STUDY ON

OIL REFINING IN THE EUROPEAN COMMUNITY

Prepared for European Commission, DG XVII/B2

Executive Summary

London, 5 December 1997

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1. Introduction

In 1996 the Commission published a 'Report on the Situation of Oil Supply, Refining and Markets in the European Community', (COM(96)143). This report drew attention to the over-capacity and poor profitability of the refining industry in Europe.

With the strategic importance of refining in mind, DG XVII of the European Commission appointed Roland Berger and Partner to carry out the present study to better understand the reasons for continued low profitability in the industry; to examine whether this represents a threat to the public interest in the EU; and, to suggest possible solutions. The Terms of Reference are set out in detail in the companion volume of Appendices to this report.

This study is presented in three booklets, this Executive Summary, the Main Report, and Appendices. The Terms of Reference are set out in detail in the Appendices.

In conducting this study we have analysed data and forecasts produced by the Commission, the International Energy Agency, the oil industry, oil industry associations, financial analysts, and other commentators on the refining industry in Europe and worldwide. We have also conducted interviews with energy ministries of EU member states, and with the majority of oil refining companies in the EU.

The views presented in this study do not necessarily reflect those of the European Commission.

2. An overview of the conclusions

2.1 General Comments

The European Commission has established three main pillars of Energy Policy:

- Competitiveness
- The Environment
- Security of Supply

This report on the oil refining industry addresses all three of these issues.

Oil provides 42% of the European Union's (EU) energy requirement, and 94% of the fuels required for transport. The health and viability of the refining industry is of critical strategic importance to the Union for maintaining a successful and internationally

competitive position for industry as a whole, and for providing competitively priced products to consumers.

The refining industry has an important role to play in assisting the EU meet increasingly stringent environmental targets. The investments required for an effective response to this challenge are potentially enormous, which in turn require a financially and technically strong industry.

The continuous supply of refined products is critical for the strategic interests of the EU. With the European refining industry now almost entirely owned by private shareholders, the strategic interests of the industry and of governments are no longer necessarily the same. Decisions taken a few years ago by many refiners on the basis of social impact are now more likely to be driven by considerations of shareholder value.

2.2 Capacity and Profitability

Even in the most favourable scenario, European refining capacity will almost certainly exceed demand for at least the next decade. International trading opportunities will only have a limited impact on Europe's overcapacity.

There is a refining capacity surplus of 70-100 million tonnes per annum (equivalent to 9 to 13 refineries) in the EU.

Estimated after-tax return on capital employed in EU refining has on average been about 4%. This includes the favourable effect of the Gulf War. This level is too low to sustain long term viability.

The Gross Refiners Margin in North West Europe has averaged about $2/bbl (ECU 1.75 per barrel) over the past five years, compared to the $3.25 - $3.75/bbl (ECU 2.85-3.25 per barrel) needed for a financially healthy industry.

Over-investment in Catalytic Cracking, combined with rising diesel demand at the expense of gasoline has further distorted product balances and refining margins.

The cost of refinery closure is high and discourages the normal economic processes for correction of overcapacity and poor profitability.

Continuation of poor profitability into the long term will lead to diversion of investment to other regions and business sectors. A few refinery closures will occur, but not enough to significantly alter margins. Eventually a vicious circle will set in, with European refining becoming uncompetitive in the global oil market.

Putting off necessary action to tackle the structural problems now is likely to lead to a more painful enforced restructuring at a later date.

2.3 Other key factors

The need to produce higher specification fuels to meet EU environmental aspirations will impose a major investment burden on the industry with little or no return.

Refining is highly capital intensive. Its impact on EU employment levels, which have been declining over many years, is relatively small and has been declining over many years.

2.4 Potential solutions and impact

We analysed a number of possible solutions from the point of view of the public interest as well as resolution of the industry's problems. None of the initiatives examined are sufficient on their own to correct the problems of the industry.

The nature of the solutions required is such that the major initiatives need to be taken by the oil companies themselves.

There is an important role to be played by the European Commission and by member state governments in encouraging and facilitating these actions.

The most attractive actions which have a significant impact are:

- A significant restructuring of the European refining industry, to remove structural overcapacity. Action to achieve this has to come from the industry itself.
- Introduction of tax differentiation to incentivise a switch towards more environmentally friendly fuels.
- An industry-financed fund for closures.
- Correction of distortions between member states in fuel specifications and taxes, and in remediation standards for closure.
- Increased transparency in reporting and accounting for refining industry results in Europe.

In the short term a restructuring of the scale envisaged would tighten margins through a small rise in consumer prices for oil products. The potential for prices to rise is limited by competition from imports. In the longer term cost savings from new investment would more than offset this price rise and be passed on to consumers.

The price cap set by imports would, in our view, mean that the industry as currently structured, will be unable to realise better than a 7-8% ROCE on average, other than during periods of external supply disruption.

2.5 Key recommendations

Our key recommendations are as follows:

- *The Commission, through DGXVII, should kick-start a more urgent impetus for restructuring by the refining industry through convening a top level management exchange of views.*

- *A final attempt should be made to establish an industry-financed closure fund.*

- *The Commission should reassess the year 2005 indicative target fuel specifications (as is planned through the Auto-Oil 2 programme), on the basis of cost-effectiveness.*

- *Governments should introduce tax differentials within Commission guidelines to encourage early phasing in of agreed new specifications and to improve refiners' return on the necessary investment.*

- *Steps should be taken by the Commission and governments to identify and remove distortions and create a 'level playing field' for oil refining.*

- *New accounting disclosure rules should be developed so that integrated oil companies show separate results for refining operations in annual accounts*

Further recommendations are set out in section 5 below.

3. Analysis

3.1 Europe has a history of refining overcapacity and low profitability

Refining distillation capacity decreased substantially in the early 1980's following the oil price shocks of the 1970's. At the same time, the industry had to invest heavily in conversion capacity to destroy fuel oil and rebalance demand.

Official figures for nameplate capacity show small further capacity reductions to the end of 1995. Combined with a slow rise in demand since 1986 this has increased apparent distillation capacity utilisation from a low point of 60% in 1981 to an average above 90% now, higher in northern Europe and lower in southern Europe.

Despite this rise in capacity utilisation, refining margins in Europe have remained low for the last two decades apart from sporadic periods of oil supply crises.

There are differences in supply and demand balances between different countries, with Germany in particular having a large supply deficit. Growth of oil products demand in Iberia has been well above the average for the EU, particularly in transport fuels. However, oil demand growth in the 1990's shows the Mediterranean region to be in line with the rest of Europe.

3.2 The return on refining is not sufficient to sustain a viable industry

With the exception of non-integrated refiners, the oil industry avoids publicly reporting European refining results separately from marketing. Despite this almost all of the companies have separate management accounts for controlling their refining businesses.

Nevertheless, a number of financial and independent industry benchmark analysts do conduct reviews of the separate sectors of integrated oil company operations. From these sources it is possible to estimate refining profitability.

Estimated return on refining capital employed in Europe has been running at around 2% to 6% p.a. since the Gulf War. Only a few niche refiners have been able to generate returns in the 10% to 15% range.

The average of about 4% return on capital employed is even below normal utility returns. For comparison the petrochemical industry has averaged 8% return over the last 20 years (lower during the 1990's).

Oil companies now generally set themselves targets of 12 – 15% return on capital employed or higher for downstream refining and marketing. This reflects the higher returns that are available to multinational companies from alternative investments in other sectors.

Our view is that European refining operations would need to return on average about 10 to 12% after tax on existing capital employed in order to maintain shareholder value. An internal rate of return of around 8% is needed for new investment projects.

The average returns currently achieved do not provide an adequate return on existing investment, and cannot justify new investment in refining capacity except in special cases.

Gross refining margins in North West Europe which have been running at about ECU 1.75 per barrel ($2.00/bbl) would need to rise by a further ECU 1.10-1.50 per barrel ($1.25-1.75/bbl) to justify new capacity investment on existing sites ('brownfield' investment).

3.3 Does it really matter that refining investment is not viable?

The increasing efficiency of international oil trading markets means that the oil industry increasingly operates as a global commodity market.

The fierce international competition that this engenders means that consumers benefit through low net-of-tax prices. Why should this situation be changed? Surely, the argument goes, oil companies are rich enough to carry poor refining results?

Integrated oil companies have continued to support their marketing networks through their own refineries, despite concerns about very low margins in refining.

However, many oil companies have been increasingly criticised by shareholders for mediocre profitability results overall, and a spotlight has been put on under-performing sectors or regions, for instance the downstream sector generally, and European and US refining. These sectors are increasingly considered as destroyers of shareholder value.

Efficient oil trading has also reduced the logic for vertical integration in the industry. While few large oil marketing companies would like to risk having no refineries, many companies' results would improve if they had a significantly less refining capacity.

A recent development in Europe is that there are very few companies in which governments still have a shareholding. The recently privatised oil companies are already behaving more commercially and less on social grounds.

One result of these changes is a marked reluctance to invest in European refining. Some are directing new investment elsewhere. Many refineries are now run on a 'Care and Maintenance' basis only. This risks a drop in safety standards, and a lagged response to the need to improve environmental standards.

If the present level of poor profitability persists, a few refinery closures will occur – but not enough to significantly alter margins. Eventually a vicious circle will set in. Lack of new investment in refining may, over time, put the EU industry technically behind other expanding areas of the world and could harm long-term global competitiveness.

As with other strategic sectors of industry that have gone into structural decline, putting off the necessary corrections now is likely to lead to a more painful enforced restructuring at a later date.

3.4 Demand is rising but excess capacity will not disappear

Taking the scenarios for energy demand prepared by the European Commission, and comparing these to forecasts of capacity adjusted by 'Capacity Creep', show primary distillation capacity likely to remain in surplus beyond 2010 (see Figure 1). A majority of oil companies we have interviewed share these conclusions.

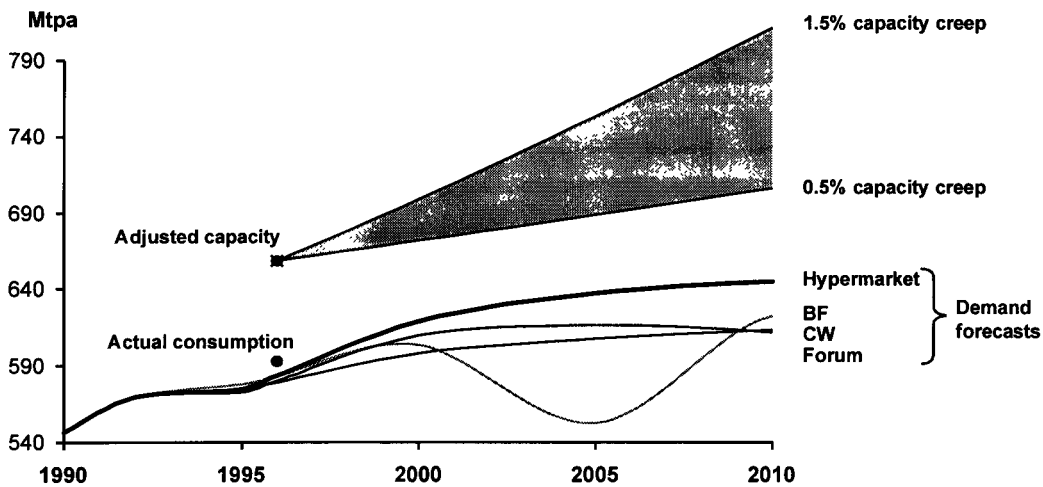

Figure 1 EU Refining Capacity and Commission Demand Forecasts

An alternative view, put forward by the IEA and some other analysts, foresees higher demand and slower capacity creep - leading to the EU moving into oil product deficit by around 2007. This still gives no short-term relief to the industry.

In addition the environmental pressures have not diminished. There is potential for more severe regulation of energy use following the Kyoto discussions.

We therefore support the view that there will be continuing capacity surplus in EU refining unless substantial further closures are made. Our estimate is that some 70 -100 million tonnes of primary distillation and associated capacity would need to be closed (about 9-13 full-sized refineries) to achieve maximum utilisation.

Refining profitability has also been harmed by excess gasoline production - primarily because the industry over-invested in catalytic cracking capacity during the 1980's, anticipating gasoline demand growth. Instead fast growth of diesel for passenger cars hit gasoline demand. This trend was initiated by tax incentives, but as diesel engines have advanced demand is no longer solely a function of tax differentials. The resultant gasoline surplus and diesel shortage is not likely to be reversed in the medium term, even if tax policies in favour of diesel are reversed.

European refineries compete in a global market. Improvements in refining margins in mid 1997 reflect increasing gasoline demand from the US. However, this improvement is

not a structural gain for EU refining. With slower growth in the Far East, EU gasoline exports to the US are vulnerable to increased supplies from the Middle East and even from the Far East.

Supply and demand developments in other regions of the world are therefore not likely to provide relief to the overcapacity in Europe over the medium to long term.

3.5 There are structural reasons for the inadequate level of returns

Marginal pricing behaviour is the essential mechanism which puts downward pressure on prices. At capacity utilisations between 85% and 95%, marginal costs are far below average costs. At the margin there is a strong incentive to maximise output and sell an extra barrel - even at very low prices. The general use of Linear Programming models encourages this short-term thinking.

Average price levels tend to settle around a margin which is a little above average fixed and variable operating costs (approximately equivalent to 'cash costs'). Contribution to capital is rarely considered in day-to-day decisions. As a result virtually no companies achieve a reasonable return on existing assets, and new investment cannot be justified on a stand-alone basis.

Amongst integrated oil companies there is cross-subsidisation between marketing and refining, and in some cases from upstream to refining. Although integrated companies see some refining capacity as essential to secure marketing sales, the trading markets have become so efficient that there is little synergy in covering all marketing needs from own refining.

A key reason for persistence of low returns is the high costs of closure in the industry, which can amount to between ECU50 million and ECU200 million for a refinery. Average closure costs are estimated at ECU100 million: 40 million typically for social costs, and 60 million for environmental clean-up. This high cost encourages the continuation of a number of poorly performing or loss-making refineries.

Margins have been further damaged by the imbalance between gasoline and diesel supply and demand. The growing surplus of gasoline has reduced margins available from upgrading.

Adequate returns will not be achieved without restructuring to remove the distillation capacity surplus. As supply for individual products becomes tight, price peaking will occur, driving up wholesale prices, and therefore margins.

However, with an efficient global market for refined products, any higher margins in Europe will draw in imports. This sets a price cap on the extra margin that tighter supply in Europe could cause. We estimate this to be about ECU 0.8 per barrel ($0.90/bbl) above current levels. This is equivalent to about 0.005 ECU per litre (half an ECU cent) on final consumer prices.

Due to increasingly sophisticated trading, the point at which prices start to rise significantly has over the past decade moved much closer to full capacity utilisation. This limits the benefits from an individual closure. At present utilisation several refineries have to close before an appreciable effect on margins will occur.

3.6 Environmental regulations increase the burden on EU refining

The European Council's 'common position' of June 1997 proposed more stringent fuel specifications for the year 2000, and indicative targets for 2005. These specifications are subject to further conciliation between the Commission and the European Parliament.

The oil industry estimates that on top of a 20 billion ECU cost to meet the 2000 standards, it would cost about a further 25 billion ECU to implement the 2005 targets proposed by the Council.

Even if the forecasts are overstated, this will be a huge cost for an underperforming industry. As argued above, the oil industry pricing mechanisms will not normally be able to recover additional investment costs.

Without some change to this position, some companies will only invest part of their needs to meet the new specifications. Some refineries will close. This would reduce overcapacity, but not enough to raise margins in current conditions.

An alternative to mandatory specification changes for 2005 would be tax differentiation (as is currently applied between leaded and unleaded gasolines. This would provide an incentive for consumers to change fuels, and for some return in the early years for refiners that invest to meet the new specifications.

Tax differentiation at appropriate levels would also provide a mechanism for smoother phasing-in of new specifications. However, the benefit to refiners of tax-differentiation is temporary rather than structural, as the competitive process will erode away gains once a substantial majority of consumers have switched to the new fuel.

Some of the specifications proposed for 2005 require a particularly high investment cost without demonstrably showing substantial gains in air quality. A second Auto Oil programme has now to evaluate the cost effectiveness of measures under discussion for 2005.

3.7 Oil companies are making some strategic changes - but not enough

Most European refiners are concentrating on similar strategies of cost reduction. While this adds to the long term trend of real price reductions to consumers, the competitive process is not giving any lasting benefit from this to the refiners themselves.

Restructuring of the European refining industry needs to be driven hard by the companies themselves if structural problems are to be significantly improved. So far there has been much less impetus to this in Europe than, for instance, in the USA.

The notable exception is BP and Mobil's European joint venture, and a small number of regional mergers and alliances, such as the Miro joint venture of two refineries in Karlsruhe.

3.8 Security of supply depends on access to crude oil more than refining capacity

Continuous supply of oil products is vital to the EU. A very large deficit of refining capacity in the EU as a whole would put supply at risk, but such an outcome is not under consideration in this study, and will not occur for the foreseeable future.

The issue is whether security of supply is at risk when refinery capacity is in deficit.

In these supply disruption circumstances it is access to crude oil and feedstocks, rather than specifically the location or capacity of refineries that is critical for security of supply. An appropriate policy for strategic stock levels is also critical, as is access to and flexibility of distribution infrastructure.

The level of refining cover needed to insure against severe supply disruption ranges between 70 and 90% of consumption over the EU as a whole. This is well below current EU refining capacity.

Austria, Denmark, France, Germany, and Ireland all operate satisfactorily with a deficit of refining capacity. In the case of Germany and Ireland this is quite large (75% and 53% cover respectively).

For a major external oil supply disruption, access to crude oil or feedstocks will determine the level at which the EU refining industry will be able to operate.

Strategic stocks are vital to cushion the initial disruption. The current 90 days level seems satisfactory, provided the stock indeed exists, although a lower level may be appropriate for net exporters. Member states do not yet see the issue on a pan-European basis, and the mechanisms and stock levels for strategic stock management need revision.

Access to, and flexibility of infrastructure is important, whether this is pipelines, road, rail, shipping or depots. Recent strikes in France showed that it was where products were stored and how they were moved rather than where they were refined, which secured local supply.

If there is a severe crude shortage, those who have access to crude will find no difficulty in renting spare refining capacity globally to refine that crude, provided they also can transport the crude and products.

3.9 Employment in EU refining is small relative to other strategic industries

Employment effects of any changes in refining are a serious concern to governments and the public. However, refining is a highly capital intensive industry which has been reducing manpower levels over many years. At about 90,000, the number of direct employees in refining are small compared with other strategic industries. Even if 10% of capacity were cut, the direct numbers released would be about 9,000 and would have a minor effect across the 15 EU members.

There are however a very few cases where a small local community is over-dependent on employment by a particular refinery. Government redeployment policies would be needed in such cases if any closure were to be considered.

3.10 Solutions need to take competition considerations into account

There is widespread concern in the industry about being seen to do anything that could be construed as anti-competitive. This is getting in the way of sensible restructuring. We have therefore examined competition implications with DGIV.

The Commission's stance on competition policy does allow scope for restructuring, and a clear understanding needs to be reached between DGIV and the industry. This includes conditions under which an industry-funded closure fund could be set up. There is a role to be played by the Commission in identifying and removing hidden incentives and exit barriers that prevent economically desirable refinery closures.

4. Summary of interviews with the industry and governments

Much of the analysis was tested in interviews with oil companies and government bodies, and is summarised below.

We conducted interviews with twenty-two oil companies, seven other oil industry organisations, and eight governments, generally at Chief Executive, EU downstream or refining director level. Further input was sought from other governments through a structured questionnaire.

4.1 Views of oil companies

There is wide agreement that profitability has been structurally too low and that the major, but not the only, cause is excess capacity. There is a widely held view that

capacity creep could be up to 1.5% pa and that the possibility of demand catching up with capacity without substantial new closures is remote.

Views on the level of excess capacity that needs to close in the short term varied between 5 and 15 refineries, with some also seeing the need for an ongoing programme of closure into the longer term.

There were divergent views on an industry closure fund, with many companies ambivalent or against. Some companies were supportive, seeing that reducing the exit costs to zero would be a win-win situation, that is:

- Governments gain environmentally because the number of refineries is reduced and the closed sites are cleaned up
- Closers gain because their costs are partly or fully paid
- Stayers gain because, for a one-off investment of say ECU 0.23/bbl ($0.25/bbl), the market will harden, perhaps by up to ECU 0.9/bbl ($1.00/bbl)

There was almost universal agreement that any closure fund should be funded by the industry, not by governments as in the case of the steel industry restructuring.

Any realistic range of closures is seen as having no detrimental effect upon security of supply, which instead depends more upon access to crude oil and feedstocks and to distribution infrastructure.

There is wide support for a rigorous process of cost-effectiveness analysis, such as Auto-oil-1, in determining the required industry actions to meet tightening environmental requirements. There is an equally forceful view that the Auto-oil 1 process became distorted by political over-rides at the end. Very serious concern was expressed about the likely cost to the industry, and the poor cost-effectiveness to the Community which could result.

4.2 Views of oil industry, other than oil companies

Industry bodies and other organisations agreed with the views on the oil companies in most areas.

Capacity creep, triggered by environmental investment, was almost universally seen at between 1 to 1.5 % pa or more. As one oil technology company, with a view at the high end of the range, put it:

> *"We should know, we are in the creep business"*

The unlevel playing field for environmental standards and taxation was seen as needing harmonisation.

Security of supply was not seen as a refining capacity issue; independent traders were confident about the industry ability to cover demand at much lower levels of refining capacity.

4.3 Views of government ministries

The governments interviewed generally preferred free market approaches for most issues and supported the concept of a single market in oil products.

One government (with substantial domestic refining) emphasised that the industry must put over a sense of urgency, stating:

> *"The industry must establish a sense of urgency, and work on this with politicians and the public. We receive few complaints from industry; there is no momentum."*

There is strong support from governments for reversing diesel's fiscal advantages. One wanted the Commission to take a much tougher line on tax harmonisation generally.

There is some support for measures to share the closure cost of refineries across the industry. A fund modelled on the successful Dutch service station closure fund was mentioned by more than one.

On the environment one government was forceful in its view that:

> *"We are very concerned. The 2005 specifications are not justified and will be a high cost to the industry."*

There was significant concern about the employment effect of closures in some countries. This was often linked to specific local communities where a refinery was the main employer, rather than on the total numbers likely to be released which were accepted as relatively low.

5. Evaluation of possible initiatives

5.1 Continuation of existing policies

We examined whether the Commission should just continue existing macro-economic and energy policies and take no extra specific steps to solve the refining issue.

These policies include, for example:

- Extension of the internal market
- European Monetary Union
- Liberalisation of energy markets

- Harmonisation of taxes, with a principle of neutrality between energies
- Assessing environmental standards on the basis of cost-effectiveness

Our conclusion is that without some intervention by the Commission there will be no significant breakthrough by the industry itself in overcoming poor refining profitability. This risks leaving an increasingly uncompetitive industry in a key strategic sector.

5.2 Possible initiatives

We evaluated a number of possible initiatives under 5 categories:

- 'Soft Options' to reduce costs to the industry
- Stringent but realistic environmental specifications - with a cost recovery mechanism for refiners
- EC encouragement of an industry 'shake-out'
- Removal of distortions to create a 'level playing field'
- Changing the profit and pricing signals in the industry through greater transparency

Other initiatives were rejected as being too interventionist or as clearly being against the public interest.

Our conclusions were that:

- *None of these initiatives are sufficient on their own to correct the problems of the industry.*
- *The major initiatives need to be taken by the oil industry itself*
- *Aspects of the solutions can be assisted by the European Commission*

5.3 Preferred actions

The most attractive actions which will have a significant impact appear to be:

- Encouragement of significant industry restructuring
  - This will require tough decisions by many members of the industry, and can be strongly influenced by the Commission. Member states (at both national and local level) need to avoid too parochial a response.
- Introduction of tax differentiation to incentivise a switch towards more environmentally friendly fuels
  - Some refineries are currently in a poor position to upgrade to new environmental standards. Such sites should be allowed to close.
  - The alternative of support through tax allowances on environmental investment would discriminate against those companies which have already invested.

- An industry-financed fund for closures.
  - It will be difficult to get industry agreement for this, and agreement of DGIV will also be required. There is a risk that this will merely lead to further delay and discourage early restructuring. A tight deadline would be necessary.
- Correction of distortions between regions and fuels, and in remediation standards for closure.
  - This is in line with single market policies, but much remains to be done.
- Increased transparency in refining industry reporting to shareholders.
  - This will have significant opposition in the industry. However it could provide a powerful longer term focus on underperforming assets.is in line with single market policies, but much remains to be done.

6. Recommendations

Our recommendations are therefore as follows:-

6.1 The Commission, through DGXVII, to kick-start a more urgent impetus for restructuring by bringing together all the interested parties from the refining industry, member state governments, and the European Parliament in a top level management exchange of views.

6.2 One follow-up exchange to be held about a year later at which the industry and the Commission would report on progress.

6.3 The Commission will carefully reassess the year 2005 indicative target fuel specifications as already planned through the Auto-Oil II programme, in order to agree truly cost-effective measures.

6.4 The resultant agreed specification changes from the year 2000 levels should not be introduced as mandatory specifications, but to be gradually introduced some time after January 2000 by regulating an EU-wide tax differentiation between old and new specifications.

6.5 A final attempt should be made to establish an industry-financed closure fund, with a time limit.

6.6 General ground rules to be set to prevent local distortions in the application of requirements for control of refinery emissions, which should be based on cost-effectveness criteria.

***6.7* Closure costs to be based on the sensible application of objective and harmonised environmental risk-based criteria for the remediation of a site and an extended time allowed for implementation.**

6.8 Unless there are exceptional circumstances, remediation to be to industrial re-use standards, not for horticulture or housing. This would best be harmonised by the Commission providing closure guideline standards across Europe.

6.9 The Commission to give serious consideration to capping a company's environmental liabilities once clean-up has been independently audited as having been completed to the required standards.

6.10 Steps to be taken by the Commission and governments to identify and remove distortions and create a level playing field across member states for oil refining.

6.11 New accounting disclosure rules to be developed so that integrated oil companies show separate divisional post-tax results for refining operations in annual accounts.

6.12 A review of the accounting treatment of write downs of non-performing refining assets to be undertaken.

7. Potential 'quick hits'

Early identification of some 'quick hits' for local restructuring, mergers, or closures would give impetus to the required restructuring. This could be a subject for the management exchange of views meeting.

As a starter for discussion we propose the following for consideration:

- France (South-East refinery cluster) – already explored, but needs new impetus
- Germany (Bavaria) – partial restructuring already, but could go further
- Ireland (Whitegate) – any closure would need the security of guaranteed supplies from a European refiner, preferably with direct access to North Sea crudeoil.

A number of other potential areas for restructuring which would require deeper evaluation are set out in the main report and appendices.

8. Potential impact of the recommendations

In the short term a restructuring of the required scale could lead to a removal over the next 5 to 7 years of 70-100 million tonnes of capacity (10-15%).

This reduction of capacity would tighten margins through a small rise in consumer prices for oil products. The potential for prices to rise is limited by competition from imports. We believe this will cap any margin increase to about 0.8 ECU per barrel ($0.9/bbl) above current levels equivalent to 0.005 ECU per litre on final consumer prices.

In the longer term cost savings from new investment would more than offset this price rise and be passed on to consumers.

Tax differentiation on the change in fuel specifications between 2000 and the specifications eventually agreed for 2005 would operate by imposition of a higher tax rate on the 2000 specifications. (To neutralise the tax effect, tax on the cleaner fuel should also be reduced). We calculate the differential needed would be about an extra 3 ECU cents/litre on 'dirty' diesel, and about 2.0 ECU cents/litre on 'dirty' gasoline. Some of the differential would be passed on to consumers to create a financial incentive to switch. Most would be kept by the refiners. The effect of the differential will disappear as the majority switch to the new fuel.

Removing distortions would improve the efficiency of market-led restructuring, while accounting transparency would prolong the margin benefit of efficient restructuring.

The price cap set by imports would, in our view, mean that the industry as currently structured, will be unable to realise better than a 7-8% ROCE on average, other than during periods of external supply disruption.

In order to avoid further destruction of shareholder value, individual refineries will need to search for profitable niche positions, or achieve superlative cost performance relative to the industry.

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ACCOUNTING

Full text for downloading (PDF format)

Accounting: Interpretative Communication concerning Directives on annual and consolidated accounts

An Interpretative Communication on a number of issues dealt with in the main EU Accounting Directives has been adopted by the European Commission. The Communication aims to give guidance to bodies responsible for setting accounting standards in the Member States, to accounting professionals and to investors and other users of company accounts. Consolidated accounts, the relationship between the Directives and International Accounting Standards and environmental issues in financial reporting are the three main issues are covered by the Communication. The Communication is based upon extensive contacts with representatives of the Member States and accounting professionals.

Basic EU-wide rules on the preparation and presentation of companies' annual accounts and the consolidated accounts of groups of companies are laid down respectively in the Fourth and Seventh Company Law Directives (78/66/EEC and 83/349/EEC). The Communication clarifies the meaning of a number of the Directives' provisions in the light of developments which have been taken place since their adoption. It forms part of the new accounting strategy adopted by the Commission in 1995. This strategy aims to improve comparability of accounts drawn up by companies in different Member States and integrate European accounting harmonisation efforts into a broader context of harmonisation at the international level, thereby facilitating EU companies' access to international capital markets.

On **consolidated accounts**, the Communication deals with the parent-subsidiary relationship, the exclusion of a subsidiary from the scope of the consolidation and the relationship between annual and consolidated accounts.

Concerning the relationship between the Directives and **International Accounting Standards**, the Communication borrows from the work of the special Task Force which was set up on this subject by the Contact Committee on the Accounting Directives. The comparison undertaken by the Task Force between the EU Accounting Directives and International Accounting Standards (IAS) did show that they were compatible in all but a few non-significant cases. The Communication reaffirms that where companies want to produce consolidated accounts also satisfying the requirements of IAS or US Generally Accepted Accounting Principles (US GAAP), this is only possible to the extent that the consolidated accounts remain in conformity with the EU Directives.

Finally, the Communication includes some clarifications on the inclusion of **environmental issues** in the financial statements. For example, it confirms that environmental risks or liabilities resulting from past transactions or events qualify for recognition as a provision in the balance sheet if the company has a legal or contractual obligation to prevent, reduce or repair environmental damage or if the company's management has committed itself to doing

so. The Commission intends to issue at a later date a separate Recommendation on environmental matters in financial reporting.

The Communication reflects conclusions arrived at in the Contact Committee on the Accounting Directives (chaired by the Commission and comprising Member State representatives) and discussions in the Accounting Advisory Forum (comprising representatives of standard-setting bodies and of interested professions).

