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COVER NOTE

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Subject:	Commission Staff Working Paper on refining and the supply of petroleum products in the EU - Accompanying document to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions = Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network

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COMMISSION STAFF WORKING PAPER

ON REFINING AND THE SUPPLY OF PETROLEUM PRODUCTS IN THE EU

Accompanying document to the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

**Energy infrastructure priorities for 2020 and beyond -
A Blueprint for an integrated European energy network**

{COM(2010) 677 final}

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

1. Falling demand in petroleum products in the EU in the last few years at a time of stable levels of refining capacity has in turn affected refining margins, which in 2009 were at their lowest levels in the last 15 years.

2. The EU petroleum product market is a mature market. On top of long-lasting effects of the global financial and economic crisis, EU regulations to tighten fuel specifications, reduce emissions from refineries and cars as well as to provide support for the development of non-fossil fuels point towards a future of diminishing demand for petroleum-based products.

3. The demand for certain products, in particular middle distillates such as jet fuel, kerosene and gasoil, including marine gasoil, is however expected to continue to grow for a few more years. On the other hand, gasoline demand in the EU is widely expected to fall further.

4. In 2008, net imports of gasoil/diesel amounted to 20 million tonnes, equivalent to 6.9% of EU gasoil/diesel consumption while net exports of gasoline amount to 43 million tonnes, equivalent to 31% of EU gasoline production. If net imports of kerosene and jet fuels are taken into account, the EU shortfall in middle distillates amounts to upwards of 35 million tonnes of net imports per year.

5. In order to contain or reduce these trade deficits, the EU refining industry would have to invest significantly in additional refinery conversion capacity to produce more middle distillates, and it would have to reduce gasoline-focussed refinery capacity.

6. The additional units needed to produce increasing amounts of middle distillates are more energy intensive, and emit more CO2 than other types of units. The EU refining sector, which is included in the EU Emissions Trading Scheme, will therefore have to pay more for the CO2 emissions from (more complex) refineries producing more of the products which the EU requires (i.e.: middle distillates)

7. Overall, known planned/actual divestments and shutdowns in EU refining capacities since the start of the crisis in 2008 extend to 18 out of 104 refineries in the EU, representing some 134 million tonnes per year/2.7 million bbl/day of crude capacity, equivalent to 17% of total EU refining capacity. Only two of these facilities have been sold, others have been put up for sale for some time but have found no buyers, others yet have been shutdown for extended maintenance until market conditions recover. It is not known how many employees these 'vulnerable' refineries represent.

8. While the industry employs directly some 100,000 people in the EU, it is estimated that perhaps as much as 400,000 to 600,000 Europeans in total are directly dependent on the EU refining industry for their livelihood. This does not include other dependent industries, the largest of which, the petrochemical industry, employs 778,000 staff in the EU.

9. EU refining capacity upgrading is expected to lead to quite significant reductions in exports of (excess supply of) gasoline by 2030, while it is expected that the import dependence of the EU in gasoil/diesel will continue to increase by 2030.

10. Even under a scenario of increasing EU dependence in gasoil/diesel, the industry will be faced with necessary investments in European refining capacity upgrades in order to cope with further growth in demand for middle distillates (including as a result of changing sulphur fuel specifications for ships).

11. Depending on assumptions on the development of the crude diet in Europe between 2005 and 2030 and taking into account adopted and implemented EU policies, investments required to upgrade European refining capacities in that period could amount to between 17.8 and 29.3 billion Euros, of which between 3.3 and 11.7 billion Euros alone will account for future marine sulphur fuel specification changes to be transposed into EU regulation by the end of 2010.

12. It is estimated that the amount of investments that the refining industry in Europe has already committed to spending (in what it calls firm projects) between 2010 and 2020 is of the order of 13.3 billion Euros.

13. In spite of projections of declining demand for fossil fuels, processing intensity in refining will increase as a result of more stringent product specifications, in particular as a result of new IMO changes. One possible consequence is that refinery CO2 emissions will increase between 2005 and 2030, by around 6% (and increasing by 12% between 2005 and 2020), mainly as a direct result of the needs for hydrogen in refinery units geared towards producing higher proportions of new IMO compliant fuel.

14. Significant falls in the projected EU demand for transport gasoline by 2030 according to PRIMES (20.7% in the Reference scenario) point to the need for gasoline-focussed refinery plant restructuring, with up to a third of necessary capacity reductions, depending on the type of unit.

2. INTRODUCTION

In November 2008, the Commission announced in the Second Strategic Energy Review[1] (SER2) that a Communication on Refining Capacity and EU Oil Demand would be prepared in 2010. SER 2 focussed on energy security and, given the EU's dependence on oil imports and also on the exports and imports of petroleum products, highlighted both the need to improve the level of transparency of the demand-supply balance for refining capacity as well as concerns regarding the potential availability of diesel fuel in the future.

Since November 2008, the concern has shifted from being mainly one of security of supply to considering also how the EU refining industry's adaptation to a changing business environment is likely to impact the EU and on how EU policies to decrease the EU's dependence on fossil fuels will further add pressure on the EU refining sector. In light of these developments, it was decided that a factual study, in the form of a Staff Working Document, would be prepared instead of the Communication announced in SER2.

[1] COM(2008) 781.

This Document accompanies the Communication on the energy infrastructure priorities for 2020 and 2030 in which the continued contribution of oil to the EU energy mix and to the transport sector up to 2030 is underlined and where it is highlighted that the future shape of crude oil and petroleum product transport infrastructure will also be determined by developments in the European refining sector. In that context, the focus of this document is to provide some light specifically on the refining activity and the supply of petroleum products in the EU, and as such to highlight and explain key current and future challenges of the EU refining industry as well as to report some initial quantification of a number of those challenges in terms of the impacts by 2030 of PRIMES EU petroleum product demand projections. It also contains a detailed, factual account of the characteristics of the EU refining industry and some comparisons to other parts of the world in order to provide the necessary background and context for these challenges and impacts.

3. OVERVIEW OF REFINING AND THE SUPPLY OF PETROLEUM PRODUCTS IN THE EU

3.1. Key facts on EU refining and trade in petroleum products

- In May 2010 there were 104 refineries operating in the European Union. The EU's crude refining capacity currently represents 778 million tonnes per year (or 15.5 million barrels per day), equivalent to 18% of total global capacity;
- The EU is the second largest producer of petroleum products in the world after the United States;
- There are refineries in 21 Member States with the exceptions of Cyprus, Estonia, Latvia, Luxembourg, Malta, and Slovenia;
- The global financial and economic crisis that began in 2008 has impacted margins in all regions of the world. If average annual margins are compared, North-West Europe has however fared rather better than other regions in comparison in the last three years;
- The average utilisation rate[2] in OECD Europe in 2009 amounted to 79%, compared to 85% the previous year. So far in 2010, utilisation rates averaged 76%, showing a continuing downward trend. This needs to be put in the context of previous utilisation rates for the EU close to 90% as recently as 2005;
- Looking at the evolution of the petroleum product demand mix in the EU, the share of jet fuel and kerosene has increased between 1990 and 2008 from representing 5.5% to 9.4%; the share of gasoil (including diesel but not heating oil) from 17.7% to 31%; the share of gasoline from 22.7% to 16.1% and the share of heavy fuel oil from 16.3% to 6.4%;
- The two key trade petroleum products in the EU in terms of volume have been gasoline and gasoil/diesel (include heating oil), gasoil/diesel being the main petroleum product imported into the EU while gasoline is the main product exported from the EU. The EU is also very import-dependent on jet fuel and kerosene;
- Russia is the biggest supplier of gasoil/diesel to the EU, followed by the United States, while the United States is the largest recipient of gasoline from the EU. In the case of kerosene/ jet fuels imports, the third largest traded product, the EU mainly relies on a number of Middle Eastern countries.

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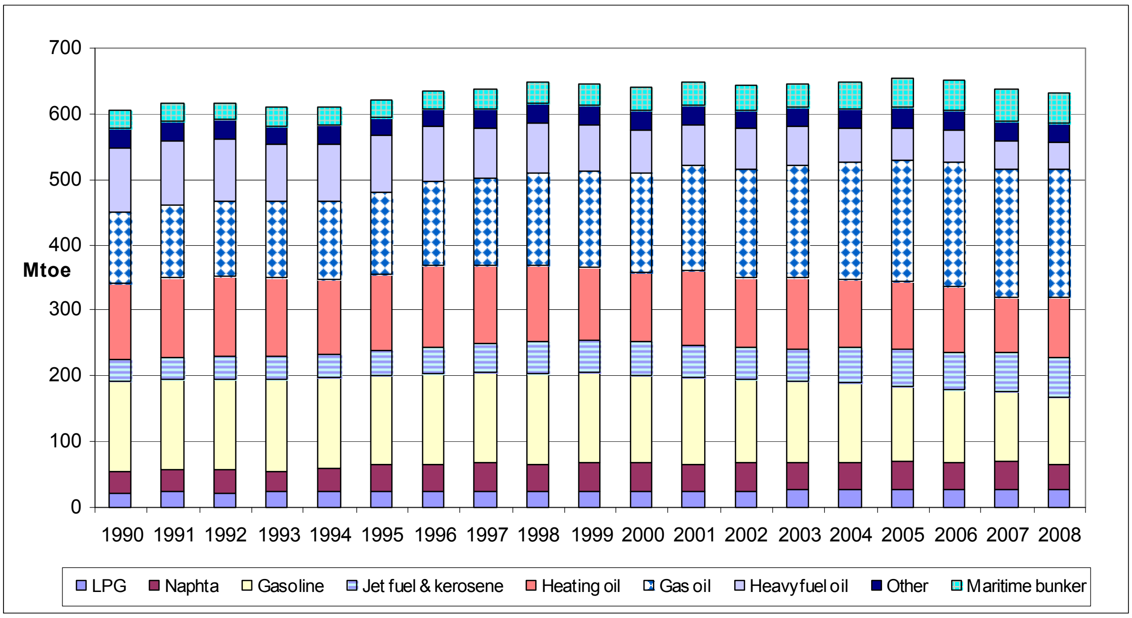
[2] Based on crude throughput as a proportion of operable refining capacity.

3.2. Current and future key challenges of the EU refining sector

3.2.1. The evolution of demand

It is widely considered that the EU petroleum product market is a mature market which has more than likely already hit its peak. Between 1990 and 2008, EU demand for petroleum products grew by an average of only 0.2% a year, recording its highest level in 2005 after which it fell every year, registering a 3% fall between 2005 and 2008.

EU 27 Petroleum product demand evolution, 1990-2008



Source: EUROSTAT/PRIMES

Analysing the progression of demand in individual petroleum products reveals very different trends. Between 1990 and 2008, jet fuel and kerosene consumption almost doubled; consumption in gasoil[3] registered a steady and sustained growth; demand for naphta registered an initial increase and then a fall; demand for gasoline and heating oil fell quite sharply, while demand for heavy fuel oil[4] fell significantly.

Projecting forward towards the short-to-medium term, what is relatively certain is that the fall in heavy fuel oil will continue, given the gradual eradication of the use of such products due to regulation on the specification of petroleum fuels towards cleaner, less polluting fuels.

With regard to the evolution of middle distillates[5], it is expected that heating oil should continue to fall as more efficient and environmentally friendly district heating systems continue to replace traditional oil burners. Gasoil evolution will depend on a number of variables, such as whether EU support to promote the wider use of non-fossil fuels is successful; whether tighter marine fuel specifications will lead to a broad switch from residual

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[3] Unless otherwise specified, gasoil refers to transport diesel fuel, of which over 90% is used in road transport.

[4] Heavy fuel oils other than bunker fuels are used in medium to large industrial plants and power stations in combustion equipment such as boilers and furnaces.

[5] Middle distillates include heating oil, diesel, kerosene and aviation/ jet fuel. Heating oil is mainly used in domestic heating, while diesel is used as a motor fuel and also as a fuel in agricultural vehicles, small boats and trains. Jet fuel and kerosene are used to power airplanes and kerosene is also sometimes used in domestic heating.

fuel to marine gasoil rather than desulphurised residual oil; and, to a lesser extent, whether the EU-wide tax differential between road diesel and gasoline[6] is maintained[7]. Kerosene/ jet fuel demand is however expected to continue to grow until large scale use of suitable renewable fuels in airplanes.

Equally, the direction of growth of the demand for light distillates (LPG, gasoline and naphta), will depend on a number of considerations. In particular, the development of demand for gasoline will depend on the growth and success of alternative fuel vehicles and energy taxation (as for gasoil), as well as developments in the penetration of sustainable, renewable fuels in the US (see section 3.2.2.) and gasoline engine efficiency.

Other than economic developments, the two factors most likely to impact future demand for petroleum products in the EU are the forthcoming revision of the Sulphur Content in Liquid Fuels Directive (SCLFD) to integrate tighter international regulations on the sulphur content of marine fuel[8] as well as recent legislation to reduce CO2 emissions from new cars and transport fuels[9].

The requirement to supply future marine fuel with a maximum sulphur content of 0.1% in the Baltic Sea and the North Sea & English Channel could amount to an increase in demand for middle distillates of around 15 million tonnes per year from 2015 (which represents close to 8% of EU gasoil demand in 2008).

This very much depends on how the new changes are dealt with. There is the possibility that ships will widely opt to continue using high sulphur fuel oil after having installed on-board scrubbers to remove sulphur from fuel oil.

Notwithstanding the fact that ship owners switching to gasoil will likely have to pay more for their fuel than if they continued to use fuel oil[10], a key advantage for ships from scrubbing is

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6 According to June 2010 figures from the Commission Oil Bulletin, while pre-tax consumer prices of premium unleaded gasoline are lower than for diesel in all but 1 of the EU 27 Member States (Malta), higher taxes and duties on gasoline means that the price of diesel is cheaper at the pump in 26 of the 27 EU Member States (with the exception of the United Kingdom). See more details in annex.

7 A future revision of the Energy Taxation Directive may address this differential, but even if it proposed changes which would lead to the disappearance of this differential across the EU, it would take a while to have an impact given 10 to 15 year replacement cycles for cars and given that most diesel is still used by commercial vehicles where the possibility to switch to gasoline is more limited.

8 The 2008 revised International Maritime Organisation MARPOL Annex VI regulation on sulphur restrictions in marine fuels provides for a shift to low sulphur fuel for maritime transport first within the European Emission Controlled Areas (the current fuel sulphur limit of marine fuels would be reduced from 1.5% to 1.0% by 2010 and then to 0.1% by 2015) and in a second phase, globally where the maximum permitted sulphur level would be reduced from 4.5% to 3.5% by 2012 and then to 0.5% by 2020 (with an alternative date of 2025 if suitable fuel is not available, to be decided by 2018). The European Emission Controlled Areas are the Baltic Sea and the North Sea & English Channel.

9 Adopted in April 2009 along with the climate and energy package, it requires reductions in the average fuel consumption of new cars, with binding targets of 130g/km (from 140g/km) by 2010 and 115g/km by 2020. The Fuel Quality Directive amended at the same time further tightens fuel specifications and introduces a requirement to lower life cycle GHG intensity of transport fuels by 6% by 2020.

10 The key deciding factor will probably be the eventual price of low sulphur marine fuels. According to Purvin & Gertz, bunker fuel for use in the emissions control areas would be expected to cost in the range of $250 to $300 per tonne more for the 0.1% maximum sulphur content quality than the 1.5% maximum sulphur content quality. This represents an increase in the cost of the fuel of 60% to 75%. They estimate that 0.5% maximum sulphur content bunker fuel is expected to cost in the range of $120 to $170 per tonne more than the current high sulphur quality. This represents an increase in the cost of bunker fuel in the range of 30% to 50%. Purvin & Gertz conclude that stack scrubbing is economically attractive for fuel cost price differentials well below $100 per tonne, and that stack scrubbing is likely to be very attractive economically compared to the price differentials above.

that it would allow them to meet sulphur cap requirements wherever the ship trades. There is however some scepticism on this option given that many ships have held back from making the necessary investments to prepare for compliance with the existing EU requirement in the SCLFD of the use of marine fuels used by ships on inland waterways and at berth in any EU ports containing no more than 0.1% of sulphur by January 2010[11].

While sulphur fuel specifications could represent a source of increasing demand for (marine) transport fuel from EU refiners, it is expected that CO2 emissions legislation will contribute to improved efficiency of vehicles such as through increased penetration of hybrid vehicles, thereby reducing the demand for transport fossil-fuels such as gasoil and gasoline. It is expected that this regulation will lead to a penetration of conventional hybrids equivalent to 27% of the total passenger fleet by 2030[12].

3.2.2. Demand & supply imbalance and dependence on trade

3.2.2.1. EU refining supply out of step with evolving demand

Two trends which have characterised the growth in demand for petroleum products in the EU since 1990 have been the continued, strong growth in middle distillates such as jet fuel and kerosene and gasoil on the one hand and the parallel strong falls in demand for gasoline on the other.

Between 1990 and 2008, demand for middle distillates (including heating oil) grew by 35% (and demand for jet fuel/kerosene and diesel increased by 82%), while demand for gasoline fell during that same period by 26%. In parallel, EU supply of middle distillates between 1990 and 2008 grew by 28%, while gasoline supply only fell by 4%.

These developments resulted in a supply/demand imbalance in the EU with regard to such products which has led it to be dependent on trade in order to balance out demand and supply.

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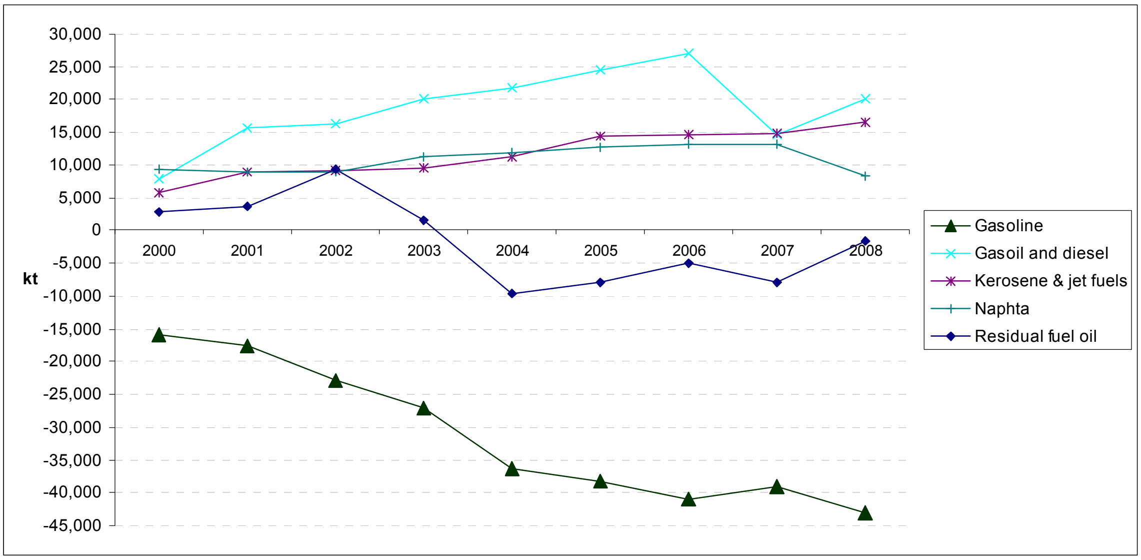
11 This led to a Recommendation by the Commission to Member States to request from ships that have failed compliance by that date to provide detailed evidence of the steps they are taking to ensure compliance, including a contract with a manufacturer and an approved retrofit plan to be completed by no later than 1st of September 2010.

12 As contained in the PRIMES Reference scenario.

Evolution of EU net imports in key petroleum products, 2000-2008



Source: EUROSTAT

By 2008, gasoil/diesel (including heating oil) was the main petroleum product imported into the EU, reaching 20 million tonnes of net imports, equivalent to 6.9% of EU gasoil/diesel consumption. In contrast, the main product exported from the EU was gasoline, with net exports of 43 million tonnes in 2008, equivalent to 31% of EU gasoline production.

With regard to gasoil/diesel imports, Russia is by far the largest supplier of the product into the EU, having exported 13.7 million tonnes of gasoil/diesel in 2008 to the EU. Though this amount only represents 4.8% of total EU demand of 288 million tonnes of gasoil/diesel for that year, it amounts to 35% of total gasoil/diesel imports. With regard to gasoline, the EU exported 18.7 million tonnes of excess gasoline to the US that same year, which was equivalent to 13.6% of EU gasoline production (of 137 million tonnes) and 37% of total EU gasoline exports in 2008.

If net imports of kerosene and jet fuels are taken into account, the EU shortfall in middle distillates amounts to upwards of 35 million tonnes of net imports per year, imports of kerosene and jet fuel coming mainly from several Middle Eastern countries.

3.2.2.2. Growing trade deficits

Should EU demand for middle distillates continue to grow (which is generally expected), and should the current structure of EU refining remain unchanged, it will mean processing more crude and obtaining more middle distillates but also more gasoline, thereby leading to a widening of the EU supply/demand imbalance for diesel and gasoline.

