Steering clear of oil disasters

How progressive CO_2 emission standards can help to reduce unconventional oil imports to the EU

GREENPEACE

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THE EU'S TRANSPORT SECTOR CURRENTLY USES AROUND

60%

OF ALL OF THE OIL CONSUMED IN THE EU, A PROPORTION THAT IS PROJECTED TO BE AS HIGH AS 65% BY 2030 WITHOUT ADDITIONAL POLICY INTERVENTIONS.

Executive Summary

The aim of this report is to estimate how much the EU's demand for oil might decline in 2020 and 2030 if more stringent CO_2 emissions performance standards for new passenger cars and vans were introduced. Additionally, it assesses the potential impact of the resulting demand reduction on the level, origin and value of the EU's oil imports and the types of feedstock that are used by the EU's oil refineries.

The EU's transport sector currently uses around 60% of all of the oil consumed in the EU, a proportion that is projected to be as high as 65% by 2030 without additional policy interventions. Over half of the oil consumed by the EU's transport sector is used by cars and vans, a proportion which is expected to have fallen to slightly less than half by 2030. Currently, 85% of the total oil that the EU consumes comes from imports. As its few domestic reserves are anticipated to decline, this dependency is expected to increase to at least 90% by 2030. Consequently, the increased use of unconventional oil feedstock elsewhere in the world increases the possibility that these types of feedstock are used to supply the EU's oil market. Globally, it has been estimated that up to 13% of oil production currently comes from unconventional sources. It is likely that more than 75% of this comes from deepwater oil fields, while the second largest contributor is tar sands.

On the other hand, proven world-wide reserves of oil, mostly from conventional sources, are estimated to be around 1.3 thousand billion barrels, which would last 46 years at current levels of use. It has been estimated that there is potentially a similar amount of oil that is not yet considered to be recoverable, but could be as economic conditions change and technology develops. Additionally, unconventional oil feedstock, such as tar sands, could potentially treble total global resources of oil in the longer term. Hence, there is a lot of oil that could still potentially be recovered that could lead to the release of a significant amount of additional CO_2 into the atmosphere. Furthermore, there are other significant environmental impacts and risks associated with the extraction of unconventional oil feedstock.

Two scenarios – a business-as-usual (BAU) scenario and an alternative car and van efficiency (CVE) scenario– were developed in order to estimate the impact of the introduction of emissions performance standards in 2020 of 80gCO_2/km for passenger cars and 125gCO_2/km for vans. In 2030, the equivalent standards that were assumed were 50gCO_2/km for cars and 88gCO_2/km for vans. It was estimated that by 2030 these standards alone could reduce the oil consumption of the EU's transport sector by around 13%, or 1.1 million barrels a day. This is equivalent to an economy-wide reduction of 8%, and a reduction in the amount of oil consumed globally of just over 1%. This assumes that no additional policy interventions are implemented, either in the EU or elsewhere, to reduce CO_2 emissions or the consumption of oil.

The amount of unfinished oils (i.e. oil that has yet to be refined into, for example, gasoline and diesel) that the EU will need to import in 2020 and 2030 is limited by the projected capacity of the EU's oil refineries and depends on the EU's own production of oil and the likely demand for oil products (e.g. gasoline and diesel) in the EU. It was estimated that the EU imported around 11 million barrels of unfinished oils a day in 2009. Under BAU, imports were estimated to be around 10 million barrels a day in 2020 and 11 million barrels a day in 2030. The reduction in 2020 is due to an expected decline in oil refinery capacity, which could eventually mean that under BAU in 2020 the EU could be a net importer of oil products, as the demand for these products is expected to increase from 2009. In 2030, imports of unfinished oils are expected to increase slightly compared to 2020 due to increases in refining capacity, however this also means that the EU will become a net exporter of oil products, as in 2009. Under the CVE scenario in 2020, it was estimated that the EU would import 500 thousand barrels a day less than under BAU. In 2030, the demand reduction may lead to reduced imports of 1 million barrels a day of unfinished oils. The need for fewer imports could deliver an annual saving of around $16 billion ($2008) in 2020 and of $42 billion ($2008) by 2030. Additional policy interventions are likely to alter these figures.

In 2009, the regions supplying the EU with up to 95% of its imports of unfinished oils were the former Soviet Union, Africa, the Middle East and Norway. It is anticipated that oil production in all of these regions will increase, or at least not decrease significantly, between 2010 and 2030. Hence, if these regions continue to export similar proportions of their total exports to the EU, it is likely that they will remain the EU's main suppliers in 2020 and 2030, assuming that there are no significant policy changes in other markets. Of course, it is possible that unfinished oils and/or oil products are imported from the Americas, particularly if the EU became a net importer of oil products, as it could do under BAU in 2020 (see above).

Whether or not the EU imports unfinished oils or oil products from the Americas is important as this is where the largest reserves and resources of tar sands, oil shale and extra heavy oil can be found. Currently, the EU imports only a small amount of its unfinished oils from the Americas and could import even less in the future since these unconventional sources are costlier to exploit and supply compared to conventional oil feedstock. Hence, little oil refined in the EU in either 2020 or 2030 needs to be from tar sands, extra heavy oil or oil shale. It is possible, however, that a certain amount of oil products refined in the Americas using these types of feedstock could reach the EU market.

As noted above, it is likely that oil from deepwater sources already contributes up to 10% of unfinished oils used in the EU. In 2020, under BAU the proportion is likely to be similar, but could be less in 2030 with increased production of conventional sources. Under the CVE scenario, the share of deepwater oil could drop in 2020, leaving practically no use in 2030. In essence, the less oil that is needed, the more unlikely it is that a larger amount of this will come from unconventional sources, where the first choice among these is likely to be deepwater due to lower exploitation and supply costs.

Ultimately, the best way of increasing the possibility that the EU will not need to import unfinished oils or oil products from unconventional feedstock is to reduce further the demand for oil in the EU. In the transport sector, other studies have shown that by 2030 a reduction in the amount of oil needed of up to 46% could be possible with the implementation of a range of policy instruments, including those that address the demand for transport (Skinner et al, 2010). Additionally, supply-side instruments, such as the Fuel Quality Directive (CEC, 2009d) could be used to reduce the possibility of a particular feedstock being used to supply the EU oil market.

EFFICIENCY ROUTE

EFFICIENCY STANDARDS FOR CARS AND VANS COULD REDUCE THE EU'S OIL CONSUMPTION BY 8%, OR 1.1 MILLION BARRELS A DAY, BY 2030.

THE NEED FOR FEWER IMPORTS COULD DELIVER AN ANNUAL SAVING OF $42 BILLION.

THE SHARE OF DEEPWATER OIL COULD DROP FROM CURRENTLY AROUND 10% TO PRACTICALLY NO USE IN 2030

Introduction 01

The EU currently consumes around 670 million tonnes of oil a year. This level of demand, coupled with the fact that the few domestic reserves of oil are in decline, results in high levels of oil imports. Without interventions to reduce oil consumption the EU could seek more imports from 'unconventional' sources (such as the deepwater projects in the Gulf of Mexico and Canadian tar sands) to make up for what cannot be recovered by 'conventional' sources of imports from traditional oil-producing regions. However, it is possible to reduce the EU's future dependency on imports, including from these unconventional sources, by reducing its total demand for oil, especially in its most oil-dependent sector, i.e. transport.

The EU currently consumes around 670 million tonnes of oil a year (DG TREN[1], 2008; BP, 2010a)[2]. Around 60% of this oil is consumed by the transport sector and over half of this sector's use of oil is by cars and vans (DG TREN, 2008)[3].

The International Energy Agency expects that global demand for oil will increase by nearly 25% between 2008 and 2030 to 5,238 million tonnes (IEA, 2009). Within the EU, the consumption of oil is expected to increase by significantly less than this, with DG TREN (2008) anticipating a 5% rise by 2030, while Organisation of Petroleum Exporting Countries (OPEC, 2009a) and IEA (2009) projected *slight decreases* in the EU's overall oil consumption by 2030. The main reasons for this difference is that the two more recent reports took account of the effect of the 2008/9 economic recession on oil demand, as well as the potential impacts of more recent policy developments, such as the EU's 2008 climate change and energy package. DG TREN (2008) on the other hand, only took account of policies implemented by the end of 2006.

In spite of the differences in total oil consumption, both DG TREN (2008) and IEA (2009) projected that, in the absence of further policy measures, the transport sector's share of the EU's oil consumption in 2030 would increase to 65%. However, the proportion of the transport sector's oil consumed by cars and vans is expected to have fallen to slightly less than half (DG TREN, 2008).

The consumption of oil at these levels would result in the release of around 1,110 million tonnes (Mt) of carbon dioxide (CO_2) from the EU's transport sector in 2010, which represents 28% of the EU's total CO_2 emissions (DG TREN, 2008). By 2020, this figure would have increased to 1210 $MtCO_2$, or 29% of total CO_2 emissions, while in 2030 transport's CO_2 emissions would be 1260 $MtCO_2$ or 30% of the total, if no further measures are taken (DG TREN, 2008)[4].

The level of demand for oil in the EU, coupled with the fact that the few domestic reserves of oil are in decline, results in high levels of oil imports. DG TREN (2008) anticipates that the EU's dependence on imported oil will increase from 86% in 2010 to 95% in 2030. The IEA (2009) expects a similar figure of 91% in 2030 compared to 81% in 2008. Without any interventions to reduce oil consumption in the EU, including that consumed by the transport sector, such high levels of oil demand in the future could require the EU to seek more imports from 'unconventional' sources (such as the deepwater projects in the Gulf of Mexico and Canadian tar sands) to make up for what cannot be covered by 'conventional' sources of imports from traditional oil-producing regions, such as the Russian Federation and the Middle East.

It is recognised, including by the oil industry itself, that the production of oil from unconventional sources results in considerably increased levels of a range of environmental impacts and risks, compared to conventional production (e.g. Total, 2007 and 2009; Greenpeace, 2009). Such environmental impacts and risks include significantly raised levels of greenhouse gas emissions due to the production of synthetic crude oil from sources such as tar sands and oil shales, potentially increased levels of damage to habitats such as the Arctic, and the risk of large-scale oil spills from deepwater operations.