Date: 22 January 1998 | For more information: D3@dg15.cec.be |

1. INTRODUCTION

The European Commission has established three main pillars of Energy Policy:

- Competitiveness
- The Environment
- Security of Supply

This report on the oil refining industry addresses all three of these issues.

Oil provides 42% of the European Union's (EU) energy requirement, and 94% of the fuels required for transport. The health and viability of the refining industry is of critical strategic importance to the Union for maintaining a successful and internationally competitive position for industry as a whole, and for providing competitively priced products to consumers.

The refining industry has an important role to play in assisting the EU meet increasingly stringent environmental targets. The investments required for an effective response to this challenge are potentially enormous, which in turn require a financially and technically strong industry.

The continuous supply of refined products is critical for the strategic interests of the EU. With the European refining industry now almost entirely owned by private shareholders, the strategic interests of the industry and of governments are no longer necessarily the same. Decisions taken a few years ago by many refiners on the basis of social impact are now more likely to be driven by considerations of shareholder value.

In 1996 the Commission published a 'Report on the Situation of Oil Supply, Refining and Markets in the European Community', (COM(96)143). This report drew attention to the over-capacity and poor profitability of the refining industry in Europe.

With the strategic importance of refining in mind, DGXVII of the European Commission appointed Roland Berger & Partner to carry out the present study to better understand the reasons for continued low profitability in the industry; to examine whether this represents a threat to the public interest in the EU; and, to suggest possible solutions.

This study is presented in three booklets, an Executive Summary, this Main Report, and Appendices. The Terms of Reference are set out in detail in the Appendices.

In conducting this study we have analysed data and forecasts produced by the Commission, the International Energy Agency, the oil industry, oil industry associations, financial analysts, and other commentators on the refining industry in Europe and world-wide. We have also conducted interviews with energy ministries of EU member states, and with the majority of oil refining companies in the EU.

The views presented in this study do not necessarily reflect those of the European Commission.

2. ASSESSMENT OF THE CURRENT SITUATION

2.1 EUROPE HAS A HISTORY OF REFINING OVERCAPACITY AND LOW PROFITABILITY

Since the early 1980s OECD Europe distillation capacity has reduced from 1050 Mtpa to under 700 Mtpa. Most of this decline took place in the early 1980's. However, demand has also fallen over that same period. While demand has been increasing since 1985, the current (1996) position is still one of surplus against nameplate capacity of some 70 Mtpa (Figure 2-1).

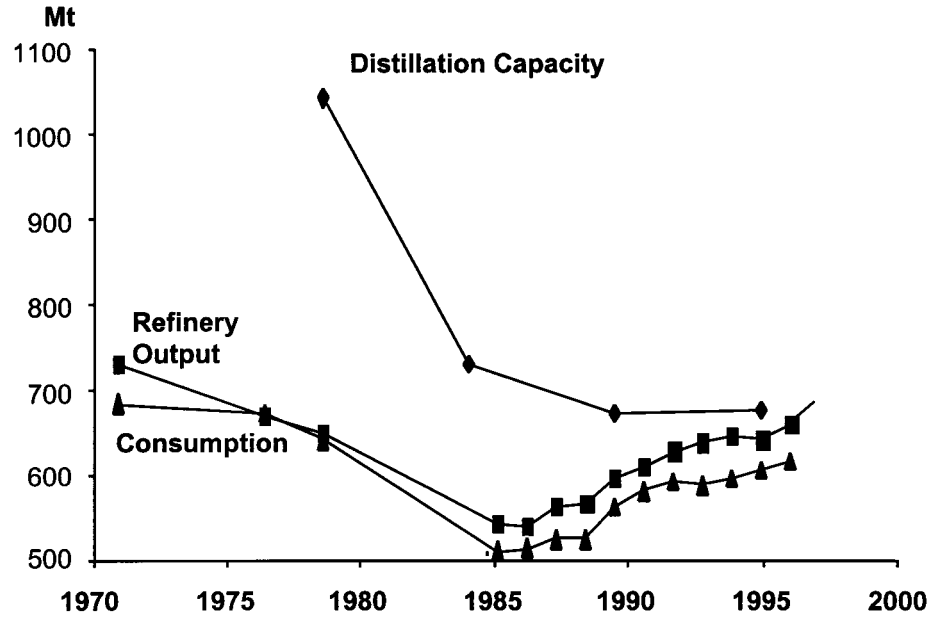


Figure 2-1 OECD Europe refining capacity vs. consumption (million metric tons)

The resulting distillation capacity utilisation has also increased from a low point of 60% to 91% now in Europe overall (Figure 2-2). Note that these utilisation figures are also based on nameplate capacity, an aspect we will discuss in detail.

There are differences in supply and demand balances between different countries, with Germany in particular having a large supply deficit. Growth of oil products demand in Spain has been well above the average for the region, particularly in transport fuels. However, in the 1990's oil demand growth in the Mediterranean region as a whole has come into line with the rest of Europe. Distillation capacity utilisation in the Mediterranean

countries of Greece, Italy, Portugal, and Spain remains lower than the rest of the EU at around 85%.

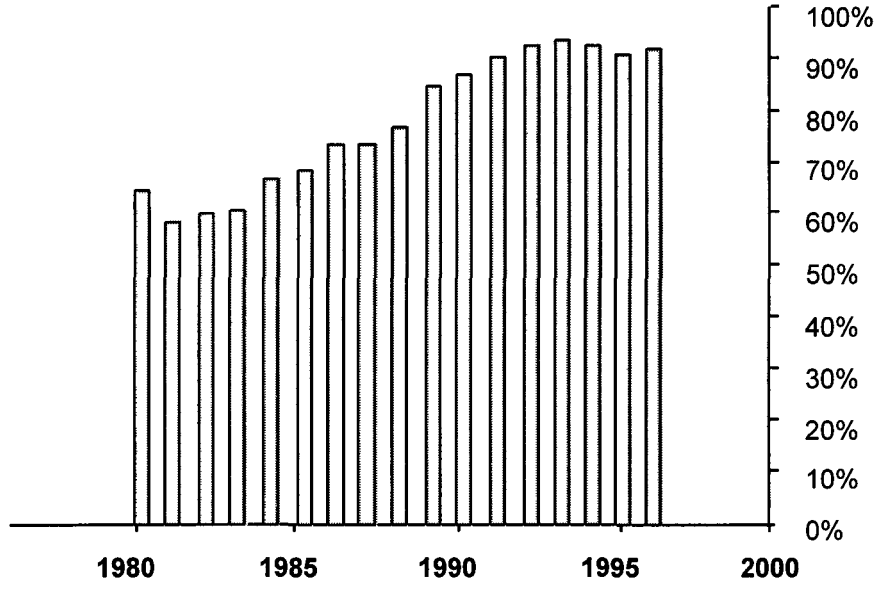


Figure 2-2 Capacity utilisation for OECD Europe (Throughput % of capacity)

Despite the increasing utilisation, margins over the past decade have generally remained low - reflecting continuing over-capacity. Apart from at times of supply crisis, such as the Gulf War, the Brent Complex Refining Margin at Rotterdam has languished at around $2/bbl (ECU 1.75 per barrel), (Figure 2-3). Even during the Gulf War supply crisis, much faster intelligence, advanced IT capability and sophisticated trading and hedging activities resulted in a relatively modest upturn in consumer prices, and hence in margins, compared to earlier crises.

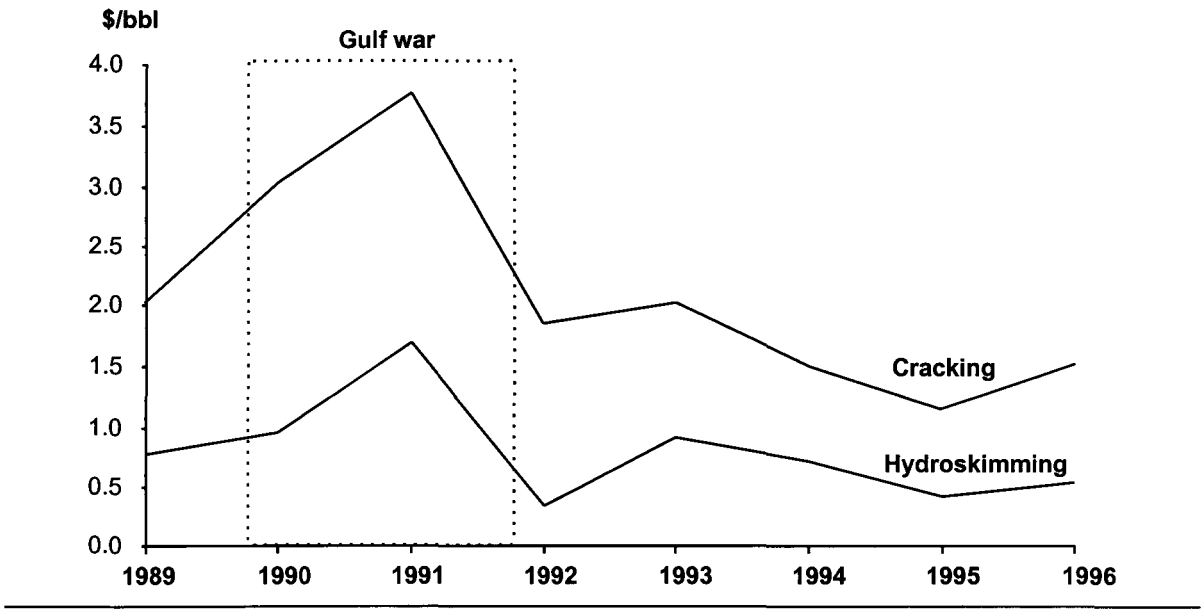


Figure 2-3 Annual average refining margins for NWE Brent crude

The impact of over-capacity, easy access to crude oil supplies and intense competition in the markets, both refinery gate and retail, has been to depress profitability.

2.2 THE RETURN ON REFINING IS NOT SUFFICIENT TO SUSTAIN A VIABLE INDUSTRY

The Commission observed in COM(96)143 that:

> *"... to sustain industrial development in the sector (refining) it is not sufficient to merely cover cash costs."*

We agree.

2.2.1 Historical profitability

Industry has traditionally been guarded about the level of profitability in different business sectors, regarding this as commercially sensitive. There is little included in company annual reports about the Return On Capital Employed (ROCE) in the European refining sector. Indeed in the reports of the majors the reference is typically to Downstream Profitability world-wide. Whether more openness might assist the industry to achieve higher profitability is discussed in section 4.2.5.

Notwithstanding this, there is a range of solid evidence to support the case that refining profitability is low. Industry bench-marking exercises indicate a range of 1% to 6.5% pre-tax ROCE for refineries in the bottom and top quartiles in 1994. Fleming's analysis

calculated an average refining return of 4% post-tax 1991-1996. Other investment analysts talk of similar figures for refining in Europe.

The many oil companies to whom we have talked indicate an industry range for average performers of between 2 and 6% ROCE, post tax, over the last 5 years with a total range of, say, -5 to +15% ROCE.

There are industry players who have profitable niches. Two, who have strong product niches appear to be at the higher end of the range. There are a few other refiners with particular geographical or niche advantages who achieve post tax returns above 10%.

European oil companies as a group make good returns on their total activities, but this includes high returns on upstream exploration and production (including a number of companies who are mainly or exclusively in the upstream), and in some cases, on non-oil activities. Comparison of annual report figures with large companies in other industries show oil generally performing well (Figure 2-4). This is reflected in the general perception of the public and of some governments who regard oil industry concerns about poor refining performance as an example of "crying wolf".

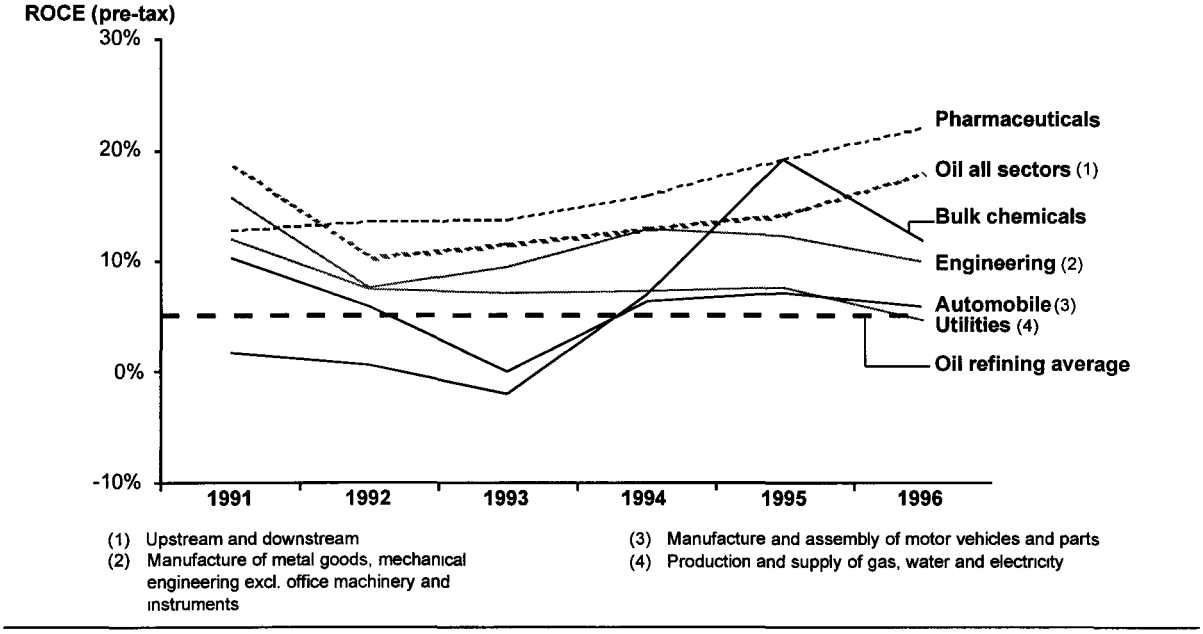


Figure 2-4 Profitability (pre-tax ROCE) of other industry sectors in Europe

However, the **estimated** average ROCE post-tax of 4% (5% pre-tax) for refining in Europe show that this part of the business is performing very poorly against key industries. Out of industries shown in Figure 2-4, only Automobile and Bulk Chemicals have produced worse individual years than the average results for oil refining. Overall, chemicals has averaged 6.4 % ROCE over the six year period, (8% ROCE over the past 20 years for European petrochemicals). Automobile has averaged 5%, and Utilities 7.8%. The complexity and technological exposure of refining should be similar to automotive and chemicals (both

industries which have their own problems of structural poor profitability). However, oil refining has higher risk and complexity than utilities, and should be aiming to exceed the long term returns for this sector.

In summary, the refining part of the oil industry in Europe has suffered unacceptably low profitability for many years, and this performance compares unfavourably to the returns achieved in other industrial sectors.

We discuss further in section 2.4 whether the EU should continue to rely on this poor performance being subsidised by the high upstream earnings of integrated oil companies.

2.2.2 Acceptable/desirable profitability in Europe

What level would be regarded as acceptable?

Comparison with other similar industry sectors gives one criterion.

Another criterion is to look at weighted average cost of capital (WACC) to establish the return below which refining operations would be destroying shareholder value. Because of historically low continental European interest rates this criterion has fallen over recent years. We calculate that for refining activities the relevant WACC for European refiners is now about 7.5% to 8%. This suggests that these companies should only approve new projects which will make a positive return post-tax against a 7.5 to 8% discount rate. Given that existing refining plant in Europe is on average about 20 years old (although a proportion of units, and particularly conversion plants have been built within the last decade), achievement of these levels requires an average industry ROCE post-tax of, we estimate, about 11% to 12% just to maintain shareholder value.

It has been argued that since the investment is sunk, and shareholder value has already been destroyed, existing underperforming assets should not be required to provide a return above WACC. This is uncommercial. Loss-making refineries, with no prospect of returning to profitability, should indeed be written off according to international accounting standards, but there are few such. (This is discussed further in section 4.2.5). It is however right for refiners to demand value from the remaining refineries which can give a positive, if still poor, return.

Oil companies now generally set themselves targets of 12 – 15% return on capital employed for downstream refining and marketing. This reflects the higher returns that are available to multinational companies from alternative investments in other sectors. As management targets these are appropriate. If the average performer in the industry is to avoid destroying shareholder value, the pacesetters will need to have significantly higher returns.

Based on the above criteria our view is that

The refining industry needs to achieve a level of profitability, in terms of

return on capital employed, of at least 10% and, to enhance shareholder value, of 12% post tax on existing assets. An internal rate of return of around 8% is needed for new investments.

To achieve this ROCE of 10 – 12% the Brent Complex Margin would need to be around $3.25 - 3.75/bbl (ECU 2.85 – 3.25 per barrel), compared with the average level of about $2/bbl (ECU 1.75 per barrel) over the last five years.

2.2.3 Re-investment economics

To invest in a typical refinery configuration for a balanced demand growth would require Complex Margins in the range $3.30 to 3.90/bbl (ECU 2.90 – 3.40), assuming this expansion took place within an existing site (brownfield construction), and taking an internal rate of return of 8%. Refining margins need to nearly double from existing levels to justify such investment.

To build expansion capacity in a new, greenfield, site requires a Complex Margin of the order of $5/bbl (ECU 4.35). While there are strong environmental, technical, and macro-economic arguments to support at least some new refineries in Europe, probably linked to the closure of several old sites, it is very clear that this type of project is not even being remotely considered by the industry.

The gap between current margins and ROCE enjoyed by refiners, and the margins that would be required for economic re-investment are illustrated in Figure 2-5.

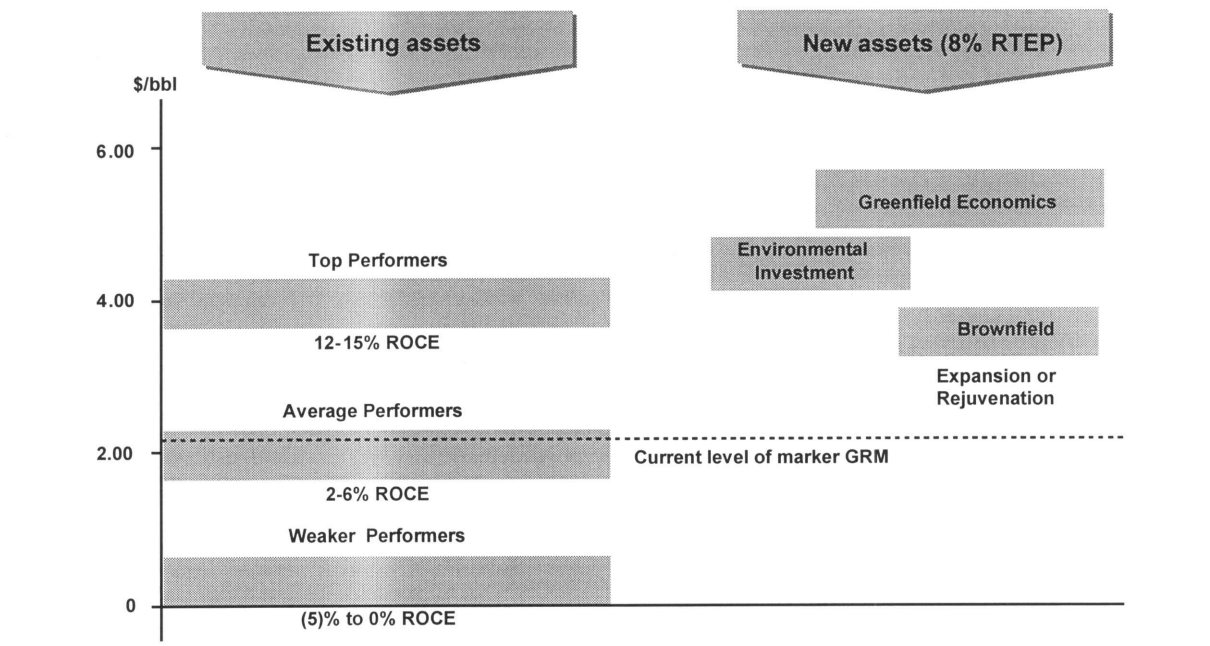


Figure 2-5 GRM achieved on current assets and required for new investment

The Leuna refinery rebuild in Germany (completed in 1997) is an exceptional example, related to the needs and rules of privatisation in the former East Germany, rather than to the realities of the refining industry. This could not have gone ahead without substantial regional subsidies.

2.3 MARKER MARGINS

As is well known in the industry, confusion can arise when "margins" are quoted unless great care is taken to define what this means. For example, which crude, processed through which configuration, to which products, placed in which market, in which time frame, and whether this is a gross margin, a net margin, or an operating margin either before or after tax.

At the request of the Commission we have expanded on this point in the Appendix. The margins quoted in the body of this report all refer to the Rotterdam Brent Complex Refiners' Gross Margin, using the International Energy Agency (IEA) definitions, unless defined to the contrary.

2.4 DOES IT REALLY MATTER THAT REFINING INVESTMENT IS NOT VIABLE?

The increasing efficiency of international oil trading markets means that the oil industry increasingly operates as a global commodity market.

The fierce international competition that this engenders means that consumers benefit through low net-of-tax prices. Why should this situation be changed? Surely, the argument goes, oil companies are rich enough to carry poor refining results?

2.4.1 Destroying shareholder value

Integrated oil companies have certainly continued to support their marketing networks through their own refineries, despite their concerns about very low margins in refining.

However, many oil companies have been increasingly criticised by shareholders for mediocre profitability results overall, and a spotlight has increasingly been put on underperforming sectors or regions – like European and US refining. These sectors are increasingly considered as destroyers of shareholder value.

The European refining industry deploys some ECU 90 billion ($100 billion) capital at book value. Uneconomic performance on assets of this scale creates a misallocation of resources in the economy.

Efficient oil trading has also reduced the logic for vertical integration in the industry. It is now much easier to operate as a wholly decoupled business, concentrating for example only on the upstream sector, or only on oil marketing. This is not a message which is welcome to the larger oil companies. Nevertheless, while few large oil marketing companies would like to risk having no refinery capacity at all to support their marketing sales, many companies' results would improve if they had a significant refining deficit. The BP/Mobil partnership for one has announced an aim of covering only about 80% of marketing needs through own refining capacity.

In addition, a recent development in Europe is that there are very few companies in which governments still have a shareholding. The recently privatised oil companies are already starting to act on more rigorous commercial rather than social interest grounds.

2.4.2 Reluctance to invest

At the more practical level, low profitability leads to a marked reluctance to invest. Apart from the Leuna refinery, and the wave of cat crackers since 1980, major oil companies have not invested in significant new capacity to improve their position in Western Europe for some time. Investment to maintain the existing equipment is being carried out at a rate

of about 1.5% of the existing asset base per annum. However, rejuvenation at the required rate to avoid technical obsolescence is not taking place.

The industry will always have safety as a key objective. Nonetheless there must be questions as to whether some of the smaller players are tempted to run at higher operating risks than would be deemed prudent. Even some of the major players, despite assurances to the contrary, may be trimming judgements too finely as budgets come under the most intense pressure.

2.4.3 Environmental investment needs

The environmental debate is now a critical matter for the industry. We return to this in section 2.7. However, as profitability has failed to improve, the oil industry has, in parts, become very defensive. Oil companies are not likely to respond quickly and positively to the prospect of another round of tighter standards which will involve very large investment costs, however much in tune they are with society's aims of protecting the environment.

2.4.4 Global competitiveness

With investments focused so strongly on minimum care and maintenance there must be serious concerns for the long-term global competitiveness of the industry. The European industry can no longer be considered as acting in an isolated local market. The refining industry is now global, and IT and trading capabilities are exposing Europe to the full intensity of that global commodity competition.

Oil companies are increasingly managing their assets as a global portfolio. The growing economies of South America and Asia have better long term profitability prospects than Europe (despite the current economic downturn) and the attractions of alternative investments elsewhere in the company's portfolio, for instance in the upstream, will compete for available capital. Major players now have explicit policies in place to reduce their exposure to Europe.

In addition to this risk of 'delocalisation', competing refiners based in the Middle East or Eastern Europe have the potential for investing in new technology in large scale plants that will provide a future competitive threat to ageing European refineries.

2.4.5 The danger of continued structural decline

If the present level of poor profitability persists, a few refinery closures will occur – but not enough to significantly alter margins. Eventually a vicious circle will set in. Lack of strategic new investment in refining will, over time, put the European Union industry technically behind other expanding areas of the world (Asia/Pacific, the Middle East, and Eastern Europe), and could harm long-term global competitiveness.

As with other strategic sectors of industry that have gone into structural decline, putting off the necessary corrections now is likely to lead to a more painful enforced restructuring at a later date.

2.5 DEMAND IS RISING, BUT EXCESS CAPACITY WILL NOT DISAPPEAR

2.5.1 Overall product imbalance in the European Union

The conventional wisdom is that there is excess capacity in European refining, and that, by stripping out the surplus, margins, and hence profitability, would be "better". An alternative view that profitability is poor mainly because of imbalance between gasoline and diesel demand is discussed in 2.5.2 and 2.6.4 below. The two views are not mutually exclusive.

Accepting the premise that tight capacity would improve margins it becomes important to establish whether and when the surplus capacity might be absorbed by the growth in demand.

Demand is rising and the call on distilling capacity will rise with demand. The Commission's 'European Energy to 2020'[1] report is a major piece of work to define possible future worlds on a consistent basis. There are four scenarios. These scenarios show a range of oil demand in 2010 between 612 and 645Mtpa, an increase from 593Mt in 1996 (Figure 2-6).

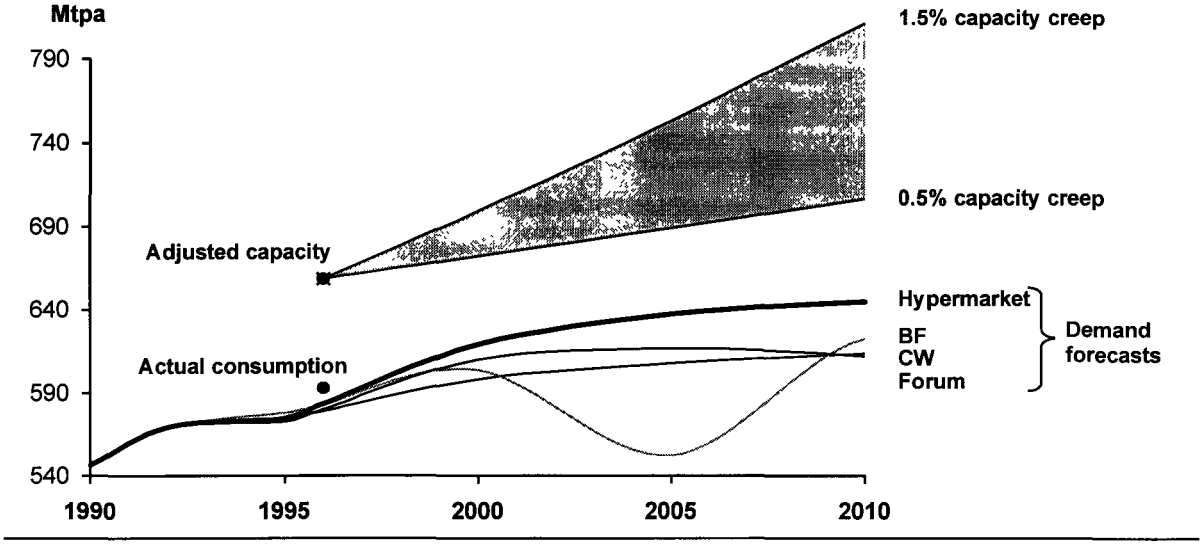


Figure 2-6 EU refining capacity and oil consumption[1]

[1] Definitions of the demand forecast scenarios Hypermarket, Battlefield (BF), Conventional Wisdom (CW), and Forum can be found in the Commission's 'European Energy to 2020' report.

The refinery nameplate distillation capacity in 1996 for EU15 countries was 645 Mtpa, using official IEA data. However the natural process of technical learning, found in all industries, will ensure that the actual capacity available to the industry will be greater. This capacity increase, largely from small improvements to existing assets, is known in the oil industry as "capacity creep".

Misunderstandings can arise on what factors cause capacity creep. At the request of the Commission we have therefore given a more detailed explanation in the Appendix. Because of the importance of capacity creep in assessing forward utilisation we have explored this in depth in all our interviews.

There is a range of views on the rate of capacity growth due to capacity creep. The IEA feels that a range of between 0.5 and 0.75% pa is appropriate, and bases this on its own work and discussions with oil companies at the technical level. Refinery engineering firms state that capacity creep is over 1.5% pa. As one of them said to us, "We should know, we are in the creep business!"

Further, as new investments become necessary to meet environmental standards the opportunities for low cost debottlenecking open up. Senior executives who we have interviewed put the likely range of capacity creep under these circumstances at the higher end. A range of between 1% pa and 2% pa, on an overall EU basis, represents an almost universally held view.

In Figure 2-6 we show the wedge of capacity creep as a range between 0.5% and 1.5% pa.

A further point to note is that there is general agreement, including with the IEA, that some 2-3% capacity needs to be added to the official IEA total nameplate capacity of 645 Mtpa in 1996 to allow for capacity creep since 1990/91. This is reflected in the base point capacity at 665Mtpa shown in Figure 2-6.

> *The demand forecast can be compared with the capacity availability (Figure 2-6). It is clear that primary distillation capacity is likely to remain in surplus up to and beyond 2010.*

Several caveats require stating, although they do not change the overall conclusion.

On the one hand, the Scenario demand estimates have been challenged as too low, on the basis that the rate of energy efficiency improvement taken is too high. The IEA, Concawe and others subscribe to this view. However, taking the higher IEA demand figures even with the IEA's lower capacity creep assumptions leads to continuing surplus up to the year 2007. This gives no short-term relief to the refining industry.

On the other hand, there is a powerful view that the oil demand projected in the Scenarios may still be high because in three of the four scenarios this would lead to an increase in CO2 emissions in Europe. There is no doubt that environmental pressures are building up, and rising up the agendas of the public and governments. For example, this summer has

seen the banning of half the cars from the centres of Paris and Mexico City due to poor air quality.

In addition, technical advances in new "supercar" developments by Mercedes and others since the scenarios were written give hope for significant savings in transport fuel use to become commercially viable towards the end of the next decade.

Discussions, such as those in Kyoto in December, are likely to put downward pressure on the consumption of all fossil fuels through regulation of use, or through new equipment standards. We note that the Scenarios show global CO2 emissions essentially doubling from 1980 to 2020. This is unlikely to be acceptable to the public or politicians. Increasingly visible congestion is also leading to a reduction of public tolerance of the rate of growth of private transport in a number of countries.

