

*About greenhouse gases  
and CO<sub>2</sub> emissions  
from our vessels and oil & gas activities*





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## *“The environment and business go hand in hand”*

The climate is changing. All over the world, large volumes of CO<sub>2</sub> and other greenhouse gases are emitted with increased global warming as a result. We all contribute to the emission of CO<sub>2</sub>, and so do our industries. The transport and energy sectors emit a great amount of CO<sub>2</sub>, because goods are transported from country to country, and because primary energy such as gas, oil and coal is required to generate the electrical and transport energies we need for our business and daily lives. That is why we, as a company, have a responsibility to reduce our impact on the environment.

Climate and environment feature prominently on the agenda of politicians, the business community and the public in general. There is no doubt that we are all concerned about the state of our world and interested in what can be done to minimise the environmental impact.



The A.P. Moller - Maersk Group's approach to the environmental debate is that not only do we have a duty to society in general, but environmental consciousness also creates business opportunities for the Group. The less fuel consumption, the less CO<sub>2</sub> emissions. This is good for the environment – and, at the same time, it is good for business. And there are many examples of how A.P. Moller - Maersk, through creativity and skill, is the first with energy-efficient solutions for the benefit of both the environment and the bottom line.

But of course, solving the world's environmental problems is something we need to do together. That is why we are involved in a number of organisations that are working to reduce environmental impact. It is crucial that global, and not local, solutions are developed if the rate of climate change is to be reduced.

I hope that this small booklet will give you useful insight into the debate and also into how A.P. Moller - Maersk, as an environmentally conscious company, is involved in seeking solutions.

With constant care, we must ensure that we continue to work for a world that is fit to live in today and in the long-term future.

Nils S. Andersen  
Group CEO, A.P. Moller - Maersk

# 1. Purpose

The purpose of this booklet is to explain the relationships in the climate debate with regard to two of the A.P. Moller - Maersk Group's business areas: shipping, and oil and gas.<sup>1</sup> International trade is dependent on shipping, and the world is dependent on oil and gas as two of the primary sources of energy.

The climate debate focuses largely on emissions of CO<sub>2</sub> (carbon dioxide) and the greenhouse effect. This is the subject of this booklet.

A.P. Moller - Maersk has five guiding principles, which we use in our approach to the climate debate:

1. Reducing environmental impact is a matter of making individual business activities as energy-efficient as possible. This applies to both oil and gas production and shipping.
2. Environmental initiatives often go hand in hand with financial benefits. The less fuel we use, the less CO<sub>2</sub> we emit. This is good for the environment – and financially beneficial for us.
3. Globalisation is increasing the need to transport goods between countries. Shipping is the most energy-efficient form of transport. Shipping emits less CO<sub>2</sub> per tonne of goods transported than transport by train, plane or truck. The more goods that are transported by sea, the better it is for the environment. Shipping companies are acknowledging their responsibility to improve the energy efficiency of their vessels.
4. Shipping is global and therefore requires international regulation. Regional or local regulation risks creating unfair competition without simultaneously achieving environmental benefits.

<sup>1</sup> The booklet covers approximately 230 vessels owned by A.P. Moller - Maersk, as well as the activities of Maersk Oil in Denmark, Great Britain, Qatar and Kazakhstan.



5. To limit emissions of CO<sub>2</sub>, it is necessary to increase the use of sustainable forms of energy (wind, solar and hydroelectric power, for example). At the same time, however, we must recognise that fossil fuels (coal, oil and natural gas) will remain indispensable for many years to come. The challenge facing Maersk Oil is to produce oil and gas in the most environmentally friendly manner.

## 2. *Global warming*

The UN's Intergovernmental Panel on Climate Change (IPCC) believes that global warming is largely attributable to an increase in the levels of CO<sub>2</sub> and other greenhouse gases in the atmosphere. We share this opinion.