So far the US has served as a convenient outlet for excess EU gasoline but it is widely predicted to reduce its consumption of gasoline going forward. While the US vehicle stock will continue to be dominated by gasoline in the foreseeable future, it is suspected that the demand for it has already peaked as more efficient vehicles are produced and as the proportion of biofuels (mainly ethanol) progressively grows to represent a greater proportion of US vehicle fuel use[13].

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13 In its Annual Energy Outlook 2009 reference case, the US Energy Information Administration projects falls in the growth of motor gasoline consumption in the US equivalent to -8.4% between 2010 and

But should there be other potential markets to which the EU could export its surplus gasoline production, keeping the status quo (in terms of refining capacity) could be an option for the industry. The most obvious markets are Africa and the Middle East as these are the closest to Europe and both are expected to experience growing demand in gasoline going forward. However future gasoline trade deficits in both these regions are likely to be well short of current EU gasoline export levels.

In terms of increasing imports of gasoil/diesel, while Russia has been a reliable source of supply to date, it could prove difficult for it to meet any substantial increases in EU demand for diesel imports given that Russian refinery capacity today remains at the same level as it was in the late 90's[14] and also taking into account relatively modest developments in capacity expected in the near future.

On the other hand, it can be expected that the situation which currently prevails in Russia which leads its refiners to process more crude than is required for domestic consumption in order to export the excess will remain in the foreseeable future. This situation is largely the result of the current tax regime which taxes crude exports more highly than product exports. Russian oil export tariffs on light oil products are typically 70% of export tariffs on crude oil, and export tariffs on heavy oil products represent only around 40% of crude export tariffs[15]. Thus it can be expected that Russia will continue to run a trade surplus in diesel in the forthcoming years.

Other countries like China, India or Saudi Arabia have greatly expanded diesel capacity in recent years and could be relied upon to supply the EU market (with the farthest locations still being open to debate, as mentioned in the global competition section). This being said, demand for diesel is expected to grow significantly across the globe, with the Asia Pacific region in particular foreseen to be running a large diesel deficit going forward as diesel experiences the fastest growing demand of refined products in the region. And while North America is currently the second biggest supplier of diesel to the EU, running a surplus in diesel capacity of upwards of 30 million tonnes, it is expected that it will run only a slight diesel surplus from 2015 as it becomes the fastest growing refined product in demand there, reflecting increasing volumes of road freight and some dieselisation of the private car fleet[16].

In conclusion, should the refining industry opt for the status quo in an environment of growing demand for middle distillates, the EU's import deficit in middle distillates will extend further. This is not only a problem for the EU in terms of growing import dependence for such products, it is also a problem for the EU refining industry in terms of growing pressures to

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2020 and -5.2% between 2020 and 2030 (equivalent to a fall of -13.1% between 2010 and 2030). Upcoming emission standards as well as the passing of the 2007 US Energy Independence and Security Act which promotes the use of biogasoline represent key influences on future US demand for gasoline. In addition, the Obama administration has brought forward a requirement for better vehicle fuel consumption. By 2011, the Corporate Average Fuel Economy requirement on car-manufacturers will shift from an average consumption of 27.3 miles per gallon from the current requirement of 35.5 miles per gallon.

14 According to Russian oil refining capacities contained in the BP Statistical Review of World Energy 2009. Note however that in his report to the State Duma on the 2nd of December 2009, the Russian Energy Minister announced that between 1.2 to 1.4 trillion roubles (32 billions Euros) would be invested into upgraded refinery capacity in Russia.

15 The Russian Ministry of Economic Development has recently prepared amendments to customs tariffs which provides for more equal export tariffs for light and heavy products.

16 Projections by Wood Mackenzie, as part of its work evaluating the impact of biofuels on the EU refining industry for the European Commission.

export excess gasoline supply to other markets, which is not evident given expected future developments in world demand for gasoline and diesel.

3.2.3. Supply challenges

3.2.3.1. Falling productions of North Sea Crude and variations in crude quality

North-Sea crude production (from Norway, UK, Denmark) fell from 6.4 to 4.3 million barrels per day between 2000 and 2008. Over the same period, the supplies to Europe of heavier, sourer/more sulphurous, crudes from Russia and Africa have been growing. The result has been an increase in the proportion of heavy and sulphurous crudes coming into EU refineries, as well as a higher dependence on oil imports from third-party countries which represented 80% of EU crude refinery intake in 2008 against 75% in 2000.

The impact on the EU refining industry of lighter crude being replaced by heavier crude has varied according to region, with North-Western European (NWE) refineries being especially concerned[17]. Conversely, in Central Europe, refineries are often located on the Druzhba pipeline, and the great majority of their intake is Urals crude. In the Mediterranean area, the larger proportion is Arabian Gulf, which is again heavier than Urals crude, with similar API[18] but higher sulphur content, followed by Urals crude.

Falling productions of North-Sea crude in an environment of growing demand for lighter distillates represents a major concern for the NWE refining industry. Lighter crude oils such as North-Sea crude produce a higher share of more valuable, light products that can be recovered with simple distillation, while heavier crude oils produce a greater share of lower-valued products (such as fuel oil) with simple distillation and therefore require additional processing to produce higher value products.

North-Sea crudes have an additional attractive property, in having low sulphur content. Higher sulphur crudes are naturally less valuable in an environment of lower sulphur fuel specifications, such as in the EU. In addition, the impurities in heavy, high sulphur crudes, such as nitrogen and metal, generally increase as the crude becomes heavier and further increase the processing severity required to convert the heavy crudes to light products.

The quality of crude oil thus dictates the level of processing and re-processing to achieve the optimal mix of product output, with a trend towards heavier and more sulphurous crudes leading to a more complex, and costlier, refining process, such as via the use of deep conversion and/or desulphurization units, also leading to higher CO2 emissions.

Going forward, it isn't clear how Europe will be affected by the changing global crude diet. In the short term, according to the IEA, the average crude density may slightly lighten with a marginal decrease in the sulphur content until 2014 mainly due to the impact of growing condensate[19] volumes produced by OPEC countries. Lighter supplies from Russia, Africa and the Middle East are also expected to increase according to the IEA, partly offset by expected Canadian crude mix, where new production from heavy oil sands is mostly sour.

In the longer run, it is expected that NWE crude intake from the Urals, the Caspian region and the Middle East will gradually come to represent growing proportions. This trend may

17 Nearly 100% of the crude refinery intake in Ireland and Denmark is North-Sea originated, followed by the UK (80%), Sweden (57%), Germany (27%), France (21%), Finland (17%), the Netherlands and Belgium (14%).

18 API expresses a crude's relative density, with the higher the API gravity, the lighter the crude.

19 Condensate is a very light, liquid hydrocarbon stream that is recovered from the processing of gas and the gas from oil reservoirs and can be regarded as almost identical to a light sweet crude.

become a key challenge for refiners in that region, pushing them towards investments for the adaptation of their plants in order to refine the changing flow of crude.

3.2.3.2. Adapting supply to regulation

The impact of biofuels[20]

In the EU, it is expected that much or all of the growth in motor-fuel supply, which represents the biggest use of processed crude oil, will be in biofuels in the next twenty years.

A key driver of the supply of biofuels in the EU will be the Renewable Energy Directive which sets a 10% target for the use of renewable energy in the transport sector by 2020, the majority of which is expected to be contributed from biofuels, which have to meet certain specific sustainability criteria.

The increasing use of biofuels will have an impact on EU refiners in terms of a reduced need for the supply of conventional fossil transport fuels. In the case of biodiesel, it has the potential to reduce the growing pressure on the need for diesel..

On the other hand, increasing the share of biogasoline blendstocks such as ethanol in the European gasoline pool could reduce further the market for refinery-produced gasoline, which would be problematic to refiners given that there is already an excess of gasoline-producing refinery capacity in Europe, as noted earlier.

Tightening marine sulphur fuel restrictions & increasing supply of middle distillates

The future marine sulphur fuel specification requirements mentioned above are likely to pose difficulties to the industry in supplying the resulting demand. While supplying 1% sulphur fuel should not pose significant problems for refiners – blends can simply be modified to redistribute the higher sulphur components - the real challenge will be the changes to 0.1% sulphur content and 0.5% respectively for the ECAs and the rest of the world, as these will likely require the conversion of bunker fuels to diesel[21]. This will require investment in desulphurisation or conversion capacities.

However, the production of additional gasoil, whether for the marine sector or in order to meet current EU demand, poses an additional problem for the EU refining sector as it implies further cracking/breaking up of the heavier remaining products. Complex refineries are more energy intensive, and emit more CO2 than simple refineries. Every additional cracking process and every additional desulphurisation step needs energy and thus increases CO2 emissions. Thus, increasing gasoil production in the context of ever tighter sulphur specifications will lead to an increase in CO2 emissions by the EU refining sector[22].

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20 A detailed analysis of the impact of the use of biofuels on EU oil refining will be published by the European Commission in the Autumn of 2010.

21 Current technology cannot achieve reductions in the sulphur content of residues to 0.1% unless a very low sulphur feed is used. If it was possible, it is questionable whether refiners would not rather prefer to focus instead on converting residual fuel to other lighter, more valuable fuels, and decide to stop supplying the bunker market altogether.

22 2009 estimates of the costs of changes in marine sulphur fuel specifications by Purvin & Gertz for the European Commission, are for 7 million tonnes per year of extra carbon dioxide emissions by 2015 (due to changes to 0.1% sulphur content), representing an increase of 5% versus Baseline carbon dioxide emissions of 142 million tonnes in 2015. Including the change to 0.5% globally, total increases in CO_2 emissions by 2020 could reach 11.8 million tonnes per year.

The EU refining sector, which will be required either to purchase permits to emit CO2 or to improve the CO2 emission efficiency of its plants[23], will therefore have to pay more for the CO2 emissions from (more complex) refineries producing the products which the EU requires (i.e: middle distillates). For the same reason, careful consideration of the impact on refineries needs to be given when designing the implementation measures to reduce fuel life cycle Green House Gas (GHG) emissions (contained in the Fuel Quality Directive).

This leaves the EU with the dilemma of on the one hand becoming more heavily reliant on imports of petroleum products into the EU or on the other hand, hoping that the EU industry will produce more of the required products, even if (all else being equal) it means emitting more CO2, and therefore having to pay for it.

The future price of carbon in the ETS scheme is therefore a crucial issue to the industry and to the EU, as the higher it is, the more the risk that it exceeds the freight costs that an importer of refined products such as diesel would incur from shipping the product from abroad, with no overall benefit in terms of CO2 emissions.

According to the refining industry, it would have to buy about 25% of its allowances to maintain activity which, inclusive of the additional costs of CO2 in purchased electricity, should cost the sector over 1 billion Euros a year based on a price of 30 Euros per ton[24].

3.2.4. The profitability of the EU refining industry

Falling demand for petroleum products at a time of stable levels of capacity have in turn significantly affected refining margins[25]. The impact of the recent crisis on refining margins has been particularly significant, as the chart below shows, with both simple (hydroskimming) and complex (cracking) margins hitting 15 year lows in 2009.

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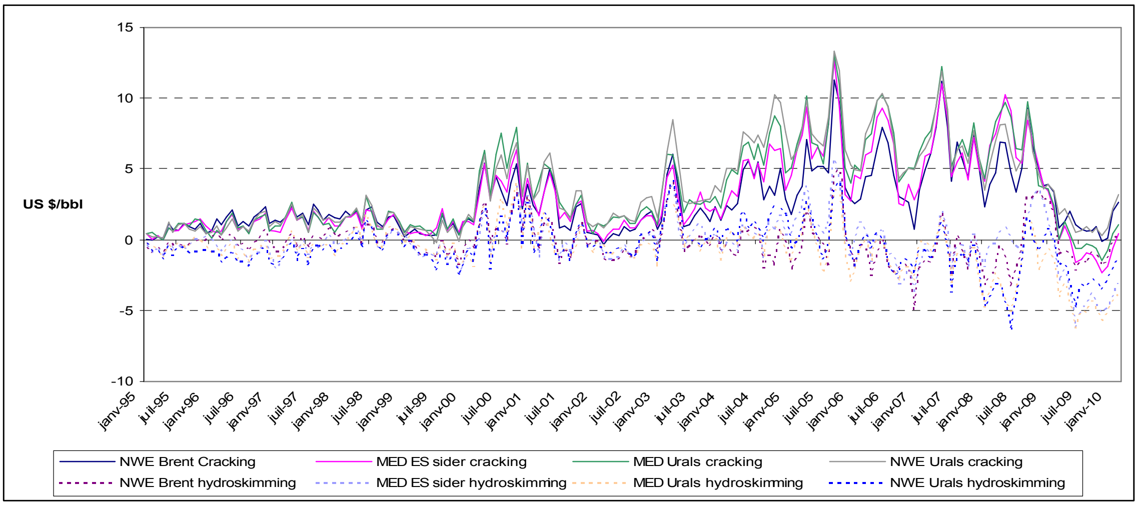
23 As the EU refining industry is included in the EU Emissions Trading Scheme (the ETS). Note that the EU refinery industry has been recognised as being at risk of carbon leakage, on the grounds that crude oil and derived products are moved around the world in a very open market in which there is complete exposure to worldwide competition, which will allow the industry to obtain free permits for the first two years of the third phase of the EU emissions trading scheme (2013-2014). Free allowances will in principle be allocated based on product-specific benchmarks for each relevant product. The starting point for the benchmarks is the average of the 10% most efficient installations, in terms of greenhouse gases, in a sector or sub-sector in the Community in the years 2007-2008. The use of such benchmarks is to ensure that the allocation takes place in a manner that gives incentives for reductions in greenhouse gas emissions and energy efficiency efficient techniques. Furthermore, given that the benchmarks will be stringent, only the most efficient installations will have any chance of receiving all of their needed allowances for free.

24 It is however worth noting that the carbon price in the EU Emissions Trading Scheme has been trading at prices much below 30 Euros per ton, a combination of the crisis, higher than expected energy prices and the build up of considerable buffer of unused freely allocated allowances, which can be carried over into phase three (2013-2020) of the ETS. The ETS carbon price in the PRIMES Reference scenario in 2030 is 19 Euros per tonne of CO_2, much lower than the PRIMES Baseline (of 39 Euros) due to the achievement of the renewables targets and additional efficiency measures, which decrease electricity demand and emissions.

25 The refinery margin is the profitability that results from processing a barrel of crude oil. It reflects the difference between the market value of the combination of products produced by the refinery and the cost of buying the crude at market price as well as the operating costs incurred in the refining process.

Refining margins for simple and complex refiners Jan 1995 – Feb 2010



Source: IEA

Going forward, there are divergent views on when the sector will experience a recovery in margins, and to what extent. While acknowledging a recovery in margins at the start of 2010 due to a drawdown in oil product inventories and recovering demand, the IEA[26] predicts that the construction of refineries globally over the past two years and a massive contraction in oil consumption during the recession have led to a glut of capacity at the global level. It thus maintains a bearish short-term outlook for the industry globally.

Looking further ahead, the combination of the prospect of increasing demand for middle distillates – including widespread global dieselisation (as mentioned above) – with consequent increases in low-sulphur fuel/middle distillates[27] prices as well as rising crude prices[28] lend support for a recovery in complex margins in the coming years in the EU[29].

3.2.5. Global competition coming to the EU

Asia and the Middle East have been building new, larger, more cost effective and generally more complex refining units in recent years, such that they are becoming key players in global refining markets.

In spite of the crisis, Asia and the Middle East have added 1.6 million bbl/day of new crude distillation capacity in 2009, and at least a further 600,000 b/day is expected in 2010. In terms of expected refining projects in the next five years, the two regions combined will add nearly three quarters of all additional capacity in the world (see annex 5 for more details).

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26 January 2010 Oil Market Report.

27 According to Purvin & Gertz, tightening sulphur marine fuel sulphur specifications would lead to increases in the prices of bunker fuels of between 30% and 75% in the Emission Controlled Areas by 2015.

28 Hydrocracking margins tend to be highest when crude prices are high and there is a wide price difference between light and heavy crudes, as hydrocrackers can take lowest-cost heavy crude and sell products into a high price market.

29 As part of its work evaluating the impact of biofuels on the EU refining industry for the European Commission, Wood Mackenzie presented projected NWE Urals cracking margins (more relevant going forward than Brent cracking margins) to reach \$3.45/bbl in 2010 compared to \$2.62/bbl 2009 and \$4.62/bbl in 2008. According to the consultant, margins should continue to rise slowly, reaching levels of \$5.13/bbl in real (2010) terms by 2015.

Given the closeness of the region to Europe, expectations are that the Middle East will likely become a key provider of refined products, especially of middle distillates, to Europe. European imports of kerosene and jet fuels already mainly originate from that region. The region is currently planning some 1.7 million bbl/day of additional capacity which is expected to come on stream by or around 2015. New projects include several large export-focussed refineries which are being co-financed by European-based oil majors such as Shell and Total.

For some, the idea of even importing refined products from places as far from Europe as Asia is not far-fetched, with the view that operators of large refineries there could prove able to deliver products to the EU at prices competitive with home production[30]. While this may be true, the extra freight and logistics costs of importing from such distant places could mean that the price of end-products will rise, to the disadvantage of end-users. Admittedly, freight and logistics costs could also go down going forward, should the size of vessels employed to import refined products increase[31].

In practice, Asian oil firms are already eyeing the EU market. India's Essar has been expanding its home refinery at Vadinar with the aim to export to Europe, and it has been negotiating with Shell for a number of months on the acquisition of three of its Europe-based refineries (Stanlow in the UK and Heide and Hamburg-Harburg in Germany) with the intention to close these refineries and turn them into import terminals. PetroChina has also been in talks with Ineos over an investment in its Grangemouth refinery in Scotland.

Additionally, state subsidies are supporting some refineries in such countries, with the example of Chinese refiners which have been running record high throughputs in 2009 due in part to guaranteed margins. For instance Sinopec, a state-controlled refiner, is subsidising its refineries to export products, thereby encouraging them to maintain high throughputs[32].

The industry believes that with limited domestic demand for high-quality fuels, Indian and Middle Eastern refiners will seek to use the EU market as a temporary outlet for excess production until local markets grow sufficiently to absorb production. It warns that over time, the combination of domestic market growth and tightening product specifications could then see such players refocus on their domestic markets, with consequences for a more import-dependent Europe[33].

3.2.6. Investments in upgrading the EU refining sector: increasing middle distillates capacity

As mentioned previously, a growing trade gap is avoidable should EU refiners decide to invest heavily in upgrading existing capacities to make them more complex and thus able to skew the production mix towards more diesel and less gasoline.

According to the industry, in order to fill an annual gap in demand of 30 million tonnes of gasoil and jet fuel (in 2008, EU net imports of gasoil/diesel and kerosene/jet fuel amounted to 36.7 million tonnes), the EU refining sector would need to build about 20 large hydrocrackers at a cost of more than 8.5 billion Euros[34].

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30 View expressed in April 2010 article of the Petroleum Economist "Downstream depression".

31 Until now, logistics have favoured transporting crude rather than refined products as the transportation of crude is less costly, due to larger vessels being employed to transport crude, than refined products.

32 Oil Market Report, March 12 2010.

33 White Paper on EU refining, Europia, May 2010

34 Ibid, 33.

As was already highlighted, an additional 15 million tonnes per year of low sulphur gas oil/diesel is expected from marine sulphur fuel restrictions being lowered from 1% to 0.1% by 2015. Producing an additional 15 million tonnes of gasoil a year would require investment of more or less 4.5 billion Euros, representing 10 upgrading projects, according to the industry[35]. This would come on top of the 20 projects cited previously.

Taking also into account the further costs that would need to be incurred to meet the proposed MARPOL global specification changes from 3.5% currently to 0.5% sulphur content globally by 2020[36], additional costs associated with the full changes in sulphur fuel specifications could run into as much as 23 billion Euros by 2020 in the EU[37].

According to the industry, capital expenditure associated with previously announced projects to be built in the EU within the next six to eight years was in the order of 34 billion Euros. However, in a context of low refining margins, many of these projects may not be implemented and the latest estimate is that only some 14 billion Euros of investments might be spent improving the European refining system in the next six to eight years, again depending on economic conditions[38].

Good and stable economic conditions – ensuring high and stable margins - are important for investment in new refining and conversion capacity to occur, as a number of years can come to pass between the decision to build a refinery and the start of production. Yet as has been said before, though margins are trending upwards again, they are still low and there is some uncertainty as to how they will develop.

Even if prospects were more positive however, there would be no guarantee that the EU refining industry would make the necessary investments to meet the shortfall in the supply of middle distillates. Tightening fuel specifications as well as the demand focus on diesel are not new phenomena in Europe, and yet the industry has been slow to adapt. This is because until now, there has been a market for the excess gasoline produced by refining units in the EU, such that the industry could opt not to carry out all of the investments required for more hydrocracking units[39] to produce more middle distillates and deep conversion units such as cokers and residue cracking installations to produce low sulphur marine fuel.