A third caveat is that as yet unannounced closures may take place. One closure of 150,000 bpcd is 7.5 Mtpa. It can be seen from Figure 2-6 that many such closures would be required to close the probable under-utilisation gap of some 70-100m tonnes pa of capacity.

Overall there is a high probability that there will be spare refining capacity well into the next century unless the industry undertakes a major restructuring.

2.5.2 Gasoline and Diesel imbalance

All the above refers to primary, distillation capacity. However, there is now a situation where the industry has some surplus secondary upgrading capacity.

Over the last 15 years the industry invested heavily in catalytic cracking capacity, with capacity rising from 4% to 13% of total distillation capacity. The total conversion capacity of all units expressed in terms of cat cracking equivalent is now about 30%. This conversion investment was driven by forecast assumptions of:

- higher gasoline demand
- a heavier crude barrel
- higher average sulphur in crude

In the event, none of these assumptions were realised. Gasoline is now in decline in Europe, and diesel demand continues to grow strongly, mainly due to tax incentives and a perception of environmental friendliness (Figure 2-7).

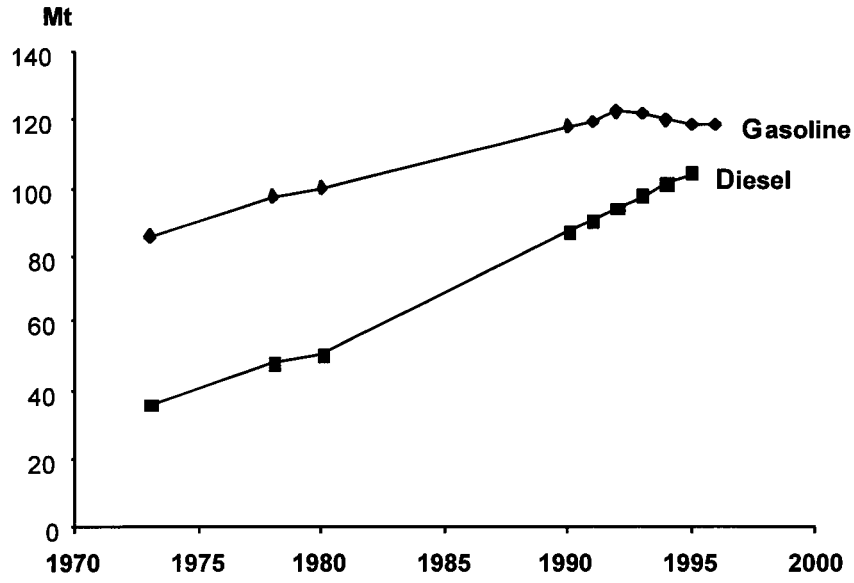


Figure 2-7 EU Gasoline and Diesel Demand

The position in Southern Europe is different. Strong growth of gasoline continued to 1994. More modest growth of diesel only began to accelerate in 1995. Northern Europe (and particularly France, where diesel cars form almost 50% of new passenger car registrations) has experienced very fast diesel growth.

For refinery upgrading it is the total middle distillates demand that is relevant. In both Northern and Southern Europe increasing diesel demand has been partially offset by declining gasoil demand for heating. This trend is expected to continue with increasing use of natural gas.

Forecasts of the forward crude mix indicate little change in the average sulphur content and a flat, perhaps marginal increase in heavy crude usage.

The industry therefore now finds itself in the position of (Figure 2-8)

- Surplus gasoline capacity and net gasoline exports of 18 Mtpa and rising
- A gasoil and diesel balance which went into deficit of 9 million tonnes in 1996 because of a cold winter, but which is broadly in balance to slight deficit. This deficit is forecast to grow over the next 10 years.

In addition to the surplus gasoline volume there has also been a resultant decline in the value of octane, which reduces the prices achievable for higher octane qualities of gasoline.

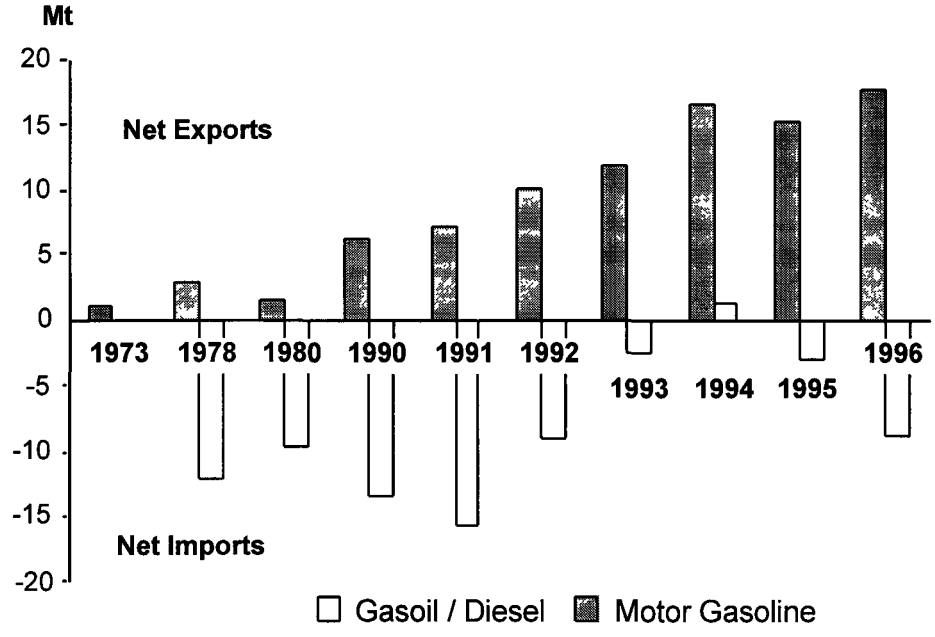


Figure 2-8 EU gasoline and gasoil / diesel imports and exports

The trend towards fast diesel growth was initiated by taxation differentials, as almost all EU countries differentiated significantly in favour of diesel. However, technical advances in diesel engines and other factors have changed customer perceptions, and there is no longer a direct correlation between demand and tax differentials, Figure 2-9.

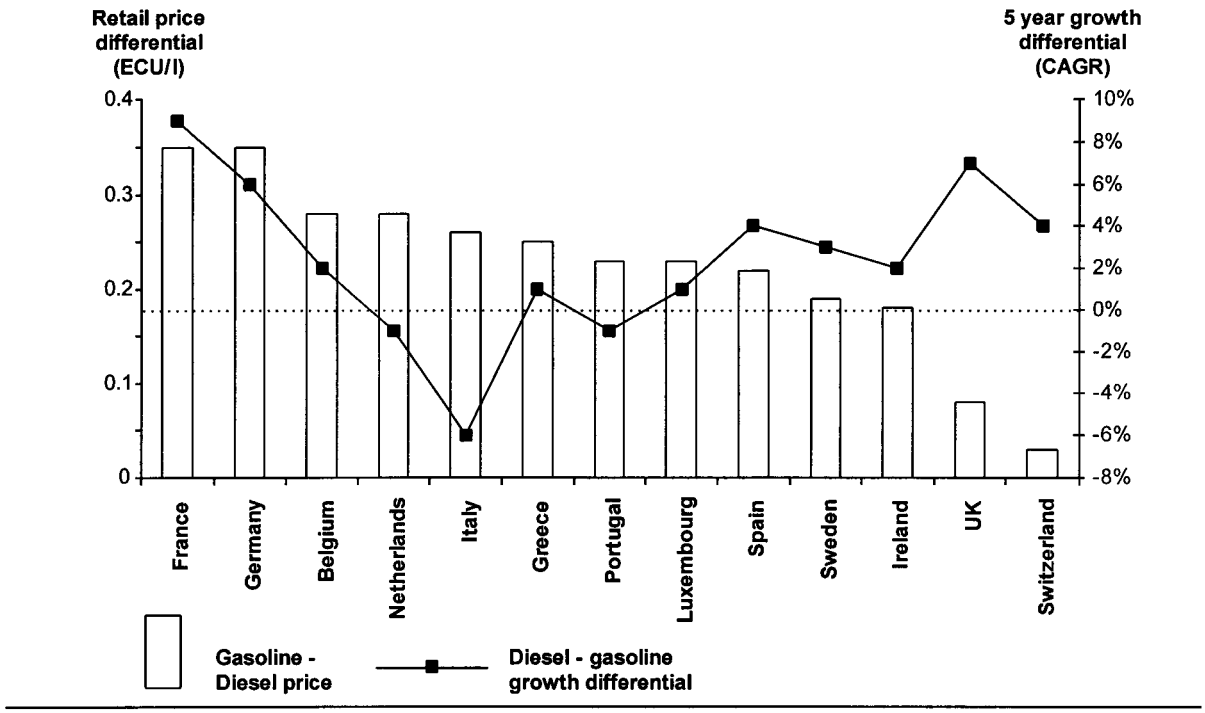


Figure 2-9 Gasoline/diesel pump price differentials (1995) and demand growth

The resultant gasoline surplus and diesel shortage is not likely to be reversed in the short to medium term, even if tax policies in favour of diesel are reversed.

The effect of the gasoline and diesel imbalance on refining companies is discussed below in section 2.6.4.

2.5.3 The effect of oil balances in other refining regions

Eastern Europe and FSU

There is currently considerable spare capacity in this region, following the collapse of these countries' economies. The Commission's Scenarios show an increase of exports from east Europe and the FSU, rather than a deficit that could load EU15 spare capacity, (Figure 2-10). In assessing this probability consideration needs to be given to:

- the physical state of the spare capacity and whether it could indeed be made available
- the extent to which part of this capacity will have to be shutdown permanently
- the requirements for local demand as the region's economy revives

- the availability of the necessary distribution infrastructure to move major volumes

- the ability of the area to produce the required EU product qualities

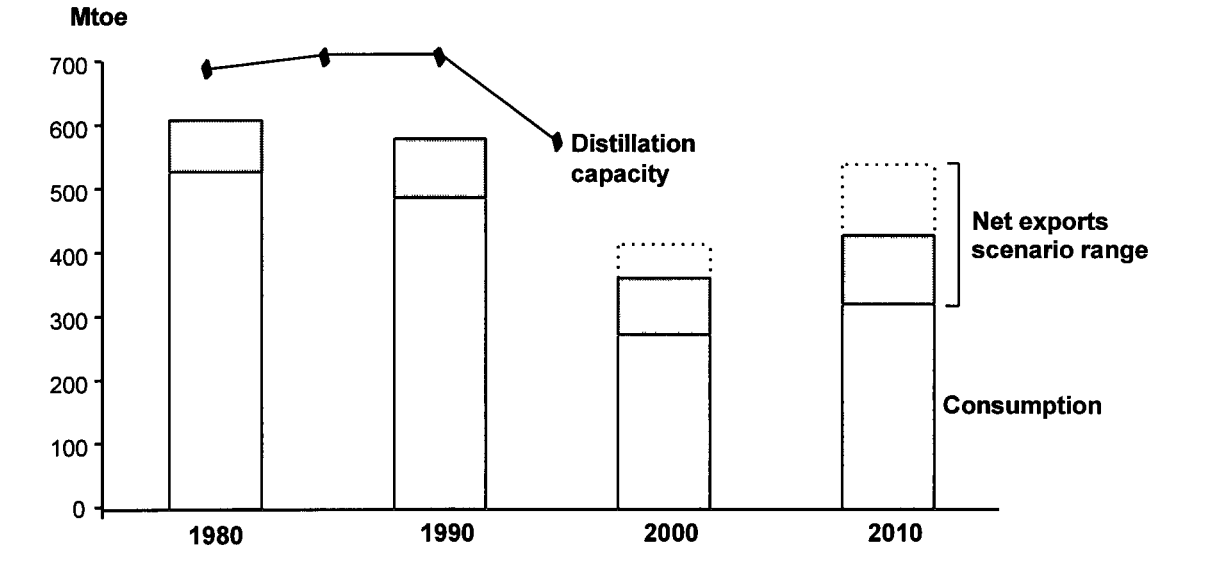


Figure 2-10 Eastern Europe/FSU oil product consumption, export and capacity

We have explored these issues with the industry. There is a clear view that in broad terms the region will have to solve its own problems to become competitive. This may be achieved fast in some countries through privatisation and restructuring. In other countries the process may be slow and less efficient.

In any event it is seen as most unlikely that there will be a major profitable export market here to even partly resolve the EU15 spare capacity problem. In the longer term there may well be increasing imports into the EU from this region. Accession of applicant countries into the EU will if anything increase this trend.

North/South America

In broad terms these regions are moving into deficit, with the higher quality CARB specification gasoline for California being particularly short. Some European refiners are already supplying these markets and boosting their profitability.

These niches may well continue, with product moving west as the arbitrage window opens for a time. As volumes have increased there are signs of nervousness in the industry at the degree of reliance on this outlet, with a freight cost of upwards of ECU 1.10/bbl ($1.25/bbl). For high quality material, price differentials offset the freight disadvantage - but only a few European refiners can meet these stringent specifications.

On the other hand, as the IEA point out, the supply demand balance for the Atlantic Basin (Americas and Western Europe) is indicating the need for some 150-200,000 bpcd (about 9 Mtpa) additional refining capacity each year between 1998 and 2002. The IEA see the demand growth being primarily for middle distillates, jet fuel and diesel. It is probable that the industry in the Americas will respond with new capacity to meet at least part of this demand.

While strength in other areas of the Atlantic Basin may well help European refiners, we do not consider it sound policy for EU refiners to plan on the basis of major long term structural exports for baseload qualities, which would have the effect of setting European price levels at export parity.

To improve margins EU refiners need a deficit of capacity in Europe which would move the margins closer to structural import parity.

Middle East / Far East

The last few years have seen the complex margins in the Far East fall from ECU 3.50/bbl ($4/bbl) and move close to European levels of ECU 1.75/bbl ($2/bbl). This has been caused by the economic downturn and industry overbuilding refining capacity, and is likely to worsen with the recent financial crisis in the region. Demand growth is expected to take the industry back into deficit in the medium term. Refinery new building is likely to broadly keep pace with demand in the region. However, short term overbuilding will back surplus supplies from the highly competitive Middle East refineries into Europe or North America.

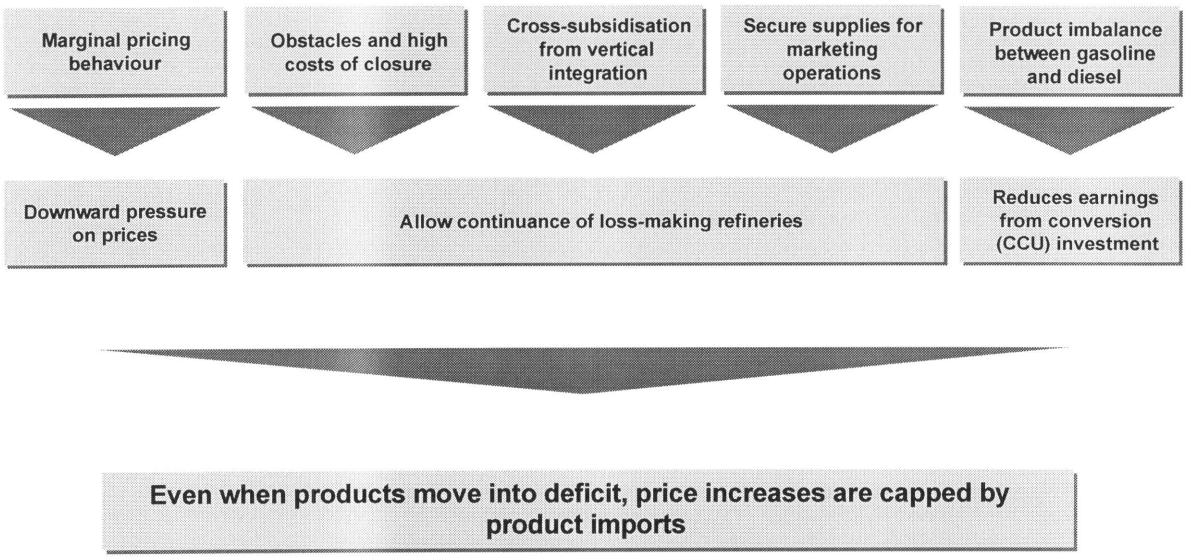
Implications for Europe

Supply and demand developments in other regions of the world are not likely to provide relief to the overcapacity in Europe over the medium to long term.

EU refineries will need to be able to compete with potential imports from other regions, or with other regions' exports when EU surpluses need to be exported to markets such as the US. To do this, Europe cannot afford to have cost structures and processing efficiencies too far below global pacesetters. This requires adequate investment for rejuvenation and competitiveness.

2.6 THERE ARE STRUCTURAL REASONS FOR INADEQUATE PROFITABILITY

An overview of the structural reasons is given below.



2.6.1 Marginal pricing behaviour

The cost of processing a marginal barrel of crude oil is very low, perhaps only a few cents per barrel above the cost of refinery fuel. In contrast, the fixed costs of a complex refinery at capacity utilisation between 85% and 95% are in the region of ECU 1.55/bbl ($1.75/bbl).

This creates a powerful incentive to run the last barrel of crude, even if this only makes a cash-contribution of a few cents. This whole marginal economic approach is driven by the near-universal use of linear programmes (LPs) to maximise refinery operations, on an annual, quarterly and monthly basis.

While most companies will limit the freedom of their traders to bid down the prices, this whole process inexorably forces prices down to the point where 'cash costs' (fixed and variable costs excluding depreciation and interest) are just covered. Contribution to capital is rarely considered in day to day decision making – although managements regard it as crucially important for the future health and viability of their companies. As a result virtually no companies achieve a reasonable return on existing assets, and new investment cannot be justified on a stand-alone basis.

This trend will continue unless industry behaviour changes radically.

2.6.2 Cross subsidisation from vertical integration

Amongst integrated oil companies there is cross-subsidisation between marketing and refining. Over 80% of the EU15 market is with companies whose refining is vertically integrated with the upstream. The proportion covered by integrated refining and marketing exceeds 90%.

It is clear that most integrated oil companies know internally the profitability of each segment with reasonable accuracy from their management accounts. They endeavour to make an acceptable return on capital from each segment, and share segment trends in broad terms with the investment analyst community.

In addition, most large traditional oil companies do not consider it viable to retain large marketing networks without the security of being able to supply largely from their own refining capacity. This does not however mean that downstream oil companies need to have full refining cover for 100% of their sales, as the BP/Mobil joint-venture and a number of other companies demonstrate.

Considering refining as a strategic component of the Downstream, or of the total corporate business, can lead to unclear commercial signals and a lack of resolve to really tackle the problem of refining under-performance. This is particularly true where a company produces a good overall return to shareholders through high returns from other business sectors.

While there are strategic links between oil industry sectors, the reality is that independent markets already allow significant decoupling of refining from marketing. Trading markets for both crude oil and products have become increasingly efficient and liquid over the past two decades. New competitors in marketing - particularly the hypermarkets - have found little difficulty in getting product supplies on the open market in most EU countries. They have found it a competitive advantage not to have to support under-performing refining assets.

2.6.3 Obstacles and high cost of closure

It is very clear from all our interviews that exit costs which are high relative to the potential cash losses of underperforming refineries are a major factor hindering necessary restructuring.

The closure cost of a refinery has two main components: the social costs of releasing staff, and the costs for the site clean-up.

Estimates of the cost of closure vary quite widely, and will depend on social legislation and the level of cleanup required. For the purposes of this project we estimate from industry and government sources that the average cost of closure is in the order of ECU 100 million, with a range between ECU 50 and ECU 200 million for individual refineries. The

average cost typically consists of about ECU 60 million for clean-up costs, and ECU 40 million for social costs.

The industry takes seriously its social and environmental obligations, and there appears to be no dispute that when a refinery closes the refiner has a duty to compensate employees and assist their redeployment, and also to clean up the land. However, the clean-up cost raises concerns for two reasons:

- The absolute level of cost
- The uncertain and open-ended exposure to future site environmental liabilities, which are virtually impossible to sell with the site.

Open ended environmental liabilities, retroactively applied, have given rise to expensive settlements in the US, and oil companies in particular are wary of being caught in the same situation in Europe. Some companies have limited this risk internally by retaining closed refineries as oil terminals.

There is also reluctance by some companies to take the write-down in their books of an asset that could be considered to be permanently impaired. This is somewhat ironic where the alternative is a low-priced sale, since the impact on the accounts is the same. Additionally, a sale is likely to place a low cost asset base in the hands of an aggressive competitor who will have much lower income requirements to reach an acceptable return on capital employed!

Clearly, the refinery sale route is a poor choice for a company staying in the market. Only permanent closure will lead to any improvement of the existing refiner's own competitive position. For a company leaving the market a sale minimises the cost of exit, but it can also be used as a spoiling tactic against those remaining.

The overall effect of all of these factors is to encourage the continuation of a number of poorly performing and loss-making refineries.

2.6.4 Product imbalance between gasoline and diesel

Section 2.5.2 above explains that the EU currently is surplus in catalytic cracking capacity and hence has surplus gasoline, but is balanced-to-deficit in diesel.

The impact of this is that

- surplus gasoline is exported, incurring a freight penalty
- the value of high octane qualities is depressed
- diesel is imported, also incurring freight.

In addition, southern Europe refiners (which still have a surplus of gasoline for export despite fast demand growth to 1994) find it difficult to meet the tighter specifications of the US for gasoline. They are therefore forced to export surplus gasoline to low value-added markets like Africa in strong competition with both Middle East and South American refiners.

These factors reduce the margin from this investment in conversion. In practice, for European refiners, the resultant depressing effect on gasoline prices is only partly offset by pressure for diesel prices to rise. This is a significant contributor to low refining margins in Europe.

However, the fact that hydroskimming margins still do not cover cash costs in Europe shows that it is the overall surplus of distillation capacity which is the main cause of poor returns on capital employed. Nevertheless, if distillation capacity is closed, at least some conversion capacity should be closed too. Alternatively new hydrocracking capacity will be needed to rebalance the supply barrel.

Bringing the demand and production barrel more in line by increasing the demand for gasoline and reducing the demand for diesel would assist overall profitability. However, even with reversed taxation differentials, this would have little effect for many years given the percentage of diesel cars now in the car park. This is also politically sensitive because of the effect on trucking costs, and on the general public.

Any move to harmonise fuel taxes within the Community would have to be seen in the context of proposals for the harmonisation of energy taxes overall.

2.6.5 Product imports

Adequate returns will not be achieved without restructuring to remove the distillation capacity surplus. As supply for individual products becomes tight, price peaking will occur, driving up wholesale prices, and therefore margins.

However, with an efficient global market for bulk refined products any temporarily higher margins in Europe will draw in imports.

While the freight cost gives a measure of price protection there is an effective cap to the sustainable European margin while product is readily available elsewhere. For substantial import volumes the most likely competitive supplying area to Europe is the Middle East.

We estimate the relevant differential of product prices with the Middle East to be about ECU 0.80/bbl ($0.90/bbl), which will become the effective average price cap for increases to North-West Europe margins - even for substantial volumes of product deficit in Europe. This is equivalent to about 0.005 ECU per litre (half an ECU cent) on final consumer prices.

However, if gasoline moved from structural export parity, to structural import parity, a larger margin improvement can be expected for the base load gasoline production.

Because of increasingly sophisticated trading, the point at which prices start to rise significantly has over the past decade moved much closer to full capacity utilisation. This in turn limits the benefits from an individual closure. At present utilisations several refineries have to close before an appreciable effect on margins will occur.

2.7 ENVIRONMENTAL REGULATIONS INCREASE THE BURDEN ON EU REFINING

The European Council's 'common position' of June 1997 proposed more stringent fuel specifications for the year 2000, and indicative targets for 2005. These specifications are subject to further conciliation between the Commission and the European Parliament.

The industry recognises an obligation to play its part in discussions and action to improve the environment in Europe, to the benefit of the whole community. However, there are important concerns which the industry has on several aspects of the current position.

2.7.1 Investments required and profitability

The oil industry estimates that on top of a 20 billion ECU cost to meet the year 2000 standards, it would cost about a further 25 billion ECU to implement the 2005 targets proposed by the Council.

Even if the forecasts costs are overstated, this will be a huge cost for an underperforming industry to bear. As argued above, the oil industry pricing mechanisms will not normally be able to recover additional investment costs.

The probability of the industry being able to achieve, and then to maintain, an acceptable additional margin in the market to cover these investments is remote.

The Auto-oil process has not sufficiently discussed how environmental costs will be recovered. There may be an imbalance between the oil industry and the automotive industry in this respect. A majority of the costs to meet air quality objectives for 2005 through fuel specifications are borne by capital investment. As shown above, the marginal pricing mechanism in refining will not in current circumstances reflect this in consumer prices. If very high costs are placed on refining to meet fuel specifications the effect will vary:

- Some will invest, and accept the unprofitable 'investment' as the price of continuing to do business in Europe.
- Some will rebalance output and decide not to supply part of the overall gasoline and distillate demand
- Many will add low cost incremental capacity (capacity creep) to achieve some incremental revenue from the investment.
- Some will decide not to supply the higher specification products
- Others will consider exit very seriously, some can be expected to close

In section 2.6 above we have argued that distillation capacity needs to close. To this extent it could be argued that by forcing closure the high environmental investment costs will help the industry. This is only true if enough refineries are forced to close to significantly raise margins. We do not think this will happen without substantial other measures.

2.7.2 The polluter pays principle

In the case of transport fuels, consumers, who through their governments have made the choice for more stringent specifications, should bear the cost. This principle is already accepted by the Commission. The refiner should not bear the cost without an accepted means of recovery.

New specifications could be introduced on a mandatory basis from a defined date. A more attractive alternative, which phases changes in over a period, is by tax differentiation. The advantages include:

- stimulates quality competition and consumer awareness
- the consumer makes the choice between "cleaner" and "dirtier" fuels
- a tax benefit partly flows through to the refiner, to provide an appropriate return, as in the Swedish city diesel case, or as in the introduction of unleaded gasoline
- allows for a progressive phasing of investment to meet higher targets
- stimulates the rejuvenation of the refining industry

Achieved quality levels through the tax differentiation mechanism can then be changed into mandatory legislation at a later date. The fiscal instrument, followed by mandatory legislation, then become a powerful complementary combination.

Tax differentiation at appropriate levels would also provide a mechanism for smoother phasing-in of new specifications. However, the benefit to refiners of tax-differentiation is temporary rather than structural, as the competitive process will erode away gains once a substantial majority of consumers have switched to the new fuel.

2.7.3 Process and cost effectiveness of alternative solutions

There are serious concerns about the process that resulted in the 2005 indicative target specifications becoming possible, even likely.

It is entirely appropriate that the desired overall air quality standards are set at the political level. However, the choice of standard should be made in full awareness of the costs to the whole of the European Community, and on Community competitiveness globally. This was the guiding principle behind the Auto Oil programme.

However, in the view of the refining industry the discussion of the specifications recommended as a result of the Auto Oil 1 programme has become disconnected from the original agreed objectives. A second Auto Oil programme will now evaluate the cost effectiveness of measures under discussion for 2005. The Commission, governments, the European Parliament and the oil and automotive industries need to ensure that the subsequent discussion of new fuel specifications takes all interests fairly into account.

2.7.4 2005 Specification levels

Whilst improved environmental standards are clearly a necessity, those specifications which are particularly costly on technical refining grounds but only lead to relatively low marginal environmental gain, should be re-examined. These may include:

- Gasoline aromatics to 35%
- Diesel sulphur to 50ppm or lower
- Other light city diesel specs

The biggest single investment cost estimated for the 2005 indicative targets is the move in road diesel from 350ppm[2] sulphur to 50 ppm sulphur in 2005. The argument for this specification is that current catalyst technology for removing emissions from diesel exhaust requires a maximum 50ppm of sulphur to prevent catalyst contamination. There has not been extensive research on the effect of intermediate levels of sulphur (for instance 150ppm) on current catalysts, nor on new catalyst technologies which could be available by 2005. This and other issues need to be critically re-examined by Auto Oil 2.

It should be noted that solutions which are feasible on a single nation basis might well lead to abnormal results on an EU wide basis. For example, light city diesel at Swedish specifications, largely met by changing crudes and importing deficits in Sweden's case, would probably lead to a shortage of jet fuel and kerosene if applied on a mandatory basis throughout the EU.

[2] Proposed by the European Commission for 2000

2.7.5 Refinery emissions

In all of the foregoing we are referring to the specifications for transport fuels. There are obligations on the refineries to meet environmental emission standards for SOx, NOx, water, noise and particulates, in particular. We note that the implications of the LCP and IPPC Directives for refiners could be significant, especially as IPPC directives are based on best available technology (BAT) and therefore represent a particularly costly scheme.

While we would argue that the same principles of rigorous cost effectiveness analysis should apply, refinery emissions have not been a part of this study. We have assumed that refineries continue to be responsible for funding agreed standards on emissions from refineries.

2.8 OIL COMPANIES ARE MAKING SOME STRATEGIC CHANGES BUT NOT YET ENOUGH

2.8.1 Convergent strategies

There is a universal and powerful drive by the refining industry to improve competitiveness. Benchmarking plays a major role in identifying weaknesses and areas for attention. The actions focus on three main areas:

Improving revenue: The industry strives to find profitable new product outlets and to broaden its revenue base. There are some revenue niches such as district heating, co-generation, access to infrastructure, ability to supply CARB gasoline or needle-coke, but with oil products traded at the refinery gate as near-commodities the scope for revenue enhancement in refining is limited.

Reducing costs: Manpower levels are under continuous scrutiny, including management structures, amalgamating operations, savings in support activities, improving IT capabilities and streamlining research.

Improving efficiency: Process technology and innovation in catalysts continue to advance. Maintenance and inspection techniques allow ever-shorter shutdown times, extend the period between shutdowns, and minimise unscheduled outages. Operating techniques and economics and scheduling activities allow more value to be extracted from each barrel. There are substantial improvements from IT and advanced process control systems.

The refining industry devotes enormous energy to all of the above. The problem is that the gains are competed away as fast as they are made, to the benefit of consumers. The industry is left no more profitable than before: in effect it is running fast to stand still.

Industry steps towards divergent strategies and restructuring, which have the potential to alter the competitive scene, therefore need to be encouraged.

2.8.2 Divergent strategies

The merger of BP and Mobil's downstream activities across Europe is the most significant development announced to date. This creates an entity roughly as large as Shell or Exxon, with these three holding about half of the European market together.

The merger of OMW and Exxon's refining interests in the Karlsruhe is an example of a local Joint Venture approach to rationalising capacity, reducing costs and giving some support to margins. The capacity involved is, however, small, only 16 Mtpa or 2.5% of the

European Union total. Unlike the upstream oil industry, joint ventures are not yet a significant feature in European refining.