A rise in temperature will have both negative and positive consequences. The effect will vary from one region to another. The negative impact is expected to be greater for the world as a whole. The higher the rise in temperature, the more serious the consequences.<sup>2</sup>

The following are possible consequences of global warming:

- A warmer atmosphere may contain more water vapour, which would exacerbate the greenhouse effect.
- Higher temperatures in arctic regions will melt snow and ice, which currently reflect sunlight back into space. As a result, less sunlight will be reflected, which will contribute to the heating of the Earth's surface.
- Melting glaciers and ice caps will raise sea levels and increase the risk of flooding.
- More storms.
- Other effects such as changing agricultural patterns, scarcity of drinking water, and expansion of drought-affected areas are also to be expected.

<sup>2</sup> *The fourth evaluation report from the Intergovernmental Panel on Climate Change: "Climate Change 2007"*

## 2.1 *What is a greenhouse gas, and what is the greenhouse effect?*

Greenhouse gases account for approximately one per cent of the Earth's atmosphere and act as an insulating 'blanket' around the Earth – or as the glass roof of a greenhouse. Greenhouse gases trap heat. Without them, the average temperature of the Earth would be around 30°C degrees colder.

The natural greenhouse effect is increased by emissions of CO<sub>2</sub> from the burning of coal, oil and natural gas. In addition, the effect is reinforced by methane and nitrogen oxides from agricultural operations and the use of industrial gases that do not occur naturally. Emissions of CO<sub>2</sub> due to human activity account for more than 60 per cent of the greenhouse effect over and above the natural greenhouse effect.<sup>3</sup>

Most greenhouse gases exist for a very long time. In fact, they become almost completely assimilated into the atmosphere. The contribution to the greenhouse effect of individual gases is determined by their concentration, their ability to absorb heat radiation, and their lifetime in the atmosphere. Even though CO<sub>2</sub> is emitted locally, it will have a global effect.

<sup>3</sup> *The United Nations Framework Convention on Climate Change:*  
[http://unfccc.int/essential\\_background/feeling\\_the\\_heat/items/2903.php](http://unfccc.int/essential_background/feeling_the_heat/items/2903.php)

## 2.2 How does CO<sub>2</sub> disappear?

Carbon exists beneath the surface of the Earth in the form of coal, oil and gas. When coal or other fossil fuels are burned, carbon reacts with the oxygen in the air and releases CO<sub>2</sub> into the atmosphere. This increases the carbon content of the atmosphere.

CO<sub>2</sub> is absorbed naturally from the atmosphere by plants through photosynthesis. In this process, CO<sub>2</sub> is broken down into its constituent elements: carbon (C) is absorbed by the plants, while the oxygen (O<sub>2</sub>) is released into the atmosphere.

The seas and oceans of the world also absorb carbon.<sup>4</sup> However, they cannot absorb carbon at the same rate as CO<sub>2</sub> is emitted by industrialised societies.

<sup>4</sup> Denmark's Meteorological Institute: [www.dmi.dk](http://www.dmi.dk)



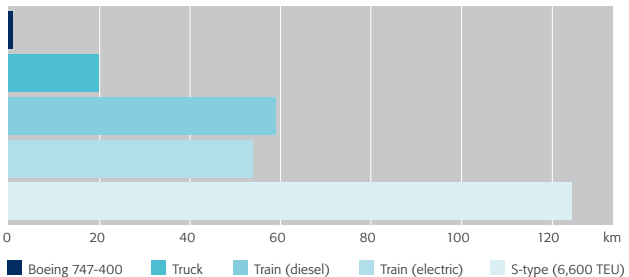
### 3. *International shipping and CO<sub>2</sub> emissions*

International shipping transports around 90 per cent of global trade. Approximately one tonne of goods per head of the global population is transported by sea every year. The goods in question may be clothes, shoes, oil, electronic items, raw materials or foods. Sea transport is therefore crucial to international trade in a globalised world.

Shipping is a very energy-efficient form of transport, the result of decades of development of improved engines, hulls, paint types and propellers. In the years to come, the shipping industry will make use of technological advances and bigger vessels to become even more energy efficient.

Shipping is the most environmentally friendly form of transport. Figure 1 illustrates how much more efficient a container vessel is than other forms of transport. For example, if air freight were to take over the goods transport currently handled by vessels, this would result in CO<sub>2</sub> emissions 50–80 times greater than those generated by shipping.

