

# HYDROCARBON ENGINEERING

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*It's a new game for EU  
hydrocarbon refiners*



# THE CHANGING GAME

COVER STORY

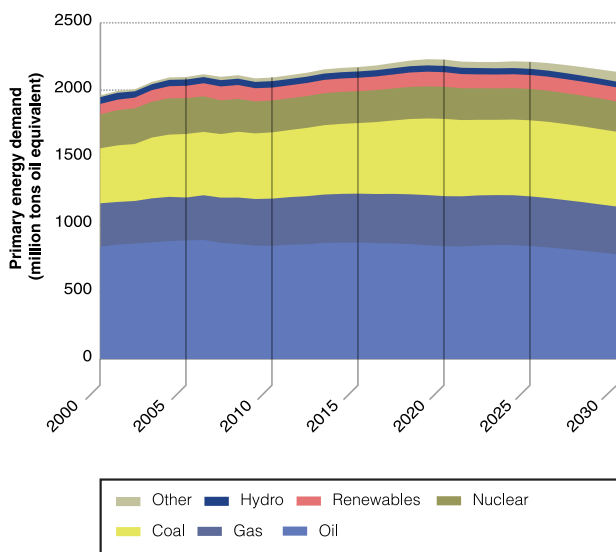




**Richard DeSantis, Sabin Metal Corp., USA, analyses how under utilisation, and over capacity and profit pressures are presenting new challenges and opportunities to European Refiners.**

**H**ydrocarbon and petrochemical refining represent a major sector of the EU economy, accounting for as much as 1.5% of the EU GDP<sup>1</sup> (US\$ 16 trillion total, approximately 26% of the world economy). In round numbers, approximately 100 EU crude oil refiners (including those in Switzerland and Norway) produce 90% of transport energy fuel for the EU and 77% of the feedstock for petrochemical processing.<sup>2</sup> This represents nearly 715 million tpy of refining capacity. EU hydrocarbon processors contribute approximately 18% of global capacity and import 82% of their crude, nearly half of this from the Middle East.

As to the industry's impact on European jobs, consider that EU refiners directly employ more than 100 000 people; with over 50 000 people employed in 'indirect' jobs in the industry, and perhaps

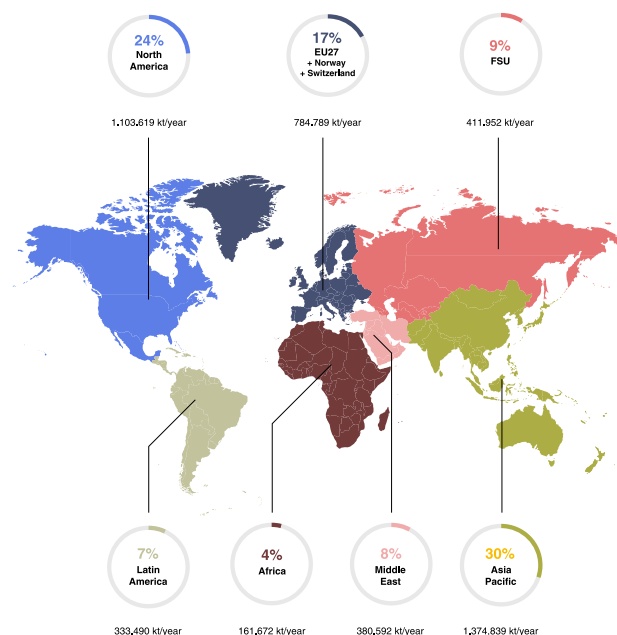


**Figure 1.** European primary energy demands (source: PFC Energy).

500 000 people working in associated industries in areas such as technical, logistics, sales and marketing.<sup>3</sup> Furthermore, as is the case with most industries, crude oil refining also supports jobs that provide services and equipment such as engineering, production and capital equipment, building, and other infrastructures. Oil refining and distribution in the EU provide approximately € 240 billion /y in duties and taxes from fuel sales alone. Now, after years of growth, the three or four dozen organisations that operate these refineries face a paradigm shift looking forward, with many new challenges in uncharted territory. There are many reasons for this, some of which were predictable and some not. For example, public and government attitudes in most industrialised nations with regard to energy reduction in general, and consumption of fossil fuels in particular, will ultimately have a negative impact on the EU refining industry. Looking ahead, many EU refiners will get squeezed by over capacity, under utilisation and increasing costs that will cut deeply into margins and profits. This trend actually began a few years ago and is expected to continue for the foreseeable future.<sup>2</sup> In fact, based on current trends, it is widely believed that demand for many hydrocarbon based refined products could drop as much as 20% in the next two decades (compared to 2006)<sup>2</sup> (Figure 1).