Also, while the European refining industry has been faced with dramatic reductions in demand for fuel oil since the 1980's, at the same time the rapid development in North Sea

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35 Ibid, 33.

36 Which would require an additional 100 hydrocracking projects globally in the next decade at a cost of 46 billion Euros (White Paper on EU refining, Europia, May 2010).

37 Estimates by Purvin & Gertz for the European Commission, 2009. These assume that 20 million tonnes of marine bunker fuel would need to be produced to a maximum of 0.1% sulphur content by 2015, rising to 24 million tonnes per year by 2020. Investments in delayed coking and hydrocracking are assumed to be needed to meet the new SECA specifications. In addition, middle distillate streams produced from delayed coking require additional hydrotreating before they can be used for the production of diesel or gasoil. Additional hydrogen plant capacity is also needed to produce hydrogen for the hydrocracking and hydrotreating units and sulphur recovery units are needed to handle the additional sulphur removed.

38 Historically, according to Europia (White Paper on Refining), European refiners have invested an average of around 5 billion Euros each year over the past 20 years in desulphurisation capacity of distillates and gasoline, the upgrading of production facilities and processes and the installation of emission abatement equipment and energy savings.

39 One alternative approach to dealing with increasing demand for diesel and falling demand for gasoline would be to implement changes to the catalytic-cracking process (rather than develop hydrocrackers), such that these units could process heavy residues into diesel. One example of a specialist heavy residue cat-cracker in existence is a unit at Shell's Pervis, Netherlands, refinery.

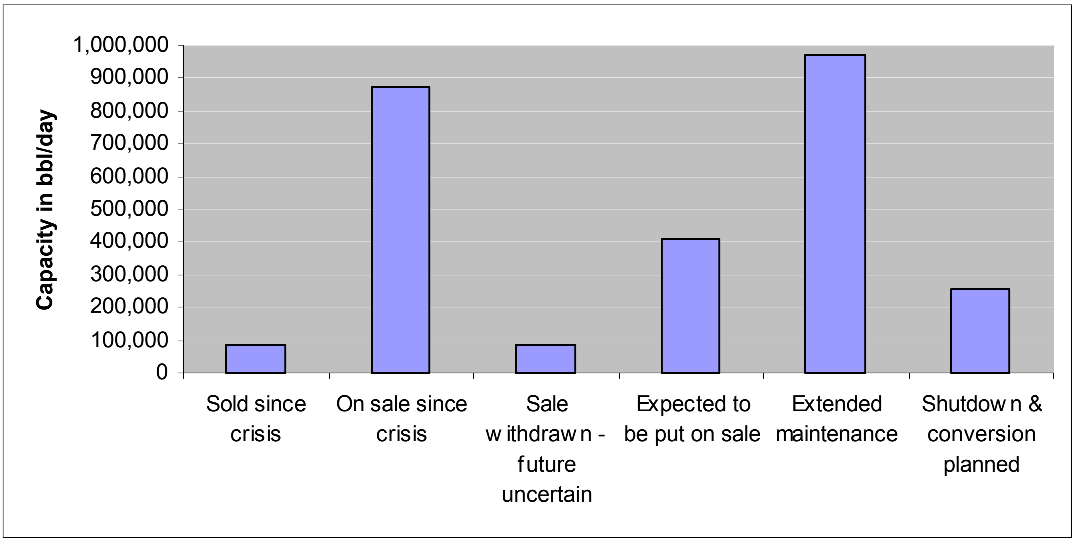
crude production, along with increasing demand for bunker fuel, allowed especially coast-based North Western EU refiners to avoid fuel oil conversion investments.

Last but not least, while the EU refining industry has suffered on a number of occasions in the past as a result of economic downturns and oil shocks, there have always been prospects of recovery and continued growth in demand which eventually did take place. In this instance, future EU demand prospects are bleak, especially if put in the context of growth prospects in other regions of the globe such as the Asia Pacific and the Middle East.

In conclusion, while there is a considerable need for further investments by the EU refining industry, and in the case of falling gasoline exports, a real incentive for the EU industry to invest, there are many developments which put together make such investments unlikely, not least the growing costs of refining in the EU, the falling supply of North-Sea crude and uncertain prospects in terms of refining margins.

3.2.7. Impacts of restructuring of the sector: reducing gasoline capacity

Summary of EU refineries planned/actual divestments and shutdowns since 2008



Source: European Commission. Note: This information has not been confirmed by the EU refining industry and is contained here for illustrative purposes.

Overall, known planned/actual divestments and shutdowns in EU refining capacities since the start of the crisis in 2008 extend to 18 out of 104 refineries in the EU, representing some 134 million tonnes per year/2.7 million bbl/day of crude capacity, equivalent to 17% of total EU refining capacity. Only two of these units have been sold, others have been put up for sale for some time but have found no buyers, others yet have been shutdown for extended maintenance until market conditions recover.

The most vulnerable types of units are either small to medium-size and/or gasoline-oriented refineries, which are less adapted to current demand patterns. The industry however warns that restructuring of gasoline capacity could also affect diesel production if, instead of divesting only of gasoline units such as Fluid Catalytic Converters (FCCs) or catalytic reformers, EU refiners opt to shut down entire refineries altogether[40].

[40] White Paper on EU refining, Europia, May 2010.

Assets which have been put on sale since the crisis and are still awaiting buyers amount to close to 900,000 bbl/day. It is expected that at least another 400,000 bbl/day of capacity is likely to be formally put on sale in the foreseeable future as a result of the crisis.

In addition, refining capacity that is known to have been temporarily shutdown as a result of the crisis amounts to some 900,000 bbl/day. These units could either be restarted or eventually also be put on sale, depending on market conditions.

Note that no complete shutdowns have been announced by EU refiners. Since the beginning of the crisis, uneconomic assets that have not been put on sale have generally been subject to extended maintenance/temporary shutdowns, while assets that have been formally 'shut down' are in fact being converted to depots/storage facilities (equivalent to 258,000 bbl/day, to date).

Opinions on the amount of capacity that needs to be shut-down in the EU abound. These range from between 640,000 to upwards of 2 million bbl/day, equivalent to between 4% and 15% of total EU capacity, with the view that such decreases are necessary for a return to acceptable margins and in order to prevent further increases in the volumes of gasoline supplies going forward.

If 2009 utilisation rates for OECD Europe (calculated as a proportion of product consumption to total capacity) of 79% is a good guide of the likely long run utilisation rate for the EU industry, then it could be argued that there is 21% excess capacity. This exceeds the total capacity of the 18 refineries in question.

It is not known how many employees these 'vulnerable' refineries represent, and estimates are imperfect as indicators such as capacity, utilisation and complexity cannot by themselves provide an accurate guide. In addition, while the number of direct employees is known for some refineries, there are a number of additional indirect employments which depend on a refinery for their livelihood, whether as sub-contractors working on-site or as providers of products/ services either to the refinery or to employees of the refinery. The number of dependent indirect employments as a multiple of direct employments for a refinery can be of the order of 3 to 5, according to representatives of the industry.

Thus while the industry itself employs directly only 100,000 people in the EU, it can be considered that as much as 400,000 to 600,000 jobs are directly dependent on the EU refining industry[41].

The gradual disappearance of the refining activity in the EU would also have consequences for the industries for which a local refining presence is important. The EU petrochemical sector, which employs 778,000, is perhaps the best example of such an industry.

There are 58 steam crackers[42] in the EU, 53 of which are currently in operation, while 77% of the feedstock of those 53 crackers in operation comes from refineries. Of the 58 steam crackers in existence, 41 are directly integrated refinery/steam crackers.

According to the petrochemical industry, having refinery and interdependent industry on the same site brings a number of synergies in terms not only of the supply of energy but also in terms of support services and product exchanges[43]. The relationship is therefore mutually

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41 Not included in this number are the further 600,000 jobs in logistics and marketing.

42 Which crack naphta/LPG feedstock into lighter olefins such as ethylene - one of the most important raw materials of the organic chemical industry - and propylene - used in the manufacture of resins, fibres and plastics.

43 Over 5.3 M/tons of products from crackers are sent back to refineries, equivalent to 12.5% of total refinery transfers to steam crackers. This includes hydrogen, which is produced in excess by the crackers and which refineries are normally short of and which is used by refineries in hydrocrackers in

beneficial, though integrating refineries and steam crackers is not the strategy employed by all the oil majors, and while Total as well as ExxonMobil are highly integrated (upwards of 74%), BP and Shell have relatively lower levels of integration (24% and 39% respectively).

The degree of integration with the petrochemicals industry is also only one of several factors that will influence how vulnerable a refinery is to being closed down. Other key aspects will likely include how clean and efficient (in terms of CO2 emissions and pollutants) the refinery is and its flexibility and fit in terms of meeting market demand. The cost of access to crude oil is another factor.

3.2.8. Long-term – 2050 and beyond: Preparing for a "decarbonisation era" in the EU

Looking beyond the next twenty years, up to and as far as 2050, the key challenge for the EU refining industry on the basis of current EU ambitions with regard to the environment and climate change is less one of partial restructuring and adaptation/upgrading of refining capacity and more of a paradigm shift with a radical departure from oil being used as the main transport fuel or as a key source of energy.

The energy and transport sectors are the targets of the vision to a move towards a low carbon, resource efficient and climate resilient economy by 2050, and as an energy-intensive industry supplying mainly fossil-based fuels to the transport sector, the EU refining industry will be concerned by developments to implement such a vision.

Transport in particular has been the sector most resilient to efforts to reduce CO2 emissions due to its strong dependence on fossil energy sources. Currently, the sector is responsible for about a quarter of EU CO2 emissions and also contributes significantly to reduced air quality and related health problems, particularly in urban areas. While energy and transport efficiency as well as effective transport demand management can all contribute to reducing emissions, the ultimate solution to near full decarbonisation of transport is the substitution of fossil sources by CO2-free alternative fuels for transport.

Such a vision is guided less by idealistic ambition than practical as well as moral imperatives:

(1) Oil, the main energy source for transport overall, supplying nearly 100% of road transport fuels, is expected, with present knowledge, to reach depletion by 2050. Substitution of oil therefore needs to start as soon as possible and increase rapidly to compensate for declining oil production, expected to reach its peak within this decade. Climate protection and security of energy supply objectives would therefore both benefit from building up CO2-free and largely oil-free energy supply to transport with a time horizon of 2050[44].

(2) By 2030, the global car fleet is predicted to grow from 800 million to 1.6 billion vehicles and to 2.5 billion by 2050. This will be accompanied by an increasing scarcity and cost of energy resources. These trends will have to be addressed by a step change in technology to ensure the sustainability of mobility in the long-term[45].

As the EU progressively decarbonises the transport sector, it is inevitable the sector must directly consume less fossil energy since it is unlikely ever to be viable to capture CO2 emissions on vehicles.

order to upgrade heavier fractions into lighter products, such as diesel, naphta and kerosene. It also includes butanes and gasoline.

44 Report of the European Commission Expert Group on Future Transport Fuels, forthcoming.

45 Communication on a European strategy on clean and energy efficient vehicles.

While the oil industry does not foresee the end of oil as a major energy source by 2050, a number of its companies have already made significant investments to move away from dependence on oil and offer some examples of how some of the actors present in the EU refining market are looking at the longer-term.

4. IMPACTS OF FUTURE DEMAND DEVELOPMENTS ON THE REFINING INDUSTRY BY 2030

4.1. Demand projections according to implemented and adopted policies

This chapter provides a quantitative assessment of the medium-term impacts of expected demand developments in EU petroleum products on the EU refining industry.

It presents the results of running the PRIMES 2009 Baseline [business as usual] and PRIMES 2009 Reference [policy] scenario petroleum product demand projections on the OURSE refining module of the POLES energy model[46] in order to estimate the impacts of evolving demand in terms of:

1. Capacity requirements and capital investment requirements for additional process capacity or upgrade of existing capacity;

2. Production levels;

3. Levels of CO2 emissions;

4. EU import and export levels of petroleum products.

PRIMES projections were also run separately in the CONCAWE refining model[47], and results have also been reported below, for comparison with OURSE outputs.

The PRIMES 2009 Baseline demand projections result from developments in the assumed absence of new policies beyond those implemented by April 2009. It is not a forecast of likely developments, given that policies will need to develop. Therefore, there is no assumption in the Baseline that national/overall green-house gas (GHG) or renewable energy sources (RES) targets are achieved, nor of non-ETS (EU Emission Trading System) targets; CO2 emissions and RES shares are modelling results.

In contrast, the PRIMES Reference scenario reveals the effects of agreed policies, including the achievement of legally binding targets on 20% RES and 20% GHG reduction for 2020.

More details on both the PRIMES 2009 Baseline and Reference scenarios can be found in annex 3.

The impacts of the PRIMES demand projections are reported with a variation on the assumptions of the refining model with regard to future marine sulphur fuel specifications which are expected to be transposed into EU regulation. The impacts of such changes are reported separately due to the important investments that they will require by the EU refining

[46] The POLES (Prospective Outlook for the Long-term Energy System) model simulates the energy demand and supply for 32 countries and 18 world regions. Further details on the OURSE refining module of POLES can be found in annex.

[47] CONCAWE is the oil companies' European association for environment, health and safety in refining and distribution. The CONCAWE EU refining model simulates the EU (incl. Switzerland and Norway) refining system. More information on the model can be found on the internet site of the association (www.concawe.be).

industry if it decides to produce shipping fuel that meets the new specifications. Specifically, the variations in fuel specification changes that are modelled here are as follows:

Case A: assumes a change in maximum permitted sulphur content in marine fuel for Emission Controlled Areas (ECAs) in the EU (the Baltic Sea and the North Sea & English Channel) from 1.5% to 1% by 2010 and then down to 0.1% by 2015; and for the rest of the world: from 4.5% to 3.5% in 2012 and then down to 0.5% from 2020[48].

Case B: assumes no changes in maximum permitted sulphur content in marine fuel beyond 2012, i.e: ECAs remain at 1% and the rest of the world remains at 3.5%.

Note that in comparing a case including future IMO changes to one excluding them, in the latter case the changes to 1% and 3.5% respectively for the ECAs and the rest of the world have been taken for granted. As was explained previously in this document, this is because it is generally regarded that such changes will not pose significant problems for refiners – blends can simply be modified to redistribute the higher sulphur components - while the real challenge will be the changes to 0.1% sulphur content and 0.5% respectively for the ECAs and the rest of the world, as these will likely require the conversion of bunker fuels to diesel[49]. This will require investment in desulphurisation or conversion capacities.

The context for the impacts on the EU refining industry which are reported below in terms of key additional outputs from the OURSE model, is as follows:

(1) Production of petroleum products: the production levels of EU refineries during the period 2005 to 2030 is projected to fall by 14%, similar to the projected fall in demand in the PRIMES Reference scenario over that period[50];

(2) Trade flows: it is expected that Russia will have sufficient refinery capacities in middle distillates during the projection period to continue to supply the EU, while North-America will not continue to absorb the excess gasoline that the EU is projected to produce, such that new markets will have to be found. According to the OURSE model, by 2030, the EU net exports of gasoline will total 19.4 mtoe, equivalent to 18% of EU gasoline production for that year while EU net imports of gasoil/diesel will be 37.7 mtoe, equivalent to 15% of EU diesel/gasoil demand in 2030. In comparison, OURSE numbers for 2005 show that the EU net exports of gasoline amounted to 32.4 mtoe, equivalent to 21.5% of its gasoline production in 2005, and gasoil/diesel net imports were equivalent to 28.2 mtoe, amounting to 9.7% of EU gasoil/diesel demand in that year[51]. In short therefore, the OURSE model projects resultant trade flows for the economically optimal capacity required to satisfy the PRIMES reference demand which amount to falling gasoline exports and increasing gasoil/diesel imports by 2030 compared to 2005.

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48 The CONCAWE EU refining model makes the same assumptions as OURSE with regard to the timing and nature of the fuel specification changes in the ECAS, while for the rest of the world it assumes that the change from 4.5% to 3.5% already occurs in 2010.

49 Current technology cannot achieve reductions in the sulphur content of residues to 0.1% unless a very low sulphur feed is used. If it was possible, it is questionable whether refiners would not rather prefer to focus instead on converting residual fuel to lighter, more valuable fuels, and decide to stop supplying the bunker market altogether.

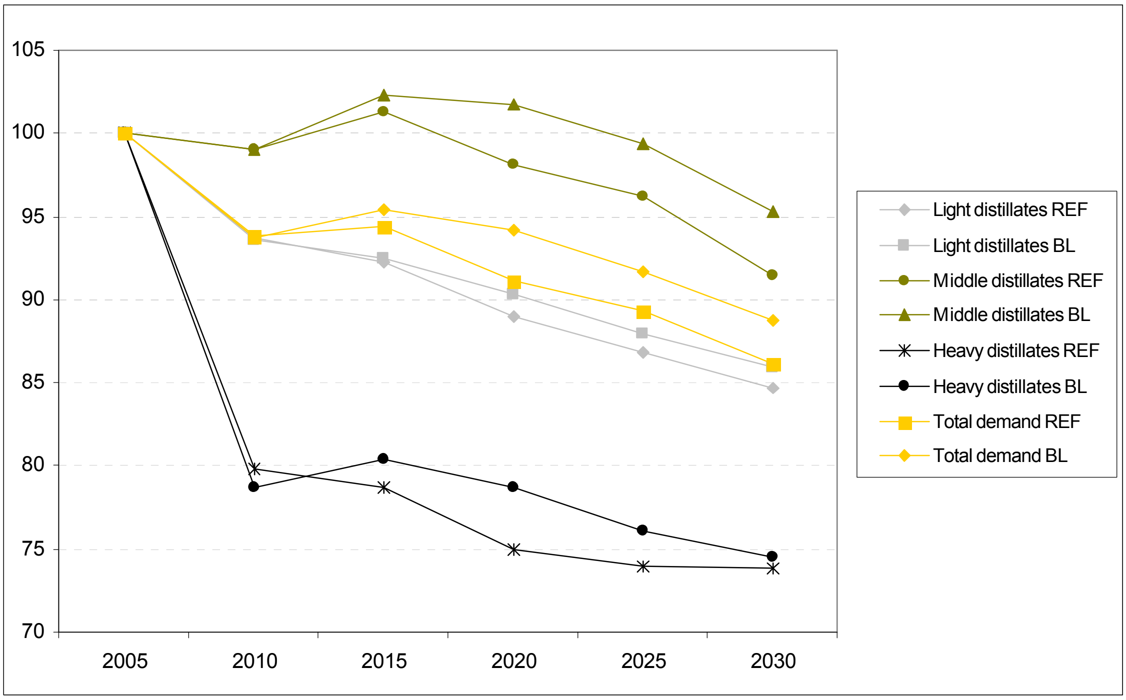
50 The CONCAWE model supply growth projections reveal an 11% drop in the 2005-2030 period.

51 The CONCAWE European refining model is run with fixed imports and exports outside the EU, and therefore keeps the trade situation constant over time. The sensitivity of the model to trade flows was however tested by changing the assumptions made with respect to the volumes of exports and imports to reflect the trade situation projected by the OURSE model as described above.

A key assumption of the OURSE model is with regard to the evolution of the EU crude diet. Globally, it assumes that by 2030, the API degree of conventional crude oil will have slowly decreased while sulphur content should increase slightly. However, it is expected that this will be balanced by an increasing share of condensates used in refinery production and the availability of upgraded crude oil from extra-heavy oil. In the case of the EU, the OURSE model assumes relative stability between 2005 and 2030, both in terms of the API degree and sulphur content of refineries supply, as along with an increasing share of condensates, the assumption is included of an expected doubling of the share of high medium distillate yielding crudes[52] .

Note in addition that the OURSE model treats the EU27, Switzerland, Norway and Turkey together as forming the region of Europe, broken down into two zones: Z3 (Northern Europe) and Z4 (Southern Europe). Impacts are therefore reported for the EU27 + these three countries. While it cannot be easily estimated what amount of the investments and CO2 emissions are EU27 specific, it is useful to note that IFP simulate EU27 demand into the OURSE model by using topping unit[53] capacity proportions. By that measure, Norway and Switzerland represent 4% of Z3 capacity and Turkey, 12.5% of Z4 capacity.

EU petroleum products demand projections, PRIMES 2009 Baseline and Reference scenarios compared



As the chart above reveals, whether business as usual or policy targets beyond April 2009 are assumed makes little differences in terms of the demand projections in petroleum products for the EU. The general trends in both cases can be summarised as follows:

(1) A general fall in the level of consumption of petroleum products;

(2) The continued gradual erosion of demand for high sulphur residual inland fuel and marine bunkers (which make up heavy distillates);

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52 The CONCAWE model assumes no change in crude mix over time.