Figure 1: Distance covered with 1 tonne of cargo and the emission of 1 kg CO<sub>2</sub>



The most recent study on the shipping industry's total fuel consumption and CO<sub>2</sub> emissions is from December 2007. The study was carried out by a scientific group of experts established under the UN's International Maritime Organization. According to this study, the total fuel consumption by vessels is 369 million tonnes.<sup>5</sup> This would suggest that around four per cent of the global energy-related CO<sub>2</sub> emissions stem from shipping.

In 2006, our own vessels<sup>6</sup> consumed around 5.6 million tonnes of fuel oil, of which vessels sailing under the Danish flag accounted for approximately half. As a rule of thumb, the weight of CO<sub>2</sub> emitted can be calculated by multiplying the weight of the oil consumed by three. Through the consumption of fuel, our vessels have thus emitted approximately 17 million tonnes of CO<sub>2</sub>.

The overwhelming majority of the CO<sub>2</sub> emissions from these vessels stems from international voyages between importing and exporting countries.

Not all vessels emit the same volume of CO<sub>2</sub> per tonne carried per kilometre, even though they may sail the same distance. It depends on how fast they sail (the faster a vessel sails, the more fuel it consumes) and the volume of the goods transported per unit of weight.

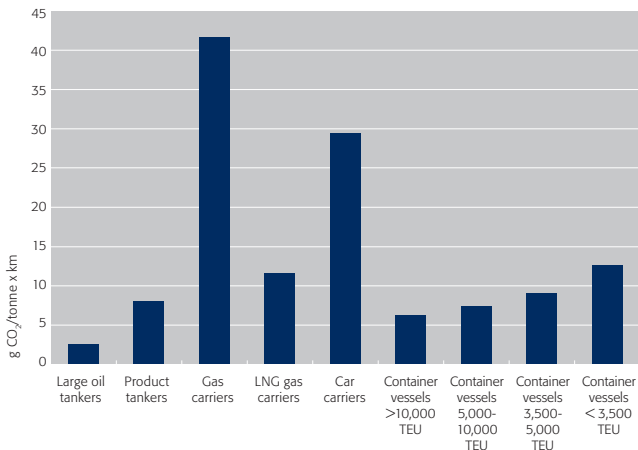
<sup>5</sup> *BLG 12/6/1: Review of MARPOL Annex VI and the NO<sub>x</sub> technical code: Report of the outcome of the Informal Cross Government/Industry Scientific Group of Experts established to evaluate the effects of the different fuel options proposed under the revision of MARPOL Annex VI.*

<sup>6</sup> *This figure does not include our supply vessels and our Ro-Ro vessels.*

Gas tankers emit relatively high levels of CO<sub>2</sub> per transported tonne as their cargo occupy a lot of space but weigh relatively little.

Figure 2 also shows that our large container vessels are more energy efficient than their smaller counterparts – and that they emit less CO<sub>2</sub> per transported unit.

Figure 2: CO<sub>2</sub> emissions from vessels owned by A.P. Moller - Maersk



TEU stands for *Twenty-foot Equivalent Units* and is a unit of measurement for vessel containers. One TEU is equivalent to a standard 20-foot container, which measures approximately 6 m x 2.5 m x 2.6 m.

### 3.1 *Environmentally friendly initiatives*

We implement numerous initiatives to limit the fuel consumption of our vessels. The less fuel they use, the less CO<sub>2</sub> they emit.

We have more than 100 different schemes and projects that involve saving energy. These include:

- Waste heat recovery from exhaust gases, which results in daily savings for vessels fitted with a Waste Heat Recovery system.
- Electronic control of the primary engine to improve combustion, even when the engine is not operating at full power. Most engines are optimised for operation at full power.
- Route planning and the use of advanced IT systems. The more carefully a route is planned (to allow vessels to sail the shortest distance possible as slowly as possible), the less fuel is consumed.
- Optimised loading of vessels (trim optimisation) so that, with a given draught and at a given speed, they are subject to the least friction through the water – and thus consume as little fuel as possible.
- Alternative fuels such as LNG and biodiesel are constantly being evaluated.