However, it is possible to reduce the EU's future dependency on imports, including from these unconventional sources, by reducing its total demand for oil, especially in its most oil-dependent sector, i.e. transport. According to the European Commission's Action Plan for Energy Efficiency, the transport sector has the potential to cut its energy use by about 26% by 2020 (compared to 2005; CEC, 2006). Greenpeace's Energy [R]evolution scenario suggests that oil consumption in the EU's transport sector could be 13% lower than 2007 levels by 2020 and 36% lower by 2030 as a result of the introduction of a range of policy measures (Greenpeace and European Renewable Energy Council, 2010). This report concludes that it is possible to reduce transport's greenhouse gas emissions by 93% by 2050, compared to 1990. Additionally, a recent project for the European Commission's DG CLIMA ("EU Transport GHG: Routes to 2050?") that concluded that it was possible to reduce transport's greenhouse gas emissions by 89% between 1990 and 2050, included a decline in oil use by transport of 30% by 2020 and 46% by 2030, compared to 2010[5]. Under the scenario that delivered the 89% greenhouse gas reduction in 2050, transport's greenhouse gas emissions in 2020 would be 9% lower than 1990 levels and 36% below this level by 2030.

The aim of this report is to identify, as far as is possible, the extent to which in 2020 and 2030 the EU would need to import oil, and more specifically oil derived from unconventional sources, if stringent CO_2 emissions performance standards were introduced for cars and vans. The estimates were based on two scenarios that were developed in the course of the project – the first of which was a business as usual scenario; the second an alternative scenario in which emissions performance standards for cars and vans in the EU are made continually more stringent[6].

For each scenario, an attempt was made to answer the following four research questions for 2010, 2020 and 2030:

- **How much oil is/will be imported?**
- **What countries does/will the imported oil come from?**
- **What is/will be the value of oil imports?**
- **What is/will be the share of different conventional and unconventional feedstock (including oil from deepwater sources)?**

In relation to the last question it is recognised that, as the oil market is complex, a reduction in demand due to the improved efficiency of cars and vans will not directly lead to a reduction in the need for a particular feedstock. However, the numbers are estimated simply to ascertain if it is likely that demand for oil could be met through unconventional sources and to identify what additional policy responses might be necessary. It is also important to note that in Sections 2 to 5, the only additional EU policies that are considered are more stringent CO_2 emissions Regulations for cars and vans. No other legislation, such as more stringent fuel standards, CO_2 emissions standards for other modes or measures directly targeting demand, is considered. The introduction of such measures would change the regulatory framework within which the oil market operates, as well as reduce the demand for oil, as can be seen in the downward trend in projections of future demand in other reports[7].

The scope of the scenarios is the EU-27, although global information is presented below where relevant, e.g. to provide a wider context. All modes of transport are considered, i.e. including international aviation and maritime shipping[8].

While the data and information was taken from authoritative and reputable sources, e.g. the IEA (2008; 2009), OPEC (2009a; 2010) and BP (2010a), assumptions had to be made in order to reach the numbers presented below. These were based on our assessment of the information and data provided in the sources and are explicitly stated, where relevant. However, it is very difficult to predict future demand and supply for oil, as the market is complex, dynamic and dependent on a wide range of factors. Hence, the numbers represent an attempt to answer the research questions within the constraints of the resources available for the project, based on a simple scenario tool, and should not be taken to be forecasts, as this was not the purpose of the project.

Oil, the global context

02

Before outlining the results of the scenarios and attempting to answer the research questions, it is important to provide the wider context in which global oil markets operate and to provide an overview of the main feedstock that supply the transport sector's needs, as well as their current and potential use.

As in the EU, the transport sector world-wide relies heavily on oil at an average level of more than 90% (IEA, 2009). This is likely to continue to be the case in the foreseeable future, without significant policy interventions. As with any other essential commodity, oil operates in extremely complex and volatile markets, which are made even more complicated due to fact that oil finds its way to final consumers mostly in the form of oil products (commonly referred to as petroleum products), such as the vast majority of fuels used in the transport sector around the world[9]. Hence it is possible to say that oil operates in multiple numbers of interlinked markets, one of which is the market for **unfinished oils**. Within the context of this report, unfinished oils refer either to natural or synthetic crude oils.

Natural crude oil refers mainly to hydrocarbons and a small amount of non-hydrocarbons that naturally take liquid form under atmospheric pressure without any need for processing. These make up the vast majority of feedstock that go into the world's oil refineries today and are expected to remain an important source of oil by 2020 and 2030 (OPEC, 2009a). Within the context of this report, **synthetic crude oil** refers to crude oil that has been created by upgrading bituminous minerals.

Natural crude oils can come from both conventional and unconventional sources. "**Conventional**" in this context refers to traditional methods of surfacing natural crude oils, whereas "**unconventional**" refers to less conventional methods of mining such oils. The most common conventional source of natural crude oil is an ***onshore oil field***, which uses inland oil wells that are operated from the surface. The greatest reserves of this type of feedstock are in the traditional oil-producing regions of the world, such as the Middle East and the Russian Federation.

Another conventional source of natural crude oil is an ***offshore oil field*** that uses traditional offshore oil rigs operated from the surface of the water. The technology used in traditional offshore oil rigs sets the boundaries of this feedstock to shallow waters with depths not exceeding 200-300 metres. One of the biggest sources of this type of feedstock is currently in the North Sea and there are future development potentials in the inland seas of the former Soviet Union (for example, the Caspian Sea).

Currently the most common unconventional source of natural crude oil is a ***deepwater oil field***, which uses high-tech offshore oil rigs and mostly relies on subsea robots for their operations. These fields are found at water depths of more than 300 or 500 metres, although the way in which the term is used varies[10]. Many of the active deepwater fields are currently operated at water depths beyond 1000 metres and these may sometimes be referred to as *ultra-deepwater*, although others classify ultra-deepwater as being in more than 1,500 metres of water (e.g. US Minerals Management Services, 2009). Despite being unconventional due to the production methods employed, deepwater operations have been active for at least a decade, and have thus seen decreases in their production and supply costs. However, the environmental risks associated with this type of feedstock are relatively high due to the use of subsea technologies that are beyond human reach.

image The Deepwater Horizon mobile offshore drilling platform was engulfed in flames after an explosion on April 20, and sank in 5,000 feet of water in the Gulf of Mexico. Eleven workers died. Oil gushed from the deepwater wellhead into the Gulf of Mexico for more than 100 days until a relief well was drilled and the leaking well clogged with mud.

The potential of oil fields in the Arctic to contribute to the future demand for oil is also worth noting, even though there has only been a relatively small amount of exploration in this area to date. Drilling for oil in the Arctic has potentially greater environmental risks than drilling elsewhere due to the specific and fragile nature of the ecosystem. The United States Geological Survey (USGS, 2008) has estimated that most of the possible oil reserves in the Arctic could be on the offshore, continental shelves, which are in water of depths less than 500 metres.

Synthetic crude oils, on the other hand, all come from unconventional sources. This report covers the three most commonly discussed of these sources: extra heavy oil, tar sands and oil shales.

Extra heavy crude oil naturally occurs in onshore fields, such as river beds. However, compared to natural crude oils that have a low density and hence can flow unaided under atmospheric pressure these oils are bituminous and have densities high enough to stop them flow readily. As a result, this feedstock requires an upgrading (using chemicals) operation to turn it into 'synthetic light crude oil' before it can even be transported. The high density of the feedstock also makes the surfacing method less traditional. **Tar sands** and **oil shale**, on the other hand, are not crude oils themselves but contain bituminous minerals that need to be upgraded to synthetic crude oils through energy-intensive processes.

Whether natural or synthetic, all crude oil enters the transport fuels market after being processed in **oil refineries**. However, oil refineries are not the sole manufacturers of transport fuels. Gas processing plants also produce transport fuels, e.g. natural gas. There are also more specialised processes employed to develop such fuels. Two of these are **gas-to-liquid (GTL)** and **coal-to-liquid (CTL)** processes, which can sometimes be referred to as 'feedstock'. As their name implies, these processes use gas and coal respectively, and never liquid crude oils mentioned above.

Natural crude oil is generally cheaper to supply than synthetic crude oil, and it is generally cheaper to use conventional feedstock than unconventional feedstock. The cost of exploiting different types of feedstock (from lowest to highest) is as follows (IEA, 2008):

- *Conventional sources* of crude oil typically cost between $10 and $40 a barrel.
- Additional sources recovered using enhanced oil recovery[11] (EoR) range from $20 to $80 a barrel.
- *Deepwater* and *ultra deepwater* oil costs up to $65 a barrel.
- *Extra heavy oils* and *tar sands*, which cost between $40 and $80 a barrel.
- Arctic oil costs between $40 and $100 a barrel.
- The costs of *CTL* and *GTL* range from $40 to $120 a barrel.
- *Oil shales* are estimated to start at around $50 a barrel and could cost well over $100.

Whether it is cost-effective to exploit a particular feedstock will depend on a number of factors, most notably the price of a barrel of oil compared to the cost of exploiting the feedstock. Hence, feedstock will tend to be exploited in the order that they cost to exploit, i.e. as the price of oil increases types of feedstock that are more expensive are exploited more.

In 2008, it was estimated that the **global production** of oil was in the order of 82 to 84.4 million barrels a day[12], while BP (2010a) suggested that the equivalent figure was around 2 million barrels a day lower in 2009. Between 2% and 3% of this production was from unconventional sources (excluding deepwater)[13], of which between 60% and 70% was from tar sands (see Table 1 below)[14]. IEA (2009) expects a similar figure (7.4 million barrels a day) to the EIA's reference scenario for the global output of unconventional oil. As is demonstrated in Table 1, it can be expected that the proportion of unconventional resources used under a high oil price will be higher than if the oil price remained low, as it would become more cost-effective to use more unconventional sources (see estimated costs above).

Table 1. Unconventional resources as a share of total world liquids production in three cases, 2008 and 2035 (percent)

	2008	2035		
		Low Oil Price	Reference	High Oil Price
Bitumen (from tar sands)	1.76%	3.03%	3.99%	6.04%
Extra Heavy Oil	0.77%	2.64%	1.22%	1.00%
CTL	0.19%	0.25%	1.22%	3.65%
GTL	0.06%	0.18%	0.32%	0.90%
Oil shale	0.01%	0.00%	0.35%	0.42%
Total:	**2.8%**	**6.1%**	**7.1%**	**12.0%**

It is difficult to identify how much oil from deepwater and ultra-deepwater sources is currently used to supply the global oil market. However, figures from various companies suggest that deepwater resources are already contributing sizeable amounts to global oil supply. For example, BP (2010b) estimates that between 20% and 35% of its production is from deepwater sources, largely from the Gulf of Mexico. Total (2007) was investing in African deepwater resources with the aim of have deepwater resources contributing 10% to the company's oil production by 2008, while Exxon (2010) has at least 10% of its oil resources in deepwater.