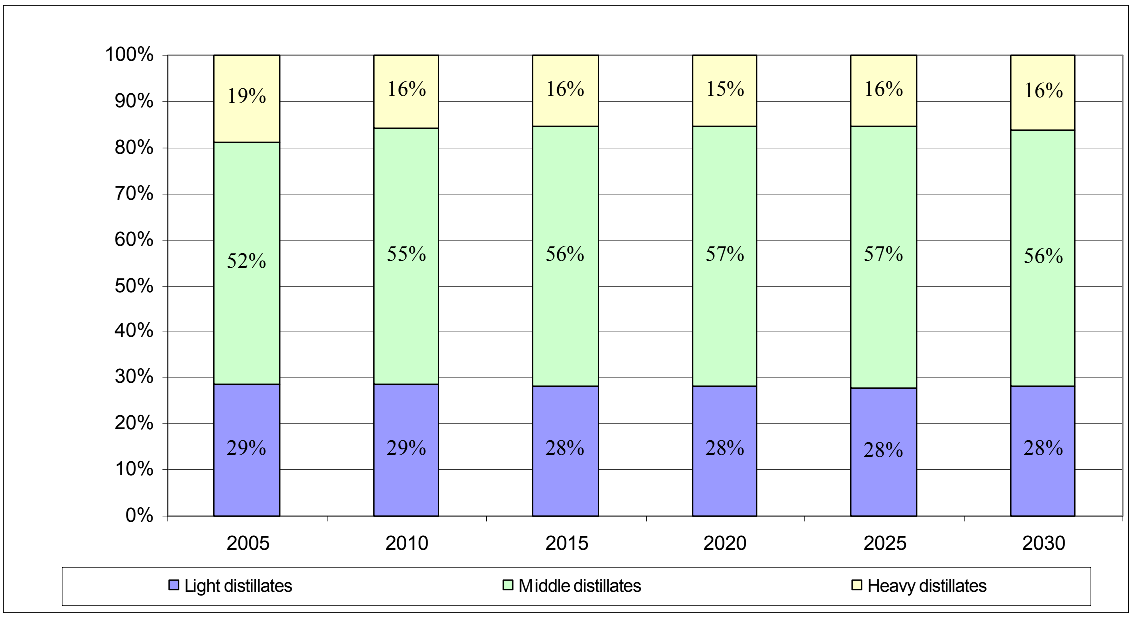
53 Topping refining is the simplest configuration of refining, and a part of the distillation process. It thus involves no treating or conversion.

(3) An initial increase in demand for middle distillates (including gasoil, heating oil, kerosene and jet fuel) followed by an eventual and overall fall, mainly resulting from a decrease in road diesel demand due to regulation to restrict CO2 emissions from cars becoming effective[54] as the car parc is gradually renewed and due also to the spill over effects from more efficient car engines to those of trucks (truck diesel consumption stabilises between 2020 and 2030);

(4) A continued fall in the demand for gasoline (included in light distillates, along with naphta). Note that the PRIMES demand projections do not assume a change in the current taxation regime in the EU, which differentiates between diesel and gasoline in favour of the former.

It is important to note that in both scenarios, the proportion of middle distillates in total demand increases quite significantly between 2005 and 2010, after which it remains fairly stable.

PRIMES Reference scenario EU demand projections split by type of product



4.2. The impact of demand projections on the EU refining industry

4.2.1. Impacts in terms of refining investments

According to the OURSE model, the impacts of the Reference scenario in terms of the investments required to upgrade EU+3 refining capacities amount to 17.8 billion Euros between 2005 and 2030, of which 3.3 billion Euros account for IMO changes[55].

54 The CO2 from cars regulations included in the PRIMES Baseline and Reference scenarios require strong reductions in the average fuel consumption of new cars. Binding targets are 130g/km by 2010 and 115g/km by 2020. (it should be noted that the Regulation contains a provisional goal of 95g/km for 2020)

55 Note that the differences between demand projections under the Baseline scenario and the Reference scenario are not significant enough to make any notable difference in terms of investments according to the OURSE model outputs.

This results primarily from investments in extra gasoil hydrodesulfurisation units which will be in short supply on the basis of both the Baseline and Reference Scenarios projections. The chart below shows the volumes that will be needed to meet demand in the Reference scenario, though there is little difference between the two scenarios (Baseline demand will require slightly more investments in all of the same types of units, excepting cokers[56]). Note that the new IMO regulations will require 14.3 million/t year of extra capacity by 2030 (the difference between case A and case B in the chart below), mainly in terms of extra hydrocraking[57] units (amounting to 6.6 million t/year), hydrodesulphurisation of residuals (amounting to 5.4 million t/year) and hydrotreating of vacuum gasoil[58] (4.2 million t/year).

Thus, the levels of investments required in order to supply initially rising (but over the whole period, falling) levels of middle distillates is quite considerable, and even with such investments, imports are projected to rise further.

One variation that has been undertaken on the OURSE model runs of the PRIMES Reference demand projections is with regard to crude oil supply projections. As was highlighted above, the OURSE model projections assume a balanced crude diet between 2005 and 2030 in Europe, which along with an increasing share of condensates relies on a doubling of the share of high medium distillate yielding crudes. Simply keeping the share of such crudes constant during that period (with the consequence of an important increase in the overall sulphur content) in the OURSE model however results in total investments between 2005 and 2030 of 29.7 billion Euros of which 9.3 billion Euros alone account for IMO changes.

Running the PRIMES Reference scenario projections on the Concawe model while keeping trade levels between 2005 and 2030 constant would require 29.2 billion Euros of investments in that period, of which 13.3 billion Euros would have to be spent due to the new IMO changes. The same demand projections combined with an augmentation in the importation of gasoil/diesel between 2005 and 2020 from 20 Mt/year to 40 Mt/year (and staying at that level every year thereafter to 2030) will however require total investments of 25.8 billion Euros between 2005 and 2030, of which IMO changes alone amount to 11.7 billion Euros.

Concawe estimates that the amount of investments that the refining industry in Europe has already committed to spending (or what it calls firm projects) between 2010 and 2020 is of the order of 13.3 billion Euros.

Note in addition that according to the Concawe model results, cumulative refining investments between 2005-2020 are higher than for 2005-2030, a reflection of falling demand in petroleum products according to the PRIMES demand projections. This highlights a particular dilemma faced by refiners of investing early in capacity that will only be partially utilised at a later point in time in the non too-distant future.

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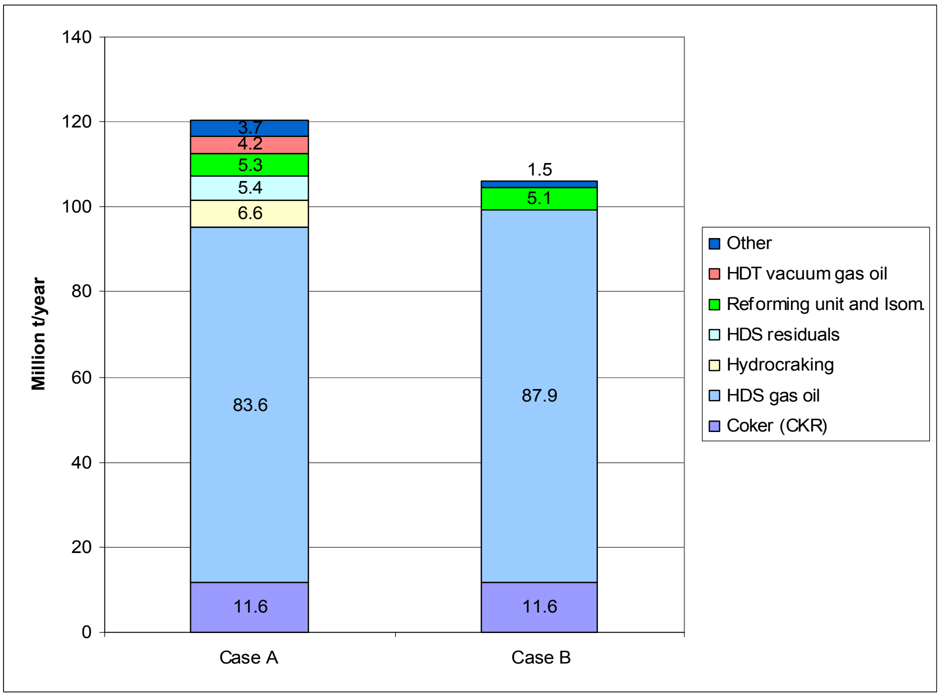
56 Delayed coking units are a type of deep conversion unit, which are the most sophisticated refining units. Cokers crack residual oil hydrocarbon molecules into coker gas oil and petroleum coke.

57 The process whereby hydrocarbon molecules of petroleum are mainly broken into jet fuel and diesel oil components by the addition of hydrogen under high pressure in the presence of a catalyst

58 Hydrotreating of vacuum gasoil is a process that removes sulfur and nitrogen from vacuum gasoil, which is the product recovered from vacuum distillation.

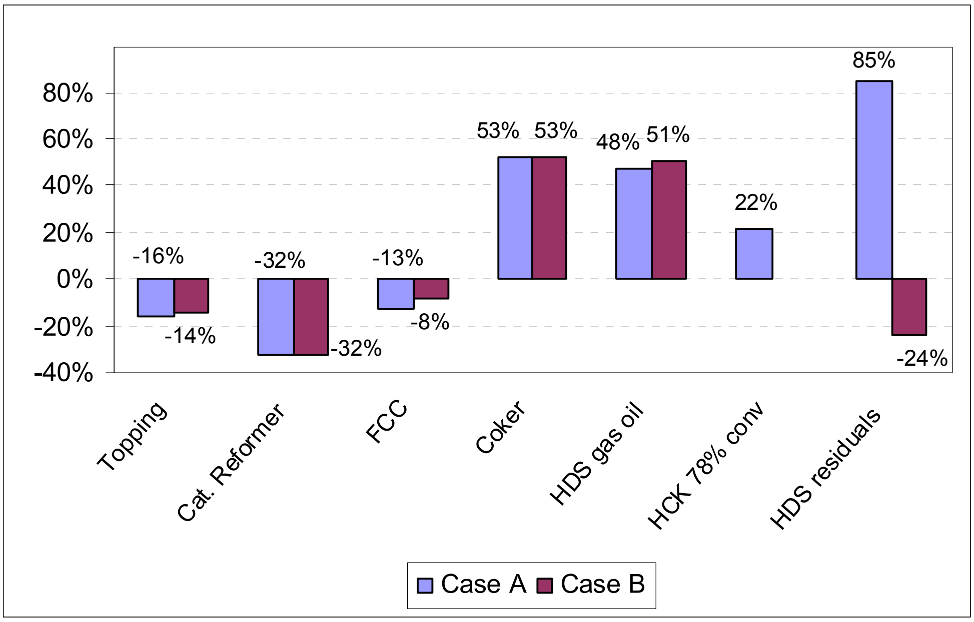
OURSE model investments in refining capacity in EU+3, 2005-2030, on the basis of the Reference demand projections, split by type of unit



4.2.2. Utilisation of refining units

According to OURSE model results, in terms of changes in refining capacity from 2005 levels by 2030, whether new IMO regulations are assumed or not, similar reductions in the use of simple refining capacity can be expected to occur, while similar increases in the use of cokers and hydrodesulphurisation units should result. In addition, assuming IMO changes will require significant increase in the use of residual hydrodesulphurisation and some 22% increase in the use of hydrocracking units. Note again that there is very little difference between the PRIMES Baseline and Reference cases in terms of the demand projections in petroleum products for the EU as there is little difference between the two in terms of the demand projections in petroleum products for the EU.

Necessary changes in refining capacity use in EU+3, 2005-2030, on the basis of the reference demand projections



4.2.3. CO2 emissions

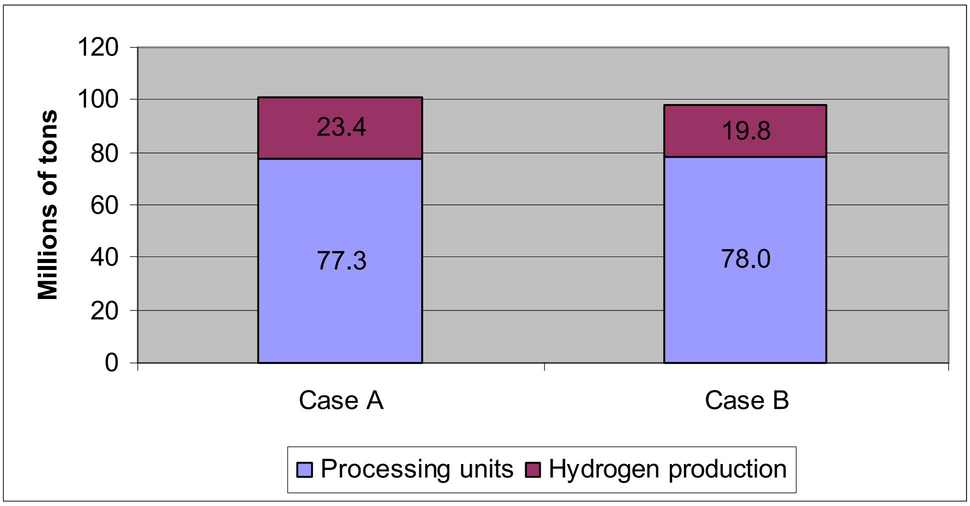
Whether IMO changes are assumed or not in the OURSE model makes little difference in terms of CO2 emissions from EU+3 refineries by 2030, which are projected to emit around 100 million tonnes of CO2. This compares to 118.5 million tonnes of CO2 in 2005[59], the fall in emissions resulting from falling production of petroleum products. Note however that in both cases, a growing proportion of the CO2 emissions will come from the needs for hydrogen in refineries (hydrocracking units uses hydrogen to upgrade heavier fractions into lighter products while hydrodesulphurisation units use hydrogen to chemically remove the sulphur), such that by 2030, 20% of all CO2 emissions from EU refineries will come from hydrogen production, compared to only 14% in 2005. Specifically, CO2 emissions due to the IMO changes amount to 3.3 million tonnes of CO2 in the reference case, essentially as a result of the extra emissions from hydrogen use.

Changing the crude supply assumptions towards an increase in the sulphur content of the EU crude diet (by keeping the proportion of high middle distillate yielding crudes, as explained above) would however result in a level of CO2 emissions of 110.3 million tonnes in 2030, 5.6 million tonnes as a direct result of new IMO changes.

In contrast, the Concawe refining model results reveal that in spite of declining market demand for fossil fuels, processing intensity in refining increases as a result of more stringent product specifications, particularly in the case including IMO changes, and consequently that refinery CO2 emissions will increase somewhat between 2005 and 2030, by around 6% (and increasing by 12% between 2005 and 2020).

59 IFP estimations of EU refineries CO2 emissions. In comparison to 118.5 million tonnes of CO2 emitted in 2005. Note that this does not include emissions related to petrochemical activities.

OURSE model CO2 emissions of EU refineries by 2030 in EU+3, on the basis of the Reference demand projections



4.2.4. Summary: impact of demand projections on the EU refining industry

EU refining capacity upgrading is expected to lead to significant reductions in exports of (excess supply of) gasoline by 2030, while it is expected that the import dependence of the EU in gasoil/diesel will continue to increase by 2030.

Depending on assumptions on the development of the crude diet in Europe between 2005 and 2030 and taking into account adopted and implemented EU policies, investments required to upgrade European refining capacities in that period could amount to between 17.8 and 29.3 billion Euros, of which between 3.3 and 11.7 billion Euros alone will account for future marine sulphur fuel specification changes to be transposed into EU regulation by the end of 2010. These figures result from a scenario of increasing import dependence in gasoil/diesel.

It is estimated that the amount of investments that the refining industry in Europe has already committed to spending (in what it calls firm projects) between 2010 and 2020 is of the order of 13.3 billion Euros.

In spite of projections of declining demand for fossil fuels, processing intensity in refining will increase as a result of more stringent product specifications, in particular as a result of new IMO changes. One possible consequence is that refinery CO2 emissions will increase between 2005 and 2030, by around 6% (and increasing by 12% between 2005 and 2020), mainly as a direct result of the needs for hydrogen in refinery units geared towards producing higher proportions of new IMO compliant fuel.

Significant falls in the projected EU demand for transport gasoline by 2030 according to PRIMES (of 20.7% in the Reference scenario) point to the need for gasoline-focussed refinery plant restructuration, with necessary capacity reductions by up to a third, depending on the type of unit.

1. ANNEX 1: REFINING AND APPLICATIONS OF REFINING PRODUCTS

1.1 Introduction to refining

An oil refinery represents one link in the chain of an integrated business that provides oil products to Europe's consumers. From exploration and production through to crude oil trading and refining to distribution, finished products trading and sales to end-consumers.

The role of refineries in the supply chain of the petroleum industry is to process crude oils into the finished products that are needed by the market. Refineries can use a variety of processes and can have very different configurations.

Essentially, refining breaks crude oil down into its various components, which are then selectively reconfigured into new products such as fuels and lubricants for automotive, ship and aircraft engines. Refining by-products can then be used in petrochemical processes to form materials such as plastics and foams.

Crude oil can be used in many different ways because it contains a broad mix of hydrocarbons (i.e. molecules made of hydrogen and carbon atoms which range from very light to very heavy) of varying molecular complexity: different masses, forms and lengths. Such various structures mean differing properties and thereby uses. These hydrocarbons must be separated and refined prior to commercial use.

1.2. Refined products

Refined products are commonly split into light, middle and heavy distillates and specialty products.

Light distillates include gasoline, which is mainly used as a motor fuel, LPG (liquid petroleum gas) which is commonly used as a fuel in heating appliances and vehicles, and naphta, used as feedstock in the production of petrochemicals such as plastics and fibres.

Middle distillates include gasoil, diesel, kerosene and aviation/ jet fuel. Gasoil is mainly used in domestic heating, while diesel is used as a motor fuel and also as a fuel in agricultural vehicles, small boats and trains. Jet fuel and kerosene are used to power airplanes and kerosene is also sometimes used in domestic heating.

Heavy distillates are composed of bunker fuels for large ship engines and heavy fuel oil for industrial installations such as power stations and boilers.

Specialty products include bitumen (used to make road asphalt and roofing materials), waxes (including polishes, candles, food paper), lubricants and greases for automotive and industrial applications, coke for specialty applications like electrodes and hydrocarbon solvents, primarily used in specialty industrial applications.

Most refineries are known as 'fuels refineries' and usually produce a mix of the main products, which are diesel, gasoline, heating gasoil, jet fuel and heavy gasoil as well as LPG. Other refineries, known as 'specialty refineries', specialise in one or a combination of the specialty products above.

1.3. Refinery processes

The processes used by refineries can be classified into three categories: separation, treating and conversion.

1.3.1. *Separation*

The first process of any refinery is the separation or fractionation of crude into different fractions by distillation, known as atmospheric distillation.

Separation is achieved by raising temperature of the input crude to circa 360°C. This vaporises individual fractions of the crude feed which then condense and separate out according to the varying boiling points and densities of petroleum products. Lighter fractions such as LPG, naphta and kerosene have lower boiling points, lower carbon content and higher hydrogen content than heavier factions such as vacuum gasoil and vacuum residues.

This process is known as simple distillation, also referred to as topping or hydroskimming when done in the presence of hydrogen. The use of a vacuum enables the products to vaporise at lower temperatures, which is known as vacuum distillation.

1.3.2. *Treating*

Treating improves the quality of petroleum fractions distilled in order to meet the specifications of finished products. Hydrotreating processes use hydrogen (a by-product of the reforming process) and catalysts to remove sulphur and other contaminants such as salts, nickel, vanadium and nitrogen oxides. Examples of hydrotreating processes include hydrogenating, hydrofining and hydrodesulphurisation.

1.3.3. *Conversion*

Cracking, visbreaking and coking processes break down (convert) large, less valuable, hydrocarbon molecules into smaller, more valuable, lighter ones.

In a cracking refinery, atmospheric residue (an output from distillation) is further distilled under vacuum conditions to recover vacuum gasoil (VGO). A vacuum residue also results from vacuum distillation. VGO is then fed into a cracking unit that converts part of it into a mix of hydrocarbons that boil in the atmospheric distillation range. The most common crackers are fluid catalytic crackers (FCCs) and hydrocrackers.

Conversion refineries such as FCCs and hydrocrackers usually contain all the processing units of a hydroskimming refinery to which a number of conversion units are added. Conversion refineries would typically require more energy per unit of crude intake compared to hydroskimming refineries. They would therefore also generate more Green House Gases (GHG) per unit of crude oil intake.

Deep conversion units are the most sophisticated types of refineries. They convert vacuum residue into lighter products. Such refineries are becoming more and more the norm, with the increasing demand for lighter, cleaner products and the rapidly declining use of heavy residual fuels. Deep conversion refineries are even more energy intensive than conversion units and as a consequence generate more GHG emissions per unit of crude oil intake.

1.4. Types of refinery units

The **topping** unit is the simplest configuration, with no conversion or treating. It is able to produce a number of products suitable for direct use in the end-market such as LPG, kerosene (which can be used directly as a heating fuel or can be upgraded to jet fuel) and heating gasoil, if produced from very low sulphur crudes. However, no crude oil can produce gasoil that meets current EU diesel quality specifications without desulphurisation, therefore topping refineries cannot produce diesel for the EU market. Topping also produces naphta, fuel gas (which is used as a fuel for the refinery) and residue. The atmospheric residue is a fuel oil with a quality that varies according to the quality of the crude processed.