Discussions over the past year to resolve the overcapacity in south-east France appear to have achieved little. In Wales, a merger was agreed between Elf, Murco and Gulf – but this fell through. Gulf subsequently decided to close its Milford Haven refinery.

This demonstrates that there are many obstacles to restructuring. One of these is the difficulty and costs of disposing of or selling poor-performing refineries. For instance, in the BP/Mobil merger, BP's Lavera refinery in S.E. France and Nerefco in Pernis, Holland were obstacles to a deal and were left out of the merger, as was Mobil's share in the Neustad refinery in Germany.

There is still much intense and commercially sensitive confidential discussion going on, some of it publicly announced – such as the declared readiness of both Elf and Total to seek suitable alliances. However progress is slow, and it could be concluded that the traditional refiners are currently locked into an uneasy transition, with as yet insufficient impetus to effective restructuring.

There are two classes of players who have the potential capability to make significant new impact.

Firstly, the **independent traders** who could buy European refineries cheaply, as TOSCO have bought the old Exxon Bayway refinery and others in the USA. Beta refinery in Wilhelmshaven is a similar example in Europe. A refinery in these hands becomes a major force in that:

- There is ruthless cost cutting and a drive to move maximum volume through aggressive trading, putting further pressure on margins

- As the asset will have been purchased at 'distress' prices the book value capital employed will be low. The operator can tolerate a much lower Net Income After Tax can be tolerated while still making an adequate Return On Capital Employed.

Secondly, **the upstream producer companies**, European State-owned producers, or more particularly OPEC, are looking for secure outlets for their crude. They may have different financial criteria. They have an incentive to cross-subsidise from the upstream just as the oil majors did up to the early 1970s, when they owned substantially all the crude oil. These companies could control the ultimate European end-game should they choose to do so. To date these companies have mostly adopted a fully commercial approach to their European downstream interests.

2.9 FOR SECURITY OF SUPPLY CRUDE OIL AVAILABILITY IS THE CRITICAL FACTOR

Continuous supply of oil products is vital to the EU. A very large deficit of refining capacity in the EU as a whole would put supply at risk, but such an outcome is not under consideration in this study, and will not occur for the foreseeable future.

The issue is whether security of supply is at risk when refinery capacity is in a small deficit.

In supply disruption circumstances it is access to supply of crude and feedstocks, rather than specifically the location or capacity of refineries that is critical for security of supply. An appropriate policy for strategic stock levels is also critical, as is access to and flexibility of distribution infrastructure.(Figure 2-11).

Premise	Impact of supply disruption
• Crude availability down 30% • Refining capacity in EU for normal demand	• Product availability constrained by crude • Substantial spare refining capacity in EU • Product price hike inevitable
• Crude availability down 30% • Refining capacity in EU well below normal demand	• Product availability constrained by crude • Probability of spare refining capacity in EU • Spare global refining capacity for rent to those with access to crude
• Crude availability at normal • Refinery capacity below EU normal demand	• Disruptions (e.g. refinery or pipeline accident, shipping outage) should be covered by compulsory stocks and imports, but with some price increase

Over 30% drop in crude availability would seriously disrupt security of supply

Figure 2-11 Impact of supply disruption on EU security of supply

We have explored this hypothesis with care in our interviews. The industry, refiners and independent traders, all hold similar views.

We explored the level of **refining cover** felt appropriate in a supply disruption. Views varied between 60-90% of the normal call on refining. This is well below current refining

capacity in the EU. Austria, Denmark, France, Germany and Ireland all operate well with a deficit in refining capacity. In particular, Germany and Ireland have large deficits of 75% and 53% cover respectively. While the percentage can be debated there is a clear consensus that it is access to crude, products and infrastructure that is most important.

If there is a severe crude shortage then those with crude will find no difficulty in renting spare refining capacity globally to refine that crude, provided they can also transport the crude and products.

In these discussions two other aspects came out:

There is a need to keep an appropriate level of **strategic stock of oil products** to cushion the initial disruption caused by any crisis. The current 90 days level seems satisfactory, provided the stock indeed exists. A lower level of stock may be appropriate for net exporters. There were several in the industry who commented that governments are not yet seeing the issue on a pan-European basis, and that the mechanisms and stock levels for strategic stock management are in need of some revision.

Access to, and flexibility of **infrastructure** is important, whether this is pipelines, road, rail, shipping or depots. One government stressed that supply security needed to be considered at several levels, the European and country level certainly, but also within countries. Depending on geography and infrastructure, major pockets of particular exposure could occur. These considerations also become important when industrial unrest hinders supply movements. Recent strikes in France showed that it is the logistics of where stocks are held and how they are moved that are critical, rather than where products are actually refined.

2.10 EMPLOYMENT IN EU REFINING IS SMALL RELATIVE TO OTHER STRATEGIC INDUSTRIES

Employment, and particularly the level of unemployment, is a serious and growing concern to governments and to the public alike.

The refining sector in Europe has been reducing manpower over many years. The days of thousands of employees at a single refinery are long past in the EU. These changes have been absorbed by society and the process will undoubtedly continue. In addition to employment related to normal refining operations, the level of refinery investment has an impact on employment for engineering and heavy manufacturing industries. About a quarter of EU refineries have associated petrochemical plants.

The numbers directly employed in EU15 refineries are now put at about 90,000, including both own staff and contractors. As is clear from Figure 2-12, this is a low number relative to other strategic industries.

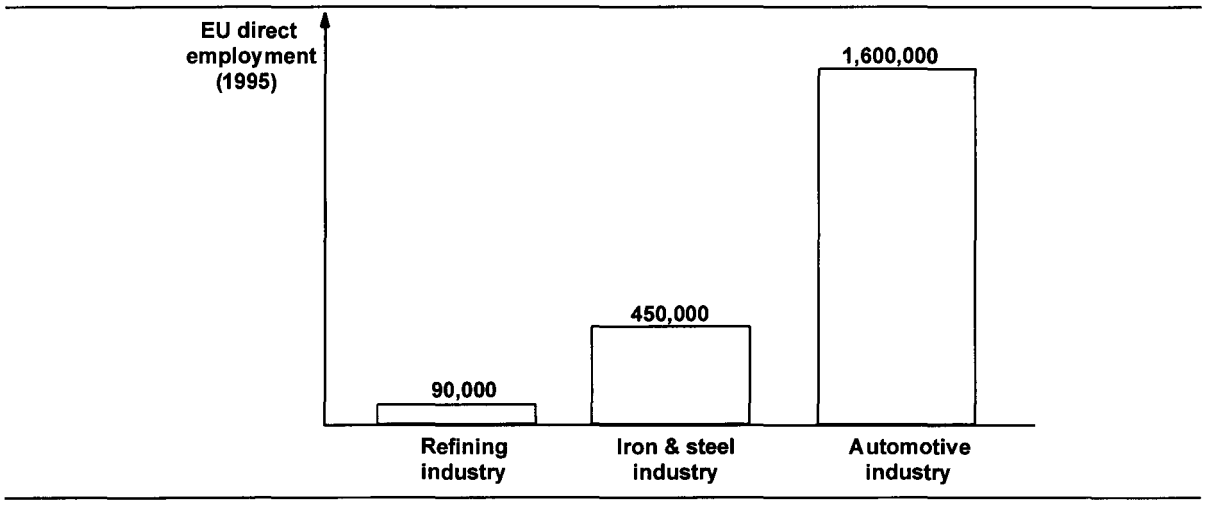


Figure 2-12 Employment in selected EU industries

In addition to direct employment there are others whose employment depends to varying degrees on the presence of a refinery. We estimate that this indirect employment has a multiplier of up to 4. There are a small number of cases where a small local community is over-dependent upon employment by a particular refinery. This is exceptional and may also be a strategically undesirable risk for the community. In these cases government policies for redeployment and broadening the skills and employment base should come into play to enable refining restructuring if necessary.

The oil companies generally have an excellent record of shedding staff in a responsible way. Even on the hypothesis of 10% cut in capacity the direct numbers released on an average basis would be no more than 9,000, realistically spread over a few years. By comparison with the announcements being made by other industries this is very low.

We are therefore of the view that redeployment of staff when refineries shutdown is not a crucial factor that should stand in the way of restructuring.

2.11 ANY SOLUTION NEEDS TO TAKE COMPETITION CONSIDERATIONS INTO ACCOUNT

2.11.1 Strategic considerations

The refining industry is among the world's most competitive industries. This is contributed to by transparency from published data as in Platts, sophisticated trading capabilities backed by ever more powerful computers, global arbitrage, a competitive mindset, concern over image, and public scrutiny.

A particularly potent force for competition is the very real, and entirely valid, concern in the industry not to do anything that might be considered to be anti-trust or against Article 85 of the Treaty of Rome.

We have formed the view that these very proper concerns about anti-competitive behaviour are now getting in the way of essential restructuring, and that necessary dialogue to enable restructuring is prevented from taking place by fears of risking breaching competition law.

As one senior executive put it,

> *"Governments, the Commission and industry need to agree what is acceptable and then let industry make the decisions that it needs to make."*

Further, we note (Community Competition Policy in 1993, Commissioner van Miert) that the Commission's policy recognises this:

> *"But if creating such entities (firms grouping together) is the only way of withstanding extremely keen competition on international markets in high-tech sectors, why should firms not be permitted to enter into such alliances, subject to certain conditions?"*

We return to these aspects later, in our recommendations.

2.11.2 Possible closure fund

There are two key aspects here. Firstly, whether or not a closure fund could be established under the Community's Competition law. Secondly, whether it may be funded by State aid. Again we note Commissioner Van Miert's comments.

> *"In return for its approval, the Community requires substantial cutbacks in production capacity in order to help put the industry back onto a sound footing."*

"Firms may need to be drastically restructured in order to adjust to economic conditions, but if they do so with State aid it must be granted once and for all and used to carry out genuine restructuring that is beneficial to the whole of the industry concerned."

In our view this gives firm support to the principle of some form of closure fund to restructure the refining industry. However, state aid for such a fund, either on a regional or community-wide basis, is unacceptable. Therefore such a fund would need to be financed by the refining industry itself.

2.11.3 Hidden subsidies and exit barriers

By the very nature of these it is difficult to find clear formal evidence what exactly is going on. Equally, there is sufficient anecdotal and confidential opinion to say that prima facie these elements exist and that they do influence closure decisions in one country to the detriment of other countries, and of sensible, market-led restructuring of the oil refining industry. We quote examples of the types of measures which exist in the Appendix.

Quoting again from Commissioner van Miert:

"Only the Commission, an independent body acting in the interests of the Community as a whole, can guarantee that common rules are applied without national bias."

"Its first task is therefore to ensure that everyone plays the game fairly, by putting an end to any behaviour that could harm the interests of other firms or ordinary people."

"It must intervene, however, when competition is threatened by state aid, cartels, mergers or any other form of co-operation."

These statements have wide application to any merger or multi-company joint venture discussions required to enable the industry to restructure. They would also seem to define an obligation on the Commission to try to identify and to remove hidden subsidies and exit barriers that are not totally even-handed across the Community.

There could be a role here for EuroPIA, to document the facts as a basis for further consideration and action.

3. RESULTS OF INTERVIEWS WITH THE INDUSTRY AND GOVERNMENTS

3.1 APPROACH AND SCOPE

We conducted interviews with twenty-one oil companies, seven other oil industry organisations, and eight governments, generally at Chief Executive or equivalent level. Further input was sought from other governments through a structured questionnaire.

Almost without exception, the organisations approached responded most positively.

The nature of the interviews was open, interactive and remarkably frank. For the first round we used a structured discussion template (see Appendix) as a basis so that we could more readily consolidate the inputs. As the project progressed we enhanced this structure to include a wide range of possible action ideas.

We are most grateful to all those who gave of their time and views so generously.

3.2 VIEWS OF INDUSTRY, INDUSTRY BODIES AND GOVERNMENTS

3.2.1 Oil company interviews

Profitability

It will be no surprise that there was wide agreement that the profitability of the refining industry is inadequate, and has been so for a long time.

The sharp focus on segmented ROCE was not prevalent in the 1960s and 1970s. Nor were there really separate markets to allow it to be calculated. A case can be made that the profitability has been low for decades, but that it is only in the 1980s, and most certainly in the 1990s, that the issue has come into sharp focus.

> *There was a clear consensus that the (after tax) profitability has been of the order of 2% to 6% ROCE over the last five years or so.*

This is not the full range, more an assessment of where some form of weighted average might lie. Input from investment analyst companies supports this range.

It is clear that there are some companies who have negative or very low ROCEs, perhaps of the order of -5% to plus 2%.

Equally there are a very few who are achieving 15% or even better from a niche, either geographic or product, and normally linked to choice of technology and market.

Only in a small number of cases were we left uncertain as to whether or not the company had assessed their refining profitability with appropriate methodologies. For the majority it was clear that they knew their own position in detail, both by refinery and by total refining and marketing sectors, and that of the industry overall from their competitor studies.

Substantial excess European refining capacity was widely agreed as being the major cause, with a consensus that some 10% or more excess capacity existed. The most common view was that 5-15 refineries should go. Some companies suggested Commission guidelines to identify closure candidates.

Roland Berger & Partner comment: *We accept that profitability has been low. The industry expects governments to provide support and frameworks for refinery restructuring. However, industry has failed to make the case to the general public and to governments. The industry has to make up its mind whether it is going to publicise its internally available data on European refining profitability, the strategic importance of refining and the case for (non-financial) support, or to accept that this support has not been earned.*

We believe that the industry is highly strategic up to say 80% of market demand and that its failure would dramatically effect the economies of Europe as the supplier of transport fuels for industry in particular.

Perceptions of industry behaviour

There is no doubting that the industry sees itself as its own worst enemy. Marginal pricing behaviour drives prices and returns down. Near universal use of Linear Programming tools exacerbate this trend. Short term gains are competed away. If one company attempts to signal a preferred higher price, or cuts production in an attempt to support margins, others do not follow but rush in to grab market share.

As one senior executive put it:

> *"Refiners are the most stupid players in the oil industry, and are likely to continue to adopt self-defeating strategies."*

Companies see no clear way out, although some have bitten the bullet and closed capacity, or merged. Many companies favour joint ventures and alliances in principle. However there is serious concern about the response of competition authorities.

There was universal agreement that *"things can't go on"* and *"something has to happen."*

Roland Berger & Partner comment: *The structural forces acting on the industry make such behaviour almost inevitable. However, it is remarkable that the industry is seemingly unable to respond to the challenge of setting production levels and prices which would give a fair return on the substantial assets deployed.*

Integration

There were widely felt to be strategic links between refining and marketing in particular, also in some cases between refining and upstream, and in a few cases between refining and chemicals if on the same site.

On the other hand there was some acceptance that synergies have reduced and a general acceptance that a 1:1 cover of marketing by refining capacity was not required. A figure of 80% was mentioned more than once, with some companies having an explicit strategy to get their European refining capacity down to this level, or below.

Roland Berger & Partner comment: *We agree the concept of refining capacity to support marketing networks. We do not see the need for that level to be at the 1:1 level.*

Why is the problem not self correcting?

The very high cost of closure is seen as the primary reason. Estimates of this cost vary between $50 and 200 million per refinery, obviously highly dependent on the site and required clean up standard.

Provided cash cost are being covered the decision to close is difficult. As one Chief Executive said:

> *"If I can earn $1 next year why should I spend $100 million to close?"*

We heard many such comments. In addition, the perceived unlimited liability to clean-up costs, even after a site is cleaned and sold, weighs heavily on several, who draw the analogy with this position in America. There was strong support for lowering exit costs, including harmonised standards for remediation.

Poor refining results are being cross-subsidised from other oil sectors, or indeed other businesses. Asked why this is acceptable the response tended to be that this was a management decision, and that management had both the necessary information and the right to make this decision.

However, some companies are diverting investments to other areas where the profitability prospects are seen as better. Some companies have an explicit policy in place to manage their downstream business on this basis and to reduce substantially their exposure to the prospects of ongoing inadequate European refining margins, a process also referred to as delocalisation.

The refining industry is one of the globally most transparent and most fiercely competitive. It is therefore surprising to hear the real concern expressed by many about the reaction of the competition authorities to multi-party discussions in particular. While the stance of the American companies in particular can be understood, these concerns appear exaggerated.

As one senior (non-American company) executive put it:

> *"The government, with the industry, should set the framework, define what is acceptable, and then get the hell out of the way to let the industry get on with what the industry needs to do."*

Roland Berger & Partner comment: *We agree that there is scope for harmonisation, and possible capping of environmental liabilities,*

The possible response of the competition authorities is genuinely felt and is getting in the way. We are recommending a top level exchange of views between the Commission and the industry in which a new publicly defensible understanding can be found between these authorities and the industry.

Closure fund

There were divergent views on a closure fund. Many companies were ambivalent or against an industry fund. Some were supportive, seeing that "reducing the exit costs to zero" is a win-win-win situation for governments, leavers and stayers.

There was near universal agreement that any such fund should be industry funded.

Roland Berger & Partner comment: *We find it surprising that there is not more serious consideration by the industry of the once-off closure cost (funded by industry) versus the much larger, and ongoing, margin improvement that would accrue to all if* ***sufficient*** *capacity is closed. We do accept the concerns that at the present overcapacity an individual closure does not bring a significant margin improvement, which may be the reason for some companies' lack of support.*

Shareholder pressure

We found that shareholder pressure to perform appears not to be a major concern. The general view was that shareholders tend to judge overall performance rather than particular areas. However, some companies feel that the pressure will increase.

Asked whether disclosure of separate refining ROCE would assist there was ambivalence. This was seen by many, but not all, as a threat. Some companies felt this to be powerful and that universal rules would be acceptable.

One Chief Executive, after considering, took a clear stance that:

> "Yes it would help, provided we all had to do it. But, it would bring the financial community down on our necks"

Roland Berger & Partner comment: *We agree with this Chief Executive. Disclosure of the (internally well known) after-tax company refining profitability in Europe might be* ***the*** *single largest spur to improvement; to the benefit of both the industry and the Community.*

Security of supply

There was wide agreement that there could be substantial closures without security of supply becoming an issue. In a supply crisis access to hydrocarbons, crude and products is seen as key. In a crisis there will be refining capacity to rent. Having capacity and no crude oil to process does not provide security.

Most companies also emphasised the importance of compulsory stocks to allow time for appropriate crisis responses to be put in place. However, a minority felt that with a lower overall supply risk in the markets, compared with a decade ago, 90 days was now too high.

Many also emphasised the need for access to distribution infrastructure as of great importance in a crisis. A few commented that the existing arrangements for compulsory stocks were in need of review and update.

Roland Berger & Partner comment:*. Compulsory stocks, their level and their working, is outside the scope of this report. However, there seems to be a prima-facie case for a thorough-going fundamental review.*

We think it is of critical strategic importance that Europe has adequate refining capacity for both cost-efficiency and strategic reasons. We do not believe that this need is anywhere near the level of 100% cover for marketing. We see a preferred level emerging from further dialogue and actions, but would be surprised if this were higher than 85% cover.

Environmental standards

There was a universal and strong view that the indicative proposal for 2005 is too stringent, and not justified on cost effectiveness grounds. There was a small minority view in support of tougher standards as a way of forcing restructuring.

There was a recognition by some that the industry lost credibility by announcing too high investment needs for 2000.

The rational cost effectiveness approach adopted for Auto-Oil 1 found universal support as the way to reach the right balance for the Community as a whole.

Many commented that the low profitability, and the political over-ride of a rational approach, had led to a defensive attitude on the part of the industry. The credibility of the current position came in for widespread criticism.

These circumstances have led to changes in attitudes. Some companies said that they no longer felt obliged to cover all of the product market, or all of a country. Limiting investment, withdrawing from some market segments or withdrawing more widely are now seen as viable options by players who previously would not have taken this stance.

Roland Berger & Partner comment: *The industry did itself a disservice by quoting too high costs in the past. They should adopt stringent defensible levels in the future.*

Notwithstanding that, we are strongly of the view, that once air quality standards are set by politicians then the auto and oil industries should adopt rigorous cost-effective analysis on ways to meet these levels. This seems to us to represent the best process and the one most likely to achieve a fair sharing of the costs of meeting environmental targets.

Diesel

The imbalance between gasoline and diesel is widely seen as having been caused by tax distortions. Many forceful comments were made that the tax differentials should be removed, and that this is in line with Community policy.

There were, however, mixed views on the ability of the industry to handle the position. This depended on individual positions to place surplus gasoline at attractive prices, and on the ability to meet increased diesel demand at the possible higher specifications.

There was a wide expectation that the issue would impact both profitability and investment need, although differing views on the extent.

Italy is the exception, with surplus diesel.

Roland Berger & Partner comment: *We accept that large tax differentials initiated the dieselisation trend and a skewed demand barrel follows. This requires a higher level of investment than a more balanced barrel, placing European refining at a competitive disadvantage. However, there is no longer a direct relationship between the tax differential and diesel demand. Even if tax differentials are removed it will take many years for diesel and gasoline to come into balance.*

Capacity creep

The widely held view was that actual capacities were well above nameplate values, and that creep over the medium term could be up to 1.5% pa plus.

In broad terms what the industry is saying is that they see no relief from capacity exceeding demand in any meaningful time frame.

Roland Berger & Partner comment: *We see no likelihood of demand catching up with capacity in the foreseeable future. We are bearish about the prospects for margins unless substantial capacity is removed.*

Eastern Europe

It was widely agreed that East Europe is unlikely to affect western European refining for at least the next five to ten years. There could be a potential threat in the longer term.

EuroPIA

Generally, EuroPIA is valued as a forum for discussion on a range of issues. There was some frustration that it was not an effective forum to secure agreed positions on the fundamental issue of the poor profitability of refining, and certainly not to secure agreement on a closure fund or restructuring.

Several interviewees commented that the Environmental lobby was much more powerful in Europe than the refining industry, or indeed the oil/energy industries.

3.2.2 Industry organisation interviews

Industry bodies and other organisations agreed with the views of the oil companies in most areas.

Capacity creep

Many organisations believe that capacity creep, triggered by environmental investment, will range between 1 to 1.5% pa plus. The IEA has published forecasts showing creep in the range 0.5 to 0.75% pa.

Closure fund

While proposals for an industry-funded closure fund have been explored, industry consensus has not been reached.

Diesel

There is uncertainty and disagreement as to whether gasoline or diesel is the more environmentally-friendly fuel overall for the longer term.

The shortfall of diesel capacity is expected to worsen. The demand for diesel may be relatively insensitive to changing taxation in the short term because of the time that it takes to change the existing vehicles in the car-park. This effect will be more pronounced in southern Europe than in the north.

Eastern Europe

Not expected to be a significant threat in the short term, although the IEA points to a refining centre developing in Hungary / Slovakia / Croatia.

Environmental standards

The unlevel playing field is seen as a problem, favouring some states and companies.

Two organisations suggested environmental investment costs for 2000 of around ECU 7 billion rather than ECU 20 billion.

Environmental standards should be based upon rigorous cost effectiveness analysis.

Harmonisation

There is support for harmonised standards across Europe, with EuroPIA expecting differentiated solutions between north and south.

Oil company behaviour

Seen as conservative and reactive.

Joint ventures

Broad support for encouraging more co-operation within the industry.

Security of supply

Security of supply is not considered a refining capacity issue at any likely level of capacity reduction, even if a significant number of refineries close.

Product distribution infrastructure and stocks are key issues.

3.2.3 Government interviews

The governments interviewed preferred free market approaches for most issues and supported the concept of a single market.

One government (with substantial domestic refining) emphasised that the industry must put over a sense of urgency.

> *"The industry must establish a sense of urgency, and work on this with politicians and public. We receive few complaints from industry, there is no momentum."*

Types of solutions

Free market solutions and actions, alongside regulatory standards which are set for Europe as a whole, are preferred.

One government was keen to avoid imposing costs on taxpayers or detracting from government revenues.

There was some view that remediation standards should remain a national matter.

Two governments emphasised strongly the need for harmonisation of taxes, one wanting the Commission to take a much tougher line here.

Diesel

There is strong support from governments for reversing diesel's fiscal advantages. However, this needs to take account of political opposition from truckers. Solutions which include separate arrangements for trucking, and also road tax levels, may need to be found.

Security of supply

While a domestic refining industry is still considered important for security of supply there is no clear view on the preferred level.

Closure cost

There is some support for measures to share the closure cost across the industry. A fund modelled on the successful Dutch service station closure fund was mentioned by more than one.

DGIV's view is that a closure fund would have to have (near) universal support to gain approval.

Environmental

One government was forceful in its view that:

> *"We are very concerned. The 2005 specifications are not justified and will be a high cost to the industry."*

JVs and mergers

DGIV suggested that whereas bilateral industry deals will often be accepted, multi-lateral deals are more likely to be challenged.

Employment

There was significant concern about the employment effect of closures in some countries. This was often linked to centres of industry locally, rather than to the total numbers which were accepted as relatively low.

4. EVALUATION OF POSSIBLE INITIATIVES

A number of possible initiatives for overcoming the problems of the industry have been evaluated based on the following considerations:

- Refining profitability is unacceptably low
- EU refining capacity will continue to exceed demand for at least the next decade
- The refining market is a fiercely competitive, transparent, global commodity business

The initiatives set out below have been evaluated on the basis of whether they will help the oil refining industry to transform its economic performance while continuing to provide secure, high quality, environmentally friendly energy products to the consumer at competitive prices.

4.1 CONTINUATION OF EXISTING POLICIES

Before considering any other initiatives, it is important to decide whether leaving market forces to take their natural course will resolve the situation. We therefore examined first of all whether the Commission should just continue existing macro-economic and energy policies and take no extra specific steps to solve the refining issue.

These policies include, for example:

- Extension of the internal market
- European Monetary Union
- Liberalisation of energy markets
- Harmonisation of taxes, with a principle of neutrality between energies
- Assessing environmental standards on the basis of cost-effectiveness

There are two basic premises which govern the outcome of following this path. They are:

Premise 1: Our analysis of future supply and demand could be wrong, and growing demand could after all exceed refining capacity before 2010

Under this assumption margins will eventually rise. However, even on current IEA predictions demand will not exceed supply for the next decade. If contrary to expectations demand does rise faster, and margins do rise, there will be an import parity price cap

which will ensure that profitability remains at an unacceptable level – albeit at an average return on capital employed around 7 to 8%.

When significant tightening of supply became apparent it would discourage oil companies from joining in the necessary restructuring and rejuvenation of refining assets – but would still leave an underperforming, increasingly uncompetitive industry.

Low profitability will continue in the short term, structural problems will remain, and environmental enhancements are likely to be resisted by many within industry.

Premise 2: Structural surplus remains in EU refining (as our analysis predicts)

In this scenario, consumer prices remain low, and difficult discussions between the Commission and individual member states can be avoided. At the same time, some hope can be read into the restructuring that has already taken place in some EU locations (e.g. BP/Mobil, OMW/Esso at Karlsruhe) and the number of operations that have recently closed or announced closure (Gulf in the UK and KPC in Denmark). It is possible that additional closures may take place following public announcements of refineries up for sale (e.g. Lavera) and capacity to be rationalised (e.g. Berre).

However, we believe there will be no significant breakthrough in overcoming poor refining profitability for the following reasons:

- The industry has been wrestling with the problem for over a decade with inadequate margins continuing – but not triggering the needed restructuring
- Closure costs are so high that it is better to generate cash from the sunk refining investment than to divest
- The few refiners that will close will not take out enough capacity to tighten the market – and so margins will remain low
- Many of the players are hopeful that others will leave first
- Hidden subsidies and exit barriers in individual EU member states distort commercial decisions

With no prospects of adequate returns, the industry will be driven to minimising investment and operating on a "care and maintenance" basis only. Thus EU refining will not be rejuvenated and the industry will strongly resist the imposition of even tighter environmental standards. If this occurs, there is a high probability that the industry will become less and less competitive in the international market where it has to operate, to the detriment of the EU's energy market, and in the longer term the consumer.

> Our conclusion is that without some intervention by the Commission there will be no significant breakthrough by the industry itself in overcoming poor refining profitability. This risks leaving an increasingly uncompetitive industry in a key strategic sector.

As a consequence other, preferred, initiatives must be considered.

4.2 PREFERRED INITIATIVES

For ease of analysis, we have grouped the preferred initiatives in the following categories:

- Initiative 1 - "Soft Options" to reduce costs to the industry
- Initiative 2 - Stringent but realistic environmental specs - with a cost recovery mechanism for refiners
- Initiative 3 - EC encouragement of an industry "shake-out"
- Initiative 4 - Removal of distortions to create a "level playing field"
- Initiative 5 - Changing the profit and pricing signals

These various approaches are not all mutually exclusive and elements of them can be combined as appropriate to tackle specific problems.

4.2.1 Initiative 1: "Soft Options" to Reduce Costs to the Industry

Most of the refining industry wants to see initiatives that reduce costs of exit and costs of environmental compliance. We have therefore considered:

- An industry-sponsored closure fund
- Lowering exit barriers by sensible changes to application of environmental remediation standards and a realistic time frame for implementation
- Softening the indicative target 2005 fuel specifications to come closer to the original Auto-oil 1 proposals for 2010

A well-thought out closure fund would benefit the industry considerably and share the pain of high exit costs. If at the same time governments lowered exit barriers by changing remediation standards, and allowing longer to carry out remedial work, refinery closures could go ahead rapidly. The tighter product supply and lower investment costs for environment enhancement will raise margins and improve industry return on capital employed. Provided the closure fund was successful in closing enough capacity, it could improve ongoing margins substantially for a relatively small investment by industry markets. We estimate margins could rise by up to ECU 0.80/bbl ($0.90/bbl) for a one-off cost of ECU 0.20/bbl ($0.25/bbl) (based on 12 refineries closing at an average cost of ECU 100 million for each refinery closed).

However, if the weaker players are to close (the only sensible economic result) then the fund has to be selective. This could be very difficult to agree and realise in practice, and will require clear, appropriate rules for operations of the fund. Furthermore, if closures do not achieve a level approaching 70-100Mta (the estimated refining capacity removal required) the capacity surplus will continue to depress margins.

Another problem with the closure fund is that there are many operators in the industry who do not want (at least presently) to participate. Without all parties involved this will be a non-starter and could merely delay tackling the fundamental problems of the industry. It is worth giving the fund one last chance but a tight deadline for reaching agreement will be essential. In any event DGIV have commented that unless all the players participate it will not satisfy their anti-competitive criteria.

A much greater concern with this set of initiatives is that by softening the fuel specifications the EU's target environmental specifications for air quality for 2005 - 2010 will not be met. This could prove to be politically unacceptable particularly if seen to be a mechanism to assist the oil industry. The oil industry is perceived by the general public, pressure groups and many politicians to be very wealthy and influential. The general view would almost certainly be that the industry has adequate funds to sort out its own problems.