In order to identify how much potential there is for each of these types of feedstock to supply the future demand for oil, it is necessary to make a distinction between "**reserves**" and "**resources**". In its respected annual statistical review, BP (2010a) defines "reserves" as oil that could be recovered "with reasonable certainty … under existing economic and operating conditions"[15]. In a report funded by the European Commission, the Institut für Energiewirtschaft und Rationelle Energieanwendung defined "resources" as "demonstrated quantities that cannot be recovered at current prices with current technology but might be recoverable in the future, as well as quantities that are geologically possible but not demonstrated" (IER, 2007, page 4).

BP (2010a)[16] estimates **proven reserves of oil** to be 1,333 billion[17] barrels, which would last for nearly 46 years at current rates of production (see Table 2). However, this figure excludes proven reserves of Canadian tar sands, which add an additional 11% to total proven reserves. In 2008, the Government of the Canadian state of Alberta, where the Canadian tar sands are found, estimated that there were even greater reserves of 170.4 billion barrels in the state's tar sands (Government of Alberta, 2010).

image The syncrude refinery outside of Fort McMurray in Alberta.

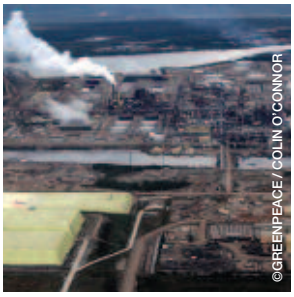


Table 2: Proven reserves of oil (billion barrels) in 2009*

Region and country**	Billion barrels	% of total
Middle East	**754.2**	**56.6%**
Saudi Arabia	264.6	19.8%
Iran	137.6	10.3%
Iraq	115	8.6%
Kuwait	101.5	7.6%
UAE	97.8	7.3%
Qatar	26.8	2.0%
South and Central America	**198.9**	**14.9%**
Venezuela	172.3	12.9%
Europe/Eurasia	**136.9**	**10.3%**
Russian Federation	74.2	5.6%
Kazakhstan	39.8	3.0%
EU-27	6.3	0.5%
Africa	**127.7**	**9.6%**
Libya	44.3	3.3%
Nigeria	37.2	2.8%
North America	**73.3**	**5.5%**
Canada	33.2	2.5%
US	28.4	2.1%
Asia Pacific	**42.2**	**3.2%**
TOTAL	1333.1	
Tar sands Canada	**143.3**	10.7%***

** These reserves include reserves of oil found in deepwater and ultra-deepwater, figures for which are not given separately.*

*** Individual countries are shown where they have more than 2% of the total global oil reserves*

**** Percentage of TOTAL of non-tar sand reserves*

Source: BP (2010a)

In addition to these reserves, it is estimated that there are still significant resources of oil that could be recoverable from both conventional and unconventional sources. IER (2007) estimated that conventional oil **resources** could amount to nearly 720 billion barrels, with an additional 565 billion barrels from various EoR processes, while unconventional resources could come to more than 2,100 billion barrels (see Table 3). As can be seen, almost all of the extra heavy fuel oil can be found in Latin America (which is in fact in Venezuela), while the largest resources of tar sands in the world are in Canada. Oil shale is found in many countries even though most resources are in the US.

More recent publications give estimates that are significantly higher than those presented in Table 3. For example, the USGS (Schenk et al, 2009) estimated a mean volume of ***extra heavy oil*** in Venezuela at 513 billion barrels. USGS (Dyni, 2006) estimated global ***oil shale*** deposits to be 2,826 billion barrels, although this report used a wide range of studies to come to its figure, including some that were over thirty years old. Potential deposits of oil shale were found around the world with deposits of over 100 billion barrels in the Republic of Congo and the Russian Federation. Smaller deposits were also identified in several EU countries; the largest of these was in Italy (73 billion barrels) with smaller deposits of between 2 and 16 billion barrels in Estonia, France, Sweden, the UK and Germany. A report by the European Commission's Joint Research Centre (JRC, 2005) estimates global resources of ***tar sands*** to be between 2.2 and 3.7 thousand billion barrels worldwide, with between 1.6 and 2.5 thousand billion barrels in Canada. Outside of Canada, JRC estimates that the largest resources are in the Russian Federation and in Venezuela (260 and 230 billion barrels, respectively). According to this report, the only EU country with tar sands resources is Romania, with estimated resources of around 24 million barrels.

Table 3: Regional distribution of selected unconventional oil resources at the end of 2002, and more recent estimates.

Billion barrels	Africa	Asia, Australia, N Zealand	Middle East	Europe	Former Soviet Union	Canada	USA	C. and S. America, Mexico	TOTAL	Other studies
Tar sands	42.9	0.4		0.2	70.2	431.7	0.2	281.9	546	>2,200
Extra heavy oil		0.5		0.4					283	>513
Oil shale	64.8	22.4	17.0	43.8	110.6	6.1	1,058.3	32.7	1,356	2,826
TOTAL	**107.7**	**23.3**	**17.0**	**44.3**	**180.9**	**437.9**	**1,058.5**	**314.6**	**2,184**	

Sources: IER (2007); original table in EJ not billion barrels; other studies are Schenk et al (2009), Dyni (2006) and JRC (2005).

IEA (2008) suggested that around 160 billion barrels could be delivered by ***deepwater*** and ***ultra-deepwater*** oil fields and that the Arctic could contain 90 billion barrels (this is the same figure estimated by USGS, 2008). The main potential areas where deepwater resources are expected to be found are in the Gulf of Mexico, the Gulf of Guinea and off the Brazilian coast (Total, 2007).

As noted above, both **GTL** and **CTL** use non-oil feedstock, both of which have significant reserves. Existing proven reserves of natural gas and coal would last nearly 63 years and 119 years, respectively (BP, 2010a). The World Coal Institute (2006) listed a number of planned CTL plants, e.g. in China, Australia and Indonesia, and feasibility studies for CTL plants in the USA and Germany.

Scenarios and assumptions

03

Two scenarios were developed to estimate the reduced amount of oil that the EU would consume if it were to introduce continually more stringent CO2 emission performance standards for new passenger cars and vans: a business-as-usual scenario and an alternative car and van efficiency scenario.

Table 4: Emissions performance standards (average of all new vehicles) – Actual and those used in BAU

	Actual (proposed*) targets		Figures used in BAU			
	Target (gCO_2/km)	Target year	2010 (gCO_2/km)	2020 (gCO_2/km)	2030 (gCO_2/km)	Target year
Cars	130	2015	143	118	97	1.9%
Vans	175*	2016*	195	163	136	1.7%

** Proposed; at the time of writing, legislation for vans was still passing through the legislative process*

As was mentioned above, one of the key elements of the research was to estimate the reduced amount of oil that the EU would consume if it were to introduce continually more stringent CO_2 emissions performance standards for new passenger cars and vans. This was to be undertaken by developing two scenarios: a business as usual (BAU) scenario; and an alternative car and van efficiency scenario (CVE) with more stringent, longer-term emission performance standards for both cars and vans. The existing standards, which apply as an average to all new vehicles produced by each manufacturer, are set by Regulation (EC) 443/2009 (CEC, 2009a) for cars and are proposed within COM(2009)593 for vans (CEC, 2009b) (see the first two columns of Table 4).

The figures used in the BAU scenario were derived from the Sultan illustrative scenarios tool, which was developed within the *"EU Transport GHG: Routes to 2050?"* project[18]. These, in turn, were based on an extrapolation of the most recent monitoring information.

For both cars and vans, BAU assumed that the 2015/16 targets in Table 4 were met, while future improvements were assumed to continue at similar rates[19]. Hence, it was assumed that the 2020 targets for both cars (i.e. 95gCO_2/km) and vans (135gCO_2/km proposed) in the legislation would not be met due to either a weakening of the legislation or manufacturers choosing to pay fines rather than to comply. Other figures used in the BAU were taken directly from Sultan's BAU, e.g. the number of new vehicles each year, the size of the vehicle fleet and the annual distance travelled per vehicle[20],[21]. The oil consumption of other modes of transport was also taken directly from Sultan, which included international shipping and aviation, unlike DG TREN (2008) and IEA (2009). Oil consumption in sectors of the economy other than transport was not included in Sultan, so projected EU oil consumption for these non-transport sectors to 2030 was taken from DG TREN (2008).

Table 5: Emissions performance standards used in the CVE scenario

	2010 (same as BAU) (gCO_2/km)	2015 (gCO_2/km) (interpolated)	2020 (gCO_2/km)	2030 (gCO_2/km)	Average annual percentage reduction assumed in…	
					2010-20	2020-30
Cars	143	107	80	50	5%	4.2%
Vans	195	156	125	88	4%	3.2%

The figures used in the CVE scenario were based on the work undertaken for Greenpeace by BRASS (2010), which looked at the feasibility of meeting an 80gCO_2/km for passenger cars by 2020. Additionally, the CVE scenario also set a target for vans in 2020 of 125gCO_2/km and a 2030 target for cars of 50gCO_2/km. The 2030 target for vans was set to be consistent with the reductions required to meet the other targets (see Table 5). These assumptions effectively assume that these targets are included in future legislation and are enforced so that the targets are met[22]. It is worth noting that the respective targets for 2015 and 2016 (see Table 4) are both over-delivered in the CVE scenario, as otherwise a steep reduction would be needed between 2015/16 and 2020 in order to achieve 80gCO_2/km and 125gCO_2/km, respectively.

It was assumed that the annual distance travelled by new cars and vans increased by 10%, as a result of the improved fuel efficiency of new vehicles under the CVE scenario, which is consistent with the findings of the UK Energy Research Centre (UK ERC, 2007) for transport. Other assumptions were similar to the BAU scenario, apart from the split by powertrain, which for cars was taken from one of the scenarios developed by BRASS (2010; see Table 6). The technological split for vans in 2020 was assumed to consist of 75% of conventional diesel and gasoline, which was 10% higher than the split for cars, and proportionately less for other powertrains (which was consistent with the "energy efficiency scenario" of Sultan[23]). For the powertrain split in 2030, it was assumed that the decline in the numbers of conventional vehicles and the increase in vehicles using other powertrains continued at similar rates as assumed prior to 2020.

Table 6: Assumptions regarding powertrain split for passenger cars in 2020

Type of vehicle (Powertrain)	Market share	Average emissions gCO_2/km
Gasoline and diesel (standard and eco-variant)	65%	92
Petrol Hybrid Vehicle	15%	75
Diesel Hybrid Vehicle	5%	70
Plug-in Hybrid Vehicle	5%	47
Battery Electric Vehicle	10%	36
Total	100%	80

Source: BRASS (2010); taken from Tables 6.3 and 6.4. The CO_2 emissions for battery electric cars include lifecycle emissions.