Hydroskimming units upgrade naphta to gasoline and gasoil to diesel and heating oil. Such refineries are equipped with astmospheric distillation, naphta reforming and the necessary treating processes. Note that hydroskimming refineries must normally produce some gasoline in order to have the hydrogen needed to produce diesel, which limits the possibilities to optimise gasoline and diesel production independently. These units generally do not contain catalytic conversion processes and therefore their product distribution reflects closely the composition of the crude oil processed.

Hydrotreating units use hydrogen (a by-product of the reforming process) and catalysts to remove sulphur and other contaminants such as salts, nickel, vanadium and nitrogen oxides. Examples of hydrotreating processes include hydrogenating, hydrofining and hydrodesulphurisation.

Isomerisation and reforming units are used to rearrange the structure of petroleum molecules to produce higher-value molecules of a similar size. These new molecules could have a higher octane number than the original ones and are therefore a more valuable gasoline blending component[60]. For example, **catalytic reforming units** are used to convert low octane petroleum refinery naphtha into high-octane liquid products called reformates which are components of high-octane gasoline.

A **fluid catalytic cracker** (FCC) uses catalysts and high temperature to crack/break down vacuum gasoil or residue into mainly gasoline and a small volume of (poor quality) gasoil. The proportion of gasoline and gasoil produced by an FCC refinery is relatively fixed. The ability to change yields and reduce gasoline production is limited by a number of constraints. FCC units were the main choice of European refineries in the 1970s and 1980s when there was a strong growth in demand for gasoline.

A **hydrocracker** uses catalysts, hydrogen, high pressure and high temperature to crack vacuum gasoil or residue into mainly (good quality) gasoil and jet fuel. Note that hydrogen produced from reforming is insufficient to feed a hydrocracker, such that a hydrocracking unit needs an additional dedicated hydrogen supply. Hydrocracking refineries can be designed with a greater ability to vary the relative yields of diesel and gasoline, resulting in increased refinery flexibility. In the 1990s, when EU demand began to switch from gasoline to diesel, gradually more investment went into hydrocracking units, although catalytic crackers are still the dominant configuration in Europe.

A **coker** unit converts vacuum residue or residue into low molecular weight hydrocarbon gases, naphtha, light and heavy gas oils, and petroleum coke. The process thermally cracks the long chain hydrocarbon molecules in the residual oil feed into shorter chain molecules.

Examples of **deep conversion** units are residue FCCs, which is an FCC unit designed to crack residue as well as VGO; residue hydrocracking, which cracks residue rather than VGO and delayed coking which is a very high-severity form of thermal cracking. Deep conversion capacity accounts for less than 3.5% of crude distillation capacity.

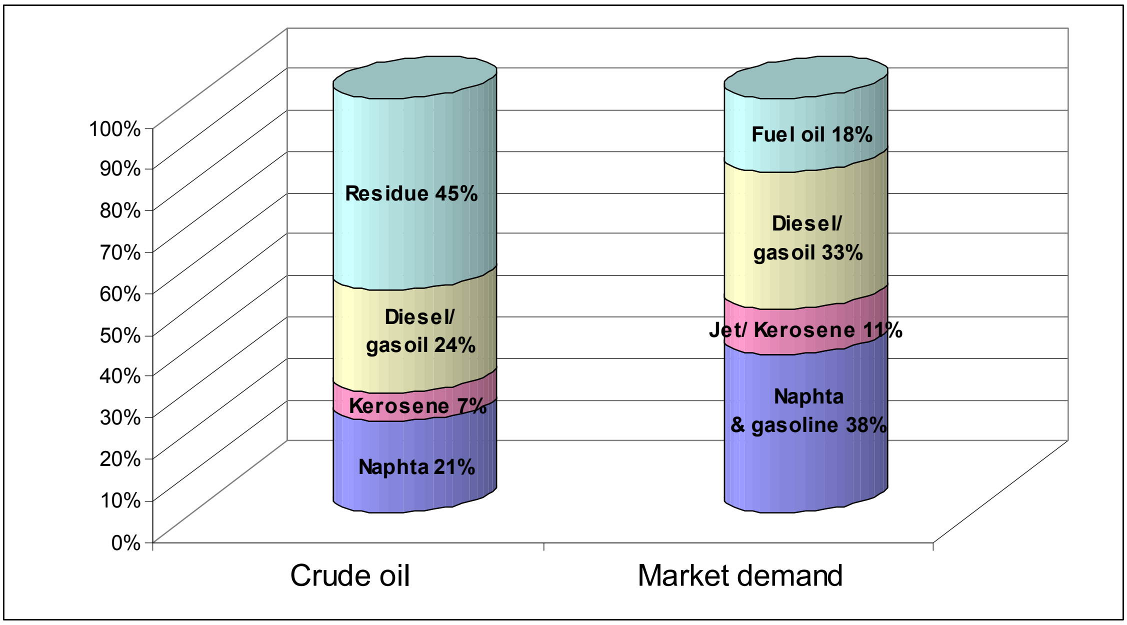
60 The octane rating of gasoline is an indicator of how much the fuel can be compressed before it spontaneously ignites. When gas ignites by compression rather than because of the spark from the spark plug, it causes 'knocking' in the engine, which can damage an engine. Lower-octane gasoline can handle the least amount of compression before igniting.

1.5. Refinery yield

The yield from a refinery will depend on the processes that it has and the type of crude oil that it processes.

Once a refinery has been built with a certain configuration and designed for a certain type of crude, there is little it can do to change its yield structure significantly without major investment in new processes.

Comparison of average yield of crude distillation and market demand



Source: Purvin & Gertz

The average yield obtained from crude distillation does not match the proportion of products demanded by the market. To rectify this, refiners use different combinations of conversion and treating processes to produce lighter products from residue. For comparison, a hydroskimming refinery designed to process North Sea Crude would achieve a fuel oil yield of approximately 33% of total finished products. An FCC refinery processing the same crude would have a fuel oil yield of only 13% of finished products while the fuel oil yield of a hydrocracking refinery would be similar to that of an FCC refinery with the additional advantage that a greater proportion of the yield would be made up of middle distillates and a smaller proportion of the yield would be gasoline.

The costs of building FCC and hydrocracking refineries are comparable and much more expensive to build than hydroskimming refineries.

2. ANNEX 2: CHARACTERISTICS AND EVOLUTION OF THE EU REFINING SECTOR

2.1. Description of the EU refining sector

2.1.1. Capacity

In May 2010 there were around 104 refineries operating in the European Union. The EU's crude refining capacity currently represents 778 million tonnes, equivalent to 18% of total global capacity. The EU is the second largest producer of petroleum products in the world after the United States. There are refineries in 21 Member States with the exceptions of Cyprus, Estonia, Latvia, Luxembourg, Malta, and Slovenia.

Over half of the refining capacity in the EU is in North Western Europe (NWE), slightly more than a quarter in the Mediterranean region (MED) and the rest in Central and Eastern Europe (CEE)[61]. These regional groupings are based on the state of infrastructure and geographical accessibility to different crude streams and transportation routings. Usually, the crude intake in NWE is mainly a mix of North Sea crude, followed by Urals, which has a lower API[62] and higher sulphur content. Conversely, in Central Europe, refineries are often located on the Druzhba pipeline, and the great majority of their intake is Urals crude. In the Mediterranean area, the larger proportion is Arabian Gulf, which is again heavier than Urals crude, with similar API but higher sulphur content, followed by Urals crude.

EU refineries by region, by number and capacity

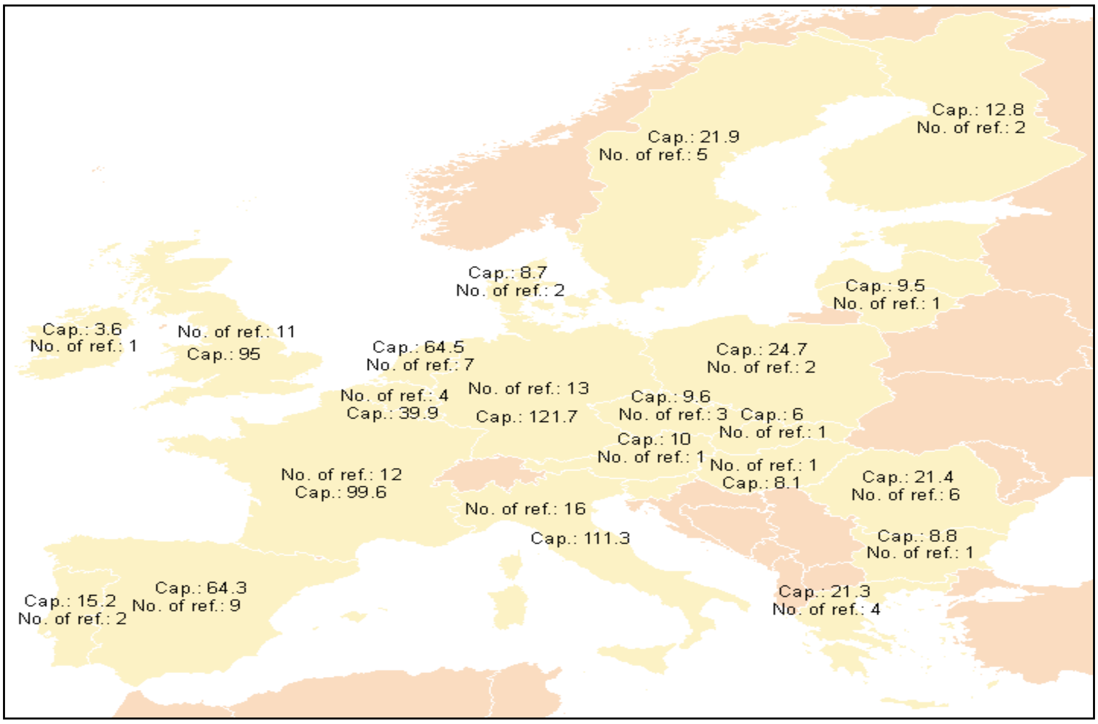
REGION	NUMBER OF REFINERIES	CAPACITY MT/YEAR	CAPACITY MBBL/DAY	CAPACITY %
North West Europe (NWE)	56	465	9.3	60
Mediterranean (MED)	31	212	4.2	27
Central and Eastern Europe (CEE)	17	101	2	13
Total	104	778	15.5	100

Source: European Commission. Note: capacity refers to crude processing capacity.

61 NWE: Austria, Belgium, Denmark, France, Germany, Ireland, Netherlands, Sweden, UK. MED: Greece, Italy, Portugal, Spain. CEE: Bulgaria, Czech Republic, Finland, Hungary, Lithuania, Poland, Romania, Slovakia.

62 API expresses a crude's relative density, with the higher the API gravity, the lighter the crude.

EU refinery numbers and capacity, in million tonnes per year, by Member State



Source: European Commission

EU refinery numbers and capacity, by Member State

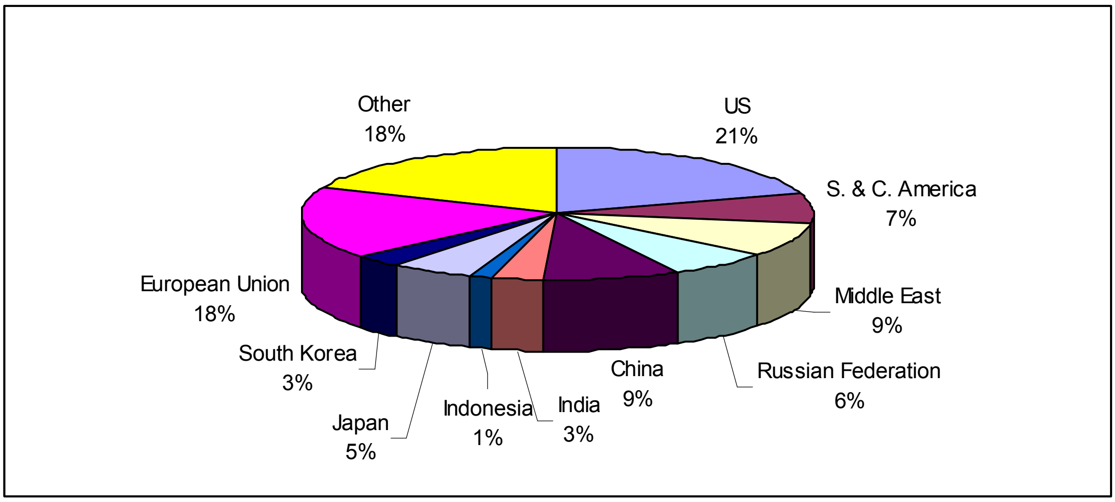
Country	Number of refineries	Crude refining capacity	
		kt/Year	bbl/day
Austria	1	10,006,852	200,000
Belgium	4	39,907,326	797,600
Bulgaria	1	8,806,030	176,000
Czech Republic	3	9,606,577	192,000
Denmark	2	8,680,944	173,500
Finland	2	12,783,752	255,500
France	12	99,578,190	1,990,200
Germany	13	121,743,365	2,433,200
Greece	4	21,264,560	425,000
Hungary	1	8,055,516	161,000
Ireland	1	3,552,433	71,000
Italy	16	111,333,164	2,225,600
Lithuania	1	9,506,510	190,000
Netherlands	7	64,534,191	1,289,800
Poland	2	24,666,891	493,000
Portugal	2	15,210,416	304,000
Romania	6	21,388,497	427,525
Slovakia	1	6,004,111	120,000
Spain	9	64,315,961	1,282,500
Sweden	5	21,864,972	437,000
United Kingdom	11	94,990,049	1,898,500

Total EU	**104**	**777,800,307**	**15,542,925**

Source: European Commission

EU capacity in the global context

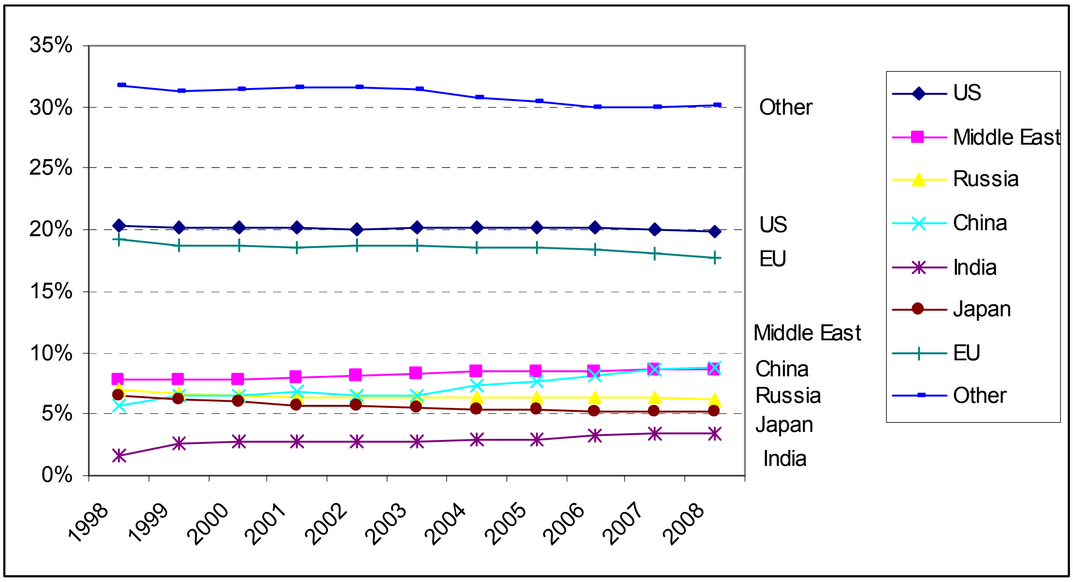
World crude processing capacity split, 2008



Source: BP Statistical Review of World Energy 2009

As the chart below providing world trends in crude processing capacity shows, in the last ten or so years, the proportions of refining capacity in mature markets such as the EU, the US and Japan have trended downwards while emerging economies such as the Middle East, China and India have progressively been building up capacity.

World trends in crude processing capacity, 1998-2008



Source: BP Statistical Review of World Energy 2009

2.1.2. The players in the EU refining market

Total S.A. has the greatest refining capacity, and together with two other International Oil Companies (IOCs) (Shell and ExxonMobil), account for around half of total capacity in the NWE region. In the MED region, the company with the greatest capacity is Eni, while the three companies with the greatest capacity - Eni, Repsol and ExxonMobil - account together for over a third of capacity in that region. In the CEE region, the biggest player is PKN, with about a third of capacity. PKN, MOL and Neste together account for around two thirds of total capacity in the CEE region.

Overview of EU players active in refining crude oil

Type of player	Description	Example
International Oil Companies (IOCs)	Vertically-integrated with supply chain operations from exploration and production through to refining and retail marketing.	Shell, BP, ExxonMobil, Chevron, ConocoPhillips and Total
National Oil Companies (NOCs)	Often began as state-owned/controlled companies with significant operations within their national borders, but some have undergone transformation to publicly quoted entities with a wide share ownership.	PKN (Poland), MOL (Hungary), Eni (Italy), OMV (Austria), Rompetrol (Romania), KPC (Kuwait) and PDVSA (Venezuela)
Pure-Play Refiners	Specialise in refinery operations alone where they refine crude oil for other market players. Their business model involves an open market for wholesale products.	Ineos and Petroplus
Refiner and Marketers	Refinery operations are integrated with retail fuel marketing.	SARAS
Niche Refineries	Specialist refinery with specific processes such as bitumen plants.	Nynas

Source: Econ Pöyry AB

2.1.3. Refining margins

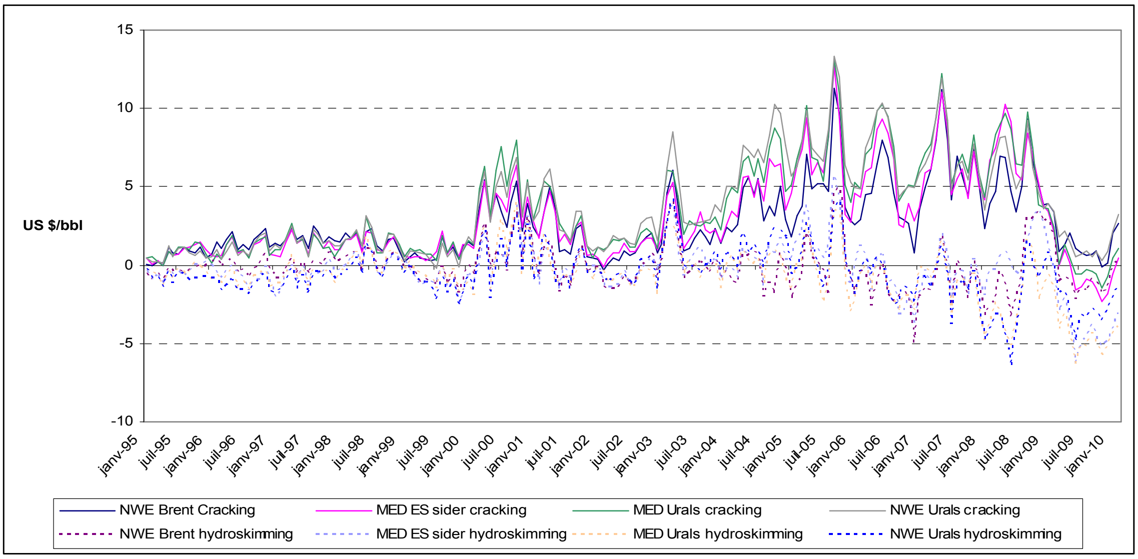
The refinery margin is the profitability that results from processing a barrel of crude oil. It reflects the difference between the market value of the combination of products produced by the refinery and the cost of buying the crude at market price as well as the operating costs incurred in the refining process.

Refining margins will generally rise if there is insufficient capacity to cover the demand needs, and will fall if the reverse is true. In Europe in the 90's, years of underinvestment in capacity in combination with high and growing oil demand kept refining margins high.

The charts below detail the trend in refining margins for simple hydroskimming refineries and complex cracking refineries for various crudes in NWE and the MED in recent years.