4.2.2 Initiative 2: Environmental standards met by stringent, but realistic specifications, with cost recovery by the refiners

The action steps examined for this set of initiatives are:

- A rigorous assessment of the cost effectiveness of the year 2005 indicative target fuel specifications
- A mechanism to recover the investment cost in refineries for the resultant fuel specifications from consumers
- An incentive through tax differentiation for consumers to buy cleaner fuels.

The new Auto Oil 2 programme is due to reassess the cost-effectiveness of the year 2005 indicative target specifications proposed in the Council's "Common Position" as well as other measures suggested to meet the air quality objectives. In this initiative we assume that re-assessment will result in agreed fuel specifications that are still stringent by comparison with the year 2000 specifications, but will be fully cost effective in meeting the target air standards. We anticipate that the resultant investment needs for the oil industry will still be large (greater than ECU 10 billion).

To recover these investment costs we examined tax differentiation as a mechanism to provide a return to refiners on their investments, and to incentivise consumers to switch to cleaner fuels. This would be applied by individual governments or across the European

Union, not as a mandatory change of specification on a particular date, but as a higher tax on the older specification fuel for a specified period of time.

The best mechanism would need to be worked out in detail between the industry, the Commission and member state governments. The Swedish or Finnish tax differentiation models for 'City' transport fuels may be a useful precedent. The level of tax differentiation needs to be carefully chosen to ensure that refiners can get an increased margin while allowing a slightly lower pump price for the cleaner fuel to encourage consumers to switch. The price differential should not be so high that it acts as harshly as a sudden mandatory change. Our analysis suggests that suitable levels of differentiation (if, after reassessment, the industry cost remains as high as ECU 25 bn to upgrade from the 2000 specifications) would be about 3.0 ECU cents per litre on diesel, and about 2.0 ECU cents per litre on gasoline. These levels are substantially lower than the tax differentiation that most EU countries have introduced between gasoline and diesel.

The arguments against tax differentiation are that the proceeds may not benefit refiners, and that it introduces yet another economic distortion.

The normal process of tax differentiation involves the government collecting a higher tax on the dirtier fuel (for neutrality it should also reduce the tax on the cleaner fuel). The benefit to the refiner is indirect. If the duty is collected by the marketer or wholesaler, they will have an incentive to pay a higher price for cleaner fuel to refiners – at least until the product is the standard grade in the market.

In countries where the refiner pays the excise duty, he has the option to keep most of the differential and only pass on a small cost saving for the cleaner fuel to marketers and wholesalers. Marketers may demand an extra incentive if they have to build new systems for handling an extra grade at terminals and service stations. The refiner can alternatively give away all the differential and rely on fast volume increase at his competitors' expense to gain extra margin. The latter tactic risks removing the differential too fast, particularly if consumers do not have to change cars to be able to use the cleaner fuel – when there is no more dirty fuel in the market the differential automatically disappears.

In either case, when a number of key suppliers in the market have upgraded their specifications, and there has been substantial consumer switching to the new fuel, the normal competitive processes will start to erode away the differential. This has happened in Sweden and Finland after the introduction of 'City' fuels.

It is possible to make the refiner's recovery direct, if the government pays proceeds of the tax differentiation direct to refiners in proportion to their sales of the cleaner fuel. Since the government income starts very large and reduces, while refiners will start with very small but increasing volumes, the allocation of tax revenues would be complicated.

Tax differentiation does not create a long term structural change in industry margins. It is a short-term measure to incentivise both refiners and consumers to switch to the new fuels, with an economic reward for those who do so quickly.

Tax differentiation would not have an equal effect for all refiners, and to this extent could be regarded as a distortion. Uncompetitive refineries with obsolescent equipment and higher upgrading costs than average will be put under pressure. Those refineries best placed to compete in high value added global markets will gain. It is in our view precisely these refineries that the EU needs to encourage in order to retain EU competitiveness, and which are the most likely to invest regularly in technical improvements to bring down costs to consumers.

An alternative mechanism for rewarding refiners for upgrading fuel specifications is to incentivise environmental investment by creating special tax credits. There is a problem of definition of what environmental investment covers (for instance, is a hydrocracker built to supply growing diesel demand, or to reduce sulphur levels in diesel?). More seriously, tax credits would discriminate against refiners who have already upgraded their units.

A decision to initiate the move towards the new tighter specifications by tax differentiation soon after 2000 would give positive encouragement to the industry. It would also allow investment to be phased in as demand changes. At the same time the environment would benefit from a partial implementation earlier than planned. This fits in well with the EU's position for Kyoto.

Substantial closures would still be required to make the industry profitable. Weaker refineries in a poor position to upgrade to the new standards should be allowed to close. However, the wider restructuring required may not happen. There is a danger, too, as has previously been experienced, that the industry will overbuild upgrading capacity.

It is possible that the higher quality material available could increase export opportunities (particularly for high quality gasoline to the USA) and boost margins in the industry by raising the EU's global competitiveness in refining.

The cost of this option to the consumer is relatively small and reflects the "polluter pays" principle.

A combination of this option with the encouragement of refiners to seek industry alliances and pool new upgrading capacity while closing obsolescent plants could make this an attractive proposition.

4.2.3 Initiative 3: EC encouragement of an industry "shake-out"

We have argued above that EU refining industry needs a "shake-out". We examined steps which the Commission could take to help this, as follows:

- The European Commission encourages wider, faster industry restructuring
- The Commission takes steps with governments to identify and remove hidden subsidies and obstacles to closure.

- Support is given to the introduction of the European Company Statute.

In order to achieve an industry "shake-out", we believe the Commission will need to positively encourage the oil refining industry to restructure. It can do this by sending a clear signal to the industry that restructuring will be welcomed by the Commission and by member states; by removing unnecessary obstacles to mergers and acquisitions; and by agreeing guidelines for cross-border deals with member states.

This is particularly important in the case of the oil industry which has a history of extreme sensitivity about being accused of anti-competitive practice, and also fears that governments in Europe will not approve cross-border alliances. Clearly, consumer interests must be protected, but restructuring of the industry is dependent on its ability to form alliances like those formed by BP/Mobil and by OMW/Esso at Karlsruhe, and the industry should be encouraged in this direction.

There is a wide-spread belief that there are many subsidies and hidden barriers to closure used by member states throughout the Region. It is well recognised by the industry that this is a "tough nut to crack" for the EC, but creating a genuinely level playing field is critical to reducing restructuring and merger costs.

The EU Company Statute currently under discussion, would enable companies to operate as single entities in the community. There are a number of advantages from this approach not least of which is that restructuring and merger costs would be reduced.

Overall, the steps in this initiative can only influence rather than initiate the needed changes. However, these steps would encourage normal play of market forces and steer the Region towards finding less parochial solutions to oil refining overcapacity.

4.2.4 Initiative 4: Remove Distortions and Create a "Level Playing Field"

The actions examined under this set of initiatives are:

- Remove hidden subsidies and exit barriers
- Remove the tax advantage on diesel
- Harmonise EU fuel taxes
- Harmonise EU fuel specifications
- Agree harmonised site remediation standards

Actions are necessary to overcome the distortions present in the EU in order to establish a "level playing field" for the oil refining industry to rationalise its operations.

Individual government incentives and inducements to retain what would otherwise be closure candidates should be removed. At the same time, there are many different and variable fuel taxes in operation throughout the Region which need to be harmonised if the correct commercial decisions are to be taken by the industry.

The logic of the tax differential between motor gasoline and diesel in almost all EU countries needs to be reviewed in terms of environmental benefit and the economic public interest. It is our view that the differential should be removed. The industry is now faced with the necessity of installing very costly hydrocracking capacity to meet future diesel demand. If the original logic for this differentiation has disappeared, the market distortion needs to be eliminated. However, any change will take several years before there is a significant impact on gasoline surpluses.

Fuel specifications need to be harmonised to prevent refiners in one region having to bear unnecessarily high costs. In particular, the Commission should agree a set of consistent guidelines to harmonise remedial measures required following refinery closure and to establish a realistic time frame for implementation. Although the main differences between very high and very low closure costs relate to different soils and locations, a substantial percentage of clean-up costs can be affected by inconsistent standards for other factors.

Directionally these initiatives are desirable as they start to redress the many market distortions and are in line with policies for the Single Market. Removal of hidden subsidies and exit barriers may encourage some closures. However, the economic impact and the impetus for restructuring would be small unless other measures are also put in place at the same time.

4.2.5 Initiative 5: Change Industry Profit and Pricing Signals

Two initiatives have been examined here:

- Put pressure on the industry to publish transparent accounts for refining in Europe
- Clarify the accounting treatment of write-downs for consistently unprofitable refineries

A discussion point for the oil industry is the extent to which the upstream, refining and marketing should be decoupled and separate accounts disclosed to the shareholder. It is now common practice in the industry to do this internally but, at best, annual reports delineate separate results only between the upstream and the downstream (refining and marketing combined).

Requiring transparent accounting disclosure in order to "unbundle" the different business sectors is a powerful weapon to expose to shareholders the poor return on invested capital in refining. This would not be popular with the industry but is likely to have a dramatic effect on closure and restructuring decisions by company management, who will

be under considerable pressure to improve. An attitude change in the industry would discourage cross-subsidisation and encourage a realistic perspective on long term pricing.

This measure could usefully be supported by a clarification of the treatment of provisions in the accounts for "impaired" refinery assets. These are refineries which are not making a profit, and for which closure or sale would require large write-downs of hundreds of millions of dollars per refinery. Within Europe only BP appears recently to have made a substantial such provision. Other companies have not made such provisions even for consistently loss-making refineries. They therefore tend to put off action until it will not have an adverse effect on shareholder sentiment.

The industry is mostly opposed to such changes, and implementation and accounting rules will take time to establish. There is however a recent precedent in Europe with the banking industry, where with Commission support the accounting bodies have had some success in agreeing uniform standards of disclosure and provisions.

Changes in accountancy rules to separate business sector performance would drive the companies to address low profitability in refining. This is not a short term solution. Nevertheless, it is a powerful tool for shareholder, and therefore management, focus. It could therefore consolidate the gains of restructuring through a change in company behaviour for the long term.

4.3 UNACCEPTABLE INITIATIVES

During the course of the project further initiatives were considered but discarded as follows:

- Forcing closure through decree

  - This was seen as too interventionist

- Limiting production through quotas

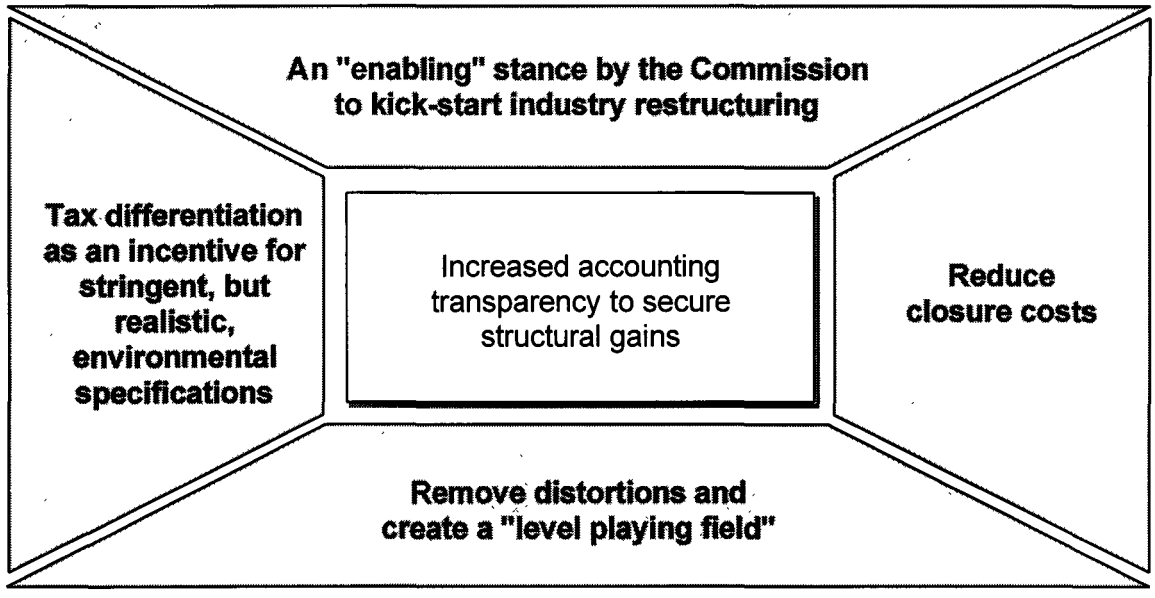
  - Seen as anti-competitive and does not solve structural problems

- Import protection through Voluntary Restraint Agreements (VRAs) and tariffs

  - Contravenes world trade agreements.

5. RECOMMENDATIONS

As a result of the evaluation of the preferred options Roland Berger & Partner recommend five combined action steps to secure the long-term viability and competitiveness of the refining industry in Europe while protecting the public interest.



5.1 THE COMMISSION "KICK-STARTS" THE IMPROVEMENT PROCESS

The success of these proposals is dependent on the extent of the commitment of the industry, governments and the Commission.

We recommend that the Commission, through DGXVII, kick-starts a more urgent impetus for restructuring by bringing together all the interested parties in a top level management exchange of views.

The purpose of this exchange of views would be for the Commission's Directorates, co-ordinated by DGXVII:

- to communicate the reasons for their concerns about the state of the oil refining industry in Europe
- to explain the initiatives DGXVII has been taking to understand the real problems.
- to set out DGXVII's understanding of the situation, and its support for industry restructuring

- to state publicly a commitment to "enable" restructuring to happen by taking all reasonable steps to create a level playing field and to remove market distortions by individual member states.

- to enable other Directorates, particularly DGs III, IV, and XI, and the Industry, to state their positions

- to agree the next action steps and a timetable

DGXVII would make absolutely clear to this multilateral audience that it is the oil industry's responsibility to take early action but with the strong support and commitment of the other participants.

We recommend that one follow-up exchange then be held about a year later at which the Commission and the industry would report on progress.

5.2 TAX DIFFERENTIATION TO ACHIEVE ENVIRONMENTAL SPECIFICATIONS

We recommend that the Commission carefully reassesses the year 2005 indicative target fuel specifications, as planned through the Auto-Oil II programme, to agree truly cost-effective measures which will meet the EU's targets for air quality in 2010.

We recommend that the resultant agreed specification changes from the year 2000 levels should not be introduced as mandatory specifications, but should be gradually introduced some time after January 2000 by regulating an EU-wide tax differentiation to encourage refiners and consumers to switch to the new specifications. To trigger early oil industry action, tax differentials would be announced for a limited specified time - preferably five years, but for a minimum of four years.

Although we have not specifically reviewed the cost to the industry of pollutants and emissions from their refineries we believe, in principle, that they should cover their own environmental costs of refining emissions.

We recommend that general ground rules should be set to prevent distortions in the application of requirements for control of refinery emissions. We recommend that these rules should be based on cost-effectiveness rather than Best Available Technology criteria.

5.3 RISK-BASED CLOSURE COSTS AND INDUSTRY CLOSURE FUND

We recommend that closure costs be based on the sensible application of objective and harmonised environmental risk-based criteria for the remediation of a site and an extended time allowed for implementation.

Unless there are exceptional circumstances, we recommend that remediation should be to industrial re-use standards, not for horticulture or housing. This would best be harmonised by the Commission providing closure guideline standards across Europe.

We recommend that the Commission give serious consideration to capping a company's environmental liabilities once clean-up has been independently audited as having been completed to the required standards.

In our view it would be inappropriate for the EU to use State funds to assist closure.

Although the chances of success may not be high, the potential benefit to all parties is large enough that we believe a final attempt to agree an industry-financed closure fund should be made. A deadline must be set on the attempt to find agreement on a fund if it is not to be an excuse for delay. We suggest that the industry should be given a deadline of the end of June 1998 to agree a mechanism between themselves and with DGIV.

We recommend that a final attempt should be made to establish an industry-financed closure fund, but within a tight time limit.

5.4 REMOVAL OF MEMBER STATE DISTORTIONS

We recommend that steps be taken by the Commission and governments to identify and remove distortions and create a level playing field across member states for oil refining.

This should specifically address:

- equalisation of gasoline and diesel taxes;
- harmonising EU fuel taxes between member states
- limiting fuel specification differences across Europe

There is also a need to identify hidden incentives and exit barriers across Europe. This will inevitably be more difficult. Examples of types of hidden incentives and barriers are set out in the Appendix.

5.5 PROVIDING A MECHANISM TO CEMENT STRUCTURAL GAINS

Ideally there should also be a mechanism to identify and then to secure the structural gains made so that the same problems do not arise in the future with the same severity. Without such a mechanism we fear that the marginal pricing behaviour of the refining industry would reassert itself after a short period and drive the industry back into chronic underperformance.

We recommend the development of new accounting disclosure rules so that integrated oil companies show separate divisional post-tax results for refining operations in annual accounts.

In advance of these being available the industry should be encouraged to do so on a voluntary basis. Broad guidelines and an agreed early start date could be co-ordinated by EuroPIA.

We recommend a review of the accounting treatment of write downs of non-performing refining assets..

It is important in the current state of the industry that refiners adopt a similar treatment, and do not hide from their shareholders the potential costs of closure or write-downs in the event of sale.

5.6 POTENTIAL "QUICK HITS"

If some 'quick hits' for local restructuring, mergers, or closures could be identified this would be a way of giving fast impetus to the required restructuring. The management exchange of views could be used to identify these.

It is not within the remit of this study to evaluate particular candidates for closure. Each case will require complex analysis. However, as a starter to the management exchange we suggest the following are re-addressed:

- France (South-East refinery cluster)
- Germany (Bavaria)
- Ireland (Whitegate- any closure would need the security of guaranteed supplies from a European refiner, preferably backed by supplies of North Sea crude oil)

A number of other opportunities which might require more extensive evaluation are:

- Belgium (Antwerp complex)
- Germany (Harburg)
- Greece (Athens)
- Italy (North)
- Italy (Sicily)
- Netherlands (Rotterdam complex) - Nerefco is already closing
- Sweden (Gothenborg)
- UK (Pembrokeshire) - Gulf is already closing
- UK (Killingholme)

- UK (Thames Estuary)

Further considerations for potential closure are set out in the Appendix.

5.7 POTENTIAL IMPACT OF THE RECOMMENDATIONS

We calculate the following potential impact from our recommendations:

5.7.1 **Restructuring including regional mergers** could lead to a removal over the next 5 to 7 years of 70-100 million tonnes of capacity (10-15%) if action is taken at the same time to reduce closure costs. If there is no industry closure fund to bear the major cost of closures, the level of closures will be less and slower. Action will in most cases be triggered when a major investment for environmental reasons becomes necessary.

When sufficient surplus capacity has been removed, margins will start to increase, but will, we believe be limited by import arbitrage to about 0.8 ECU/bbl above current levels. This is equivalent to ECU 0.005 per litre on consumer prices. Closure of capacity which includes a high proportion of upgrading to gasoline will have the quickest effect on margins.

5.7.2. **Environmental investment needs** for the move to 2005 fuel specifications from the Council's 'common position' levels for 2000 depend on the specifications finally agreed for 2005-2010. Based on the Council's proposals these needs would cost up to ECU 25 billion.

Tax differentiation will spread the investment over several years, and will need, we estimate, about an extra 3.0 ECU cents/litre tax on 'dirty' diesel, and about 2.0 ECU cents/litre on 'dirty' gasoline. Some of this will pass to consumers to create a small financial incentive to switch fuel, the majority is likely to be kept by refiners. The cost to consumers will only be paid by customers who stay with dirtier fuels – this will be a declining figure over time.

Our calculations of investment and differential taxes will be altered proportionately if the recommended review of 2005 indicative target fuel specifications results in a change of some of the more costly specifications.

5.7.3 **Closure cost reductions** and harmonisation across the EU could save substantial amounts in individual cases, with, we estimate, an average of some 10m ECU per refinery.

An industry closure fund would probably need to be financed by a levy on refiners of up to ECU 1.50/tonne installed. This cost would not be borne by consumers.

5.7.4 **Removal of distortions** would improve the efficiency of market-led restructuring, while **accounting transparency** would prolong the margin benefit of efficient restructuring.

5.7.5 **Restructuring** and the more competitive structures that these recommendations would encourage, would lead to cost savings and other efficiency improvements in the longer term. Discussions with industry experts suggest that these could create up to an average 1.0 ECU/bbl saving, which would largely be passed on to consumers.

STUDY ON

OIL REFINING IN THE EUROPEAN COMMUNITY

Prepared for European Commission, DG XVII/B2

Appendices

London, 5 December 1997

Roland Berger & Partner GmbH

International Management Consultants

TABLE OF CONTENTS

1. Terms of Reference

The call for tender document specifies the following Terms of Reference for this project.

"

1.1. Background

The framework of this study is the Working Document of the Commission "Report on the situation of Oil Supply, Refining, and Markets in the European Community", COM (96)143 and the Energy Council Conclusions of 3 December 1996 on the same.

The subject of the above Report was to identify and explore the key issues concerning the above sectors, in particular refining industry performance, the environment, security of supply, the Internal Market and where appropriate to comment on the implications for the Community.

The Commission has received a mandate from the Council to examine in depth the main causes of the current difficulties in the Refining Sector. The present study will deepen the analysis of the most important issues identified in the Commission Report.

1.2. Objective

The final objective is to deepen the understanding of the causes of poor profitability and how they interact, and how the sector is likely to develop on current trends. In addition possible options for the improvement of the sector's performance should be identified and analysed. Where appropriate analysis should be undertaken on a regional basis rather than at a Community or national level.

1.3. Scope of Work

i. The consultant will have to address the main issues identified in the Commission's Report as contributing to poor profitability in the sector and any others identified during the course of the study. In particular the following areas will need to be addressed:

ii. Inventory of current refining capacities in the Community including details of ownership and current status etc. together with an analysis of how this corresponds to the forecast supply and demand in iii).

iii. Current crude supply data and forecast developments over the period up until 2010. Current and forecast trade patterns and flows for the major products.

For both crude and products trade should be analysed not only from a community wide perspective but also where appropriate on a regional or national basis. The implications of an expanded Community and developing trade arrangements with would-be Member States should also be taken into consideration, as should the global market where appropriate.

iv. Capacity Creep. The apparent contradiction of high reported utilisation rates and excess capacity should be addressed by examining the subject of capacity creep and how this effects the existing publicly quoted utilisation rates.

v. Diesel and gasoline supply and demand developments. Some regions have experienced a shift in demand from gasoline to diesel for transport requirements and the reasons for this should be examined in detail. In particular the role of taxation, duties and VAT, should be examined in order to establish their influence across the Community. Current and future developments in technology of both gasoline and diesel vehicles and transportation trends should also be considered in this context. Changes in the general structure of the retail sector such as effective separation of refining and marketing, concentration and distribution developments including the entry of hypermarkets should be addressed under this heading.

vi. Clean up costs for refinery closures. It has been suggested that these may have led to inefficient refineries remaining open, or being mothballed, or being sold at low prices to investors with different strategic objectives and these issues should be examined in depth. The range of environmental requirements, the costs, including the range of tax treatment across the Community should be addressed together with the historic background to the issues. In particular where requirements have changed these should be highlighted and the source of the requirements, be it environmental legislation or lease conditions should be identified where possible.

vii. Employment. The number of workers in the Refinery sector should be established, including direct employees of refinery companies and employees in supporting services and industries in order to understand the employment implications of developments in the sector.

viii. Current situation. An update of the refining sector should be presented including details of planned closures, sales, joint ventures, financial schemes etc. The impact of current EU government policies should also be considered, including general industrial and social policy; extending to related downstream activities such as the petrochemical sector where appropriate. The strategic nature of the refining sector and the issues of security of supply should also be given due priority. "

2. Refining Margins And Profitability

2.1. Marker Margins

There are several marker margins that are used by the industry to track the day to day and longer term developments of refinery gate, wholesale, product markets.

The most popular crudes are: Brent, at Rotterdam and US Gulf; West Texas Intermediate at US Gulf; Dubai and Arab Light, usually at Singapore. These crudes are taken as either being available in significant quantities or because they are used as a norm for trading. The locations normally represent the major refining centres of the world.

The process configuration is normally either Hydroskimming or Complex. Note that much confusion can arise from these terms. Care needs to be taken to understand which combination of processes has been taken (e.g. cat cracking, hydrocracking, or both, for complex; and for hydroskimming, distillation plus reforming) and which mode of operation (e.g. maximum mogas or maximum middle distillate). Which product quality is produced is also important, for mogas, diesel and fuel oils in particular, as it directly influences both yield and price.

It is particularly important to note that the marker margin is usually the Gross Refiners Margin, i.e. it is the value of products produced from a barrel of crude, with the refinery fuel and loss taken from the crude barrel, and before the deduction of cash costs and overheads.

Above all, it is vital, when a "margin" is quoted, to be very clear what margin is being used. Major confusion arises on this point.

2.2. GRM definition and margin trends

The Rotterdam Brent Complex Margin is the one most commonly quoted in Europe. We have adopted the deemed yield used by the IEA. Figure 1. Other industry markers use different deemed yields, or in some cases vary the yield measured each month by 'optimisation' against spot product prices. This margin (or the Brent Hydroskimming Margin if that were the one being used) is the Gross Refiners Margin (GRM). Note three points:

- The refinery fuel and loss, by convention, is taken out of the GRM
- For a complex yield there will be a volume gain from the conversion units.
- The net effect of the above two points is to reduce the output, on a *volume* basis, to 0.983 barrels of product per barrel of intake Brent crude, processed through the underlying process configuration to the defined product yield.

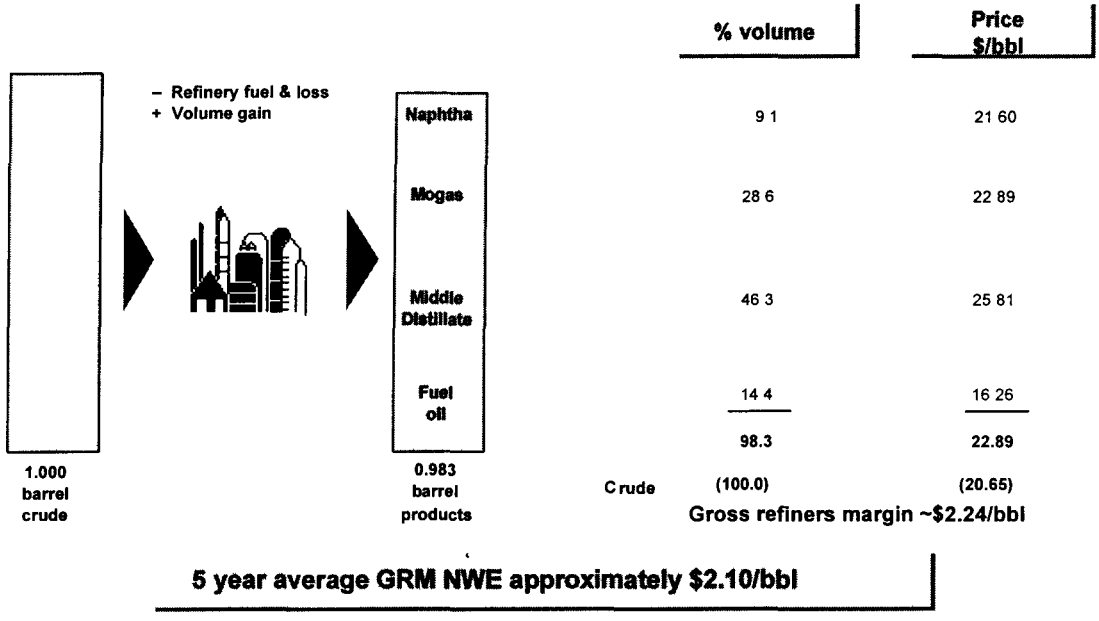


Figure 1 Brent Complex Margin - Rotterdam (1996 averages)

On this basis the Rotterdam Brent complex margin has been of the order of $1.75/bbl - $2.00/bbl (ECU 1.55 - 1.75 per barrel) over the last decade or so, as shown in appendix 2.9. There was a peak at the time of the Gulf War, when the margin approached $4/bbl (ECU 3.50/bbl), but this cannot be regarded as structural margin.

During the past five years the Mediterranean complex margin (measured as Urals crude oil Gross Refiners Margin - Mediterranean) has averaged about $0.45 / bbl (ECU 0.40 / bbl) above the Rotterdam Brent Complex margin.

As described in the main report, this level is not sufficient for adequate industry profitability. The linkage between GRM and Return on Capital Employed (ROCE) is developed further in this Appendix two.

2.3. Net Refiners Margin

Once the GRM has been defined the Net Refiners Margin (NRM) can be calculated by deducting the cash costs and allocated general cost (overheads). As indicated in Figure 2, for complex processing these are of the order of $1.75/bbl (ECU 1.55/bbl) crude with a range of say +/- $0.50 (ECU 0.45).

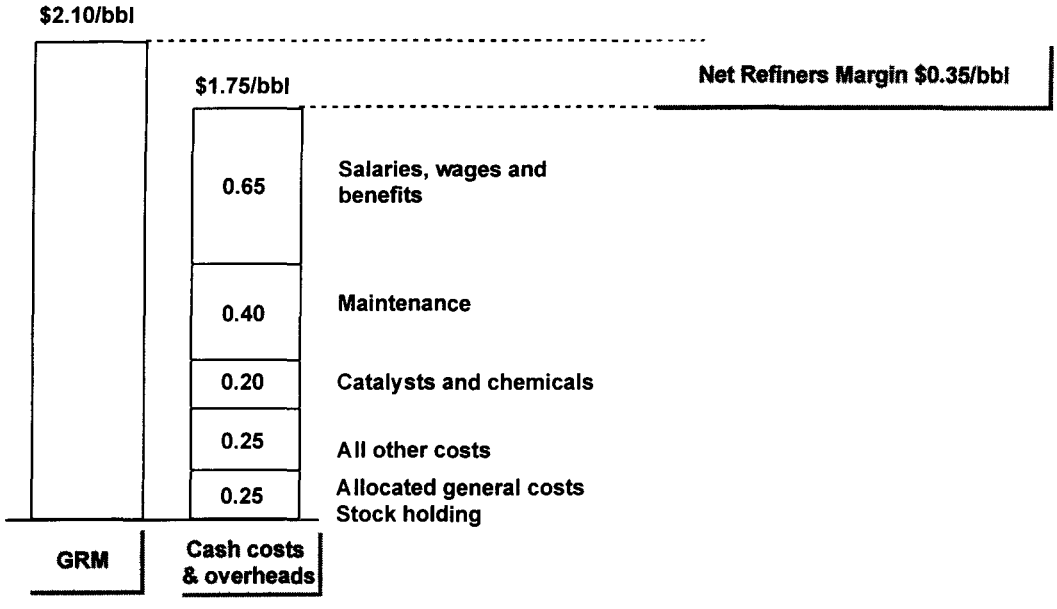


Figure 2 Components of Net Refiners Margin (NRM)

A typical Rotterdam Brent NRM has been of the order of $0.35/bbl (ECU 0.30) over the last few years, the figure of $0.35/bbl being that for 1996.