The results of the scenarios are presented in Figure 1 and are summarised in Table 7. These suggest that oil consumption by cars and vans could be 76% of BAU in 2020 and 61% by 2030 if the more stringent emission performance standards for 2020 and 2030 of Table 5 were introduced. This would be a reduction in the amount of oil needed in the EU of 42 million tonnes in 2020 and 58 million tonnes by 2030. This would translate into a 13% saving in the oil consumption of the EU transport sector as a whole and an economy-wide reduction of 8% compared to BAU by 2030. Globally, the impact in 2030 would be a reduction of just over 1% in the amount of oil consumed. In terms of greenhouse gas emissions, this would amount to a saving of 134 $MtCO_2$ compared to BAU in 2020 and 186 $MtCO_2$ by 2030.

Figure 1: Oil consumption in the EU under BAU and CVE scenarios

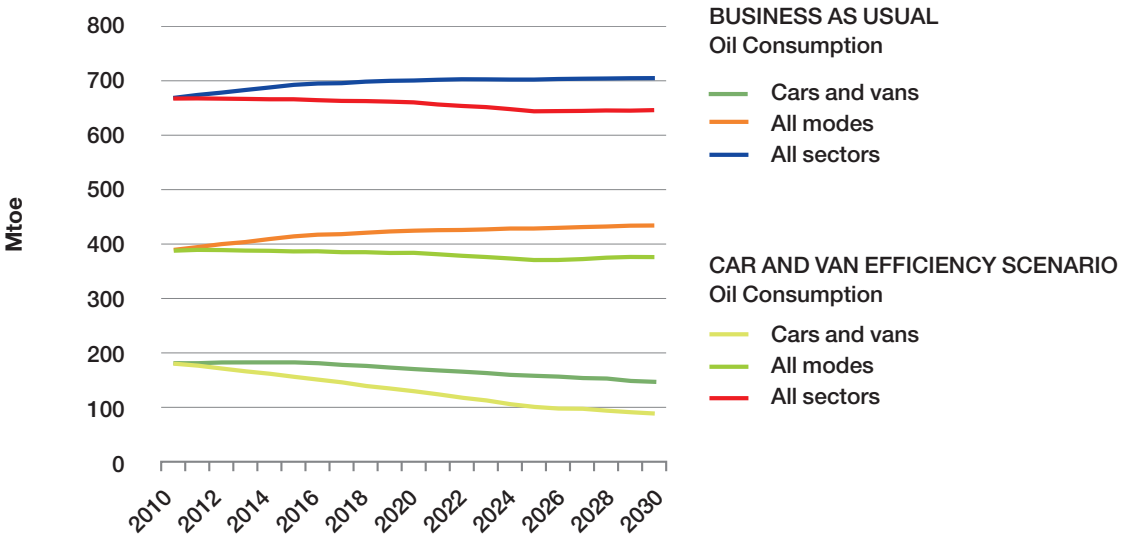


Table 7: Total EU consumption of oil products (all sectors)

		2010	2020	2030
BUSINESS AS USUAL	Million barrels/day	13.5	14.2	14.2
CAR and VAN EFFICIENCY SCENARIO	Million barrels/day	13.5	13.3	13.1

image Oil slick coats dead shells at a bay decimated by the oil spill disaster in Dalian, China, 26 July 2010

STRINGENT CAR AND VAN EFFICIENCY STANDARDS COULD HELP TO REDUCE OIL CONSUMPTION IN THE EU BY 58 MILLION TONS AND SAVE 186 MILLION TONS OF CO_2 BY 2030.

Imported oil: amount, source and value

04

This section addresses three questions, for 2010, 2020 and 2030: How much oil is/will be imported? What countries does/will the imported oil come from? What is/will be the value of oil imports?

This section focuses on the analysis of the imports of unfinished oils, as described in Section 2, and does not look at the import of oil products in detail. Currently, over 98% of the EU's oil-based imports are unfinished oils and less than 2% are oil products; this trend is not projected to change significantly in either 2020 or 2030 (DG TREN, 2008). There is, however, some reference to possible changes in imports of oil products resulting from the analysis, where this is relevant. For example, in recent years the EU has been importing more diesel to meet the EU's increasing demand for this fuel, although it remains a net exporter of oil products overall.

It should also be noted that the following analyses are based on relatively simple assumptions that may not accurately represent complex, real market conditions. The analysis assumes that the EU's imports of unfinished oils for 2020 and 2030 are limited by the projected maximum capacities of the oil refineries within the EU (as given by OPEC, 2009a); it is also assumed that the refineries will operate at full capacity in these years and that no surplus products are produced. Where additional oil products are needed to meet the EU's demand, these will need to be imported. The analysis also assumes that the regions that currently supply the EU's oil imports will continue to be the main suppliers due to the established trade links and that these regions will continue to export similar proportions of their total exports to the EU, unless there is reason to suspect otherwise, e.g. depleting reserves or competing demand from other parts of the world. Such simplifications are a necessary part of the process of drawing a general picture for the mid- to long-term future of the oil markets in the EU in the absence of sophisticated tools. Moreover, this section does not analyse the potential impact of any additional policy interventions other than those included in the CVE scenario in Section 3. The numbers in this section draw on various data in IEA (2009), OPEC (2009a) and BP (2010a), particularly expectations of the regional production of oil and of inter-regional trade.

In 2009, around 13 million barrels per calendar day of oil entered the refineries within EU-27 and roughly 11 million barrels of this came from outside of the region (derived from data in BP, 2010a and OPEC, 2010)[24]. The biggest contributor to the EU's imports that year were countries of the former *Soviet Union*, notably the *Russian Federation* and *Kazakhstan*. These countries have become increasingly important suppliers to the EU, with an increasing contribution to the EU's oil imports since 2000. In return, the EU has remained the largest client for these countries, receiving about 86% of the former *Soviet Union's* total exports (based on data in OPEC, 2010). *Norway* has been another major exporter of oil to the EU, although that country's contribution to imports has been declining since 2000 as a consequence of the depletion of its North Sea oil reserves (see Table 8 below).

Apart from these two regional partners, the other main sources of the EU's oil imports have been, as can be seen in Table 8, the *Middle East* and *Africa*. As the largest producer of oil in the world, the *Middle East* has been supplying at least 20% of the EU's oil imports over the last decade, and in 2009 this figure accounted for approximately 16% of the *Middle East's* total exports. Africa has also been an important source of oil imports to the EU and these contributed to 36% of the continent's total oil exports in 2009.

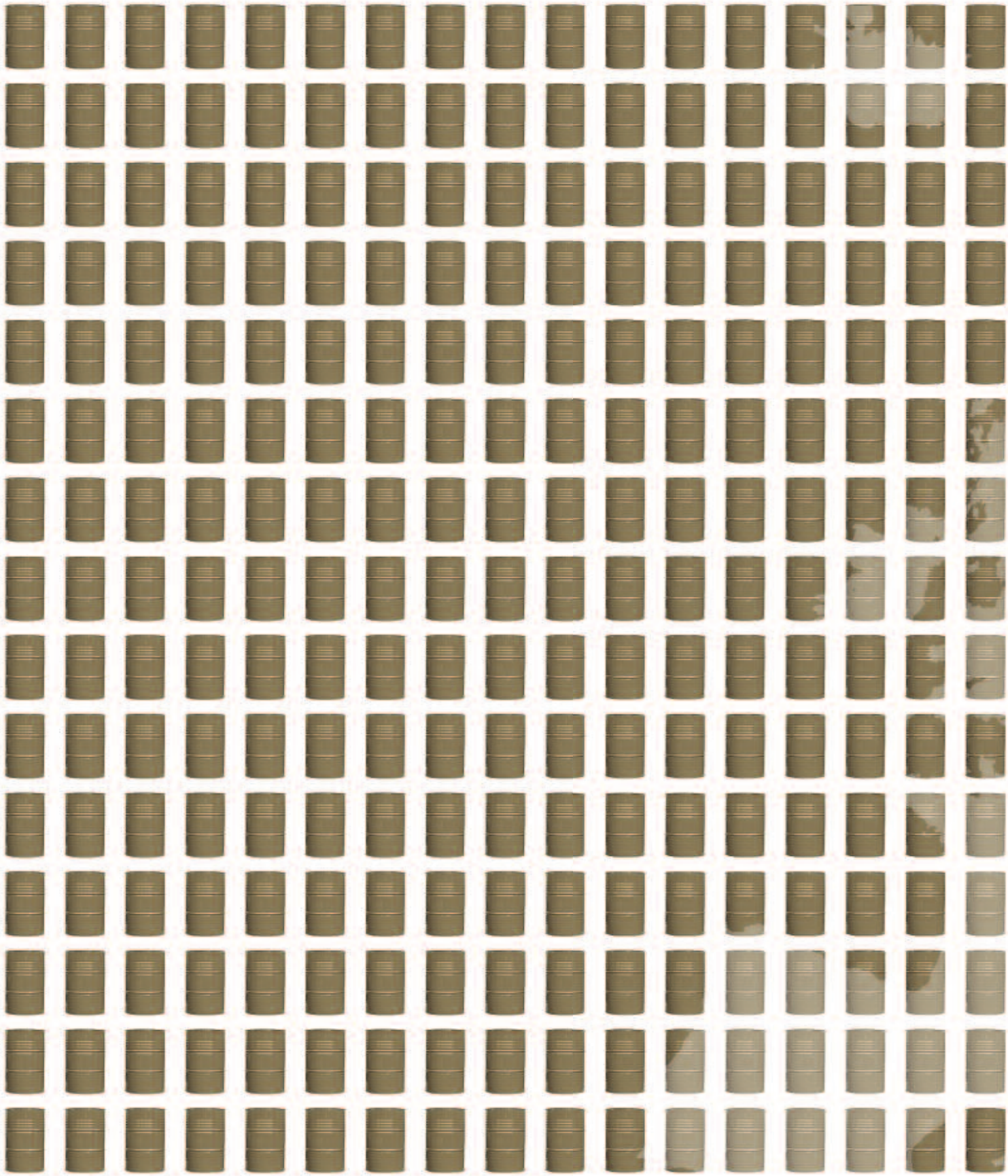
Table 8: Suppliers of EU's imported unfinished oils (as percentage share)

Imports from			2000 (a)	2000 (b)	2000 (c)
Former Soviet Union			-	-	40 - 45%
	of which	*Russian Federation*	21.8%	33.5%	-
		Kazakhstan	1.9%	4.7%	-
Africa			-	-	20 - 25%
	of which	*Libya*	8.8%	9.4%	-
		Nigeria	4.3%	3.6%	-
Middle East			30.1%	21.1%	20 - 25%
	of which	*Saudi Arabia*	12.6%	-	-
		Iran	6.9%	-	-
		Other Middle East	10.6%	-	-
Norway			22.5%	15.8%	5 - 10%
Latin America, inc Mexico			-	-	4 - 5%
US and Canada			-	-	1 - 2%
Asia-Pacific			-	-	up to 1%