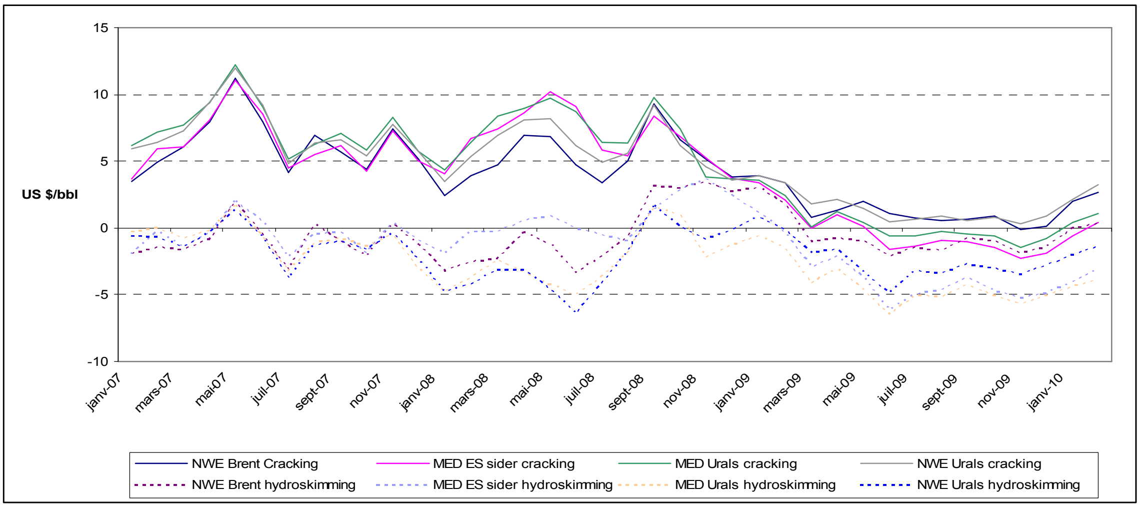
Looking at refining margins displayed in the next chart reveals more clearly the recent evolution of European refining margins. While a depression in margins can clearly be observed over the course of 2009, a pickup can also be seen at the end of the year, continuing into 2010.

Refining margins for simple and complex refiners in the EU, Jan 1995 – Feb 2010



Source: IEA

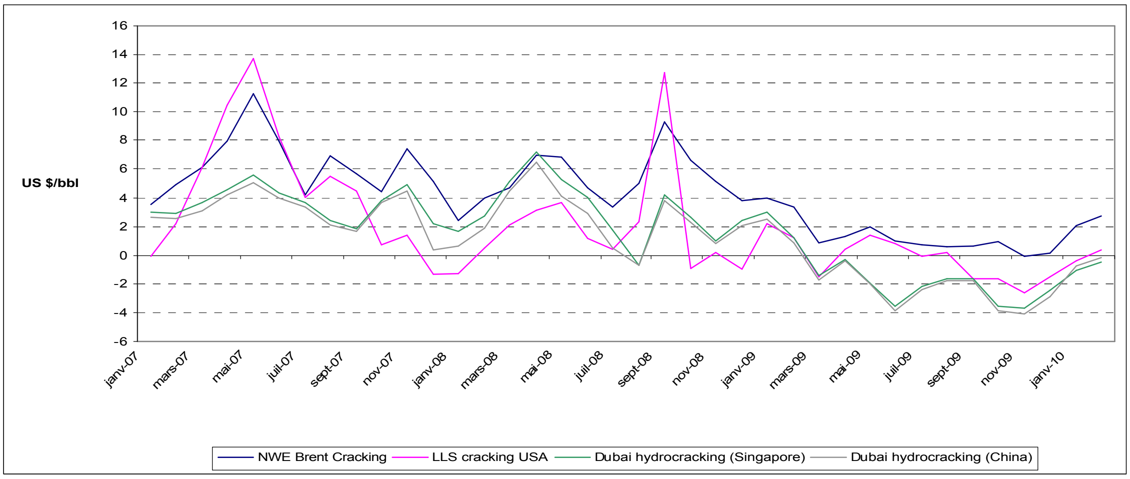
Refining margins for simple and complex refiners Jan 2007 – Feb 2010



Source: IEA

EU margins in the global context

Refining margins for complex refiners Jan 2007 – Feb 2010, comparison of world regions



Source: IEA

The chart above clearly shows that the crisis has impacted margins in all regions of the world. If average annual margins are compared, North-West Europe has even fared rather better than all other regions in comparison in the last three years (table below).

Average annual margins (in $/bbl)

YEAR	NWE BRENT CRACKING	LLS CRACKING USA	DUBAI HYDROCRACKING (SINGAPORE)	DUBAI HYDROCRACKING (CHINA)
2007	6.3	4.6	3.6	3.1
2008	5.2	1.9	3.1	2.4
2009	1.3	-0.2	-1.5	-1.8

Source: IEA

Margins outlook

In its January Oil Market Report the IEA explained that while refining margins rebounded this winter due to a drawdown in oil product inventories and recovering demand, the construction of refineries over the past two years and a massive contraction in oil consumption during the recession have led to a glut of capacity at the global levels. It thus maintains a bearish short-term outlook for the industry.

According to Wood Mackenzie consultancy, expectations in the EU are for continued negative simple margins, but for a recovery in complex margins to occur already in 2010. Wood Mackenzie project NWE Urals cracking margins[63] to reach $3.45/bbl in 2010

63 Given the increasing relevance of Urals crude in Europe (and falling relevance of Brent crude), it is more useful to look at Urals cracking margins going forward.

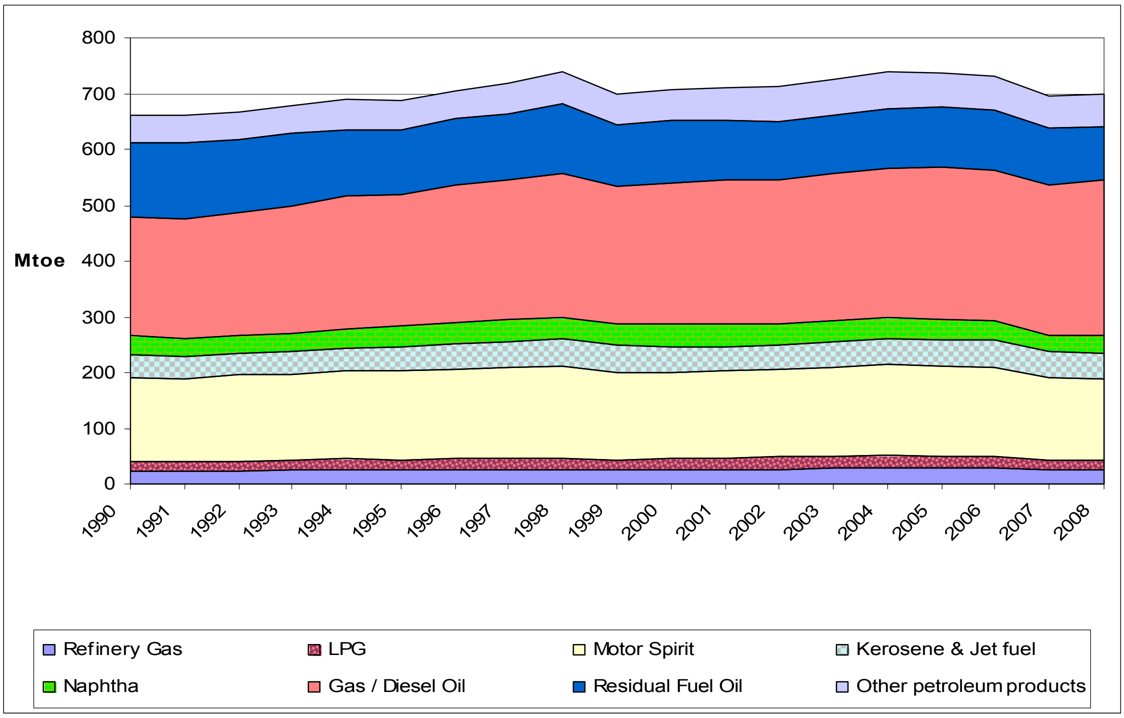
compared to \$2.62/bbl 2009 and \$4.62/bbl in 2008. According to the consultant, margins should continue to rise slowly, reaching levels of \$5.13/bbl in real (2010) terms by 2015.

According to the IFP, complex margins from \$3.4/bbl are "perfectly satisfactory from a refiner's perspective"[64]. On this basis, should Wood Mackenzie expectations be realised, complex refining in the EU should return to 'satisfactory' levels of returns before the end of the year.

2.2. Role of the EU refining sector in the supply of petroleum products

2.2.1. Output of the EU refining sector

EU refining sector production[65] evolution, 1990-2008

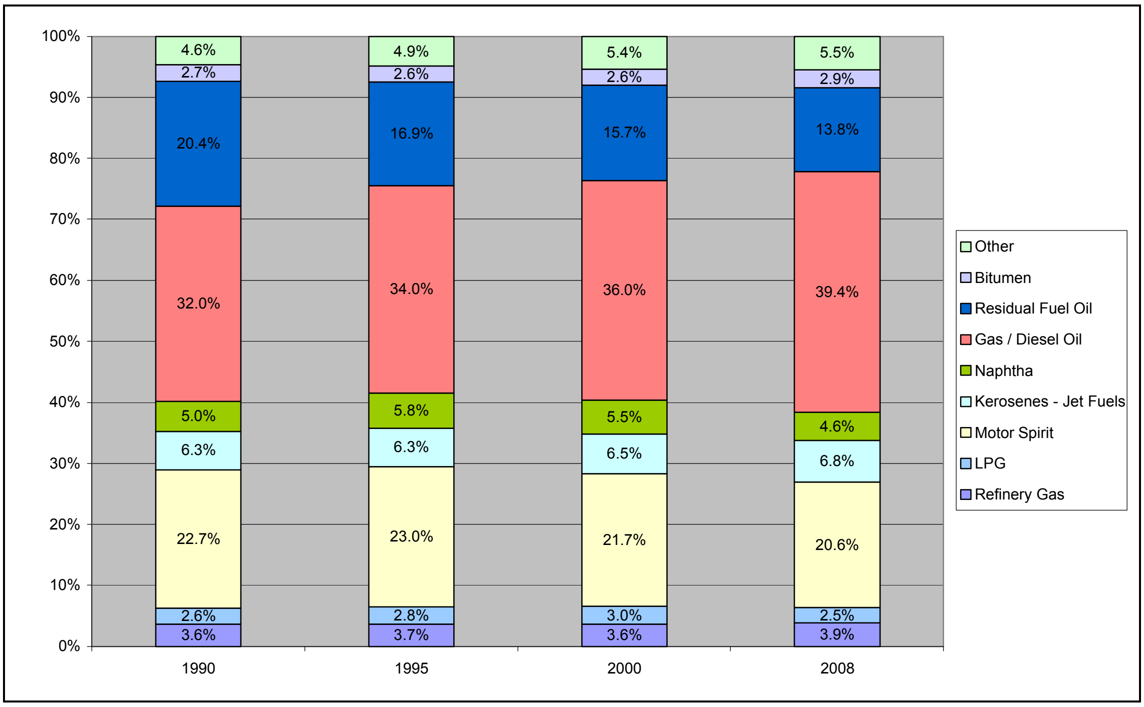


Source: Eurostat

64 Panorama 2009 "A look at refining", IFP.

65 EU refining production data shown here is equivalent to net transformation output of refineries, which excludes consumption in refineries.

EU refining sector production split, 1990-2008

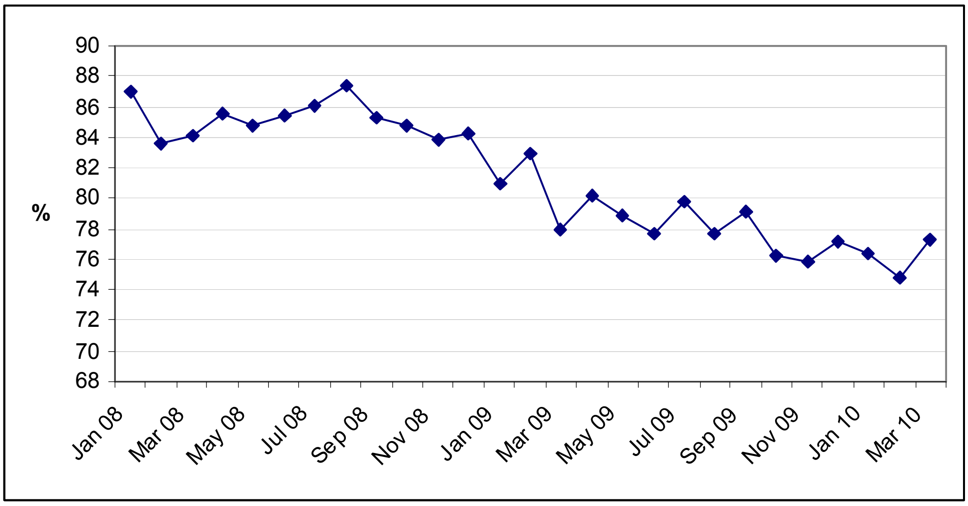


Source: Eurostat

Since 1990, EU refinery sector production has increased by 0.3% per year. In that time, fuel oil production was significantly reduced, while motor spirit (gasoline) production decreased by 4.2%. Gas/diesel oil production increased by 30.4% during that period, and it went from representing 32% of total production in 1990 to 39% by 2008.

2.2.2. Utilisation rates

Utilisation rates, OECD Europe



Source: IEA

Utilisation rates, OECD Europe

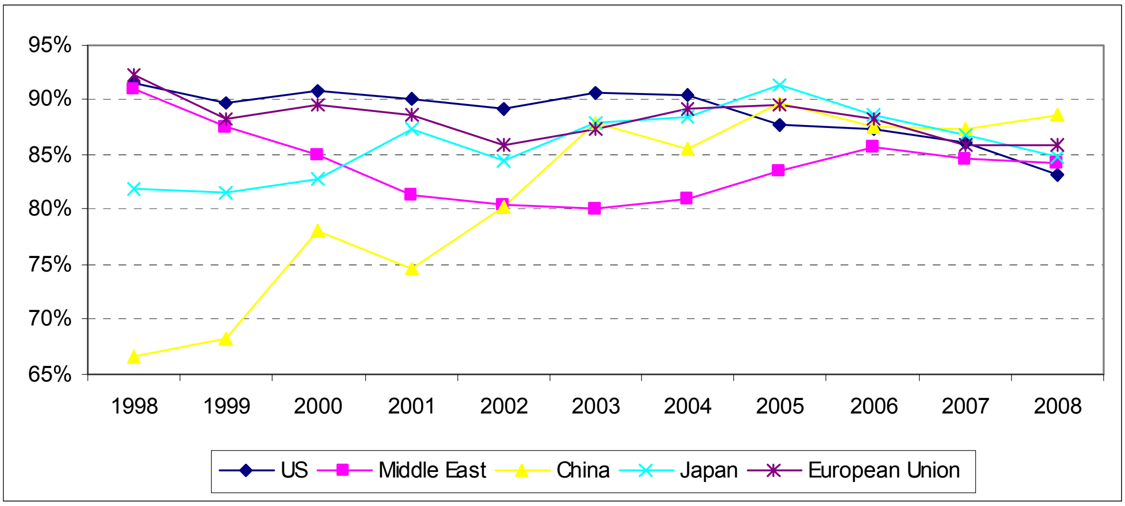
Year	2008	2009	2010 (3 MONTHS)
Average of monthly rates	85.2	78.7	76.2

Source: IEA

The average utilisation rate[66] in OECD Europe in 2009 amounted to 79%, compared to 85% the previous year. In the first three months of 2010, utilisation rates averaged 76%, showing a continuing downward trend. This needs to be put in the context of previous utilisation rates for the EU close to 90% as recently as 2005.

EU utilisation rates in the global context

Comparison of utilisation rates, different regions, 1998-2008



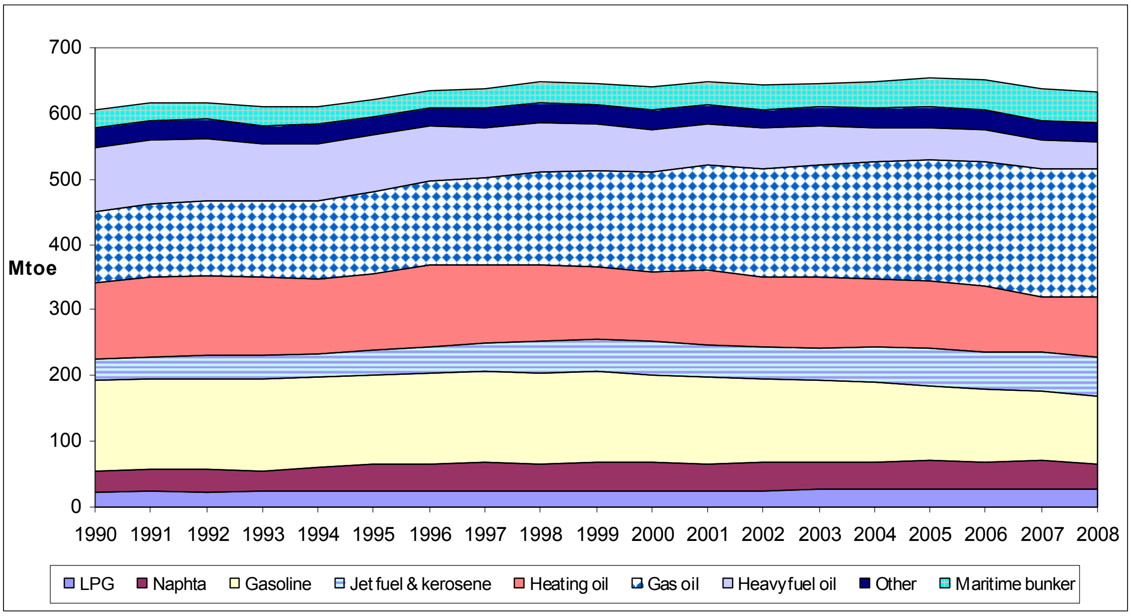
Source: BP Statistical Review of World Energy 2009

In comparison to a selection of other major refining nations, the chart above reveals that utilisation rates in the EU since 1998 have generally been high compared to the rest of the world. US utilisation rates were more constant than the EU in the first part of the last decade, though have trended downwards in the latter part. Mature markets such as the US, EU and Japan have registered falls in utilisation rates in the more recent years as China's has continued to increase, registering the highest utilisation rate in 2008, while in the Middle East, crude capacity utilisation has been relatively stable since 2006.

66 Crude throughput/production as a proportion of operable refining capacity.

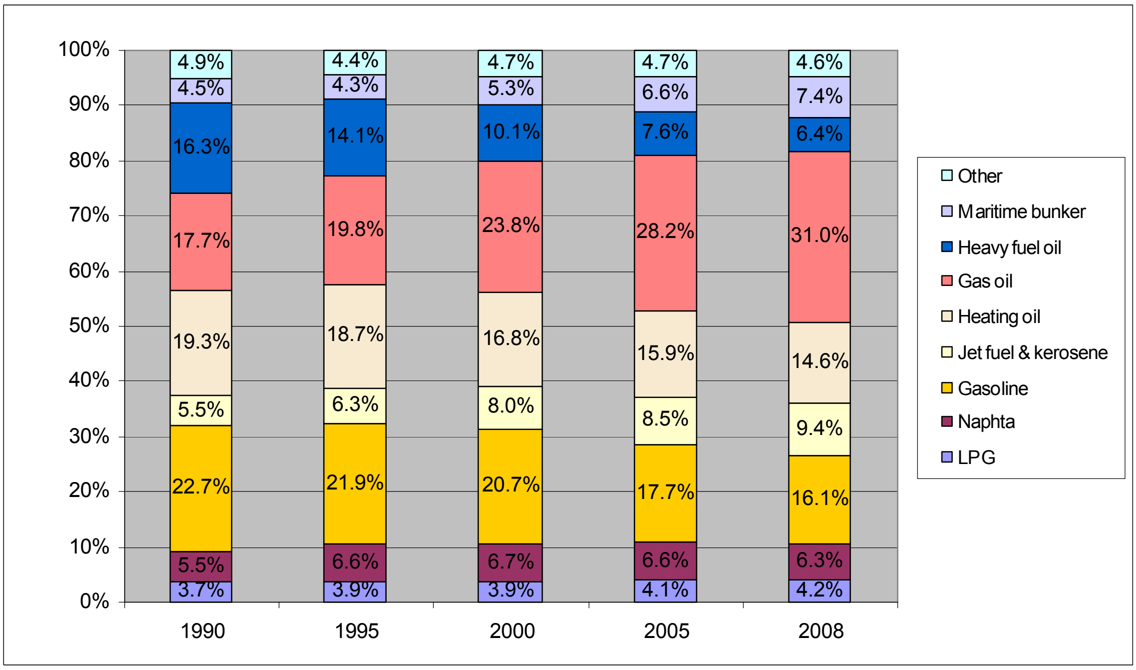
2.2.3. EU demand for petroleum products

EU 27 Petroleum product demand evolution, 1990-2008



Source: Eurostat/Primes

EU 27 Petroleum product demand mix, 1990-2008



Source: Eurostat/Primes

EU27 demand in petroleum products increased relatively steadily until 2005, after which it fell every year until 2008. This has been the result of opposing trends in key products, with, at one extreme, jet fuel and kerosene consumption almost doubling during the period; consumption in gasoil registering steady and sustained growth; demand for naphta registering an initial increase and then a fall; sustained falls in demand for gasoline and heating oil, and quite significant falls in demand for heavy fuel oil.