GRMs increase with complexity of processing but so do the cash costs and overheads. The capital cost of the more sophisticated equipment, on which it is necessary to earn a return is also higher.

2.4. Marker NRMs and individual refinery positions

The Brent based GRMs and NRMs described so far are *ONLY MARKER MARGINS*. They are not typical or average or maximum margins. Their sole purpose is to provide the industry with a simple marker of market trends, based upon defined assumptions.

An analogy can be drawn with the stock markets where the FTSE 100 or Hang Seng index is a marker. There are many other markers. Further, the marker is most unlikely to correspond to individual portfolios, where the individual investor will have made unique choices to optimise his portfolio.

It is exactly the same in the refining business. Each refiner will have made a range of specific choices on the plant he has installed, and, how it is to be operated. In addition, he will have optimised his trading position and the mix of different crudes to process, and optimised his processing conditions and blending options. Actual refinery yields may therefore be substantially different from the marker margin deemed yields. Most importantly, many refiners produce so called special products,

particularly lubricating oils, bitumen, solvents and LPG, all of which carry added value (and added costs!). There may also be synergies with petro-chemicals. An outline of some of the many individual variables is given in Figure 3.

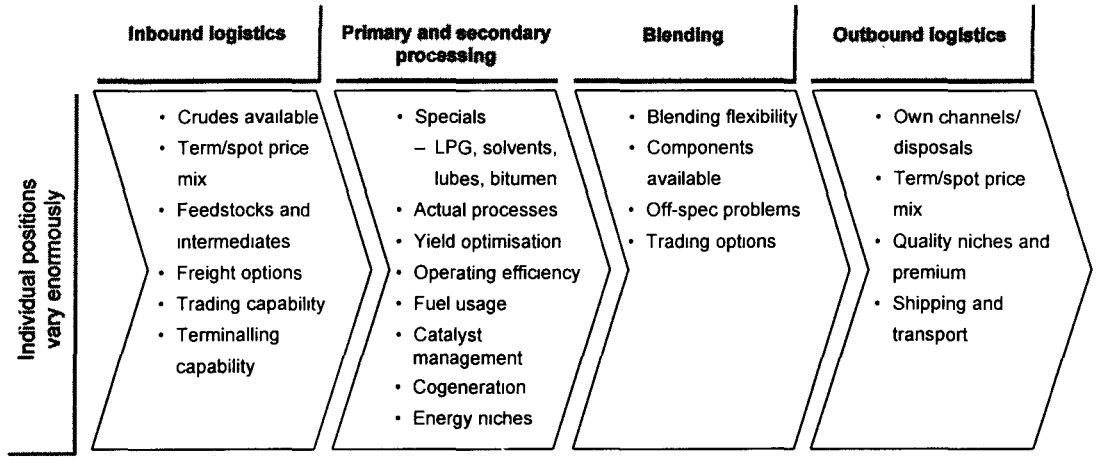


Figure 3 Variables affecting actual margins

The impact of all these individual positions is significant. As may be expected there will be a wide range about the norm. In any specific time-period unforeseen plant outages, off-specification product, shipping delays etc will further increase the offset from the marker GRM. The range is likely to be from nil, or even negative, up to $2 - 3/bbl (ECU 1.75 - 2.60/bbl). For the purposes of illustrating a typical NW Europe position an added NRM of say $1/bbl (ECU 0.90/bbl), by adding $0.50 / bbl for base load specials and for individual refinery optimisation, is indicated in Figure 4.

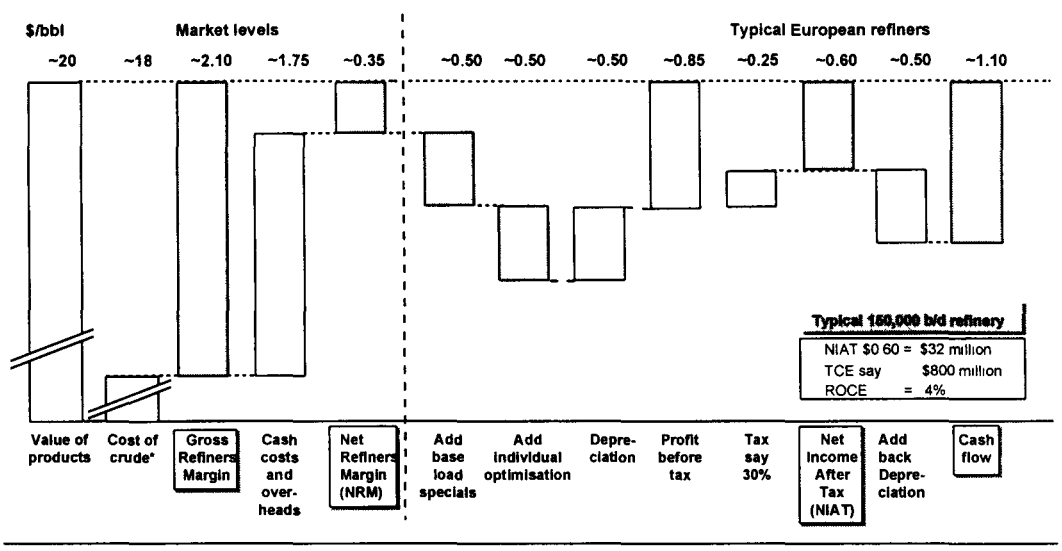


Figure 4 Relation between marker margins and actual cash flows

2.5. Linkage between NRM and Net Income After Tax (NIAT) and profitability expressed as Return On Capital Employed (ROCE)

Figure 4 shows the sequential build up from marker GRM to marker NRM, and then the addition of individual positions. To calculate NIAT it is now necessary to:

- Deduct depreciation, typically $0.50 - 0.55/bbl (ECU 0.45 - 0.50/bbl)
- Deduct tax. The tax positions will vary from refiner to refiner and country to country. For this illustration a notional tax rate of 30% has been taken

In this example the resultant NIAT is $0.60/bbl (ECU 0.55/bbl).

For a typical 150,000 b/d refinery the book value of the assets deployed (Total Capital Employed, TCE), being the written down value of the Plant Property and Equipment (PPE), plus value of stocks and net liabilities may well be of the order of ECU 700 - 880 million (£800 - $1000 million).

A ROCE of, say, 4% then results, as shown in Figure 4.

Figure 4 also shows the calculation of cash flow, being the NIAT plus depreciation added back. This cashflow is then available to fund dividends, interest and investments.

It is important to stress that this explanation is illustrative of the financial linkages involved. It does not attempt to show an accurate accounting view.

2.6. Measures of profitability

Cost of capital

In order for shareholder value to be sustained in the refining industry, new investments need to provide a post-tax return on capital (ROC) at least equal to oil companies' weighted average cost of capital (WACC). For an equivalent accounting return on existing written down assets (ROCE) the WACC value needs to be adjusted to reflect the replacement cost of existing assets. In the case of the EU refining industry this adjustment is considerable because the average age of European refining plant is 20 years. WACC, and therefore minimum required returns, for individual companies will vary from the industry average.

The WACC is based upon estimates of the risk-free interest rate, the general equity risk premium, beta factors for the industry (a measure of volatility) and average gearing levels of the industry. For the European refining industry we have estimated WACC of 7.5 to 8.0% for new investments and an average ROCE on existing assets

of 11 to 12%, as a minimum to maintain shareholder value. This approach is the Capital Asset Pricing Model (CAPM).

Existing assets

ROCE, as defined above, is the measure most often used to describe the profitability of existing assets. There are other measures for Return On Investment (ROI), such as Return On Average Capital Employed, (ROACE), Return On Equity (ROE), Return on Net Assets (RONA), and others. All have their own definitions and applicability. A discussion on their respective merits is outside the scope of this appendix.

New Investments

Most important for the refining industry are the measures that are used to describe the profitability of a new investment proposal. Again, there are many measures, including simple Payout Time and Net Present Value (NPV).

For the purposes of this appendix only one is described, the Real Terms Earning Power (RTEP), often referred to as the Internal Rate of Return (IRR). This is the discount rate at which the net cash flow of a project (investments out and **cash** (earnings) in) is zero. Figure 5.

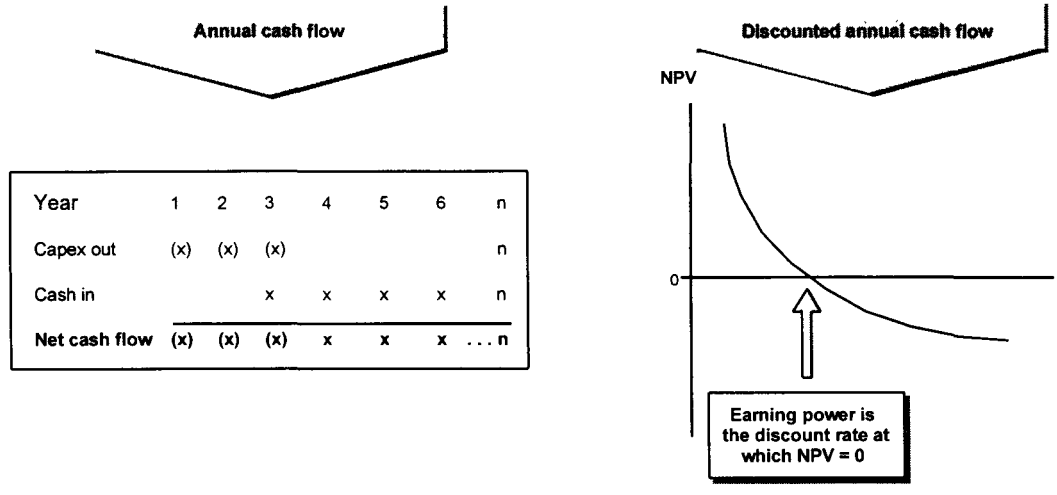


Figure 5 Real terms earning power as a measure of profitability

Oil companies will typically set a screening rate for the RTEP or IRR of between 8-10%, depending on size of project, country/political risk, margin risk (as for environmental investments in Europe at the moment) and other such factors.

Note that a RTEP of say 8 % on proposed new assets is broadly comparable to a ROCE of 12 % on those assets at mid-life. Figure 6.

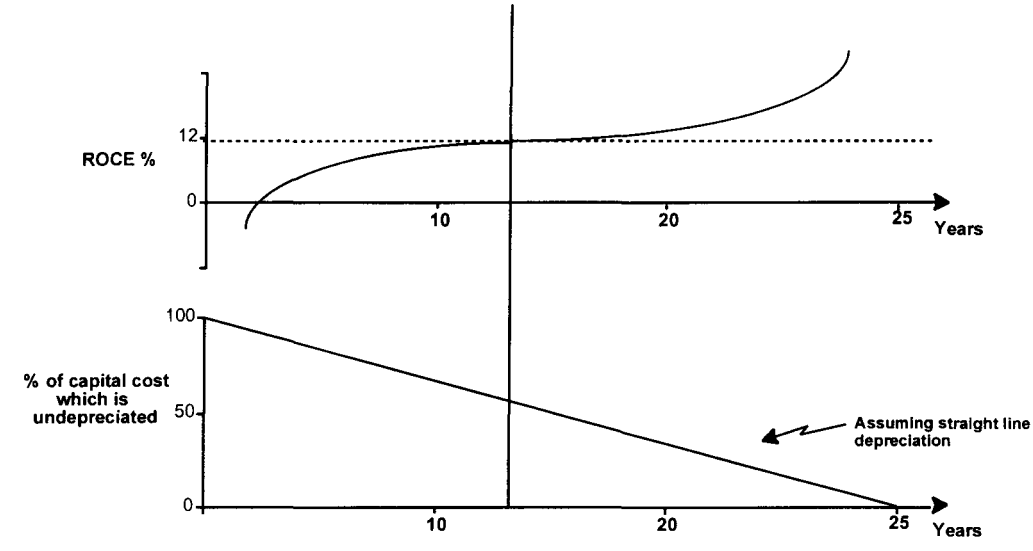


Figure 6 Time profile of profitability in terms of ROCE

2.7. Capital charge

A capital charge is not a measure of profitability.

It is however a valuable tool. The capital charge concept is a means of expressing a one-off expenditure in the form of a cost per unit of time, or quantity. A capital charge is the margin that must be earned to give a preset earning power on capital; i.e. Earning Power (EP) is an input to the calculation. For example the required RTEP may be set at 8%.

Figure 7 illustrates some typical capital charges, expressed as a % of capital per annum.

These capital charges are illustrative.

Many detailed assumptions would lie behind the calculation of an actual case. These assumptions would include the profile of the income stream, the actual depreciation and tax regime and any investment incentives.

10 year lifetime

Tax rate [%]	Required earning power (RTEP)		
	8%	10%	12%
0	15.5	17 1	18.8
30	17 9	20 1	22 5
50	21 0	24.2	27.5

20 year lifetime

Tax rate [%]	Required earning power (RTEP)		
	8%	10%	12%
0	10.6	12.3	14.2
30	12.2	14 5	17 0
50	14.4	17.6	20.8

Figure 7 Capital charges for different project scenarios

The principle illustrated has then been used to calculate the required GRM for a variety of refining investments. In this report we have taken 12% as a representative capital charge for new refinery investments.

2.8. Reinvestment economics and environmental investments

To provide indicative reinvestment economics for refining we have taken the capital cost of a new 150-180,000b/cd complex refinery at ECU 1.3 - 1.75 billion ($1.5 - 2.00 billion). A capital charge of 12% has then been applied, equivalent to ECU 2.60 - 3.50/bbl ($3.00 - 4.00/bbl).

Adding fixed costs and overheads at ECU 1.30/bbl ($1.50/bbl) gives:

An indicative required complex margin, GRM, of ECU 3.90 - 4.80/bbl ($4.50 - 5.50/bbl) for a new refinery. Figure 8.

Should a new processing train be installed within an existing refinery there are major savings on refinery infrastructure, site, roads, offices, perhaps jetties and tankfarm. Thus:

An indicative required complex margin, GRM, of ECU 2.90 - 3.40/bbl ($3.30 - 3.90/bbl) for a brownfield expansion. Figure 8.

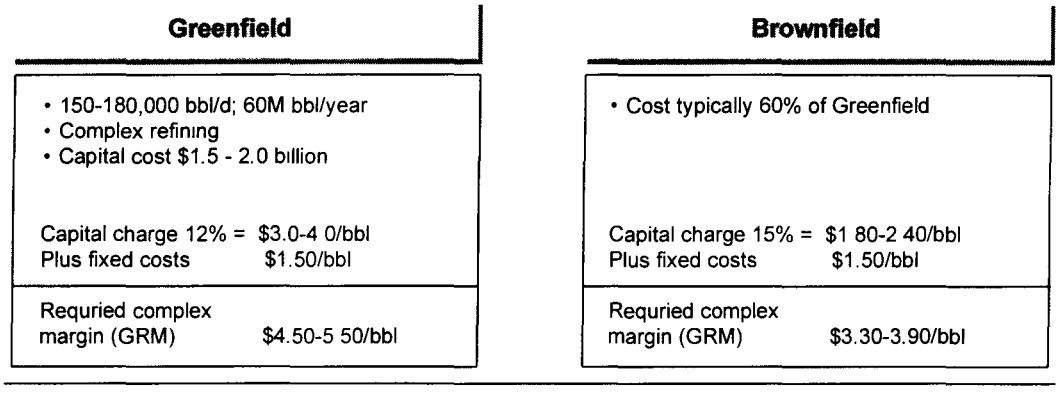


Figure 8 Required GRMs for new investment

The same logic can be applied to foreseen environmental investments. The cost of meeting the European Council Common Position of 6/97 is foreseen to be of the order of Net Present Value ECU 20bn. We have assumed this is split into ECU 13.5bn capital expenditure and ECU 6.5bn NPV of operating expenditure. A choice needs to be made of the appropriate capital charge. For example, applying a capital charge of 12% gives:

> *An indicative required complex margin for environmental investments of some ECU 0.50/bbl ($0.60/bbl), **above** that required for acceptable base profitability.*

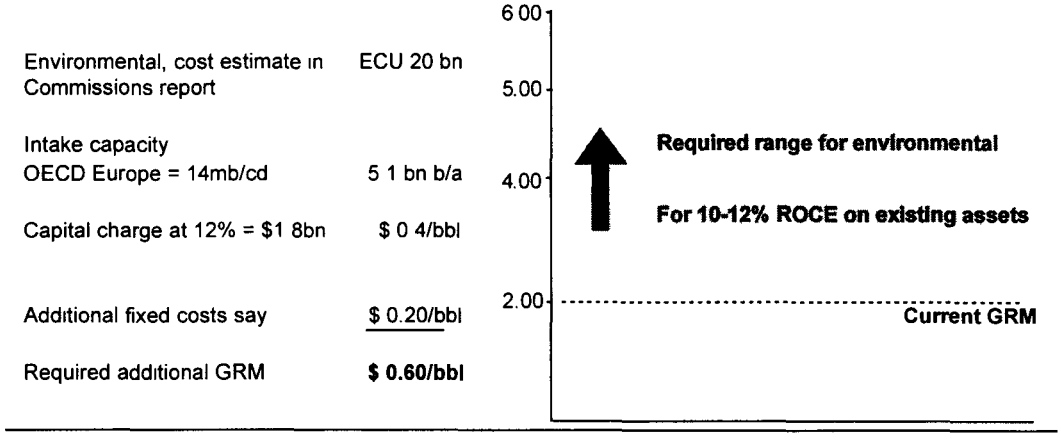


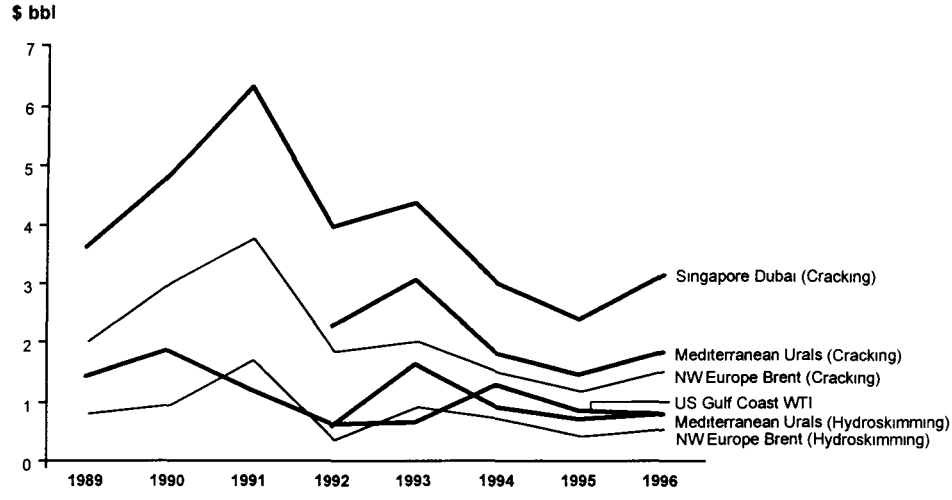
Figure 9 GRM required for environmental investment

If allocated over the road transport fuels volume of around 1.85bn barrels this is approximately 1 cent/litre.

The same logic can be applied to the 2005 European Parliament targets of 4/97 and the Council indicative targets of 6/97. The cost can also be expressed as cents/litre of transport fuels.

	Total Cost Bn ECU	Cost $/bbl Refinery Intake	Cost $c/litre Transport Fuel
Council "Common Position" 2000 (6/97)	20	0.60	1
European Parliament 2005 (4/97)	60	1..80	3
Council "Indicative Targets" 2005 (6/97)	45	1.35	2.35

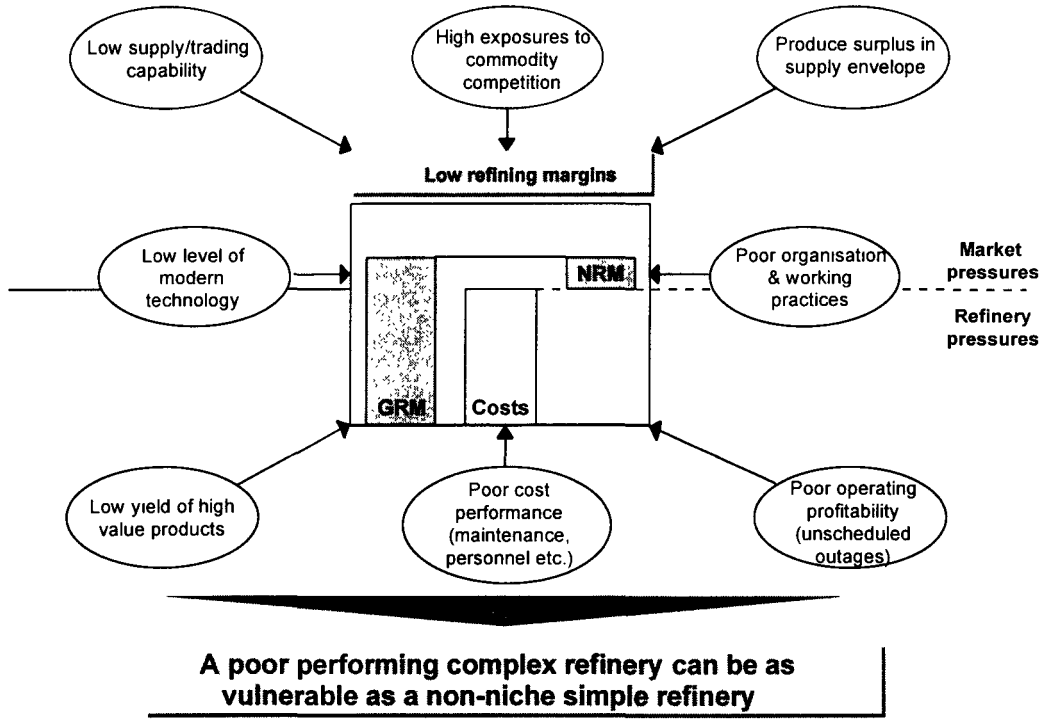
2.9. Worldwide Gross Refining Margins 1989 - 1996



$/bbl	1989	1990	1991	1992	1993	1994	1995	1996
NW Europe Brent (Hydroskimming)	0.78	0.94	1 69	0.34	0.91	0.70	0.43	0 54
NW Europe Brent (Cracking)	2.02	3.01	3 76	1.85	2 03	1.49	1.15	1 51
Mediterranean Urals (Hydroskimming)				0 58	1 59	0.87	0.68	0 75
Mediterranean Urals (Cracking)				2.25	3 03	1 79	1.44	1 80
US Gulf Coast WTI (Cracking)	1 40	1.84	1.17	0 59	0.63	1.24	0.82	0.75
Singaport Dubai (Cracking)	3 57	4.75	6.26	3.93	4 32	2.97	2.35	3.10

3. Changes in Refining

3.1. Refinery Candidates for Closure have known vulnerabilities



The charts on the following pages show proposed changes to refining capacity already announced. Also indicated are refineries which under certain circumstances could be closure candidates on at least one of the criteria listed above.

Note that these possibilities in no way suggest that particular refineries should close. In depth analysis would be needed in each case with particular emphasis on the supply envelope and operating performance. Some simple refineries have a geographic or niche advantage which make them highly profitable while a high conversion refinery might have serious dis-advantages which might make it a closure candidate.

3.2. Recently Announced Changes in European Refining

Region	Country	Refinery	Ownership	Proposal	Date	Net distillation capacity change	Distillation capacity sale
European Union	Denmark	Gulfhavn	KPC	closure	1997	-59 kbd	
	France	Lavera	BP	sale / (closure)	1997		190 kbd
		Berre L'Etang	Shell	reduction	1997	-63 kbd	
	Germany	Karlsruhe	Esso / OMW	merger	1997	-67 kbd	
		Wilhelmshaven	Dreyfus / Beta	upgrade / sale	1997	13 kbd	174 kbd
		Leuna	Elf	modernisation	1997	71 kbd	
		Holborn Harburg	Oelinvest	upgrading	1997	20 kbd	
		Schwedt	PCK Schwedt	reduction	1997	-30 kbd	
	Greece	Aspropyrgos	Hellas	upgrading	1999	44 kbd	
	Netherlands	Nerefco	BP / Texaco	closure BP part	1997	-70 kbd	
		Rotterdam	KPC	upgrading		70 kbd	
	UK	Milford Haven	Gulf	closure	1998	-112 kbd	
European Union Total						-183 kbd	364 kbd
West Europe (other)	Norway	Mongstad	Statoil	upgrading	1999	55 kbd	
	Switzerland	Cressier	Shell	sale	1997		60 kbd
West Europe (other) Total						55 kbd	60 kbd
Grand Total						-128 kbd	424 kbd

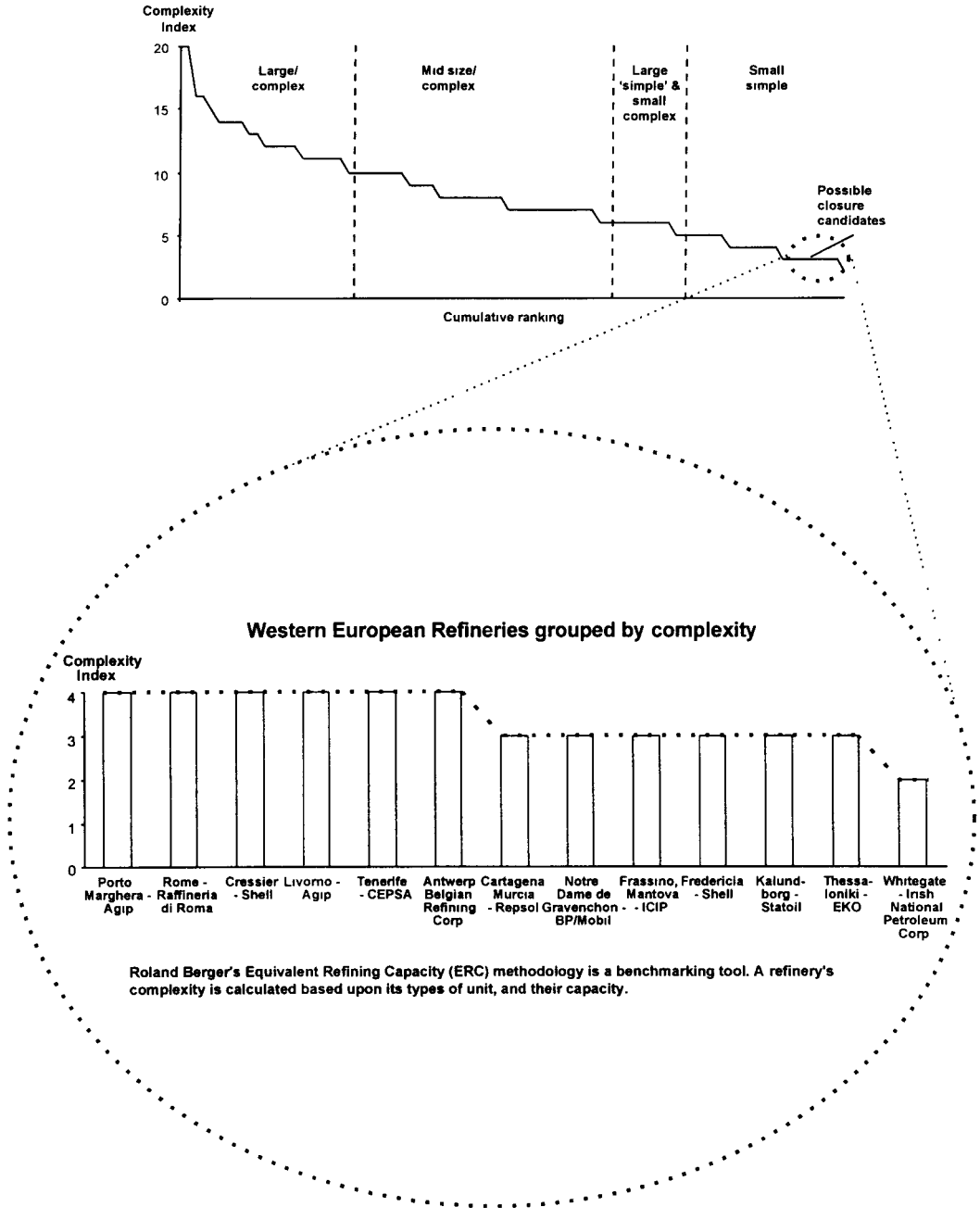
Source: IEA, Wood Mackenzie

3.3. Potential Candidates for Closure: The Financial Analysts View

Region	Country	Refinery	Holding	Crude capacity (kbd)
European Union	Spain	Cartagena Murola	Repsol (100%)	120
	France	Lavera	BP (100%)	190
		Berre L'Etang	Shell (100%)	127
	UK - England	Coryton Essex	BP/Mobil (100%)	171
		Shell Haven	Shell (100%)	92
	UK - Wales	Milford Haven	Elf (70%), Murco (30%)	108
	Italy	Roma	Agip (5%), Cameli (50%)	82
	Netherlands	Europoort - Pernis	Texaco (35%), BP/Mobil (65%)	399
Europe (other)	Switzerland	Cressier	Shell (100%)	60
			Total:	1349
				= 67 Mtpa

Note. Italics indicates refineries already up for sale, closure, or reduction in capacity

3.4. A number of the lower complexity refineries will be among candidates for closure (excluding speciality refineries)



3.5. Refinery Regional Groupings (with possible merger / alliance / closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Belgium - Antwerp																				
Antwerp (BRC)	Belgian Refining Corp NV	Belgian Refining Corp (100%)	81	40	18		10		23	20				2				x		
Antwerp (Esso)	Esso Belgium	Esso (100%)	246	123		33	39		86	119	7									2
Antwerp (FRA)	Fina Raffinaderij Antwerpen	Fina (100%)	288	96	43	78	50		135	103	7	2		5						11
Antwerp (NP)	Nynas Petroleum NV	Neste (50%), PDVSA (50%)	15	13																12
			630	271	61	111	98		243	241	14	2		7						25
South of France																				
Berre l'Etang	Ste des Petroles Shell	Shell (100%)	127	52		34	19		37	37										6
Feyzin	Elf France	Elf (100%)	128	36	16	25	9		35	14			2			3				
Fos sur Mer	Esso SAF	Esso (100%)	117	33		25				90										
La Mede	Cie de Raffinage et de Distribution Total France	Total (100%)	127	48	17	30	24			58	3			9						
Lavera	Ste Francaise des Petroles BP	BP (100%)	200	74	22	28	11	15		64				14						14
			699	243	54	142	63	15	72	263	3		2	23		3				20