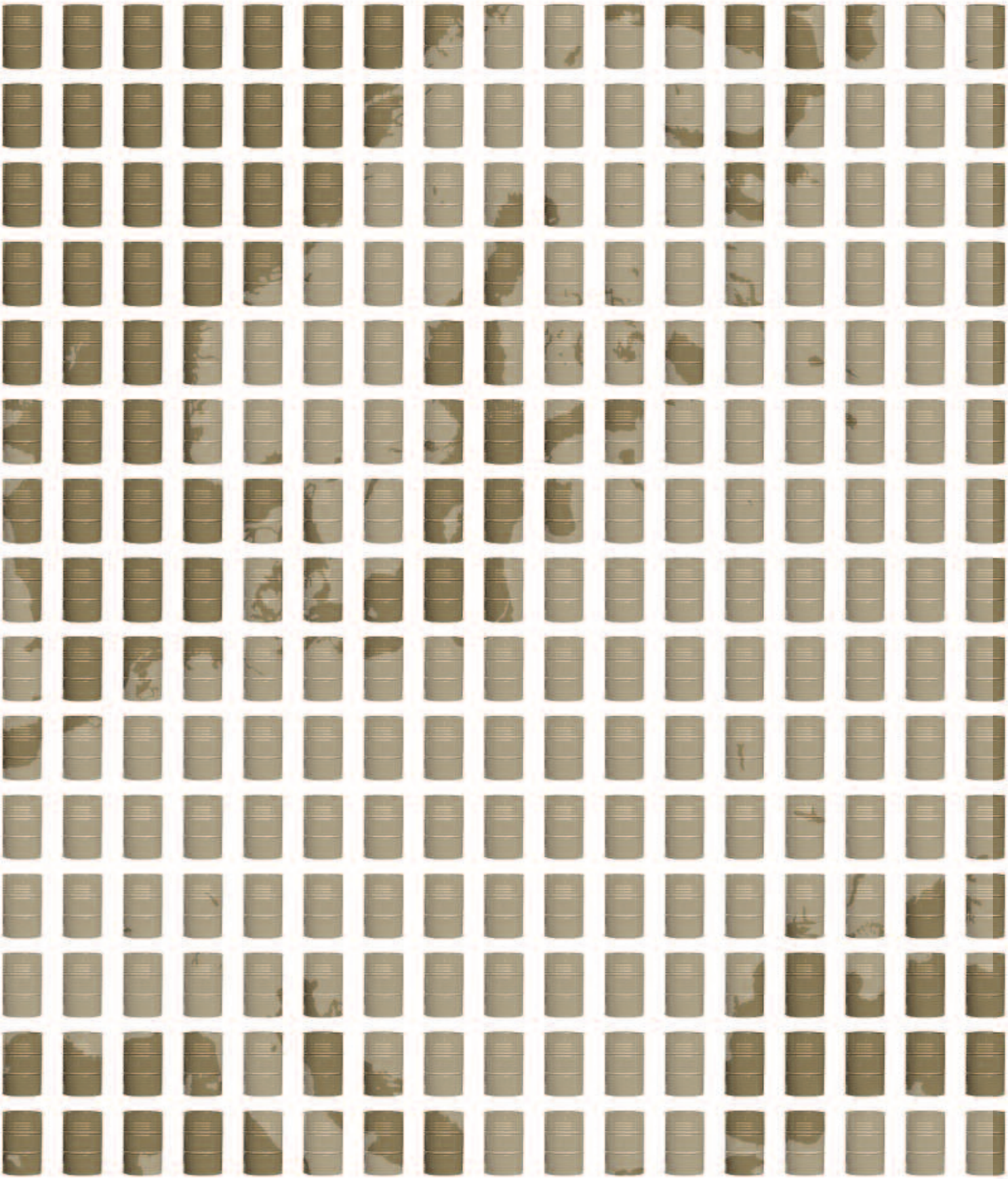
Sources:(a) (b) DG TREN (2009), actual figures. (c) Based on data from BP (2010a) and OPEC (2010). The range was estimated from data in BP (2010a) and OPEC (2010), as actual figures were not available.

In 2020, the maximum refining capacity of the EU is expected to reduce to around 12 million barrels per day (OPEC, 2009a; BP, 2010a). This is partially due to the effect of current investment shortages in refining operations but is also a reflection of the current perception of some of the major operators (such as Total, BP and Shell) that the EU has an overcapacity problem. Total and Shell have already announced plans to downsize their refining operations in the region and focus instead on being more selective on oil products that the EU needs (such as more diesel) (e.g. Total, 2010). As a result, the total imports of unfinished oils in 2020 could be limited to around 10 million barrels per day (see Table 9), assuming that the EU retains about 2 million barrels per day of its own net production after exports (estimated from BAU projections in IEA, 2009). Considering that a refinery throughput of around 12 million barrels per day can produce an estimated 13.8 million barrels per day of oil products[25], it can be expected that the EU will have to become a net importer of oil products in 2020 to meet its projected demand for oil products (see Table 7 above).

Under the CVE scenario in 2020 the demand for oil reduces to 13.3 million barrels per day (Table 7). This figure is below the region's capacity for producing oil products as mentioned above under the BAU scenario, meaning that under the CVE scenario the EU may no longer be a net importer of oil products (compared to under BAU). Furthermore, such a demand reduction may reduce the region's total oil imports by a further 0.5 million barrels par day, assuming its own net production remains the same[26].



THE EU CURRENTLY CONSUMES AROUND



678 MILLION TONNES OF OIL A YEAR

Table 9: EU imports of unfinished oils in 2009, 2020 and 2030 for BAU and CVE scenarios

Million barrels/day	2010	2020	2030
BUSINESS AS USUAL	about 11	about 10	about 11
CAR and VAN EFFICIENCY SCENARIO	about 11	about 9.5	about 10

In 2030, the total refining capacity of the EU is expected to rise slightly compared to 2020 to around 12.5 million barrels per day, due to potential mid-term investments (OPEC, 2009a), while the EU's net production is projected to be around 1.5 million barrels per day. This figure takes into account the limited potential of new deepwater operations within the region, especially in the North Sea (estimated figures based on BAU projections in IEA, 2009), but ignores the potential contribution from other unconventional resources. This suggests that the potential oil imports of the EU under the BAU scenario might be about 11 million barrels per day (see Table 9). The above refinery capacity could potentially produce around 14.4 million barrels per day of oil products, making the EU a net exporter of oil products (compared to the projected demand of 14.2 million barrels per day in Table 7).

Under the CVE scenario in 2030, Table 7 suggests that the demand may reduce by 1.1 million barrels a day compared to BAU. As the EU will already be expected to be a net exporter of oil products under the BAU scenario this year, such a reduction in demand is likely to result mainly in a significant reduction in the region's oil imports. Assuming that the refineries utilise their full capacity, the above reduction may result in up to 1 million barrels per day, including a potential input from the region's own unconventional resources. The results of this analysis are summarised in Table 9.

Before making any estimations about the **potential suppliers of the EU's imported oil in 2020 and 2030**, it is important to identify how the global oil markets may change from today. The most significant future change in the market is likely to happen as a result of the shifting trade balances to meet the anticipated sharp increase in demand in the Asian markets, especially in China and India, as compared to the gradual reductions in demands from North America and the EU itself (OPEC, 2009a; IEA, 2009). The anticipated demand shift has already initiated new upstream and downstream strategies across the oil industry. Hence, even before 2020 these Asian countries are likely to become key players in determining how the markets are further shaped in terms of pricing, investments and supply chains. It is also possible, on the other hand, to suggest that the other key players in shaping the markets in the future will the biggest spenders in monetary terms. In 2030, the region with the highest annual expenditure on net imports of oil and gas under 'business as usual' is expected to be the EU, following the current trend (IEA, 2009). This is partially due to the fact that the price of a barrel of oil is generally much higher in the EU than elsewhere (OPEC, 2009b).

Under BAU scenarios for 2020 and 2030, the biggest contributor to the EU's imports is expected to be the **former Soviet Union**, as was the case in 2009. Both OPEC (2009a) and IEA (2009) expect increases in the total production and exports of these countries. Assuming that the current trade links remain unchanged and the necessary improvements in the supply infrastructure are in place by 2020, the countries in the region may continue to send more than 80% of their combined exports to the EU. The volume of such exports could reach 7 million barrels per day to the EU in 2020 and almost 9 million barrels per day in 2030 under BAU (based on projections in IEA, 2009).

Under the CVE scenarios for 2020 and 2030, the former Soviet Union is still likely to be the biggest contributor to EU imports. OPEC (2009a) anticipates that this region's production will come mostly from conventional sources in 2020 and 2030, and also states that demand reductions in the importing regions such as the EU due to policy changes are likely to give more price-determining powers to traditional oil-producing countries, such as those in the former Soviet

Union. Hence, it is possible to assume that the production and export figures mentioned for the BAU may also apply to the CVE scenario, further increasing the region's percentage input into the EU's imports in these years (see Table 10 below).

Another region that is likely to stay as a major supplier to the EU **under the BAU scenario in 2020 and 2030** is Africa, since all of the EU's main sources of oil imports in **Africa** (i.e. Libya, Nigeria, Angola and Algeria) are expected to be producing more oil in 2030 compared to 2009 (IEA, 2009). Even though Asia is likely to increase its demand for African oil, the strong trade links between the EU and the major African producers, coupled with the planned upstream investments in Africa by the EU's major market players (for example, Total's largest proven reserves are in Africa), suggest that the EU could continue to import a fair amount of its oil from the continent. Hence, it is possible that at least 30% of Africa's total exports may reach the EU in both 2020 and 2030 under BAU, reaching respective figures of around 2.5 and 2.7 million barrels per day (based on projections in IEA, 2009). The demand reductions **under the CVE scenario** may have an impact on the future investments in the costliest of deepwater projects in the Gulf of Guinea, and this may cause reductions in the amount of supply to the EU by an average of 0.5 million barrels per day (equivalent to expected rises in Angola's production according to IEA, 2009).