These efficiency improvements have, for example, resulted in fuel savings of 5.7 per cent for container vessels, and reduced CO<sub>2</sub> emissions per TEU per kilometre between the years 2002 and 2006. This is illustrated in Figure 3.

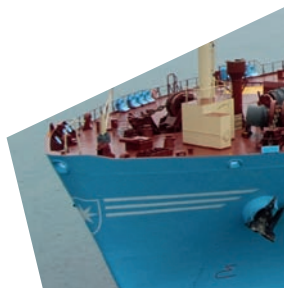
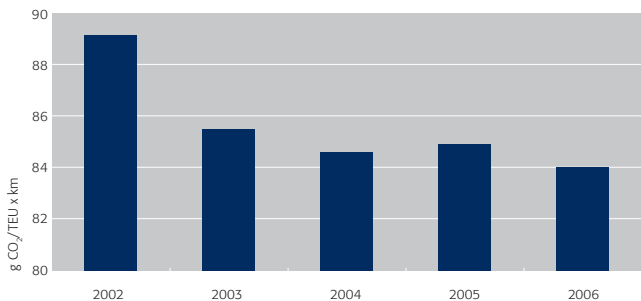


Figure 3: Average CO<sub>2</sub> emissions from container vessels owned by A.P. Moller - Maersk in the period 2002–2006.



## 4. *CO<sub>2</sub> emissions from oil and gas production*

Even though it is necessary to think in terms of environmentally friendly sources of energy (such as wind, water and the sun), we will still be reliant on fossil fuels (such as coal, oil and natural gas) for many years to come. The oil industry contributes to CO<sub>2</sub> emissions through the energy required to extract and refine oil and gas.

Maersk Oil operates oil and gas facilities in Denmark, Great Britain, Qatar and Kazakhstan and is a non-operating partner in Algeria. Oil and gas are drawn from various depths and reservoirs, which mean that different levels of energy are consumed, and different volumes of CO<sub>2</sub> are emitted, from field to field and from country to country. In total, CO<sub>2</sub> emissions from Maersk Oil's operations in 2006 in the North Sea, Qatar and Kazakhstan amounted to around five million tonnes.

It is quite a challenge to limit CO<sub>2</sub> emissions from production activities at old oil and gas fields, as the energy required per unit produced tends to increase at such fields. This is largely the case in Danish and British fields and eventually becomes an issue as every field matures.

*Tyra East in the Danish section of the North Sea*



## 4.1 Initiatives and goals

The oil industry is subject to stringent environmental regulations intended to minimise the impact on the environment. In addition, Maersk Oil works actively to improve and develop work processes and techniques designed to minimise environmental impact.

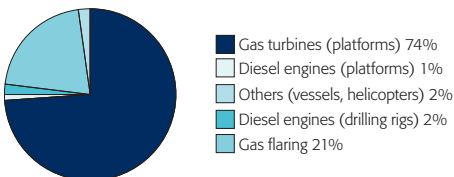
The distinctive flame (the flare) that burns on production platforms is primarily a safety measure. The flare is also needed when the facility is started up following disruptions to operations. One of its primary safety functions is to safely dispose of gas from the facility in the event of a fire, which minimises the risk of explosion.

The volume of gas flared offshore has been continuously reduced in recent years, and Maersk Oil has laid down goals for the reduction of such flaring. Maersk Oil's target for 2007 was to reduce flaring by five per cent compared to 2006. This was achieved, and now the company is working to establish a similar goal for 2008.

In Qatar, Maersk Oil is working on significantly reducing flaring by implementing its latest development plan, which aims at exporting to shore a large volume of the gas produced.

All new facilities apply the principle of keeping emissions of CO<sub>2</sub> as low as practicable. The intention is to ensure efficient and environmentally responsible production of oil and gas.

Figure 4: CO<sub>2</sub> emissions from DUC<sup>7</sup> oil and gas field in the North Sea



<sup>7</sup> DUC (Dansk Undergrunds Consortium) is a co-operation between A.P. Moller - Maersk, Shell and Chevron. Maersk Oil is operator for DUC and takes care of exploration, development and production from the Danish oil and gas fields in the concession area.