Source: RB&P Analysis; Oil & Gas Journal

Refinery Regional Groupings
(with possible merger/alliance/closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Germany - Bavaria																				
Ingolstadt	Esso AG	Esso (100%)	105	30		28	18			100				7						9
Neustadt-Donau	Erdoel Raffinerie Neustadt GmbH	BP / Mobil (50%), Veba (13%), PDVSA (13%), Saarberg (25%)	125	62	12	23	18		41	24									x	5
Vohburg / Ingolstadt	Raffineriegesellschaft	Agip (38%), BP (63%)	114	45	23	35	33		27	70				11		9				11
			344	136	35	86	70		68	194				18		9				25
Germany - Hamburg / Harburg																				
Hamburg	BP Oil Deutschland GmbH	BP / Mobil (100%)		14						3					10					
Harburg (HER)	Holborn Europa Raffinene GmbH	OilInvest (67%), Coastal (33%)	78	15		19	15			74										
Harburg (Shell)	Deutsche Shell AG	Shell (100%)	98	44	16	16	17		16	31				3	6					6
			176	59	16	35	32		16	105				3	6					6

Source: RB&P Analysis; Oil & Gas Journal

Refinery Regional Groupings
(with possible merger/alliance/closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Greece																				
Aghil Theodori	Motor Oil (Hellas) Corinth Refineries SA	Motor Oil (Hellas) (100%)	100	62	24	30	13			50	2	1		5	3	1				
Aspropyrgos	Hellenic Aspropyrgos Refinery SA	Hellas Aspro (100%)	121	56	21	36	31	28	16	52		7		7		1				2
Elefsis	Petrola Hellas SA	Petrola Hellas (100%)	108																	
			329	118	46	66	44	28	16	102	2	9		12	3	2				2
Italy - Sicily																				
Augusta, Siracusa	Esso Italiana SpA	Esso (100%)	183	86		43	22		16	81	8			2	17					
Gela, Ragusa	Praoil	Agip (100%)	105	53		35	14		47	17	10		15	8		2		2		
Milazzo, Messina	Raffineria Mediterranea SpA	Agip (50%), Kuwait (50%)	160	75		49	14	30	16	21	5					1	x			
Priolo Gargallo	Isab SpA	Agip (20%), ERG (80%)	235	103	78		38	65		160				9						
Priolo, Siracusa	Praoil	Agip (100%)	220	50	25	32	9		18	9	4		14			1				
			903	366	103	159	96	95	97	288	27		30	19	17	5		2		

Source: RB&P Analysis; Oil & Gas Journal

Refinery Regional Groupings
(with possible merger/alliance/closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Italy - north(1)																				
Cremona	Tamoil Raffinazione SpA	Tamoil (100%)	90		33		24	6	27	36				11						
Frassino, Mantova	Italiana Energia E Servizi SpA	ICIP (100%)	50	17	29		7		24	15				2						
			140	17	62		31	6	50	51				13						
Italy - north(2)																				
Busalla	Iplom SpA	Iplom (100%)	47	13											7					13
Sannazzaro, Pavia	Agip Raffinazione	Agip (100%)	200	85	32	34	29	30	41	39	3			16		1				3
			247	97	32	34	29	30	41	39	3			16	7	1				15
The Netherlands - Rotterdam																				
Europoort & Pernis	Netherlands Refining Co	Texaco (35%), BP / Mobil (65%)	399	102	60	50	53			160	6			7		1				
Pernis	Shell Nederland Raffinaderij BV	Shell (100%)	374	148	45	87	42	22	86	146	7				7	3				6
Rotterdam (Esso)	Esso Nederland BV	Esso (100%)	180	81			28	34		127									1	
Rotterdam (KP)	Kuwait Petroleum Europoort BV	Kuwait (100%)	76	38	16		23			79				7	4					3
			1029	368	121	137	146	56	86	512	13			14	12	4			1	9

Source: RB&P Analysis; Oil & Gas Journal

Refinery Regional Groupings
(with possible merger/alliance/closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Sweden - Gothenburg																				
Gothenburg (ABNP)	AB Nynas Petroleum	Neste (50%), PDVSA (50%)	13	9																9
Gothenburg (PR)	Preem Raffinaden AB	OKP (100%)	106				21		44	60				10						
Gothenburg (Shell)	Shell Raffinaden AB	Shell (100%)	81	30	25		17		28	33				4						
			200	39	25		38		72	93				14						9
UK - Killingholme																				
Killingholme South Humberside	Lindsey Oil Refining Ltd	Fina (50%), Total (50%)	192	92	29	48	33		42	51	6	2				4				7
South Killingholme	Conoco Ltd	Conoco (100%)	180	175	40	50	50			168	14	4	7	19				3		
			372	267	69	98	83		42	219	20	5	7	19		4		3		7
UK - Pembrokeshire Coast																				
Milford Haven (Elf)	Elf Oil UK Ltd	Elf (70%), Murco (30%)	108	55		33	18			86	6	2		13						
Milford Haven (Pembroke)	Pembroke Cracking Co (65% Texaco, 35% Gulf Oil GB)	Gulf stake in process of being sold to Texaco				90					33			21					x	
Pembroke, Dyfed	Texaco Ltd	Texaco (100%)	180	91	26		39		34	39										
			288	186	26	123	79		67	125	39	2		51						

Source: RB&P Analysis; Oil & Gas Journal

Refinery Regional Groupings
(with possible merger/alliance/closure potential)

000s bcd

Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
UK - Thames Estuary																				
Coryton Essex	Mobil Oil Co Ltd	BP / Mobil (100%)	171	58		56	34		42	67	18			14	7					2
Shell Haven	Shell UK Ltd	Shell (100%)	92	30			39	24		94				20						5
			263	88		56	73	24	42	161	18			34	7					8

Source: RB&P Analysis; Oil & Gas Journal

4. Inventory Of Refining Capacity

4.1. Summary of Refinng Capacity by Region

000s b/cd

	No of refineries	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Worldwide	701	76066	25336	3725	12762	10971	3577	7309	27172	1657	200	1023	1325	906	229	12	121	28	1981
European Union	102	12999	4858	1534	2040	2000	656	2123	4998	224	37	153	435	158	47	4	10	4	404
Western Europe (non-EU)	5	439	24	68	48	75	6	61	208		12		18				1		5
Applicant States group one	12	809	316	14	70	98	22	38	263	6		11	5	13	6				42
Applicant States group two	15	1214	337	68	149	122	19	3	444	2	5	18	7	14	3		3		29
Other Eastern Europe	7	385	61	11	32	48		21	52			20	8	3					
CIS	54	10101	3033	448	564	1197	50	9	3222	12	3	72	14	168	6		9		229
north Africa	19	1547	99		5	136		20	186	9		2	2	10			1		16
Middle East	41	5503	1788	247	252	569	527	413	1387	24	3	13	43	36	2	1	2	3	76

4.2. Summary of Refining Capacity in the European Union

000s b/cd

	No of refineries	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Austria	1	210	68	18	26	16		38	46				14		2				10
Belgium	4	630	271	61	111	98		243	241	14	2		7			0		0	25
Denmark	3	189	45	74		32		11	92				6					0	8
Finland	2	200	95	35	45	43	16	104	58	4	0		4		4	0			12
France	14	1786	752	148	356	245	15	192	643	16		2	62	32	3	0	1	0	41
Germany	18	2108	829	289	276	399	177	648	909	16	2	64	56	27	15	1	4	1	97
Greece	4	396	126	46	66	52	28	16	137	2	9		12	3	2	0	0		5
Ireland	1	65				12		10	14										
Italy	17	2262	756	416	298	287	197	330	707	37	3	30	90	34	6	0	2	1	34
Netherlands	6	1187	434	121	137	169	95	86	538	13			14	12	4	0		1	15
Portugal	2	304	78	23	32	50	9		121	5		17							
Spain	10	1296	424	145	178	194	15	91	403	13		24	18	12	9	0	1		65
Sweden	5	427	135	63	30	70	49	72	190		3		28	3		0		0	29
United Kingdom	15	1941	845	95	485	334	56	281	899	104	17	16	124	36	4	2	3	0	63
European Union Total	102	12999	4858	1534	2040	2000	656	2123	4998	224	37	153	435	158	47	4	10	4	404

Note: Due to rounding, a zero in a field indicates a true value of between 0 and 0.5

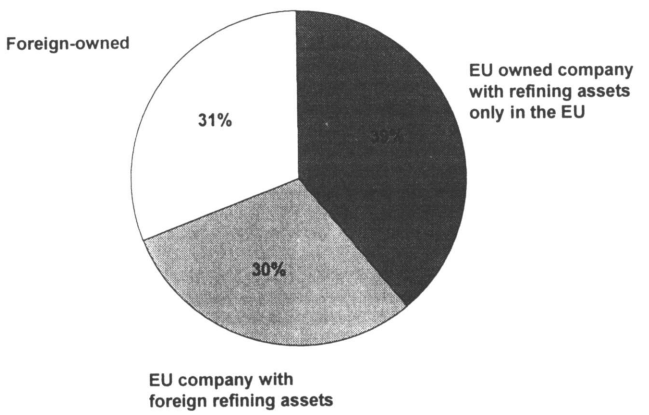


Figure 10 European refinery ownership structure

European Union and other Western Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Austria	Schwechat	OeMV AG	OMV (100%)	210	68	18	26	16		38	46				14		2				10
Belgium	Antwerp (BRC)	Belgian Refining Corp NV	Belgian Refining Corp (100%)	81	40	18		10		23	20				2					x	
	Antwerp (Esso)	Esso Belgium	Esso (100%)	246	123		33	39		86	119	7									2
	Antwerp (FRA)	Fina Raffinaderj Antwerpen	Fina (100%)	288	96	43	78	50		135	103	7	2		5						11
	Antwerp (NP)	Nynas Petroleum NV	Neste (50%), PDVSA (50%)	15	13																12
Denmark	Fredericia	AS Dansk Shell	Shell (100%)	67		23		13		11	23				6						
	Gulfhavn	Kuwait Petroleum Refining (Danmark) A/S	Kuwait (100%)	57	23	24		11			49										
	Kalundborg	Dansk Statoil AS	Statoil (100%)	65	22	28		9			20										8
Finland	Naantali	Neste Oy	Neste (100%)	40	27	7	14	7		22	7										4
	Porvoo	Neste Oy	Neste (100%)	160	68	28	31	36	16	82	51	4			4		4	x			9
France	Berre l'Etang	Ste des Petroles Shell	Shell (100%)	127	52		34	19		37	37										6
	Donges	Elf France	Elf (100%)	214	120	33	49	29		36	56	4			5						
	Dunkirk	Ste Francaise des Petroles BP	BP (100%)		18											11					
	Feyzin	Elf France	Elf (100%)	128	36	16	25	9		35	14			2			3				
	Fos sur Mer	Esso SAF	Esso (100%)	117	33		25				90										
	Gonfreville L'Orcher	Cie de Raffinage et de Distribution Total France	Total (100%)	211	73	19	40	45			102				17						
	Grandpuits	Elf France	Elf (100%)	98	50	15	31	15		29	28	3							x		
	La Mede	Cie de Raffinage et de Distribution Total France	Total (100%)	127	48	17	30	24			58	3			9						
	Lavera	Ste Francaise des Petroles BP	BP (100%)	200	74	22	28	11	15		64				14						14
	Mardyck	Cie de Raffinage et de Distribution Total France	Total (100%)	127	42		32	22			24				9						
	Notre Dame de Gravenchon	Mobil Oil Francaise	BP / Mobil (100%)	64	26			11		7	35				8	5					4
	Petit Couronne	Ste des Petroles Shell	Shell (100%)	141	76	12	20	28		33	48					6		x			11
	Port Jerome	Esso SAF	Esso (100%)	156	71		30	18			64	6				10					
	Reichstett-Vendenheim	Cie Rhenane de Raffinage	BP (12%), Elf (10%), Mobil (5%), Shell (65%), Total (8%)	76	34	14	13	14		15	23										7
Germany	Burghausen	OMV AG	OMV (100%)	72							19			2					1		
	Gelsenkirchen	Veba Oel / Ruhr Oel GmbH	PDV (50%), Veba (50%)	227	77	16	21	27	30	104	31			12					1	1	6
	Godorf	Deutsche Shell AG	Shell (100%)	170	73	25		38	36	32	98			20	8						12

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

European Union and other Western Europe
Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by	Beneficial Ownership	Crude cap	Vacuum cap.	Thermal	Cat. crack	Cat reform	Cat h/crack	Cat h/ref	Cat h/treat	Alkylation	Pol./ Dim	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Hamburg	BP Oil Deutschland GmbH	BP / Mobil (100%)		14						3					10					
	Harburg (HER)	Holborn Europa Raffinerie GmbH	Oilinvest (67%), Coastal (33%)	78	15		19	15			74										
	Harburg (Shell)	Deutsche Shell AG	Shell (100%)	98	44	16	16	17		16	31				3	6					6
	Heide/Grasbrook	DEA Mineraloel AG	DEA (100%)	80	30	14	9	20		29	25			6		8					4
	Ingolstadt	Esso AG	Esso (100%)	105	30		28	18			100				7						9
	Karlsruhe	Mineraloelraffinerie Oberrhein GmbH	Conoco (25%) PDVSA (17%), DEA (42%) Veba (17%), Esso (??)	326	156	104	74	67		134	182	10			13		3		1		22
	Krumpa	Addinol Mineralol GmbH	Addinol (100%)		26											3					2
	Leuna	Leuna Raffinenegesellschaft mbH	Leunewerke (100%)	100	70	26		15	48	33	19						x				
	Lingen	Wintershall AG	Wintershall (100%)	80	38			35	23	42	18			10							9
	Neustadt-Donau	Erdoel Raffinerie Neustadt GmbH	BP / Mobil (50%), Veba (13%), PDVSA (13%), Saarberg (25%)	125	62	12	23	18		41	24									x	5
	Salzbergen	Schmierstoff Raffinerie	Wintershall (100%)	3	6																
	Schwedt	PCK Schwedt AG	Agip (8%) Elf (8%), PDVSA (19%), DEA (38%), Total (8%) Veba (19%)	230	94	27	51	34		150	37	6		5	15		2				12
	Vohburg / Ingolstadt	Raffinenegesellschaft	Agip (38%), BP (63%)	114	45	23	35	33		27	70				11		9				11
	Wesseling	DEA Mineraloel AG	DEA (100%)	120	50	26		21	40	41	27		2	8			2				
	Wilhelmshaven	Beta Raffinenegesellschaft Wilhelmshaven mbH	Beta	180				40			152										
Greece	Aghil Theodori	Motor Oil (Hellas) Corinth Refineries SA	Motor Oil (Hellas) (100%)	100	62	24	30	13			50	2	1		5	3	1				
	Aspropyrgos	Hellenic Aspropyrgos Refinery SA	Hellas Aspro (100%)	121	56	21	36	31	28	16	52		7		7		1				2
	Elefsis	Petrola Hellas SA	Petrola Hellas (100%)	108																	
	Thessaloniki	EKO - Hellenic Refineries & Chemicals of Macedonia Industrial & Commercial Co SA	EKO Group	67	8			8			35										3
Ireland	Whitegate	Irish National Petroleum Corp	Irish National Petroleum Corp (100%)	65				12		10	14										
Italy	Augusta, Siracusa	Esso Italiana SpA	Esso (100%)	183	86		43	22		16	81	8			2	17					
	Busalla	Iplom SpA	Iplom (100%)	47	13											7					13
	Cremona	Tamoil Raffinazione SpA	Tamoil (100%)	90		33		24	6	27	36				11						

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

European Union and other Western Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by	Beneficial Ownership	Crude cap	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. hdcrack.	Cat. hdref.	Cat hdtreat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Falconara, Marittima	Anonima Petroli Italiana	Agip (100%)	77	42	38		20		27	23				7						
	Frassino, Mantova	Italiana Energia E Servizi SpA	ICIP (100%)	50	17	29		7		24	15				2						
	Gela, Ragusa	Praoil	Agip (100%)	105	53		35	14		47	17	10		15	8		2		2		
	La Spezia	Arcola Petrolifera SpA	Arcola (100%)	33																	
	Livorno	Agip Plas SpA	Agip (100%)	84	36			12		32	22				6	10					4
	Milazzo, Messina	Raffinera Mediterranea SpA	Agip (50%), Kuwait (50%)	160	75		49	14	30	16	21	5					1	x			
	Porto Marghera	Agip Raffinazione	Agip (100%)	80	38	41		15		27	16				6						4
	Priolo Gargallo	Isab SpA	Agip (20%), ERG (80%)	235	103	78		38	65		160				9						
	Priolo, Siracusa	Praoil	Agip (100%)	220	50	25	32	9		18	9	4		14			1				
	Rome	Raffinera di Roma SpA	Agip (5%), Cameli (5%), Erg (14%), Fina (58%), Montedison (9%), Shell (10%)	82	12	32		14		21	21				7						10
	S Martino Di Trecate	Sarpom	Agip (5%), Cameli (5%), Erg (14%), Esso (67%), Fimica (9%)	248	27		25	26			122		3		11						
	Sannazzaro, Pavia	Agip Raffinazione	Agip (100%)	200	85	32	34	29	30	41	39	3			16		1				3
	Sarroch	Saras SpA	Agip (15%), Saras (85%)	285	108	45	80	27	50		103	7									
	Taranto	Agip Raffinazione	Agip (100%)	84	14	64		17	16	34	24				6						3
Netherlands	Amsterdam	Smith & Hollander Raffinaderij BV	Smith & Hollander (100%)	10	8																6
	Europoort & Pernis	Netherlands Refining Co	Texaco (35%), BP / Mobil (65%)	399	102	60	50	53			160	6			7		1				
	Pernis	Shell Nederland Raffinaderij BV	Shell (100%)	374	148	45	87	42	22	86	146	7				7	3				6
	Rotterdam (Esso)	Esso Nederland BV	Esso (100%)	180	81			28	34		127									1	
	Rotterdam (KP)	Kuwait Petroleum Europoort BV	Kuwait (100%)	76	38	16		23			79				7	4					3
	Vlissingen	Total Raffinaderij Nederland NV	Total (55%), Dow (45%)	148	58			23	39		26										
Portugal	Leca da Palmeira Porto	Petrogal	Petrogal (100%)	91	11			25			55			17							
	Sines	Petrogal	Petrogal (100%)	213	67	23	32	25	9		67	5									
Spain	Cartagena Murcia	Repsol Petroleo SA	Repsol (100%)	120	14			25			29					3					5
	Castellon de la Plana	BP Oil Espana	BP / Mobil (100%)	102	45		23	15		29	44				8						
	Huelva	Compania Espanola de Petroles	Cepsa (100%)	100	35	10	18	17			36			8		2					7
	La Coruna	Repsol Petroleo SA	Repsol (100%)	135	40		28	22			17						1		1		5

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

European Union and other Western Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by	Beneficial Ownership	Crude cap	Vacuum cap	Thermal	Cat. crack	Cat. reform.	Cat. h/crack	Cat. h/ref	Cat h/treat	Alkylation	Pol./ im	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Puertollano Ciudad Real	Repsol Petroleo SA	Repsol (100%)	135	62		30	18		10	38	3		2		3	1		1		6
	San Roque (Cadiz)	Compania Espanola de Petroles	Cepsa (100%)	205	40	32	40	35			84	5		15	10	4	1				
	Somorrostro Vizcaya	Petronor SA	Repsol (100%)	209	89	38	40	30		32	91	4					5				22
	Tarragona (AE)	Asfaltos Espanoles SA	Cepsa (50%), Repsol (50%)	21	17																15
	Tarragona (RP)	Repsol Petroleo SA	Repsol (100%)	180	72	30		16	15	21	20						1				
	Tenerife	Compania Espanola de Petroles	Cepsa (100%)	89	10	35		16			44										6
Sweden	Brofjorden-Lysekil	Skandinaviska Raffinaden AB	Norsk Hydro (21%), OKP (79%)	200	65	38	30	32	49		95		3		14						
	Gothenburg (ABNP)	AB Nynas Petroleum	Neste (50%) PDVSA (50%)	13	9																9
	Gothenburg (PR)	Preem Raffinaden AB	OKP (100%)	106				21		44	60				10						
	Gothenburg (Shell)	Shell Raffinaderi AB	Shell (100%)	81	30	25		17		28	33				4						
	Nynashamn	AB Nynas Petroleum	Neste (50%), PDVSA (50%)	28	31						3					3		x			20
UK - England	Coryton Essex	Mobil Oil Co Ltd	BP / Mobil (100%)	171	58		56	34		42	67	18			14	7					2
	Ellesmere Port	Eastham Refinery Ltd	Shell (50%), Briggs (50%)	22	19																15
	Fawley	Esso Petroleum Co Ltd	Esso (100%)	317	136		85			23	218		10		21	9		2			20
	Killingholme South Humberside	Lindsey Oil Refining Ltd	Fina (50%), Total (50%)	192	92	29	48	33		42	51	6	2				4				7
	Port Clarence	Philips Imperial Petroleum Ltd	ICI (50%), Phillips (50%)	100						18											
	Shell Haven	Shell UK Ltd	Shell (100%)	92	30			39	24		84				20						5
	South Killingholme	Conoco Ltd	Conoco (100%)	180	175	40	50	50			168	14	4	7	19				3		
	Stanlow	Shell UK Ltd	Shell (100%)	262	46		73	59		57	73	11		9		5					
UK - Scotland	Dundee	Nynas UK AB	Neste (50%), PDVSA (50%)	10	10																7
	Grangemouth	BP Refinery Grangemouth Ltd	BP / Mobil (100%)	195	65		19	40	32	32	62	5						x			
UK - Wales	Llandarcy Neath	BP Refinery Llandarcy Ltd	BP / Mobil (100%)		29						7					15					7
	Milford Haven (Elf)	Elf Oil UK Ltd	Elf (70%), Murco (30%)	108	55		33	18			85	6	2		13						
	Milford Haven (Gulf)	Gulf Oil	Gulf (100%)	112	40		31	23		33	36	11			18						
	Milford Haven (Pembroke)	Pembroke Cracking Co (65% Texaco, 35% Gulf Oil GB)	Texaco (65%), Gulf Oil GB (35%)				90					33			21					x	
	Pembroke Dyfed	Texaco Ltd	Texaco (100%)	180	91	26		39		34	39										
	European Union Total			12999	4858	1534	2040	2000	656	2123	4998	224	36	153	435	158	47	2	9	1	404

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

European Union and other Western Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by	Beneficial Ownership	Crude cap.	Vacuum cap.	Thermal	Cat. crack	Cat. reform	Cat. h/crack.	Cat. h/ref	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Norway	Mongstad	Statoil Division Mongstad		154			48	26		34	36		12		4				1		
Norway	Slagen	Esso Norge AS		100		30		12			71										
Norway	Sola	Norske Shell AS		53		18		11			29				4						
Switzerland	Collombey	Raffinene du Sud-Ouest SA		72				10	6		37				6						
Switzerland	Cressier	Raffinene de Cressier SA		60	24	20		16		27	35				4						5
	Western Europe (non-EU) Total:			439	24	68	48	75	6	61	208		12		18				1		5
	EU + Western Europe Total.			13438	4882	1602	2088	2075	663	2184	5205	224	47	153	453	158	47	2	9	1	409

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

Applicant States, and other Eastern Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by		Crude cap. (000s b/cd)	Vacuum cap	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack	Cat. h/ref	Cat h/treat	Alkylation	Pol./ Dim	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Cyprus	Lamaca	Cyprus Petroleum Refinery Ltd		26	3			5			11										1
Czech Republic	Kolin	Koramo Kolin														3					
	Kralupy	Kaucuk s p		67				8			34						2				
	Litinov	Chemopetrol a s		100	46			17	22		48				3			x			10
	Pardubice	Paramo A S		20	6											1					3
Hungary	Szazhalombatta	Mol Rt - Danube Refinery		161	78	14	24	30		38	45	3		7	3	4	1				6
	Tiszaujvaros	Mol Rt - Tiszai Refinery		61	33						14						1				
	Zalaegerszeg	Mol Rt - Zalai Refinery		10	6																5
Poland	Gdansk	Rafinena Gdanska S A		60	30			14			46					5					4
	Plock	Petrochemia		260	115		46	25			65	3		4			2				13
	refinenes at Czechowice,Gorli ce, Jaslo, Jedlicze, Trzebinia	Government-owned		32																	
Slovenia	Lendava	Nafte Lendava d o o		12														x			
	EU applicants group one Total			809	316	14	70	98	22	38	263	6		11	5	13	6				42
Bulgana	Refinenes at Burgas, Pleven, Ruse	Government of Bulgana		300																	
Lithuania	Mazeikia	Mazeikiai State Oil Refinery Nafta		240	80	31	41	24			125						1				8
Romania	Barcau	Petrolsub SA		8	5											x					3
	Campina	Steau Romania SA		9	6											x					1
	Darmanesti	Rafinana Darmanesti SA		33		9		3											x		
	Midia	Petromidia SA		110	44		24	12			70			5			1		1		
	Onesti	Rafo SA		87		11	23	24			79			7							
	Pitesti	Arpechim SA		70	40	11	19	12	2		31			2		1					3
	Ploiesti (Astra SA)	Astra SA		56	9					3						6		x	x		2

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

Applicant States, and other Eastern Europe

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by		Crude cap (000s b/cd)	Vacuum cap.	Thermal	Cat. crack	Cat reform.	Cat h/crack.	Cat h/ref.	Cat h/treat	Alkylation	Pol./ Dim	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Ploiesti (Petrobrazi SA)	Petrobrazi SA		69	39		21	13			19			2	1						
	Ploiesti (Petrotel SA)	Petrotel SA		104	56	6	21	11			44	2				3	1				4
	Ploiesti (Vega SA)	Vega SA		12	4						x										
Slovakia	Bratislava	Slovnaft, Joint Stock Co		115	53			22	17		75		5	3	6	3					9
	EU applicants group two Total			1214	337	68	149	122	19	3	444	2	5	18	7	14	3		3		29
Albania	Refinenes at Ballsh, Cernk, Stalin	Albanian government		40																	
Croatia	Rijeka	Ina d d Zagreb Rafinenja Rejeka		150	45	11	22	18			28			5	8	2					
	Sisak	Ina-Industnja Nafte d d Zagreb		143	16		10	19			24			12							
	Zagreb	Ina d d Rafinenja Zagreb		1												x					
Macedonia	Skopje	OKTA Crude Oil Refinery		51				11		21				3							
	Other Eastern Europe Total.			385	61	11	32	48		21	52			20	8	3					
	Applicants and other Eastern Europe Total			2408	714	93	251	269	41	62	758	9	5	50	20	30	8		3		71
	CIS Total			10101	3033	448	564	1197	50	9	3222	12	3	72	14	168	6	x	9	x	229

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

North Africa and Middle East

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by		Crude cap. (000s b/cd)	Vacuum cap.	Thermal	Cat. crack.	Cat. reform	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim.	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
Algeria	Ain Amenas	Sontrach		7																	
	Arzew	Sontrach		60	6			12			11					2					2
	Hassi Messaoud	Sontrach		30				2													
	Maison Carree	Sontrach		58				15			15										
	Skikda	Sontrach		310	9			30							2						3
Angola	Luanda	Fina Petroleos De Angola		32	2			2		3	4										1
Egypt	Alexandria	Amena Petroleum Refining Co		69	15			12		17	21	9		1		2					
	Alexandria (El-Mex)	Alexandria Petroleum Co		95	23						1			1		1					2
	Assiout	Assyout Petroleum Refining Co		44																	
	El-Suez (E-NPC)	El-Nasr Petroleum Co		99																	3
	El-Suez (SPPC)	Suez Petroleum Processing Co		63	10			13			29					1			1		
	Mostorod	Cairo Petroleum Refining Co		141				9			26										
	Tanta	Cairo Petroleum Refining Co		29																	
	Wadi-Feran	El-Nasr Petroleum Co		7																	
Libya	Azzawiya & Benghazi	Azzawiya Refining Co		120	8			13			37					1					3
	Brega	Sirte Oil Co		8				1			1										
	Ras Lanuf	Ras Lanuf Oil & Gas Processing Co		220																	
Morocco	Mohammedia	Samir		129	20			24			36					2					2
	Sidi Kacem	Ste Chemienne des Petroles		27	8		5	3			6										
	north Africa Total			1547	99		5	136		20	186	9		2	2	10			1		16
Abu Dhabi	Ruwais	Abu Dhabi National Oil Company		132	45			17	27		41										
	Umm Al-Nar 2	Abu Dhabi National Oil Company		81				13			75										
Bahrain	Sitra	Bahrain Petroleum Co		249	200	19	41	15	49		36		3								7
Brunei	Seria	Brunei Shell Petroleum Co Sdn Bhd		9				6													
Iran	Abadan	National Iranian Oil Co		400	80		30	26			26					2					1
	Arak	National Iranian Oil Co		150	71	27		22	25		22							x		x	6
	Isfahan	National Iranian Oil Co		265	119	38		30	30		30					10		x		x	6

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

North Africa and Middle East

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by		Crude cap (000s b/cd)	Vacuum cap	Thermal	Cat crack	Cat reform	Cat h/crack	Cat h/ref	Cat h/treat	Alkylation	Pol./ Dim	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Kermanshah	National Iranian Oil Co		30				3			6										
	Lavan Island	National Iranian Oil Co		20																	
	Shiraz	National Iranian Oil Co		40	18	9		6	9		10										2
	Tabriz	National Iranian Oil Co		112	50	17		11	18		24										5
	Tehran	National Iranian Oil Co		225	120	35		27	29		23					8		x		x	20
Iraq	Baiji	Oil Refineries Admin		150	65			39	38	100											
	Basra	Oil Refineries Admin		70	18											2					
	Daura	Oil Refineries Admin		100				5			13					8					2
	K3-Haditha	Oil Refineries Admin		7																	
	Khanaqin	Oil Refineries Admin		12																	
	Kirkuk	Iraqi Co for Oil Ops		2																	
	Mufthia	Oil Refineries Admin		5																	
	Qaiyarah Mosul	Oil Refineries Admin		2																	5
Jordan	Zerka	Jordan Petroleum Refinery		100	17		4	9	4		14							x			
Kuwait	Mina Abdulla	National Petroleum Co		255	137				38	96	79								2	1	
	Mina Al-Ahmadi	National Petroleum Co		415	82		28	34	36	125	110									1	
	Shuaiba	National Petroleum Co		154	107			14	82		81										
Lebanon	Sidon	Zahrani Oil Installations		18				3			3										
	Tripoli	Tripoli Oil Installations		20	13		7	4		7											x
Oman	Mina Al Fahal	Oman Refinery Co		85				16			20										
Qatar	Umm Said	National Oil Distribution Co		58				12			39				5						
Saudi Arabia	Al-Jubail	Petromin Shell		292	84	32		19	44	49	133			13							
	Jeddah	Saudi Arabian Oil Co (Saudi Aramco)		82	34		13	3	10		3										
	Rabigh	Saudi Arabian Oil Co (Saudi Aramco)		290							47							x			
	Ras Al Khafji	Arabian Oil Co Ltd		30																	
	Ras Tanura	Saudi Arabian Oil Co (Saudi Aramco)		300	135			54			54										
	Rihadh	Saudi Arabian Oil Co (Saudi Aramco)		140	52			36	34		50										
	Yanbu (SA)	Saudi Arabian Oil Co (Saudi Aramco)		190				35			50										
	Yanbu (SA-M)	Saudi Aramco-Mobil		332	142	46	91	47			167	24			33		2				
Turkey	Aliaga-Izmir	Turkish Petroleum Refineries Corp		226	79	20	15	10	17		47					6					5
	Batman, Siirt	Turkish Petroleum Refineries Corp		22	2	5		1			1										3
	Izmit	Turkish Petroleum Refineries Corp		226	88		23	21	23	27	129				5						9

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

North Africa and Middle East

Inventory of Refining Capacity, 000s b/cd, as at 1/1/97

Country	Refinery	Owned by		Crude cap (000s b/cd)	Vacuum cap.	Thermal	Cat. crack.	Cat. reform.	Cat. h/crack.	Cat. h/ref.	Cat h/treat	Alkylation	Pol./ Dim	Aromatics	Isomerization	Lubes	Oxygenates	Hydrogen	Coke	Sulphur	Asphalt
	Kırıkkale	Turkish Petroleum Refineries Corp		113	30			20	15		35										6
	Mersin	Anadolu Tasfiyehanesi AS		95				13		9	20										
	Middle East Total			5503	1788	247	252	569	527	413	1387	24	3	13	43	36	2	1	2	3	76

Source Oil and Gas Journal / RB Analysis
Note 000s barrels per calendar day at 1/1/97

5. Hidden incentives and exit barriers

Hidden incentives for refining operations exist across the whole of the European Community on a national, regional, or even individual basis. Apart from straightforward subsidies, examples of hidden subsidy include:

- aid grants for R&D
- concessional financing
- special tax treatment of profits or investments
- special treatment of depreciation costs, write-down timescales, and other accounting measures
- transfer pricing regulations, including geographic transfer of tax liabilities
- favourable land deals
- sponsored worker training
- infrastructure building
- abatement of environmental regulations
- subsidies for electricity from cogeneration plants

In addition, there are also hidden exit barriers. One example is linking of continued operation of a refinery to local or national concessions or permits relating to other parts of the company's operations. In the past this may also have extended to upstream exploration and production concessions.