The share of the EU's oil imports from **the Middle East** has been declining over the last decade, but given these countries significant reserves, it is likely that the EU would still be importing oil from the region by **2020 and 2030 under BAU scenarios**. However, the EU only imports around 15% of region's exports, while a significant proportion is imported by Asia. Given Asia's anticipated increase in demand for oil, which could be as much as 15 million barrels a day higher than in 2009 (OPEC, 2009a; IEA, 2009), it is likely that the oil trade between the Middle East and Asia will remain and possibly strengthen. This could restrict the potential for the EU to increase its own imports from the region, as under business as usual projections Asia's anticipated increased demand would more than consume the expected increase of 10 million barrels per day in the Middle East's oil production during the same period (IEA, 2009). However, counter-balancing an increased demand for oil from Asia is a likely decrease in demand from North America, which may result from policy interventions such as the tightening of the CAFE standards, as well as their increased capacity to meet their oil needs from their own resources, e.g. the extensive investments in Canadian oil sands. Hence the EU could easily import an average of 2 million barrels per day from the Middle East in 2020 and 2030 under both BAU and CVE scenarios.

It is also likely that the EU's imports from **Norway** will continue to drop, as its North Sea oil reserves decline. The effect of such a decline may be balanced if Norway were to reduce its exports to regions other than the EU, which could keep its supply at similar levels to 2009 (i.e. around an estimated 1 million barrels per day) **under both BAU and CVE scenarios in the years 2020 and 2030**[27].

Given the **Asia-Pacific** region's anticipated increase in demand, it is not likely that the EU's imports from this region will increase significantly. Hence, any remaining EU requirements for oil are likely to come from imports from the **Americas**. This region has large reserves (Canada's reserves are only second to Saudi Arabia's if its tar sands reserves are taken into account) and resources, most of which are unconventional (see Table 3 and accompanying discussion). However, as international trade in the synthetic crude oil from this region is potentially the most volatile compared to oil from more cost-effective resources in the rest of the world, the future share of the Americas in the EU market is likely to be influenced mainly by what the EU cannot readily import from other regions. North America's potential capacity to reduce its import dependency by 2030 will also have an impact on whether the EU will compete with North America and potentially with China (also a major investor in Canadian tar sands to meet its future oil demands) for these potentially costly resources in 2030. Having said this, the extent to which oil or transport fuels from unconventional feedstock do make a contribution to the EU's market will be influenced by the decisions of the companies involved, as well as by policy interventions in either in North America or Europe.

On the basis of this discussion, a possible share of the potential suppliers of the EU's oil imports in 2030 is given in Table 10.

Table 10: Potential suppliers of EU's imported unfinished oils in 2020 and 2030[28]

	Potential percentage of total EU oil imports*			
	2020		2030	
Imports from	BAU	CVE	BAU	CVE
Former Soviet Union	up to 70%	up to 75%	up to 80%	up to 90%
Africa	up to 25%	up to 20%	up to 25%	up to 20%
Middle East	up to 20%	up to 20%	up to 20%	up to 20%
Norway	up to 10%	up to 10%	up to 10%	up to 10%

** Estimates calculated on the basis of projected data in IEA (2009) and OPEC (2009a) on regional production and inter-regional trade.*

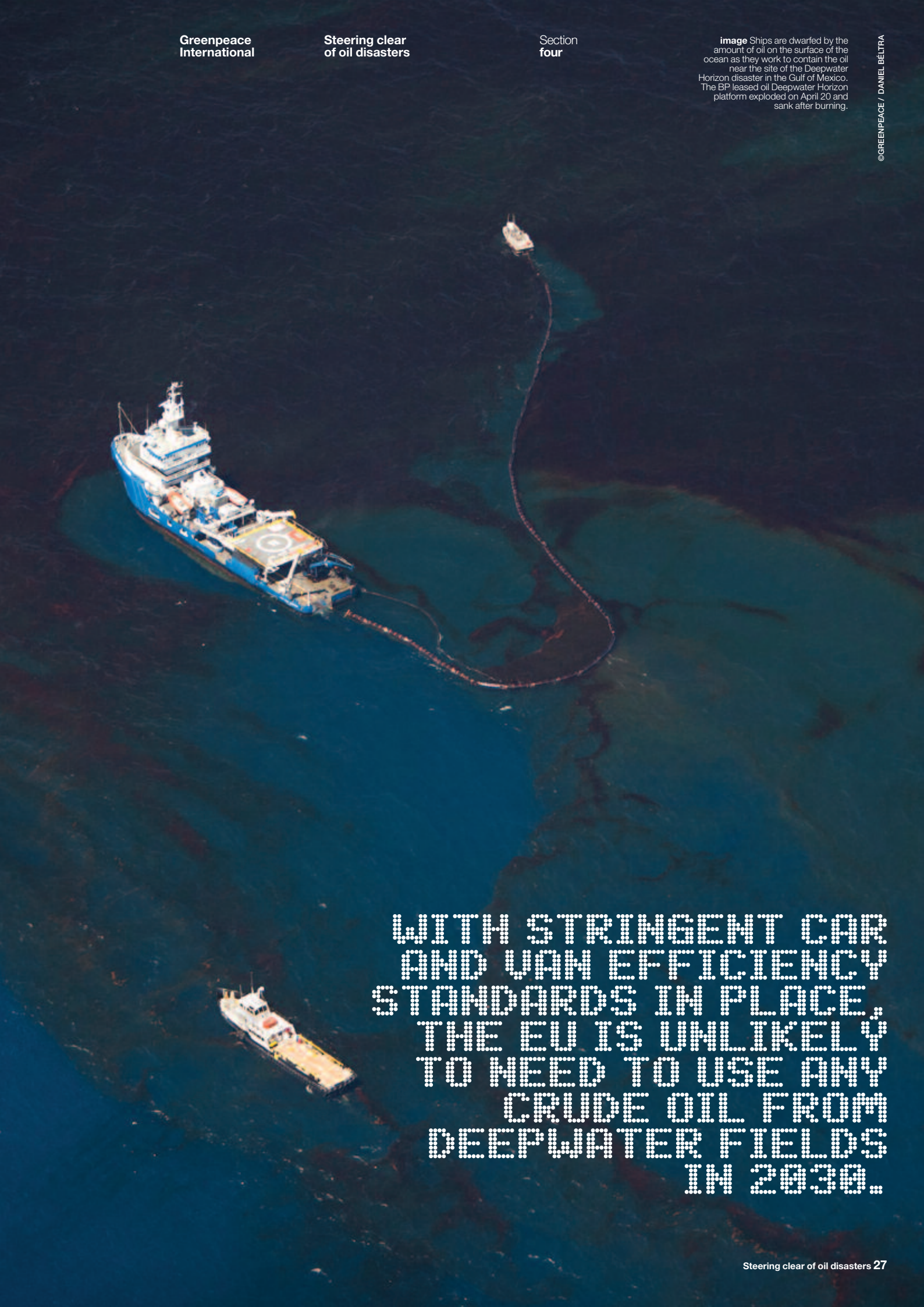
In order to estimate the **value of the EU's imported oil**, it is necessary to identify what the price of a barrel of oil might be in the respective years. The IEA (2009) assumes a price per barrel of $60 (USD 2008) in 2009, which it anticipates will increase to $115 (USD 2008) per barrel in 2030. The US EIA (2010) assumes slightly higher figures[29], while DG TREN (2008) assumes a comparable figure for 2010 ($54.5 (USD 2005)), but a much lower figure for 2030 ($62.8 (USD 2005)). An estimate of the value of the EU's imports, i.e. of the amounts presented in Table 9, is given in Table 11.

Table 11: Estimated value of the EU's imported unfinished oils in 2010, 2020 and 2030

Billion $2008/year	2010	2020	2030
BUSINESS AS USUAL	$251	$324	$462
CAR and VAN EFFICIENCY SCENARIO	$251	$308	$420
Savings compared to BAU	-	$16	$42
Assumed price (IEA, 2009), $2008/barrel	$62.6*	$88.8*	$115.0

**Note: Interpolated between values given for 2009 and 2030*

image Ships are dwarfed by the amount of oil on the surface of the ocean as they work to contain the oil near the site of the Deepwater Horizon disaster in the Gulf of Mexico. The BP leased oil Deepwater Horizon platform exploded on April 20 and sank after burning.



WITH STRINGENT CAR AND VAN EFFICIENCY STANDARDS IN PLACE, THE EU IS UNLIKELY TO NEED TO USE ANY CRUDE OIL FROM DEEPWATER FIELDS IN 2030.

Potential share of different feedstock in the EU markets

05

The aim of this section is to identify the share of different conventional and unconventional feedstock in 2010, 2020 and 2030 under the business-as-usual (BAU) and car and van efficiency (CVE) scenarios.

The analysis looks mainly at the share of different types of unfinished oils in the EU's markets. However, there is some assessment of the potential contribution of certain unconventional non oil-based processes that contribute to the EU transport fuels market. There is currently no reliable way of identifying which particular types of feedstock any oil refinery uses to produce oil products, including transport fuels, as refineries are not required by any legislation to report such detailed information. Until December 2009 the US Securities and Exchange Commission required companies not to report any production from Canadian oil sands as part of general production data. However, this requirement no longer applies. Hence, one of the main assumptions underlying the analysis in this section is that the share of different types of feedstock used in the EU will depend on the anticipated share of different types of feedstock in the production of unfinished oils in the supplier regions and in the EU itself. The other main assumption is that the order in which feedstock will be exploited is based on their relative costs of exploitation, as listed in Section 2.

It has already been noted that oil markets are complex and volatile and are therefore difficult to predict. On top of this, decisions about the future developments and use of feedstock do not only rest with the markets but on the individual choices of oil producing private companies. The oil companies with the biggest power on such decisions are the so-called 'super-majors' that also dominate the markets in end products. The reaction to the 2008/9 recession suggests that super-majors can be more resilient than state-owned oil companies in dealing with economic downturns and changes in the markets (OPEC, 2009a). In the EU, the 'super-majors', which between them have the largest share of the transport fuels market with 45%, are Total, BP, Royal Dutch Shell and Exxon Mobil[30]. These companies all have a global presence in both upstream (exploration and production) and downstream (refining and marketing) operations. Of course, markets and the decisions of oil companies can also be influenced by additional policy interventions, which are not considered by this analysis.

Hence, there is a lot of uncertainty with the numbers that result from the assessment presented in this section (i.e. those in Table 12). These should be taken to suggest a scenario that could arise if the conditions were right. In essence, the more oil that is needed, the more likely it is that a larger amount of this will come from unconventional sources (see, for example, the US EIA scenarios presented in Table 1).