## *5. Future regulation of CO<sub>2</sub> emissions*

CO<sub>2</sub> emissions constitute a global problem and therefore require international regulation. The emission of greenhouse gases is regulated internationally by the Kyoto Protocol, which will remain in effect until 2012.

The energy sector – and, as a result, Maersk Oil – falls within the Kyoto Protocol. In contrast, international shipping operations – including our vessels – do not.



## 5.1 Oil and gas activities

Today, CO<sub>2</sub> emissions from Maersk Oil's operations are regulated according to the countries that control the ocean territories where we extract oil and gas. In practice, these countries are regulated by the Kyoto Protocol, as many of them are EU member states with reduction obligations pursuant to this protocol.

In 1998, the EU Member States divided their reduction obligations between them so as to fulfil the EU's total obligation in relation to the Kyoto Protocol. As a consequence of this, in the period 2008–2012, Denmark is to reduce its average annual emissions of greenhouse gases by 21 per cent compared to 1990 levels. In comparison, Great Britain is to reduce its emissions by 12.5 per cent.

There is a political desire for additional CO<sub>2</sub> reductions – as a voluntary industrial initiative before 2012, and as a tightening of requirements after 2012.

The EU member states would like the stricter reduction burden to be applied primarily to energy production and power plants. This applies to Maersk Oil's offshore power plants for electricity production and the operation of equipment on platforms and at processing facilities.

For this reason, Maersk Oil is holding talks with the appropriate authorities and environmental politicians in Denmark and the EU. In addition, Maersk Oil are working with other oil companies through organisations such as OGP and Danish Operators<sup>8</sup> in order to ensure co-ordinated efforts in this area.

<sup>8</sup> OGP: *International Association for Oil & Gas Producers*  
Danish Operators: *Oil and Gas Operators in the Danish North Sea.*

## 5.2 *International shipping*

There is a political desire to regulate CO<sub>2</sub> emissions from international shipping. Even though shipping is the most environmentally friendly form of transport, it still emits around four per cent of global energy related CO<sub>2</sub> emissions.

The key issue is therefore how CO<sub>2</sub> emissions from shipping are to be regulated. We believe that international regulation is the right way forward. National regulation would neither solve general climate problems nor promote equal terms for the vessels.

International shipping is not covered by the regulatory mechanism of the Kyoto Protocol. Instead, it has been placed in the hands of the UN's International Maritime Organization (IMO).

IMO has initiated work to regulate CO<sub>2</sub> emissions. If the IMO cannot demonstrate real progress, the alternative may be to include shipping in the agreement that is to continue the efforts of the Kyoto Protocol after 2012.

The reduction obligations laid down by the Kyoto Protocol are distributed according to a principle of shared but differentiated responsibility between industrialised countries and developing countries. The obligations only apply to the industrialised countries, and not to the developing countries.

This means that if shipping is to be included in the next climate agreement for the period after 2012, and unless the number of countries with reduction obligations increases significantly, only around 25 per cent of total global tonnage will be registered in countries subject to reduction obligations. This is illustrated in Table 1.

**Table 1: How global tonnage is divided between industrialised and developing countries.**

	Number of vessels	Deadweight tonnage
Industrialised countries	14,668	195,488,277
Developing countries	31,321	720,216,954

*The figures in the table are taken from Lloyd's Register on 1 April 2007.*

As developing countries are not subject to reduction obligations (cf. the principle of shared but differentiated responsibility), vessels will not be required to reduce CO<sub>2</sub> emissions. This means it would be advantageous to move the registration of vessels from industrialised countries to developing countries.

Therefore, international regulation – covering all vessels – is best for the environment. This would also be best for business, as it would help to maintain equal terms for competition. The environment and business would actually go hand in hand.

A.P. Moller - Maersk is working on finding a global IMO solution to regulate emissions of CO<sub>2</sub> from vessels. This work is being carried out in collaboration with the Danish Shipowners' Association, appropriate Danish authorities, the European Commission and international shipowners' associations.





*If you have any comments  
to this booklet, you are more  
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