Hidden subsidies are, by their nature, difficult to uncover. Nevertheless, it is in the Community's interest to eliminate as many of them as possible.

6. Capacity Creep

6.1. An overview

What is capacity creep?

This could be defined in many different ways. For the purpose of this report the following is proposed:

"Capacity creep is the growth of refining capacity, other than due to new units, which arises from the technical learning curve that applies to all industries, and which growth probably does not appear in the published statistics of industry capacity"

Is it important?

Yes, it can lead to misunderstandings on the true capacity of the industry and of the level of utilisation of that capacity.

More significantly, it can influence perceptions of when high capacity utilisation might lead to prospects for improved profitability.

How is capacity defined?

The most common way of defining capacity in refining is to define the ***Intake Capacity of the crude oil distiller.*** This is often called the ***Nameplate*** capacity of the refinery. The distiller is the first processing unit in the refinery and separates the crude oil into its constituent parts for further processing. The most common unit of intake capacity in industry statistics is the ***volume*** measure of:

"barrels per calendar day", normally abbreviated to bbl/cd, b/cd or BCD

At country or European Union level, intake statistics are normally given in weight, not volume. The weight measure is normally tonnes. More on definitions in 3.6.2 below.

Is this capacity a precise measure?

Unfortunately not! And herein lies a major source of the confusion that often arises.

Paragraph 6.3 below gives more detail on the many factors influencing an understanding of "What is Capacity". As will be noted, "capacity" can vary significantly depending on the crude oil and feedstocks being processed and on the processing conditions adopted.

Is the capacity stable over time, within a range?

Again, unfortunately not. This appendix gives an understanding of the most important components of Technical Learning Curve in the refining industry. Opinions on the magnitude of this capacity creep on an EU-wide basis are typically in the range 0.5 to 1-2% per annum.

6.2. More on definitions

What is capacity creep?

As outlined above, for the purpose of this project the following definition is used:

> *"Capacity creep is the growth of refining capacity, other than due to new units, which arises from the technical learning curve that applies to all industries, and which growth probably does not appear in the published statistics of industry capacity."*

There could be many other definitions. The Financial Times has adopted the following:

> *"The slow but measurable process whereby technical modification and debottlenecking carried out on refineries increase the de facto capacity of the refinery without changing the nameplate capacity of the unit. Results in an overstatement of capacity utilisation."*

Report COM(96)143 EN adopted:

> *"An industry term used to describe the slow but steady expansion of actual capacity compared to the nominal capacity of plant that normally comes about as a result of ongoing improvements made by operators to plant, for example by way of the removal of debottlenecks in the flow of process liquids, etc."*

Whatever definition is adopted the important points to note are that:

- this is a process found in all industries, which benefits the industry and ultimately the consumer by making available low cost incremental capacity
- although capacity creep is measurable in principle, in practice it is unlikely to be measured! Thus, it is unlikely that much of the increase will be found in statistics
- the cumulative effects of capacity creep, at company, country and EU Union levels, are significant

Are there different types of capacity creep?

Yes, the IEA and some others have found it helpful to consider two categories (Other categorisations are possible):

- "Soft" creep, arising from management processes such as shorter shutdowns, streamlining operations (e.g. single crude operation), IT improvements etc. This type of creep is not readily captured in published numbers.

- "Hard" creep, arising from changing equipment, adding new capacity etc. This type of creep is more likely to be captured in statistics, probably with a delay.

For the purpose of this project creep has not been categorised, as those whom we have interviewed have expressed their estimates in overall terms.

What refinery units does it apply to?

Capacity creep is usually referred to in the context of distilling units. Note that 'distilling units normally means '*Atmospheric Distillation*'. Vacuum distillation, a subsequent process in most refineries, is not included. The logic for this is that, at the level of government and the IEA the call on available distillation capacity is of primary importance.

Note, though, that capacity creep, driven by the technical learning curve, will apply to all refinery units, including for example product blending capability and jetties. It is significant for secondary units if the capacity of those units becomes limiting. This could be caused be tighter environmental legislation, which puts pressure on secondary capacity.

Where do new units fit in?

New units are not included in the definition. A grey area may arise when a new unit replaces an old unit that is shutdown. The new unit will incorporate technical advances and may well be of higher capacity than the old. This net increase may not be made visible. This is unlikely to be a significant factor with distillers, in that few are being built in a situation of overcapacity and low margins.

However in any consideration of capacity creep in secondary units, for example new hydrodesulphurisers driven by environmental legislation, much greater care is needed. Further, although any new unit may be designed tightly to its nameplate capacity in practice small improvements can invariably be achieved once the unit is on stream.

Intake capacity

As above, the normal unit of intake is *barrels per calendar day*.

The "barrel" is a historical convention from the times when oil was literally shipped in barrels. A barrel is defined as a US barrel of 34.9726 Imperial Gallons or 158.984 Litres. There is no confusion here.

"Per calendar day", when multiplied by 365 days, obviously gives a figure for the annual intake capacity.

Confusion can arise with "barrels per *stream* day", as specific circumstances will decide how many days in any year any given distiller will be on stream. More on this below.

Where a weight measure is used, typically at country and EU Union level, this will normally be in millions or thousands of metric tons, each of 1000kg, and also referred to as a tonne.

Whether the capacity is defined per calendar or stream day, or in volume or weight, the fundamental point remains that the definition of capacity depends on several important underlying assumptions each of which is judgmental. There is no right or wrong answer.

6.3. What factors inflence capacity?

Number of days on stream

The distiller will have a capacity, each day, to intake so many barrels of crude (barrels per stream day; bbl/sd). The annual capacity is, of course, the daily intake times the number of days the unit is on stream. The number of stream days available will depend on many factors, the main one being the number of shutdown days required for scheduled and unscheduled maintenance work.

Actual crude diet

The processing configuration of the distiller is defined when the unit is designed and built. The configuration of a distiller is, in itself, complex. Crude oils have a very wide variation in the proportions of their constituent components. Taken together this results in any given distiller having widely varying intake capacities, depending on the crude being processed. For example, a distiller able to handle 120,000 bbl/sd of say Brent crude may be able to handle only say 90,000 bbl/sd of a heavier crude at full capacity.

Assumptions about density of crude intake

Statistics at country level are normally in millions of tonnes per year. To convert from the ***volume*** measure of barrels to the ***weight*** measure of tonnes requires the number of barrels to be multiplied by the density, expressed as weight per unit volume.

This density could be as actually measured over the year in the individual refineries. In practice it will be an assumed or deemed number. The density will vary significantly, dependent on the assumptions made about the typical crude diet of the refinery or company. For example UK crudes have an 'average' density of 0.836 and those of Venezuela 0.913, a difference of 9%. (Source: IEA). There are much wider differences between individual crudes.

Intake or output?

Perhaps illogically, confusion can sometimes occur between intake and output. In the conventions of the oil industry the fuel required by the distiller to process the crude oil is taken from the output. In other words 100 tonnes of input will give about 98 tonnes of output from the distiller. Over the whole refinery 100 tonnes of intake will typically produce between 92-97 tonnes of output depending on processing complexity.

Refining is more than a distiller

A refinery is a highly complex factory. At a constant intake level on the distiller, but with different crude oils being processed, the output of key products can be varied widely. After the distiller there are multiple secondary processing units. This is followed by sophisticated component blending capabilities to produced the finished products, motor gasoline, diesel, jet fuel and gasoil in particular.

This complex frequently has the ability to take in feedstocks and blending components ***after*** the distiller. In addition, by changing operating conditions, there is capability to vary the ***output*** of the key products widely.

Taken all together this can mean a variation of say +/-20% of main products output while the distiller maintains a constant intake expressed in bbl/sd. Conversely, for any given demand the capacity of the distiller will vary widely depending on the feedstocks and processing route chosen.

Is the industry reporting "accurate" figures?

In general terms the answer is yes. However for the reasons above there cannot be any single 'mathematically correct' definition of capacity. The variation, depending on the underlying assumptions taken, could be +/-5%; significant at the EU level.

The industry has sophisticated sets of data covering the intake capacity and typical yields for a wide variety of crude oils. In providing data within their own organisation, and to governments and the IEA, companies will take a view on the appropriate average. The release of data to journals may not be given the same attention; further, there may be commercial competitive reasons not to be too precise to the outside world on the available capacity of any given refinery.

In practice, over the industry and over a year, and with available crudes and feedstocks, the variations from all the factors will be less than the range on a daily basis, but could well be +/-5% of nameplate capacity. With a refinery distillation

capacity in the European Union of 600 to 650 million tonnes this is significant, and sufficient to cause difficulty in understanding statistics.

6.4. Technical learning curve in refining

Major overhauls

All refinery units require shutting down for periodic major overhaul. For distillers the period is typically every three to four years. Advances in materials sciences, non-destructive on-line inspection and other techniques enable the refiner to extend the period between major overhauls. Some advanced companies are at a five-year cycle. This represents a significant increase of available capacity.

In addition, there is a continuing trend for the time that it takes to complete a major overhaul to be shorter. Here the main factors are those mentioned above, improved shutdown planning and advances in design. Advances in design enable major items of equipment to be isolated and worked on while the unit is on-stream, with lower net loss of capacity.

On-stream factor

With high fixed costs all refiners have an incentive to strive for improved on-stream availability. There are two components of on-stream availability *between* major shutdowns. Firstly the number of unplanned shutdowns, secondly the reduction of available capacity while the unit remains on stream. Both will arise from unforeseen equipment difficulties. Technical and management process improvements result in a steady improvement in available capacity. Other gains arise from the sparing of less reliable equipment, such as pumps and heat exchangers.

Technological learning curve

There is a wide range of research activities, which work through to significant debottlenecking of installed capacity. For distillers, the most significant are advances in the design of the trays installed in the columns to separate the fractions. Gains here can be spectacular, at may tens of percent. Other minor advances, taken together, can be significant in total.

Information technology, advanced process control, on-line optimisers and sophisticated supervisory systems all work towards maximising the output of valuable products from the distiller, increasing their production from any given intake of crude oil. This is a source of significant capacity increase.

Economics & Scheduling activities

A further component of capacity creep may arise from the ability to increase capacity for a short time. This can be by moving a major shutdown from a period of high demand to one of lower demand when the loss of required capacity is lower. Further, throughputs above nameplate, but at a lower overall operating efficiency, can be profitable in periods of rapidly moving prices.

Likewise, when capacity becomes limiting, or the need for an expensive major debottleneck is looming, the attention of management, technologists and E&S specialists focuses on novel and cost effective ways to remove the constraint, accelerating capacity creep.

It should be recognised that the rate of capacity creep will have boundaries to its range, limited by the rate of technical learning that underpins it.

6.5. Capacity utilisation

As will be clear, any work to define capacity utilisation, based on supply/demand balances, will have to take into account all the points made. Assumptions will have to be made on each.

At best, it will be possible to make an informed estimate. This can give rise to misunderstandings of the actual capacity utilisation and of future trends.

These considerations are important whether the rate of demand increase is low or high.

If the rate of demand growth is low relative to the rate of growth of capacity in the form of capacity creep then the under-utilisation will increase.

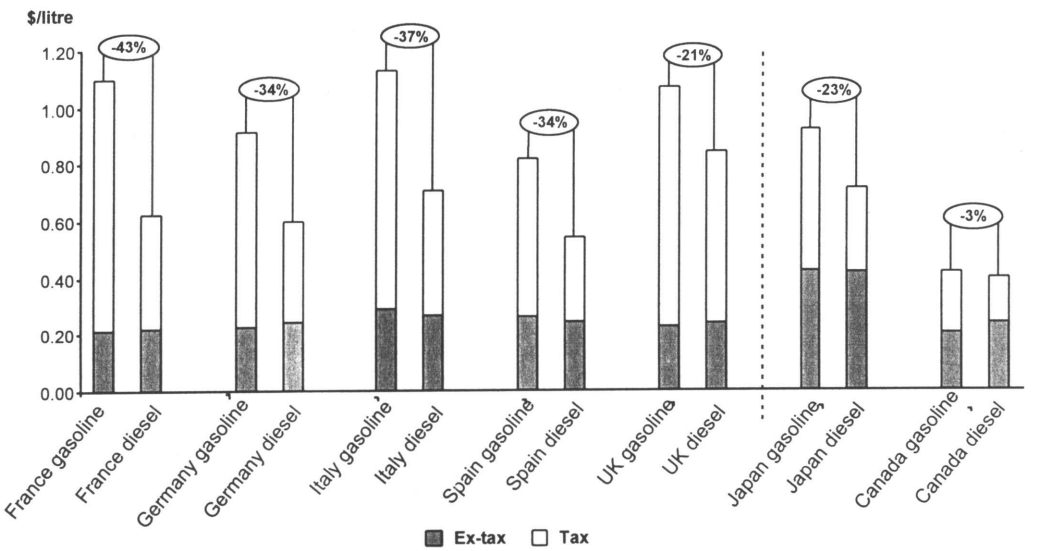
If the rate of demand growth is high (probably for a specific product such as diesel) or new specifications have to be met, then all the talents of the industry will focus on finding cost-effective ways of meeting these demands. The rate of capacity creep will then accelerate sharply.

7. Taxation on Transport Fuels

7.1. The Effect of Taxation on Gasoline and Diesel Demand

In Europe the tax incentives offered for diesel are greater than those found elsewhere in the world.

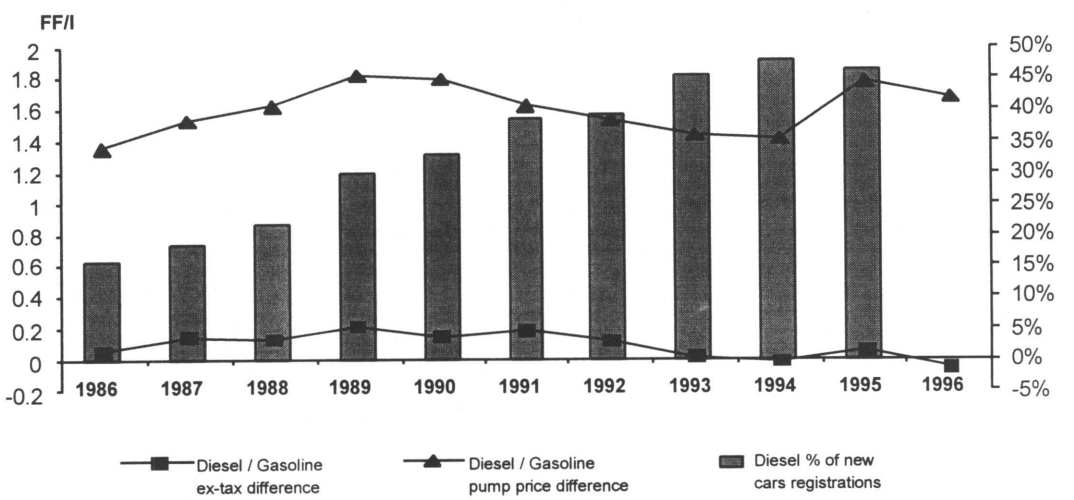
Worldwide Gasoline and Diesel End-User Prices



Figures for June 1997; Source: IEA

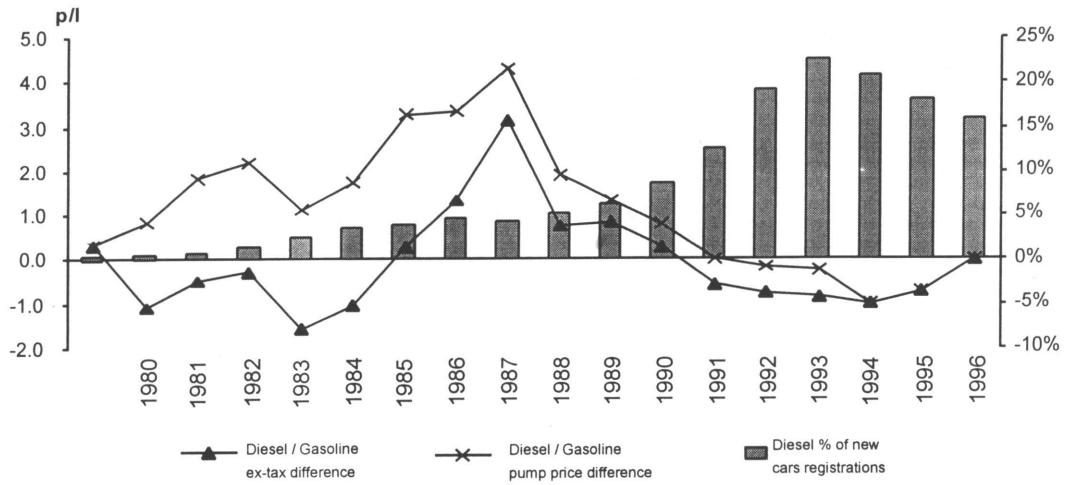
In France where diesel has had a sustained tax advantage, the new registration share of diesel vehicles has grown fast to reach 47% in 1995.

French diesel market evolution



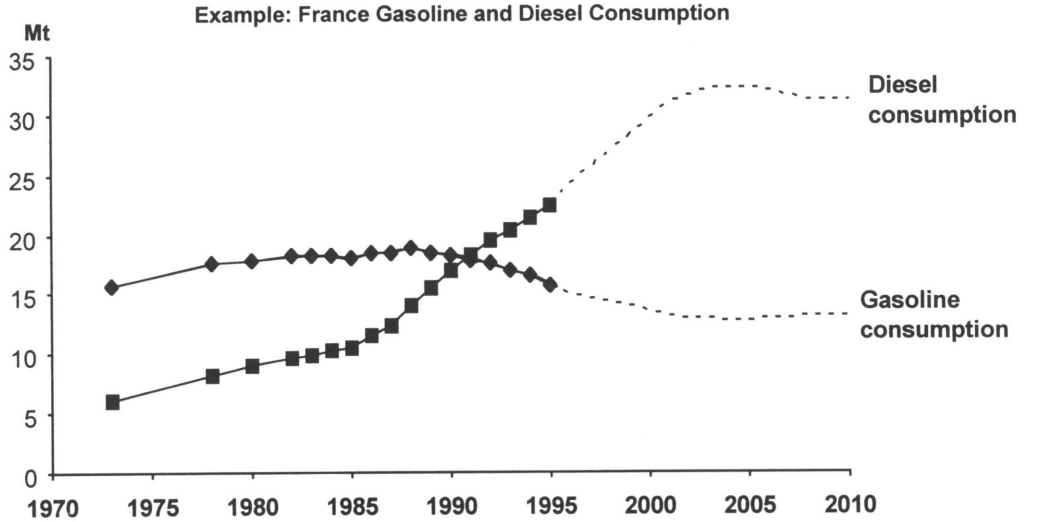
The UK example shows no direct correlation between the level of tax difference and the relative growth of diesel registrations. There is therefore no easy solution to the mogas / diesel problem without major reverse discrimination.

UK diesel market development

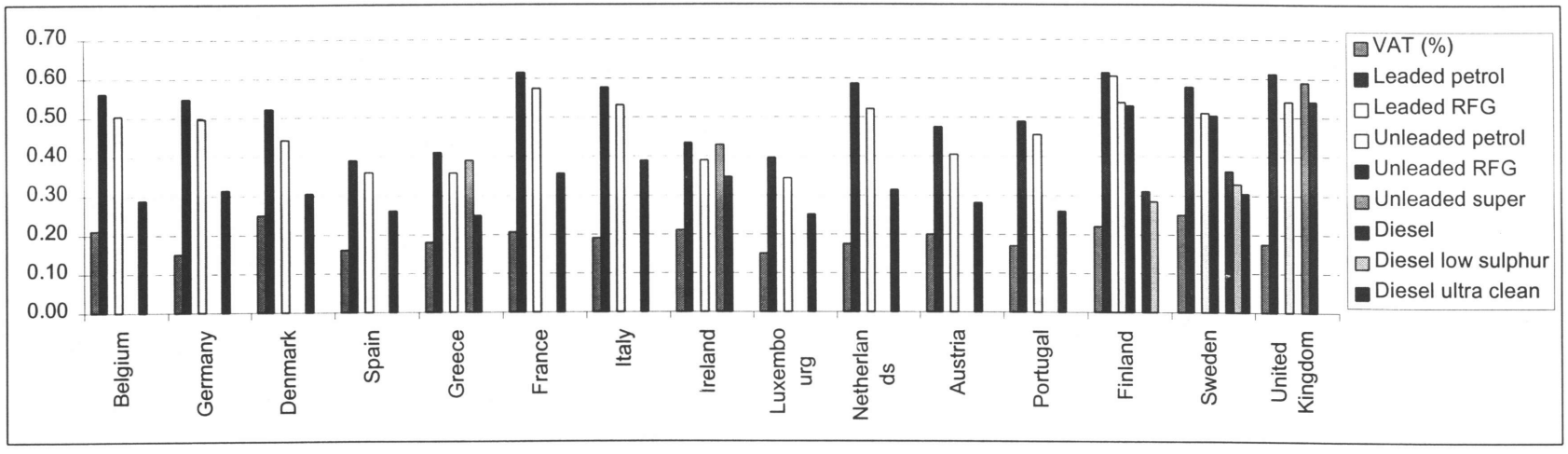


Even if there is no further increase in the % of diesel car registrations the imbalance will increase in the medium term.

Example: France Gasoline and Diesel Consumption



7.2. Excise Duty Rates in EU Countries



Country		Belgium	Germany	Denmark	Spain	Greece	France	Italy	Ireland	Luxembourg	Netherlands	Austria	Portugal	Finland	Sweden	United Kingdom
VAT	VAT (%)	21%	15%	25%	16%	18%	21%	19%	21%	15%	18%	20%	17%	22%	25%	18%
Excise duty in ECU	Leaded petrol	0.56	0.55	0.52	0.39	0.41	0.61	0.58	0.43	0.40	0.59	0.48	0.49	0.61	0.58	0.61
	Leaded RFG													0.61		
	Unleaded petrol	0.50	0.50	0.44	0.36	0.36	0.57	0.53	0.39	0.34	0.52	0.40	0.46	0.54	0.51	0.54
	Unleaded RFG													0.53	0.50	
	Unleaded super					0.39			0.43							0.59
	Diesel	0.29	0.31	0.31	0.26	0.25	0.36	0.39	0.35	0.25	0.31	0.28	0.26	0.31	0.36	0.54
	Diesel low sulphur													0.28	0.33	
	Diesel ultra clean														0.30	

8. European Fuel Specifications - 1987 to 2005

	1	2	3	4	5	6	7	8
				2000 - EC Dir 96/163			2005	
				European Commission 6/96	Parliament, Values 4/97	Council, "Common position" 6/97	Parliament, Values 4/97	Council, "Indicative values" 6/97
Mogas, ULG 95 EN228	**1987**	**4/91**	**1/95**					
Sulphur ppm	1,000	>	500	200	30	150		50
Benzene % vol	5	>	>	2	1	1		
Aromatics % vol	–	–	–	45	35	42	30	35
Lead ppm m/v	130	130	130	50	50	50		
Diesel, EN590	**1987**	**1994**	**10/96**					
Sulphur ppm	3,000	2,000	500	350	50/100	350	50	50
Cetane number	49	>	>	51	52	51	58	
Density g/litre	890	860	>	845	837	845	825	
Distillation 95% at °C	370	>	>	360	350	360	340	
Polycyclic aromatics %m/m	–	–	–	11	6	11	1	
Costs, NPV ECU billion			**6.3 - 8.3**	**11.5**	**?**	**20**	**± 60**	**± 45**

9. Costs of Refinery Closures

The cost of refinery closures has been estimated at ECU 50m to ECU 200m per refinery.

Aspects of closure include:

- Gas freeing
- Dismantling of plant
- Cleaning of process plant
- General demolition expenses
- Site clean-up costs
- Redundancy costs

A number of factors influence the site clean-up cost:

- Size of refinery
- Complexity of refinery
- Type of crude run
- Age of refinery
- Location, including
  - Type of soil
  - National remediation standards applicable
  - Intended use after clean-up
  - Water-courses and other sensitive environment surroundings

Site clean-up costs can in some cases exceed ECU 100 million, but average about ECU 60 million. Redundancy and staff redeployment costs are the next largest item - averaging around ECU 40m for a refinery with 250 employees.

10. Interviews

Agip
BP
Cepsa
Concawe
Conoco
Elf Aquitaine
EuroPIA
Exxon
Holborn refinery
IEA
Institut Francais du Petrole
KBC
KPI
Mobil
Motor Oil Hellas
MWV
Neste
OMV
Petrofina
Petrogal
Repsol
RWE / DEA
SARAS
Shell
Statoil
Texaco
Total
UOP
UPEI
Wintershall

Danish government
Dutch government
European Commission, DG IV
Finnish government
French government
German government
Irish government
Italian government
Spanish government
UK government

11. Briefing Document for Interviewers

What is current position?

- What are the fundamental causes of low INDUSTRY refining profitability?
- What is your assessment of the industry's profitability and (in confidence) your own?
- What would be a an acceptable/desirable level of profitability?
- What is going to change and what does this mean for future profitability?

Motivation and rationale

- Does low industry profitability matter and why?
- Why has it not been self-correcting?
- Why do existing players continue to take the pain of poor profitability?

Impact of marketing

- What developments in marketing are impacting on refining and how?
- What is the impact on the industry of oil products becoming increasingly a commodity?
- How has/will the imbalance between gasoline and diesel impact on refining profitability?
- Will the introduction of the Euro have any effect?

Shareholder pressures

- Why is shareholder value for refining apparently not a sufficiently sensitive stockmarket issue?
- Why are refining and marketing not decoupled to highlight poor profitability?

Company strategies

- How does your company's strategy for refining differ from competitors'?
- What key factors influence your views on closing own capacity?
- How important is the growing presence of oil producing countries to refining in the EU?
- How do you expect your own Company strategies to impact on profitability in refining?

Government actions

- Are EU/Government policies distorting refining profitability and if so how?
- How do tightening environmental standards really affect the refining industry?
- How would it help the industry to have a level playing field on energy taxes?
- What is the "Security of Supply" issue and how important is it to have indigenous capacity?

What should now be done?

- What can we learn from other industries experience?
- What Industry/EROPIA/Company mechanisms or strategies would improve and sustain INDUSTRY profitability
- What EU/Government mechanisms or strategies would improve and sustain INDUSTRY profitability?
- What are the obstacles to mergers?

Next steps

- What are the top 5 actions you believe RB & P should recommend to the Commission?
- May we come back to you to test the thoughts/proposals arising from our evaluation?

12. Bibliography

The following lists indicates the main publications referred to during the course of the study.

Challenges for Oil Refining - Meeting new fuel specifications and emissions legislation, Jane Wiltshire, 1996, *Financial Times Energy Publishing*

Energy Statistics of OECD Countries, 1994-1995, *IEA*

Energy Balances of OECD Countries, 1994-1995, *IEA*

Energy Statistics and Balances of Non OECD Countries, various issues, *IEA*

Working Document of the Commission on Report on the Situation of Oil Supply, Refining and Markets in the European Community, *European Commission*

Energy in Europe, European Energy to 2020, *European Commission, Dirctorate General for Energy (DG XVII)*

An Energy Policy for the European Union, *White Paper of the European Commission*

Eurostat (*EU Transport in Figures – Statistical Pocketbook, Eurostat / European Commission DGXVII*

European Oil Refining - Strategies for a Competitive Future, James MacDonald, 1997, *Financial Times Energy Publishing*

Oil Information (1996 and earlier issues), *IEA*

Various issues, *Official Journal of the European Communities*

Various publications, Concawe

The World of Oil and Gas, September 1997, *UBS*

In addition the information resources of the Insitute of Petroleum, London, were extensively referred to.