In 2009, around 70% of the EU's imported oil came from the former Soviet Union and the Middle East, which are the two main regions in the world with significant sources of **conventional onshore fields**. Neither of these regions currently produces oil from any other type of feedstock in any recordable amount. This type of feedstock also contributed to almost all of North Africa's production, and at least 70% of Africa's total production (equivalent to around 18% of the EU's total imports). Hence, in 2009 around 90% of the EU's imports of unfinished oils (equivalent to at least 75% of the region's total unfinished oils) might have come from conventional onshore fields producing natural crude oil.

image Adult brown pelicans wait in a holding pen to be cleaned by volunteers at the Fort Jackson International Bird Rescue Research Center in Buras. Members of the Tri-State Bird Rescue and Research team work to clean birds covered in oil from the Deepwater Horizon wellhead disaster. The BP leased Deepwater Horizon oil platform exploded on April 20 and sank after burning.

In both 2020 and 2030, it is expected that oil production in the former Soviet Union, the Middle East and North Africa (accounting for about 70% of Africa's total production under in 2020 and 2030) will still be mainly from natural crude oil from conventional onshore fields (OPEC, 2009a). As these figures are similar to those in 2009, this type of feedstock may be expected to contribute up to 85% to the EU's imports in 2020, and up to 90% in 2030 under both the BAU and CVE scenarios (see Table 12). Indeed, this feedstock has the potential to meet almost all of EU's import needs in both of these years under both the BAU and CVE scenarios (see Table 9 above), assuming the necessary trade and pricing conditions continue to apply to these supplies. This is especially likely to be the case under the 2030 CVE scenario, when the former Soviet Union alone could contribute up to 90% of the EU's imports due to new resources in the region coming into operation.

Natural crude oil from **conventional offshore fields** is currently the main type of feedstock for the EU's own production and contributes to almost all of Norway's oil production. This feedstock is estimated to have contributed to a minimum of 15% of the EU's total unfinished oils in 2009. Although North Sea oil is currently in decline, there is a possibility that any further decline up to 2030 could be balanced by good resource management and the reduction of exports to other regions. In the mid- and long-term, it is also possible that further supplies of this type of feedstock could come from areas such as the Caspian Sea, keeping the percentage contribution of this feedstock roughly constant until 2020 under all scenarios. Under CVE, conventional offshore is expected to drop to around 10% in 2030, due to fact that around 90% of oil could come from conventional onshore sources. As with conventional onshore oil, the use of oil from conventional offshore fields is unlikely to be adversely affected by any demand reductions; however any significant increases are also unlikely due to a potentially limited supply.

In 2009, natural crude oil from **deepwater fields** contributed to an estimated 15% to 30% of Africa's total production and almost all of the imports that came from the Americas into the EU were likely to have been from this feedstock, in particular from the Gulf of Mexico. In total, this feedstock may have contributed to around 10% of the EU's total oils in 2009. In 2020 and 2030, deepwater projects could make up an approximate minimum of 30% of Africa's total oil production, mainly due to potential developments in the Gulf of Guinea. The future of the Gulf of Mexico production is less clear but the EU is not expected to depend on any imports from the Americas under any scenario in either 2020 or 2030 (see Table 9). It is, however, important to note that, the ultimate decision to stop imports of unfinished oils from the Gulf of Mexico into the EU may lie with the oil companies operating in the area, including all of the super-majors that dominate the EU markets, unless legislation is put in place to control production in or imports from this area.

Under both scenarios in 2020, the EU may need to rely partially on the deepwater feedstock of Africa to meet its demand, due to the fact that this is the cheapest unconventional feedstock (see Section 2) and would therefore be used to fill any gap in supply. Hence, around 10% of total unfinished oils under the BAU scenario for 2020 might still come from deepwater sources. However, this could decrease to 5% under the 2020 CVE and 2030 BAU scenarios, taking into account the potentially lower need for this feedstock due to reduced EU demand for unfinished oils, as discussed in Section 4. Similarly, the need for this feedstock is likely to be minimal under the 2030 CVE scenario, since the EU's demand for unfinished oils could be met fully by conventional feedstock (see Table 12). However, as in the case of the Gulf of Mexico, in the Gulf of Guinea and elsewhere – including potentially the North Sea – the EU's super-majors that have large investments in this feedstock, but insufficient investments in conventional reserves may choose to exploit such resources to supply the EU market unless policy measures are put in place with the aim of controlling the production and supply of this feedstock.

Total has one of the largest **extra heavy oil** operations in Venezuela and hence some of this feedstock might have found its way into the EU transport fuels markets in 2009. In 2030, Venezuela is expected to be the main oil producer in Latin America and most of the country's production is likely to come from its vast reserves of extra heavy oil. It is, however, expected that Latin America's contribution to the EU's imports in 2020 and 2030 under all scenarios will be minimal since the demand can easily be met from elsewhere (see Table 9). Therefore, without additional policy intervention, this type of feedstock is more likely to enter the EU markets as oil products coming from refineries in the Americas than as unfinished oils.

The largest resource of **tar sands** in the world is in Canada, and this is where significant investments have already taken place. Canadian tar sands have recently experienced the most significant cutbacks in the oil industry, making up the largest share of the 20% reduction in global oil investments during 2009 (IEA, 2009). As a result, this feedstock is unlikely to have contributed in any recordable amounts to the imports of unfinished oils of the EU in 2009, despite the significant involvement of the EU's super-majors in Canadian tar sands. However there is a possibility that some oil products imported from North America might have come from this feedstock (e.g. see Greenpeace, 2010). By 2020, unless future policy interventions affect demand or supply, production from Canadian tar sands is expected to have recovered and by 2030 production from this feedstock may reach 3.9 million barrels per day (IEA, 2009). Despite this increase, this feedstock may not contribute significantly to the EU's unfinished oils supply in 2020 and 2030 as the demand may not require the EU to import anything from the Americas. Again, it is important to note that the decision about how much of this feedstock may come into the EU markets in the future rests, in the absence of any additional policy interventions, on the decisions of the EU's super-majors that already have investments in the tar sands. Also tar sands crude may find its way into the EU in the form of oil products, particularly since the EU is expected to become a net importer of oil products under BAU in 2020 (see Section 4).

Oil shales are currently at an early stage of their development and are not generally considered to be economically viable and are unlikely to become operable in significant amounts within the next 20 years.

In 2009, the only major active **CTL** operation was based in South Africa, serving only the oil product markets in Africa. It is unlikely that this feedstock contributed to the EU's markets in anything other than minimal amounts in that year. Similarly, **GTLs** may have contributed to less than 0.1% of global oil production in 2009. Although the biggest operation of GTL in the world was actually run by Royal Dutch Shell, one of the biggest market players in the EU, any contribution from this feedstock into EU's markets would have been minimal.

Some CTL and GTL processes are economically viable at relatively low oil prices, making some of these processes perhaps as cost-effective as deepwater projects. Hence, it would be logical to expect an increased interest in these operations by 2030 if not 2020. However, the use of CTLs in 2030 is most likely to materialise in China, as it is the leading coal-producing region in the world, and this region is not a likely supplier of transport fuels to the EU market in 2030. Some coal-producing countries of the EU, such as Germany, have the potential to invest in CTL operations (e.g. see Section 2) but any input to the EU markets is likely to be relatively small under any scenario. GTLs have the potential to contribute more significantly to the transport fuels markets in the EU. Yet the main barrier for their development potential is perhaps the fact that other sectors, such as power generation, compete with the transport sector for natural gas. As a result, very few companies currently show interest in GTL investments. Accordingly, any contribution from this process to the EU markets is also likely to be relatively small under any scenario in 2030.

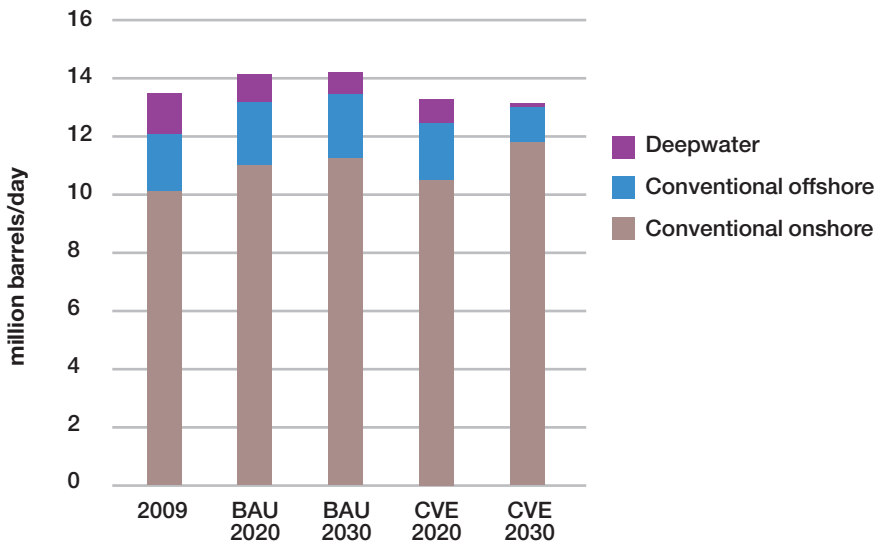
image The site of the explosion and fire at Xingang Port Dalian, a major site for China's state reserves of petroleum. Crude oil started pouring into the Yellow Sea off a busy northeastern port after a pipeline exploded late last week, sparking a massive 15-hour fire. The government says the slick has spread across a 70-square-mile (180-square-kilometer) stretch of ocean.

Table 12: Estimated potential share of different types of feedstock used in the EU*

	2009	2020		2030	
		BAU	CVE	BAU	CVE
Conventional onshore	at least 75%	75 – 85%	80 – 85%	80 – 90%	around 90%
Conventional offshore	at least 15%	At least 15%	at least 15%	at least 15%	around 10%
Deepwater	around 10%	Up to 10%	Up to 5%	up to 5%	minimal
Extra heavy oil	minimal				
Tar sands					
Oil shales	none				

** Calculations are based on estimations in Table 10 and some other assumptions, as noted in the text above; they reflect projections of real demand*

Figure 2: EU consumption of oil products from the estimated share of different types of feedstock (shown Table 12)



Conclusion

06

This project had two broad objectives for 2020 and 2030, i.e. to:

1. Identify the potential oil savings that might result from the introduction of stricter EU CO_2 emissions performance standards for cars and vans; and

2. Estimate what this might mean for the amount of oil imports to the EU, their origin and value, as well as the type of feedstock from which the unfinished oils might come.

The first objective was achieved by the development of two, relatively simple scenarios: one a business as usual (BAU) scenario; the other an alternative (CVE) scenario in which emissions performance standards for cars and vans in the EU are made continually more stringent. The stricter CO_2 emissions performance standards assumed in 2020 were 80gCO_2/km for cars and 125gCO_2/km for vans, while the respective standards for 2030 were 50gCO_2/km for cars and 88gCO_2/km for vans. The CVE scenario suggested that (compared to the BAU scenario):

- Oil consumption of cars and vans could be 24% lower in 2020 and 39% lower by 2030 as a result of the implementation of the stricter standards.
- Savings in CO_2 emissions could be up to 134 MtCO_2 in 2020 and 186 MtCO_2 in 2030.
- Oil consumption in the EU's transport sector (including international aviation and maritime transport) could be 13% lower by 2030, while the economy-wide savings could be 8%.
- Global oil consumption could reduce by around 1% in 2030 (see Section 3).