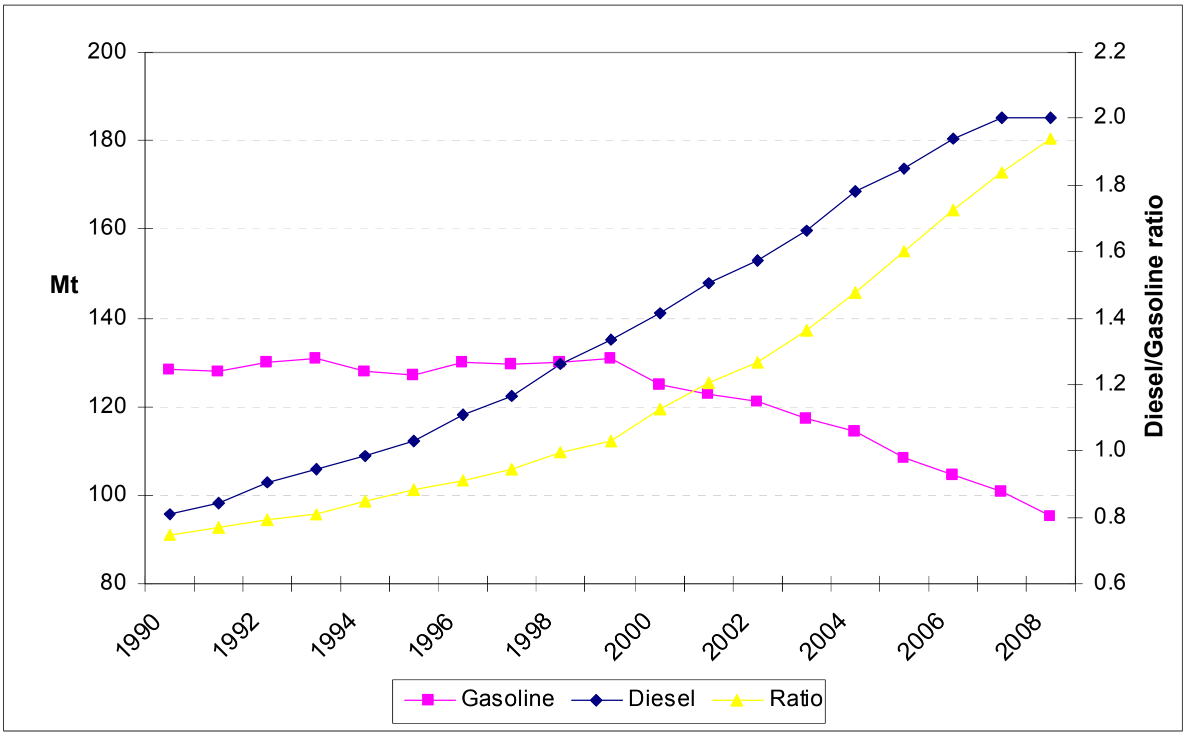
This has therefore meant if one looks at the evolution of the petroleum product demand mix in the EU, that the share of jet fuel and kerosene has increased between 1990 and 2008 from representing 5.5% to 9.4%; the share of gasoil from 17.7% to 31%; the share of gasoline from 22.7% to 16.1% and the share of heavy fuel oil from 16.3% to 6.4%.

Note that almost two thirds of the total demand for petroleum products comes from the transport sector (industry use makes up 25%, while household & services use is only 13%), and therefore that the evolution of the use of transport fuels is a vital element for the EU refining industry.

Gasoil (diesel use in the transport sector) demand represents by far the largest single component of EU demand for petroleum products. Gasoil use in the transport sector (excluding bunkers, which are shown separately in the demand charts above) can be further broken into three uses: road, rail and inland navigation. Road diesel represents the vast majority of gasoil demand (96% in 2008).

Key to understanding the important growth of gasoil since 1990, and to appreciating the importance of this product to the EU consumer, is therefore an understanding of the evolution of the demand for road diesel. To complete the picture, the evolution of the demand of gasoline as a road fuel is plotted against the evolution of demand for road diesel in the diagram below, in order to appreciate the relative evolution of these two key road fuels.

EU 27 transport diesel and gasoline demand evolution 1990-2008



Source: Eurostat

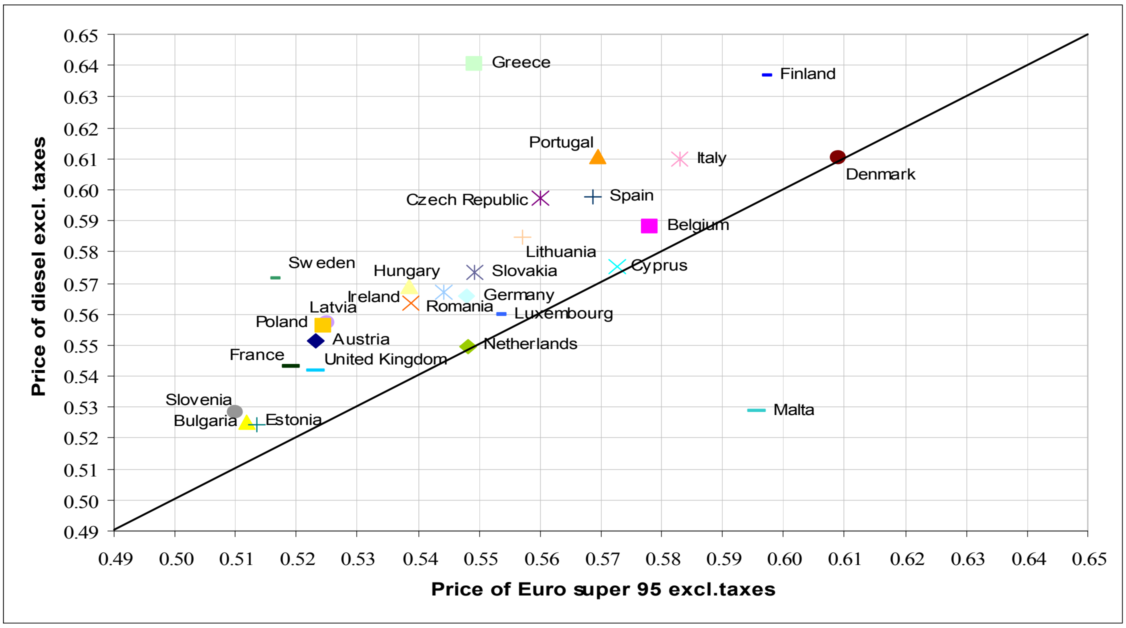
It can clearly be seen that the evolution in diesel demand as a road fuel has been at the expense of gasoline.

One factor which has driven the demand for road diesel in the EU is the higher efficiency of diesel engines, which has meant that car consumers in the EU have tended to purchase diesel vehicles in increasing proportions, despite their higher initial price.

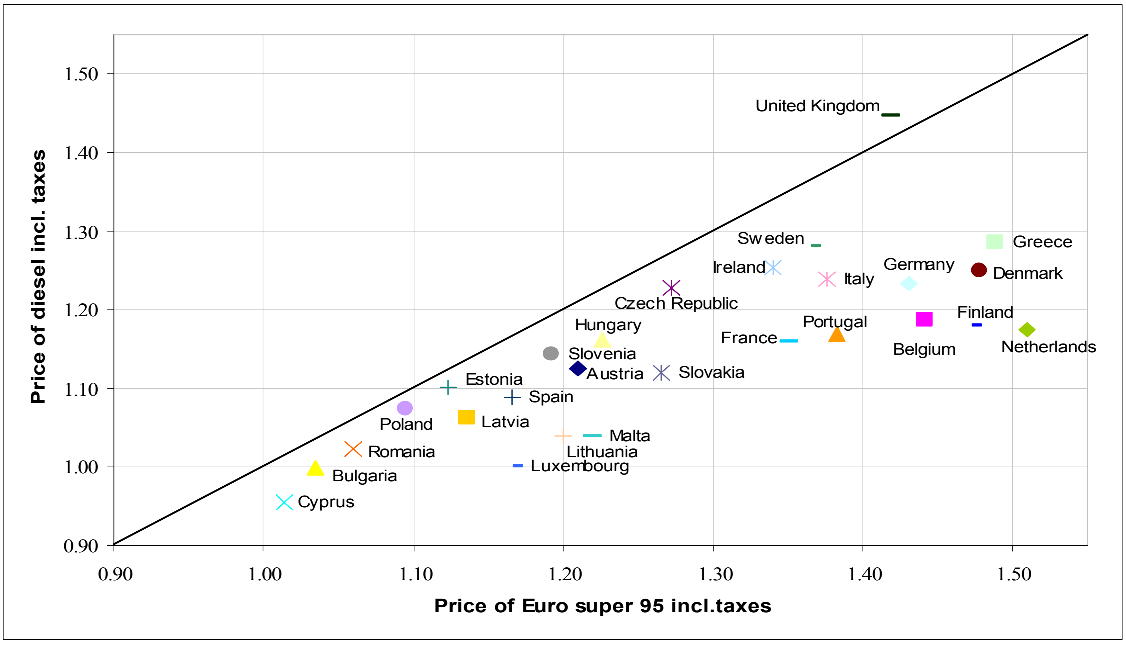
Demand for road diesel in the EU has also been growing constantly partly as a result of a tax differential between diesel and unleaded gasoline for vehicle use which has long favoured the former against the latter.

As an illustration, June 2010 figures[67] show that while pre-tax consumer prices of premium unleaded gasoline are lower than for diesel in all but one of the EU 27 Member States (Malta), higher taxes and duties on gasoline means that the price of diesel is cheaper at the pump in 26 of the 27 EU Member States (with the exception of the United Kingdom).

Vehicle diesel and unleaded gasoline tax differential, excluding and including taxes, prices as at 14/06/2010



67 European Commission Oil Bulletin, 14th of June 2010.



Source: European Commission Oil Bulletin

2.2.4. Imports and exports of petroleum products to/from the EU

Evolution of EU net imports/ exports in key petroleum products, 2000-2008

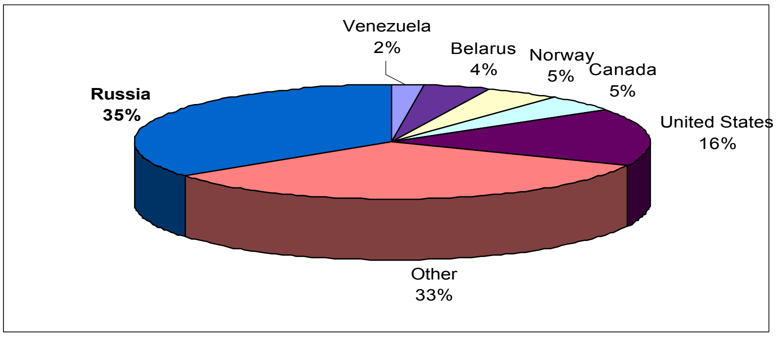
Source: Eurostat

In the last few years, the two key trade petroleum products in the EU in terms of volume have been gasoline and gasoil/diesel (include heating oil), gasoil/diesel being the main petroleum product imported into the EU while gasoline is the main product exported from the EU. Looking back at the chart showing the evolution of demand in diesel and gasoline in transport, it is interesting to note that the general trend in net imports of gasoil/diesel has been towards increasing import dependence as the demand for diesel in transport has been growing which, confirming the evolution of growth in demand and supply of gasoil/diesel and gasoline, shows that the industry has not been able to meet the growing demand for diesel[68].

[68] One important thing to note with regard to the evolution of gasoil/diesel imports: 2007 net imports of gasoil/ diesel were significantly below the preceding year and constituted a significant break from the

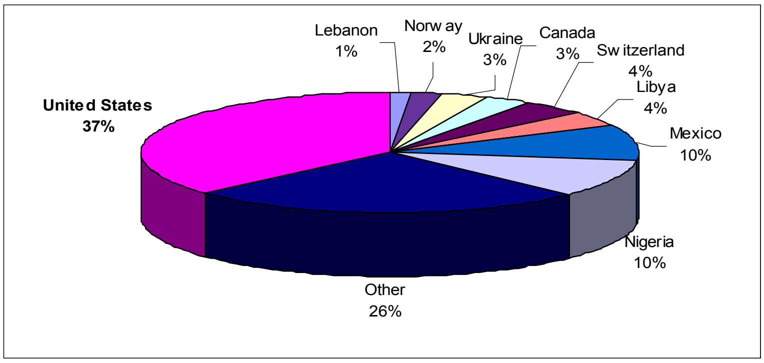
The charts below provide some details of the countries from which the EU imports its middles distillates (gasoil/diesel and kerosene/ jet fuels) and to where the EU exports gasoline. The import dependence of Russia for gasoil/diesel and the export dependence of the United States for gasoline can quite clearly be seen. In the case of kerosene/ jet fuels, the import dependence is more evenly spread out though the reliance on Middle Eastern countries is high.

Volume breakdown of gasoil/ diesel imports into the EU, 2008



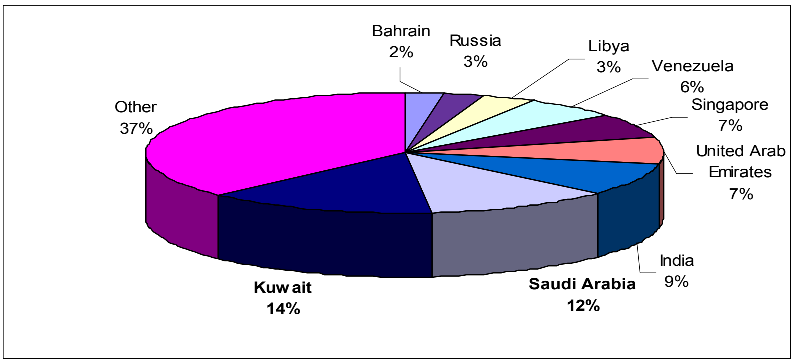
Source: Eurostat

Volume breakdown of EU gasoline export destinations, 2008



Source: Eurostat

Volume breakdown of kerosene/jet fuel imports into the EU, 2008



trend of increasing levels of net importation in the last few years. This was a one-off event, resulting from quite significant falls in the level of total gasoil/ diesel imports into the EU (while exports remained relatively constant) due mainly to much lower gasoil/ diesel imports into Germany in 2007, resulting from reduced households consumption of heating oil that year. Germans purchased much of their heating oil needs for 2007 in 2006, ahead of an anticipated VAT increase on the 1st of January 2007.

Source: Eurostat

There are other important things to note in observing these figures denoting trade dependence:

- The EU was also quite significantly reliant on the US for gasoil/diesel imports in 2008. However, this was not so in 2007 (US only exported 5.4% of gasoil/ diesel), while EU dependence on Russia in 2007 was much more significant (47%);

- Judging from 2007 and 2008 data, the only country to which the EU exports a significant proportion of its gasoline supply is the US (In 2007, the EU exported 32% of its gasoline production to the US; the next country was Mexico, to which it exported only 6% of its gasoline production);

- The 'other 'element is significant for all products, revealing that the EU trades small proportions of petroleum products with a multitude of nations.

3. ANNEX 3: DESCRIPTION OF SCENARIO ANALYSIS AND MODEL ASSUMPTIONS

3.1. PRIMES demand projections

3.1.1. Description of main assumptions in the PRIMES 2009 Baseline and the Reference scenario

The PRIMES 2009 Baseline (BL) demand projections result from projections of developments in the assumed absence of new policies beyond those implemented by April 2009. It is not a forecast of likely developments, given that policies will need to develop. Therefore, there is no assumption in the BL that national/overall green-house gas (GHG) or renewable energy sources (RES) targets are achieved, nor of non-ETS (EU Emission Trading System) targets; CO2 emissions and RES shares are modelling results.

The PRIMES Reference (REF) scenario reveals the effects of agreed policies, including the achievement of legally binding targets on 20% RES and 20% GHG reduction for 2020.

Macroeconomic projections in the BL and the REF reflect the recent economic downturn, followed by sustained economic growth resuming after 2010, but the downturn is expected to have long lasting effects leading to a permanent loss in GDP (GDP level in 2030 is assumed to end up 10% lower than before the crisis). Average annual economic growth of 1.7% per annum is assumed over the period 2005-2030 in both the BL and REF.

Oil prices are expected to reach $88/barrel in 2020 and $106/barrel in 2030, expressed in 2008 prices, in both the BL and REF. In nominal terms, this amounts respectively to $112/barrel in 2020 and $164/barrel in 2030, assuming 2% inflation per annum.

ETS carbon prices are lower in the REF than the BL due to the achievement of the RES targets and additional efficiency measures, which decrease electricity demand and emissions. Thus ETS carbon prices (in real terms, 2008 prices) in 2030 are 39 Euros per tonne of CO2 in the BL and 19 Euros per tonne of CO2 in the REF.

Non-ETS carbon values in the REF are low due to relatively low energy demand (as a result of the crisis), policy measures (incl. for cars) and the currently inexpensive opportunities in non-CO2 GHG abatement. Non-ETS carbon value in 2008 prices is 0 Euros per tonne of CO2 in the BL and 5 Euros per tonne of CO2 in the REF in 2030.

All policies implemented by April 2009 were included in the BL. This includes the effects of measures of the current Energy Efficiency Action Plan that have already been implemented, e.g. the five Ecodesign implementing measures adopted by April 2009. The recast of the Energy Performance of Buildings Directive is not included in the assumptions, but implemented national measures on e.g. building codes are reflected.

The BL also includes legislation to reduce CO2 emissions from new cars and transport fuels which was adopted in April 2009 along with the climate and energy package. The legislation sets emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles. It requires significant reductions in the average fuel consumption of new cars, with binding targets of 130g/km by 2010 and 115g/km by 2020. This leads to a penetration of hybrids, equivalent to around 30% of the passenger fleet by 2030, which is a policy outcome in PRIMES, as opposed to a constraint.

Policies beyond April 2009 were also included in cases where there was very little uncertainty about how they will evolve. Thus, the ETS Directive and its full implementation were included in the BL given that clear market conditions were already established in the directive and that structures and caps for ETS were agreed before April 2009; where issues were pending (e.g. carbon leakage) a conservative approach was followed excluding auctioning for most branches for modelling purposes. Similarly, a conservative view was taken on CDM credits and banking (allowing for the maximum possible) as well as regarding future specific CO2 emissions for cars (not yet assuming fully the indicative target for 2020).

Regarding the non-ETS sectors, the BL does not impose the achievement of the agreed targets for 2020 as, similar to the targets in the Renewables (RES) directive, the achievement depends on the forthcoming policies and measures in the individual Member States. Pending the implementation of vigourous policies in the Member States, only a minimal decline of non-ETS emission by 2020 result in the BL.

With regard to the RES directive, it requires Member States to submit a National Renewable Energy Action Plan (NREAP) to the European Commission by 30 June 2010. Therefore, only the RES measures that had been already implemented at national level have been included in the BL, showing that Member States need to step up their efforts to reach their RES targets. Similarly to the RES Directive, the Effort Sharing Decision is only reflected through policy measures that have already been implemented. Specifically, the BL achieves 15% of RES share in final energy demand in 2020 instead of the 20% target, with the RES share in transport amounting to only 7% by 2020 instead of the 10% target.

Specifically, the BL projects a penetration of diesel biofuel as a proportion of final transport diesel demand of 4.3%, 7.5% and 9.2% respectively for 2010, 2020 and 2030 and gasoline biofuel penetration as a proportion of final transport gasoline demand of 3.0%, 5.8% and 7.6% respectively for 2010, 2020 and 2030.

In addition, the overall 20% reduction (below the 1990 level) target for GHG is not achieved, the BL only achieving an 8% reduction for energy related CO2 (-14% for all GHG).

The REF mirrors achievement of 20% RES and 20% GHG reduction targets for 2020, as set in the energy and climate package, which includes the achievement of national RES targets and the RES transport sub-target, as well as the respect of the ETS cap and the achievement of non-ETS national targets (GHG Effort Sharing Decision). However, energy demand declines significantly in the REF but not enough to reach the indicative 20% energy savings objective.

With regard to RES transport targets, the REF projects a penetration of diesel biofuel as a proportion of final transport diesel demand of 4.3%, 10.1% and 12.6% respectively for 2010, 2020 and 2030 and gasoline biofuel penetration as a proportion of final transport gasoline demand of 3.0%, 8.0% and 10.2% respectively for 2010, 2020 and 2030[69].

