surplus at the same time as US imports of crude oil are not likely to increase.

Shipping is very important for Swedish industry, making political support likely if maritime transport suffer as a result of the Directive. So far, some shipping lines have managed to reduce fuel consumption by reducing speed so they are not anticipating increasing transport prices if the low-high sulphur fuel spread stays below $300\textsuperscript{19}. Ships driven by LNG or methanol are likely to have a busy schedule inside SECA\textsubscript{s}, at least up until 2020.

While the "wait-and-see" approach is preferable for the individual players, it is very risky from a top down perspective. If shipping lines were to be suddenly cancelled, increased railroad traffic on railroad would lead to crowding and traffic jams, or if fuel will not be distributed over the whole country (gas companies are closing down stations in sparsely populated areas), the effects might be severe for parts of society. Much of heavy road transport work is necessary for basic functions, such as wastewater cleaning or grocery distribution.

We see a high risk for suboptimal transport patterns in 2015. This will result in negative environmental effects, increased goods flows to ports outside SECA\textsubscript{s} where ships use higher sulphur fuel, and increased personal transport by aviation as train transport becomes even more unreliable. In addition, diesel import from the US and Asia means higher sulphur emissions as international shipping is operates on 3.5 % sulphur fuel.

A longer-term goal in Sweden has been to eliminate oil from all sectors except transport. Sweden is very close to succeeding with this goal, with a steady decline in demand of oil for heat or electricity generation. The Sulphur Directive may reverse this trend overnight as roughly 20 % of all crude oil that goes into a refinery and currently used to power the shipping industry, will instead risk being used in industry, competing with coal.

The following questions are outside the scope of this report but are important for the development of transportation in SECA\textsubscript{s}:

- Will Europe\textquotesingle s refineries invest to be able to convert high sulphur fuel?
- What will happen with global production of crude oil and how will demand evolve in oil producing countries?
- Will Europe support the refining industry if it proves to be a cost-effective way to reduce sulphur emissions?

\textsuperscript{19} According to Wagenborg Shipping Sweden.
5 Conclusion

The amended Sulphur Directive will have significant and serious consequences for the Swedish transport system, and will significantly impact the European transport system as well. This conclusion has been reached in spite of optimistic assumptions of improved efficiency within the shipping industry, the ability for railroad to take on increased amounts of goods, and a belief that the refinery industry can extend the diesel shares beyond today’s already strained capacity.

Key stakeholders affected by the Directive - the refining and shipping industries - has adopted a “wait-and-see” attitude, partly because it is a low risk alternative, and partly because to the ability to invest is limited. When the outcome of fuel prices is known, closer to the date in which the tighter environmental regulations will start being enforced, the involved stakeholders will react. We believe that transport patterns will then return to the same market share as in 2011.

Our estimate is that price difference between 0.1 % and 1 % sulphur fuel will be over USD 350 per ton in 2015. This will push the price of diesel in Sweden to 0,8 SEK per litre. We see it likely that MK3 will be favoured over MK1 as refineries try to expand diesel shares as much as possible. In this case, the price of diesel will increase an additional 0,4 SEK due to different taxation.

The trend with a high share of new diesel cars registrations will be broken when the price of diesel overtakes the price of gasoline in 2015. Combined with a larger share of heavy oil used in industry for heat and electricity generation this will mean a negative environmental effect and also a risk that bioenergy now going to CHP is outcompeted by heavy oil.

Organizations with no clear customer and limited ability to pass on price increases to end consumers will be more deeply affected by diesel price increases. Examples are public transporters, municipalities and governmental organizations. Sectors that are very exposed to global markets must find a way to reduce costs or adapt their business – examples are agriculture, steel, pulp and paper and wood industry.

It is not clear whether increased demand for distillates, in particular diesel, can be met by supply. Trends point to oil increasingly being consumed domestically, and shrinking amounts being exported and trading on open markets. Combined with growing demand for diesel, local diesel shortages cannot be ruled out. Since there is only one fraction of crude oil where we expect a demand increase (demand for other fractions is expected to remain constant or decrease) it is not certain that the price of crude oil will increase, taking away an important motive to prospect for new oil fields, thus limiting supply.
The installation of scrubbers represents additional costs for shipping companies even if the price spread between 0.1 % and 1 % would be high. Furthermore, shipboard scrubber technology is new and therefore surrounded with risk. Combined with limited investment room, we expect no more that approximately 2.5 % of all ships operating in SECAs daily to have installed scrubbers by 2015.
About Sweco

Sweco’s experts are working together to develop total solutions that contribute to the creation of a sustainable society. We call it sustainable engineering and design. We make it possible for our clients to carry out their projects not only with high quality and good economy but also with the best possible conditions for sustainable development.

With around 7,000 employees, Sweco is among the largest players in Europe and a leader in several market segments in the Nordic region and Central and Eastern Europe.

Sweco Energy Markets delivers value to our clients through deep insights on energy markets. We work with market design, regulation and market analysis. We support a continuous development of the market and help our clients to effectively participate on the energy markets.