It is important to note that the above figures assumed no additional policy interventions, either in the EU or elsewhere in the world. They also take no account of any potential changes in other industries, such as the car manufacturing industry. Policy measures aimed at reducing CO_2 emissions generally, or oil consumption specifically, would clearly impact on these figures.

In order to analyse the impact of the above reductions on the EU's imports of oil, a number of assumptions were made. The oil market is complex and dynamic and is influenced by many factors. The source of oil imports also depends on numerous geo-political and commercial decisions. Some of the assumptions made relate to projected refinery capacity and their utilisation, trade links and the cost of exploitation of various types of feedstock. The figures are calculations based on estimates that reflect projected data in IEA (2009) and OPEC (2009a), particularly the projections of regional production and inter-regional trade.

The assessment concluded that more stringent CO_2 emissions performance standards for cars and vans might have the following impact on the amount and value of the EU's oil imports:

- Unfinished oil imports may reduce by up to 0.5 million barrels a day in 2020 and about 1 million barrels a day in 2030.
- An annual saving of around $16 billion ($2008) in 2020 and of $42 billion ($2008) by 2030 could be made.

Under the BAU scenario, the demand for oil products in the EU increases by 2020, but will have stabilised by 2030 (see Table 7). The extent of the impact of demand changes on the imports of such products relies mostly on the refining structure within the EU, which ultimately supplies most of the oil products consumed in this region. By 2020, the maximum refining capacity within the EU is expected to decrease significantly from 2009. This is likely to result in increased levels of oil product imports, making the EU a net importer of such products in 2020 under BAU. However, the demand reduction under the CVE scenario in 2020 and refining capacity increases in 2030 will be enough to reverse this situation.

The EU's current major suppliers of oil - the former Soviet Union, Africa, the Middle East and Norway – are likely to remain so in 2020 and 2030 due to expected increases in production from most of these regions and the resulting inter-regional trade (see Section 4). These regions are where conventional onshore and offshore fields contribute to the largest proportions of oil production. Hence, there is a strong possibility that the EU's demand for unfinished oils in 2020 and 2030 under all scenarios can be met by conventional sources only.

Where the demand cannot be met by conventional sources, the gap is likely to be covered by the cheapest unconventional feedstock, which currently is deepwater. This feedstock is found predominantly in the Gulfs of Mexico and Guinea, but could also contribute to the EU's own production in the North Sea. Under BAU, deepwater could contribute up to 10% in 2020, decreasing to 5% in 2030. Under CVE, the EU is unlikely to need to use any deepwater oil in 2030.

Other types of unconventional feedstock are most likely to originate from the Americas, where the largest reserves are, particularly in the form of Canadian tar sands and Venezuelan extra heavy oil, although small deposits of tar sands are found in Europe as well. The EU is unlikely to need oil from these types of feedstock in either 2020 or 2030 under all scenarios (see Section 5). However, market conditions and the decisions of companies may determine otherwise, unless legislation to control the production and supply of these types of feedstock is put in place. An example of such legislation is the EU's Fuel Quality Directive (CEC, 2009d) that has the potential to influence the types of feedstock that are used to supply the EU market.

Ultimately, the best way of increasing the possibility that the EU will not need to rely on unconventional feedstock is to reduce further the demand for oil in the EU. In the transport sector, other studies have shown that by 2030 a reduction in the amount of oil needed of up to 46% could be possible with the implementation of a range of policy instruments, including those that address the demand for transport (Skinner et al, 2010).

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Footnotes

1 DG TREN refers to the European Commission's former Directorate General for Energy and Transport.

2 DG TREN (2008) anticipated that in 2010 the EU would consume 674 million tonnes of oil. This is consistent with the most recent actual figure from BP (2010a) that estimated the EU's oil consumption in 2009 to be 670.8 million tonnes.

3 Both DG TREN (2008) and the International Energy Agency (IEA, 2009) estimated that oil consumption by the EU's transport sector in 2010 would be around 60% of the region's total primary oil consumption. Primary oil consumption includes the use of oil by end users, e.g. in the transport and domestic sectors, oil used directly by industry, e.g. as inputs to chemical processes, as well as the oil used by energy suppliers, e.g. in oil-fired power stations in the electricity generation sector.

4 DG TREN (2008), in common with IEA (2009), does not include international aviation and shipping in its figures for the transport sector. If these were included, the amount of CO2 emissions from transport would be higher, as would the transport sector's proportion of total CO2 emissions.

5 Skinner I et al (2010); see www.eutransportghg2050.eu. The percentages quoted were taken from the Sultan illustrative scenarios tool, which can also be found on the website.

6 The scenarios were developed in an Excel spreadsheet using information identified in the course of this review.

7 For example, Figure 1.37 of OPEC (2009) shows that the projections of the IEA, OPEC and the United States Energy Information Administration of oil production in 2030 have been revised downwards in each of the last five years. In 2005, all of the organisations were estimating that global oil demand would be around 113 million barrels a day in 2030, whereas the estimates made in 2009 were just over 100 barrels a day.

8 Unlike other projections; for example DG TREN (2008) includes domestic sea shipping and intra EU air transport, but not international transport leaving EU air- and seaports; see Note 4

9 The complexity of oil markets is partially based on the definition of the term 'oil'. For example, the IEA use an extended definition to include everything from crude oil to non-liquid oil products such as asphalt. Within the context of this report, the term oil will be used to refer only to unfinished oils, and transport fuels that derive from oil will be referred to as oil products.

10 Different definitions are used. The US Minerals Management Services (2009) defines "deepwater" as oilfields in water depths of 305 metres (1,000 feet) or more, and "ultra deepwater" as depths of more than 1,524 metres (5,000 feet). Total (2007) used 500 metres and 1500 metres, respectively, while German institute IFM-GEOMAR classifies anything in waters deeper than 150m as deepwater.

11 These processes effectively improve the proportion of oil that can be recovered from oil fields.

12 BP (2010) quoted a figure of 82 million barrels a day, while the equivalent figures in IEA (2009, page 84) and US EIA (2010, page 29) were 83.1 and 84.4 million barrels a day. The original BP and IEA figures excluded biofuels, whereas the original US EIA figure included biofuels, but figures for these were taken out of the figures presented.

13 The figures for the unconventional sources include oil from extra heavy oil, natural bitumen (from tar sands), oil shale, GTL and CTL; they do not include oil from deepwater sources or biofuels. The actual figures were 1.8 million barrels a day (or 2.2%) from IEA (2009) and 2.8% (or 2.4 million barrels a day) from US EIA (2010). The former excluded extra heavy oil from Venezuela, which is likely to explain most of the difference. The US EIA included biofuels in its definition of "unconventional" sources, but figures relating to biofuels have been excluded from the figures presented.

14 IEA (2009) quoted a figure of 1.2 million barrels a day from Canadian tar sands (out of 1.8 million barrels, not including Venezuelan extra heavy oil); US EIA (2010) quoted a proportion of 1.8% of the total (non biofuels) oil production was from tar sands.

15 Quote is taken from note to the Table on page 6 of BP (2010a).

16 BP (2010a) is the latest in a series of annual reports that is considered to be an objective and consistent source of information on world energy markets. It is compiled with the assistance of researchers at Heriott-Watt University in Scotland. However, the report also notes that the definitions that it uses for proven reserves are not necessarily consistent with those that companies themselves use (as required by national reporting requirements).

17 In this report we use "billion" to mean one thousand million.

18 See www.eutransportghg2050.eu

19 Initially, it had been anticipated that the improvements in vehicle efficiency in Sultan's BAU scenario would be used in the BAU scenario for this project, as these had been based on assumptions used in existing models (e.g. the UK energy model Markal). However, the rate of improvement in the energy efficiency of both cars and vans used by Sultan was slower than what might be expected based on current policy frameworks. Hence, in order not to overestimate the baseline, it was assumed that under the BAU scenario, improvements in the energy efficiency of cars and vans would occur at similar rates after the 2015/16 targets had been met, as were needed to meet these targets.

20 In the context of this project, biofuels were not considered to be unconventional sources of oil (as they are in some studies). However, biofuels are included in both the BAU and CVE scenarios, as they are included in Sultan's BAU which assumes that the target set in Directive 2009/28 (the Renewable Energy Directive; CEC, 2009c), i.e. that a 10% share of transport energy should be renewable by 2020, is met through biofuels in road transport. While the targets in the Renewable Energy Directive cover all transport fuels, Sultan assumed that the 10% target in the Directive applied only to road transport.

21 The scenarios in this report made no explicit assumption in relation to whether the fuel decarbonisation targets of the Fuel Quality Directive (CEC, 2009d), either the mandatory 6% target or the additional indicative 4%, were met in 2020.

22 No additional assumptions (compared to those in the BAU) were made in the CVE scenario in relation to any other policy changes, e.g. related to the Renewable Energy Directive or the Fuel Quality Directive.

23 This was scenario 2a of Sultan, which assumed that the only measure to be implemented was improved vehicle efficiency for all vehicles.

24 On average, the EU's refineries did not operate at full capacity, as OPEC (2009a) estimates that the total capacity was around 15.5 million barrels a day in 2009.

25 An average conversion factor of 1.15 was used for this calculation to reflect the difference between the average densities of unfinished oils and oil products.

26 It is unlikely that there will be any significant unconventional sources (other than oil from deepwater fields) in operation by 2020 within the borders of the EU in order for the total net production in the region to be affected by reducing demand.

27 The CVE scenario is very likely to favour more imports from the conventional offshore fields of Norway as one of the first choices.

28 The figures presented in this table are based on an analysis of projected data and information from a range of sources, including 'business as usual' scenarios from OPEC, IEA and EIA and strategic outlooks and plans that have been made public by major oil companies in the EU market. Any quantitative data in this analysis is a rough estimate, based upon a combination of projected data from the above sources.

29 $70.3 (USD 2008) for 2010 and $123.5 (USD 2008) for 2030

30 This is based on an assessment undertaken within this project. The market shares of the main companies (according to Platts' Top 250; see www.platts.com/Top250Home/) were estimated on the basis of sales data to either Europe or the EU that were identified in the respective company reports. These figures were then compared to an estimated total 2009 EU consumption figure for the transport fuels covered in this assessment of 10 million barrels per day (based on the figure in BP, 2010).

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