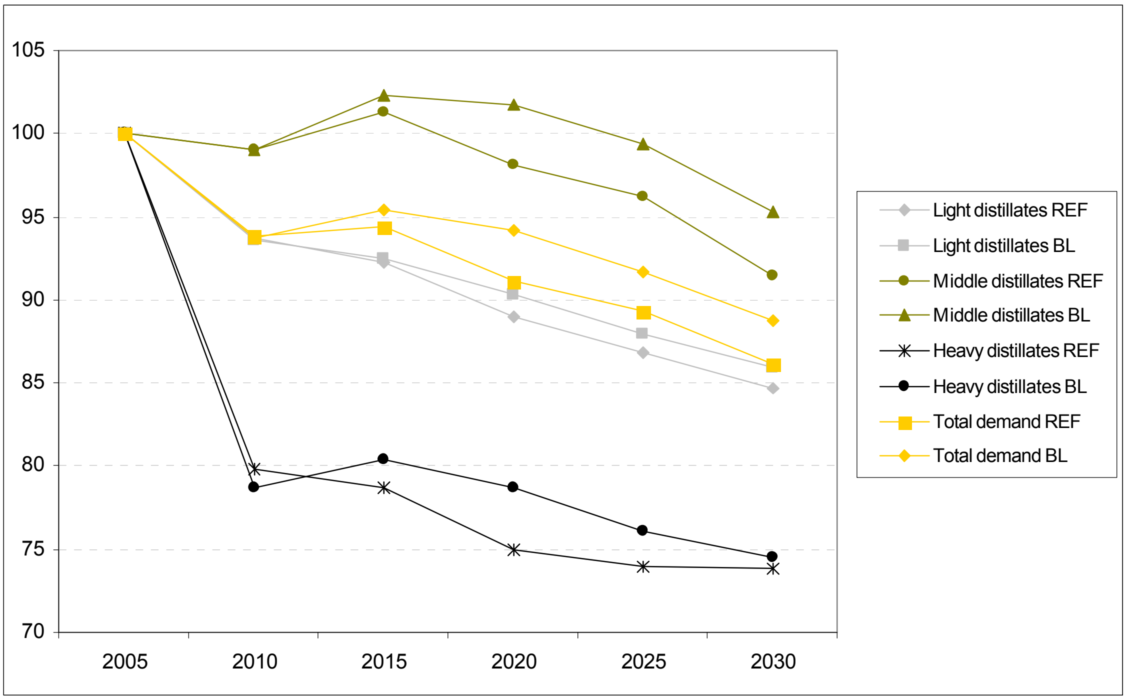
The penetration of hybrids as a proportion of total passenger car fleet in the REF is equivalent to 27% of the passenger fleet by 2030.

Other policies which the REF takes into account includes legislation adopted between April and December 2009, i.e: the four Eco-design measures, the recast of the building Directive and the labelling of tyres.

[69] Note that the total renewables target of 10% in the transport sector by 2020 is met in the reference case, with the breakdown of the 10% being split as follows: diesel biofuel 6.6%, gasoline biofuel 2.6% and green electricity accounting for 0.8%.

3.1.2. PRIMES petroleum products demand projections

EU petroleum products demand projections, PRIMES 2009 Baseline and Reference scenarios compared



Source: European Commission

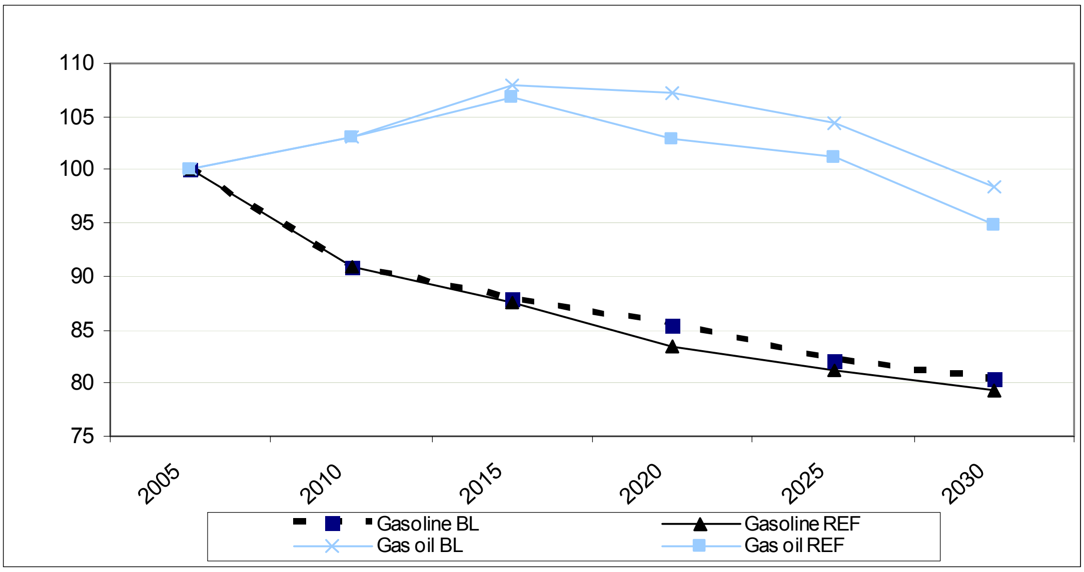
Overall petroleum product demand is projected to decline by 13.8% in the REF compared to 11.3% in the BL between 2005-2030. Both the BL and the REF project a continuation in observed historical trends in a number of products, including the continued significant falls in demand for heavy fuel oil; continued sustained falls in demand for gasoline and heating oil; a continued slow decrease in the demand for naphta. Both the BL and the REF project a break from recent trends in the growth for other petroleum products including continued but slower growth in demand for jet fuel and kerosene; and an initial but small increase in diesel, followed by a slow decline, leading to an overall fall.

As noted already in this document, one of the main challenges faced by the EU refining industry going forward would be in terms of continued growth in demand for middle distillates parallel to a fall in demand for gasoline, which poses a problem to EU refiners given the current EU refining configuration which cannot produce more middle distillates without also increasing the supply of gasoline.

If a comparison of the BL demand projections for middle distillates for different years is made, it reveals that while 2010 volumes end up slightly below 2005 levels, by 2015 demand for middle distillates is projected to grow by 2.3% from 2005 levels, after which it will gradually fall to a level in 2030 below that of 2005 (-4.7%). Note that 2015 is the turning point for the demand of gasoil, while the demand for jet fuel/kerosene is expected to continue growing to 2030. In the REF case, the trends are exactly the same, with the key differences that by 2015, demand for middle distillates will grow by less than the BL (only 1.2%), and the fall thereafter will be greater, (by 8.5% from 2005-2030).

The trend for transport diesel in the BL is for an overall fall by 2030 from 2005 levels of 1.7% compared to 5% in the REF case. In comparison, the BL projects gasoline demand to fall by 19.6% in comparison to a projected fall of 20.7% in the REF case.

PRIMES Baseline and Reference transport diesel and gasoline projections comparison



Source: European Commission

Key differences between the BL and the REF cases are in terms of the assumed penetration of renewables and the use of alternative fuel vehicles in the transport sector[70].

The Baseline projects a penetration of diesel biofuel as a proportion of final transport diesel demand of 4.3%, 7.5% and 9.2% respectively for 2010, 2020 and 2030 and gasoline biofuel penetration as a proportion of final transport gasoline demand of 3.0%, 5.8% and 7.6% respectively for 2010, 2020 and 2030.

In contrast, the Reference scenario projects a penetration of diesel biofuel as a proportion of final transport diesel demand of 4.3%, 10.1% and 12.6% respectively for 2010, 2020 and 2030 and gasoline biofuel penetration as a proportion of final transport gasoline demand of 3.0%, 8.0% and 10.2% respectively for 2010, 2020 and 2030[71].

Note in addition that the penetration of hybrids as a proportion of total passenger car fleet (assumed to be equivalent to 30% of the passenger fleet by 2030 in the Baseline and 27% of the passenger fleet by 2030 in the Reference Scenario) contributes significantly towards meeting the requirements of the CO2 from cars regulation.

The penetration of electric vehicles is insignificant in both the Baseline and Reference scenarios.

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70 Note that the demand projections shown above and used in the OURSE model are net of biofuel demand.

71 Note that the total renewables target of 10% in the transport sector by 2020 is met in the reference case, with the breakdown of the 10% being split as follows: diesel biofuel 6.6%, gasoline biofuel 2.6% and green electricity accounting for 0.8%.

3.2. Description of OURSE refining module of the POLES energy model

The objective of the OURSE model is to represent the refining activity at a world scale level. It is included in the POLES (Prospective Outlook for the Long-term Energy System) model.

Because the model designed to represent the world-wide refining industry must have a limited number of equations, a representative refinery has been defined for a restricted number of regions in the world (corresponding to the POLES nomenclature). Moreover the crude oil supply has been aggregated (the size of the model is directly linked to the number of crude oil which are introduced in the model). Finally, as the model has to represent the oil product exchanges between the main regions in the world, a multi-refinery approach is considered.

The main inputs of the model are (i) the oil product demand (in terms of both quantities and specifications), (ii) the crude oil availability, (iii) the CO_2 emissions restrictions and taxes. The main output are (i) the refineries throughput (activity level), (ii) the products blending, (iii) the products trade, (iv) the investments (technology dynamic of the refining processes), (v) the marginal costs of oil products (supply prices), and (vi) the pollutant emissions.

All the relevant techno-economic characteristics of the oil refining industry (technical processes, investment and operating costs, pollutant emission factors...) are included in the model.

The refining model of POLES is able to simulate the consequences of:

– changes of oil product demand such as a modification of the share of the automotive fuels (gasoline and diesel)

– changes of specification of oil products (sulphur content of oil products for instance)

– carbon emissions regulation (bounds and taxes)

– adoption of alternative type of policies.

As the model permits exchanges of petroleum products between the main regions in the world, the refining industry has been split into several geographical areas. In each refining area, it is assumed that the crude oils are processed together and that there is only one investment variable for each unit. Moreover the model implicitly allows intermediate product exchanges inside each area.

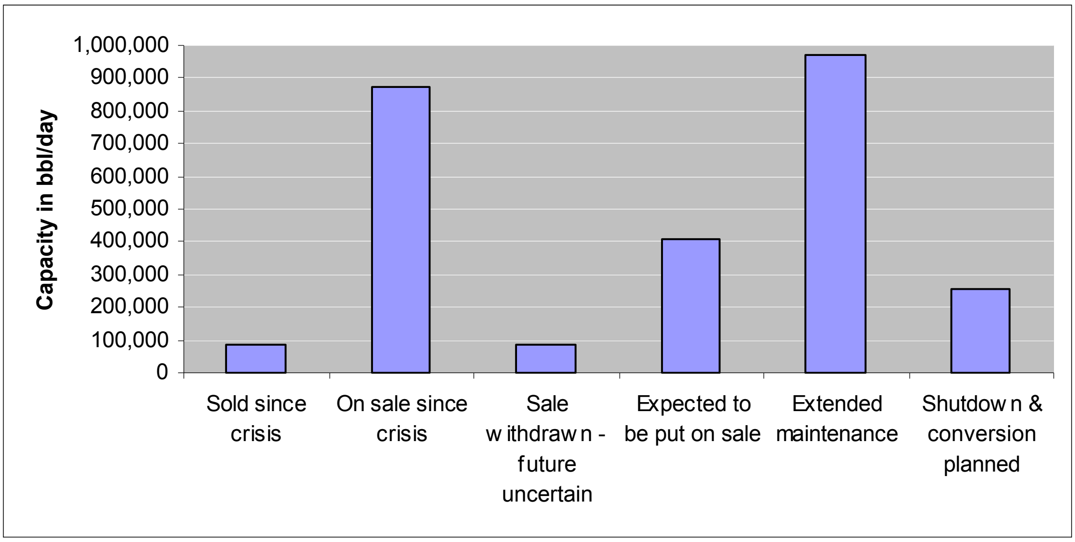
The geographical considerations upon crude oil supply and petroleum product demand, and the technical analysis of the refineries lead to nine refining areas being defined in the world:

Area 1 - Z1	North and Central America : Canada, USA, Mexico
Area 2 - Z2	Latin America,
Area 3 - Z3	North Europe : all Europe except South Europe
Area 4 - Z4	South Europe : Italy, Greece, Portugal, Spain, Turkey, Croatia, Slovenia, Former Yugoslavia
Area 5 - Z5	Former Soviet Union (CIS)
Area 6 - Z6	Africa
Area 7 - Z7	Middle East
Area 8 - Z8	China
Area 9 - Z9	Other Asia

The general denominations "Latin America", "Former Soviet Union", "Africa", "Middle East" are those which are used by the International Energy Agency (IEA) in its statistical yearbooks (energy balances).

4. ANNEX 4: SUMMARY OF KEY PROJECTS & PLANNED/ACTUAL DIVESTMENTS IN THE EU REFINING SECTOR

Summary of EU refineries planned/actual divestments and shutdowns since 2008



Source: European Commission. Note: This information has not been confirmed by the EU refining industry and is contained here for illustrative purposes.

- Known planned/actual divestments and shutdowns in EU refining capacities since the start of the crisis in 2008 extend to 18 out of 104 refineries in the EU, representing some 2.7 million bbl/day/134 million tonnes per year of crude capacity, equivalent to 17% of total EU refining capacity.
- Actual deals have been few and far between, with the exception of the sale of a small processing facility in Belgium by Petroplus and part of a Dutch plant by Total.
- In general, both planned and actual divestments have been of simple refining plants of mainly small capacity.
- Assets which have been put on sale since the crisis and are still awaiting buyers amount to close to 900,000 bbl/day. It is expected that at least another 400,000 bbl/day of capacity is likely to be formally put on sale in the foreseeable future as a result of the crisis.
- All of the known potential/actual buyers of assets on sale are non-Europeans. Other than the Russian Lukoil, willing acquirers of EU refining assets include India's Essar and Reliance and China's PetroChina though no deals have been concluded yet. Swiss oil trading firm Vitol bought Petroplus's processing unit in Antwerp last year (21,000 bbl/day) while American refiner Valero has expressed interest in purchasing Chevron's Pembroke refinery (202,000 bbl/day).
- While interest in acquiring stakes in the EU refining market by oil companies located in neighbouring countries such as Lukoil is to secure outlets for their crude production, the interest of PetroChina stems from the wish to grow their global presence in refining, and they see the current environment of low margins, and therefore low prices, as opportune. Though not from a neighbouring country, India's Essar sees the acquisition of EU assets as an opportunity to turn them into import, storage and distribution centres for its refined products produced at its home refinery in Vadinar.

- Refining capacity that is known to have been temporarily shutdown as a result of the crisis amounts to over 900,000 bbl/day. These units could either be restarted or eventually also be put on sale, depending on market conditions.
- The numbers employed in the refineries represented by these capacities are not known and are not formally communicated by refiners.
- Note that no complete shutdowns have been announced by EU refiners. Since the beginning of the crisis, uneconomic assets that have not been put on sale have generally been subject to extended maintenance/temporary shutdowns, while assets that have been formally 'shut down' are in fact being converted to depots/storage facilities (equivalent to 258,000 bbl/day, to date).
- There have also been reports of planned investments in extra diesel capacity/ hydrodesulphurisation/coker capacity at medium to large, more complex plants, as follows:

ExxonMobil

- The company announced plans in December 2008 to invest $1 billion in extra diesel capacity expansion (by 143,000 bbl/day) in three of its refineries (two in the US, one in Belgium: Antwerp). The Antwerp refinery has a capacity of 305,000 bbl/day.

Repsol

- Repsol was granted a Euro 400 million loan from the European Investment Bank for the construction of a coker unit at its 220,000 bbl/day Petronor refinery in Bilbao, Spain. The project consists of a 2 million tonne/year coker unit and related treatment units. The coker plant, which will cost a total Euro 780 million, will convert heavy fuel oils into diesel, gasoline, propane and butane;

Royal Dutch Shell

- Shell is planning on continuing to invest in larger integrated refining and chemical sites, including a $500 million investment in a new hydrodesulphurisation unit at the firm's 406,000 bbl/day Pernis plant.

Total

- Earlier in the year, Total announced its intention to restructure its refining output to reduce its production of gasoline and increase its production of diesel. This would include investing 800 million of Euros in adapting its French Gonfreville (338,000 bbl/day) refinery to change its output in favour of diesel.

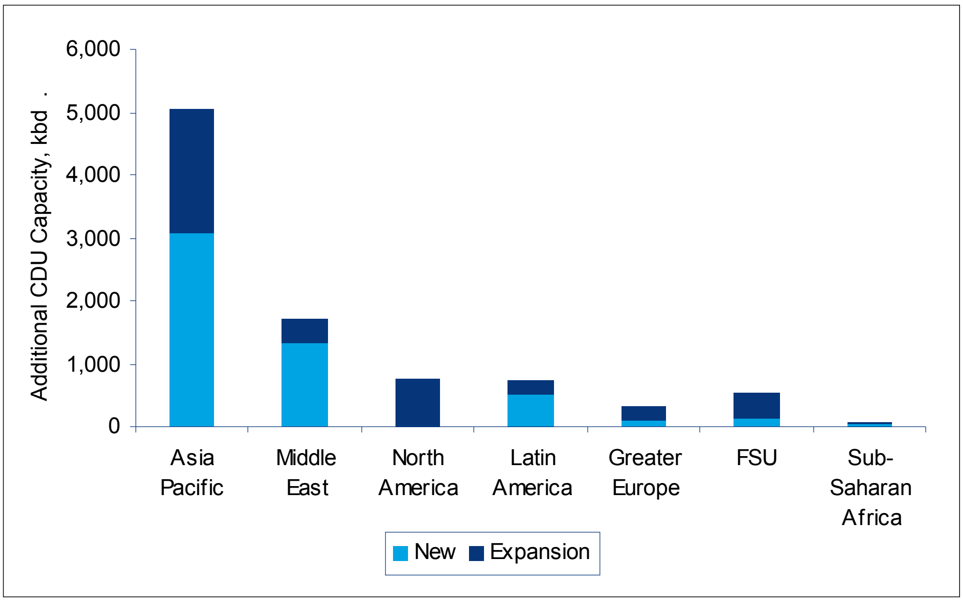
5. ANNEX 5: NON-EU REFINING CAPACITY DEVELOPMENTS & DIVESTMENTS

The IEA reported in May 2009[72] that the impact of the financial and economic crisis on the global refining sector amounted to 1.6 million barrels/day of postponement or cancellation of new refining capacity (by April 2009). In addition, according to the IEA some 800,000 bbl/day of refining projects have been delayed for 18 months or more.

The crisis has certainly hit all parts of the globe, with falling refining margins and utilisation rates recorded in many regions (more details in annex 2).

Future prospects in terms of additional refinery capacity are however for some 9 million bbl/day between 2008 and 2015, according to Wood Mackenzie, equivalent to a 10% increase in total world refinery capacity.

Expected additional refinery capacity by region, 2008-2015



Source: Wood Mackenzie

According to the above data, 59% of world new refinery capacity between 2008 and 2015 (amounting to 3 million bbl/day) will be in the Asia Pacific region, while 50% of world capacity expansion will come from that region (2 million bbl/day). The Middle East will contribute 26% of world new refinery capacity during that period, and 10% of world capacity expansion. In comparison, Europe is expected to contribute 2% of world new refinery capacity during that period, and 5.6% of world capacity expansion, amounting in total to 322,000 bbl/day of additional capacity.

North-America

North-America, which includes the US, Canada and Mexico, has total refinery capacity of 21 million bbl/day, equivalent to 24% of total world refining capacity.

In spite of the challenging climate and its impact on the industry in that region, it is expected that close to 800,000 bbl/day of additional capacity will come on stream between now and 2015 in North-America.

[72] Impact of the Financial and Economic Crisis on Global Energy investment, IEA, May 2009.

Middle East

The Middle East consisting of Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, UAE and Yemen has 7.6 million bbl/day of refining capacity, equivalent to 9% of world refining capacity.

By 2015, the region is expected to add 1.7 million bbl/day of refinery capacity, amounting to almost a quarter of current capacity in the region.

Asia-Pacific

The Asia Pacific region consists of China, Asia, South Korea, Indonesia and Japan along with many other smaller refining countries. The region has capacity of 25 million bbl/day, amounting to 28% of world refining capacity.

As highlighted above, the biggest expectations for additional refinery capacity in the world in the next five years are in the Asia Pacific region. It is expected to add five million bbl/day of additional capacity by that date, amounting to 56% of total additional world capacity and amounting to increasing existing capacity in that region by 20%.

A number of EU oil majors are attempting to establish a refining presence in China, such as BP, which is in talks with state company Sinopec on a new refining joint venture there, while Total is known to be in talks with Sinochem and China Petroleum & Chemical about a number of refining projects also in China.

Other regions

- South and Central America which includes Brazil, Argentina and Venezuela as well as other small refining countries has 6.6 million bbl/day of refining capacity, equivalent to 7% of total world refining capacity. Around 500,000 bbl/day of new refining capacity is expected in that region between 2008 and 2015, and some 200,000 bbl/day of capacity upgrades of mainly coking and hydrocracking, mainly in Brazil and Venezuela.

- The former Soviet Union region, which includes Russia, Ukraine, Belarus, Georgia among others, has 8 million tonnes of refining capacity, equivalent to 9% of total world refining capacity. An additional 500,000 bbl/day of new and expanded capacity is expected to come on stream in that region by 2015.

- Africa has 3 million bbl/day of refining capacity, amounting to 3.6% of world refining capacity. Only very small capacity additions are expected in the next ten years, amounting to less than 100,000 bbl/day.