### Europe's energy stability

With the current global geopolitical instability, maintaining EU refiners' ability to meet domestic demand for refined oil products has vital security, economic, industrial and environmental implications. The region's independent refining system must be capable of ensuring a reliable supply of hydrocarbon and petroleum based products both to EU refineries and other industries dependent upon them. The following recent production statistics offer a useful background on the issue. EU refineries' total production includes over 50% diesel fuel, which in turn includes transport fuel (vehicles and vessels), as well as heating and industrial fuels. They also produce 22% gasoline. Approximately 15% of fuel utilised for power generation is produced by EU refineries, with smaller portions of lubricants, naphtha, kerosene, LPG, aromatics, sulfur (for fertiliser) and miscellaneous byproducts. The EU refining industry also provides feedstock materials for the European petrochemical



**Figure 2.** Global refining capacity at the end of 2009 (source: PFC Energy).

sector, representing approximately € 241 billion /y and supporting employment for over 780 000 people.<sup>4</sup> Crude oil refining is closely integrated with petrochemicals, which contribute to a major and broad based European economy.

The impact of a global economic downturn has affected EU refineries with regards to the continuing trend of declining usage of hydrocarbon and petrochemical products in most industrialised nations. A number of factors could potentially influence the future of EU refining.

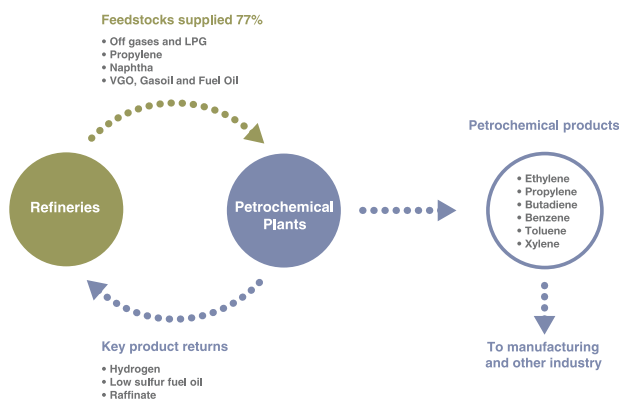
### Challenges

In addition to global geopolitical and economic instability, other future challenges facing EU refiners include imposition of stricter emission standards, unstable foreign oil producing governments, competition from Middle East and Indian refiners, terrorism threats, and rising costs that result in lower margins and lower profits.

### Environmental regulations

With regard to refinery emissions standards, new and more stringent environmental regulations are also adding downward pressure on EU refiners' profitability. Even now, stricter emissions standards have forced many EU refiners to invest significant funds for compliance. As much as US\$ 18 billion will be spent in this decade to comply with the new and/or proposed EU standards.<sup>2</sup> This, on top of the fact that European refiners have already invested significant resources in order to meet some of the world's most stringent air/water quality and soil protection rules. One positive result: the amount of sulfur emitted by EU refineries has been cut in half since 1998, according to PFC Energy and the EU.

The EU refining industry is directly affected by many EU policies towards reducing emissions of various pollutants and greenhouse gases, reducing overall energy consumption, supporting energy security, and boosting renewable energy sources and technologies. None of these factors is particularly optimistic for the industry.



**Figure 3.** Feedstock exchange between refineries and petrochemical plants (source: CEFIC European Chemical Energy Council).

With regards to the aforementioned ‘paradigm shift’, it is worth noting that based on current trends and predictions, demand for various types of refined products might drop by as much as 20% by 2030 compared to 2006.<sup>2</sup> Currently, EU refiners export their gasoline mainly to the US; however, by 2030 the US market may not be able to absorb as much of this gasoline.<sup>3</sup>

Also, for the balance of this decade, the combined EU demand for diesel and heating oil is forecast to remain flat while gasoline demand could fall by 2 – 3% /y. As a result, European refiners must seek other export markets to replace the US market to absorb a probable gasoline surplus.

There is also the trend towards reducing fossil fuel consumption with renewable energy projects for transport; no doubt this will worsen Europe’s existing gasoline over capacity as well. The US, the EU and many other countries have been promoting use of biofuels for transport. Biofuel consumption is expected to more than double by 2030<sup>4</sup> Many countries have also slowed oil consumption through increased use of ethanol in gasoline; this trend is further impacting the structural imbalance of the EU market for refined oil products. Another factor that may have a negative impact on EU refiners’ volume includes new fuel efficiency standards, which have been (or soon will be) introduced in many industrialised nations.

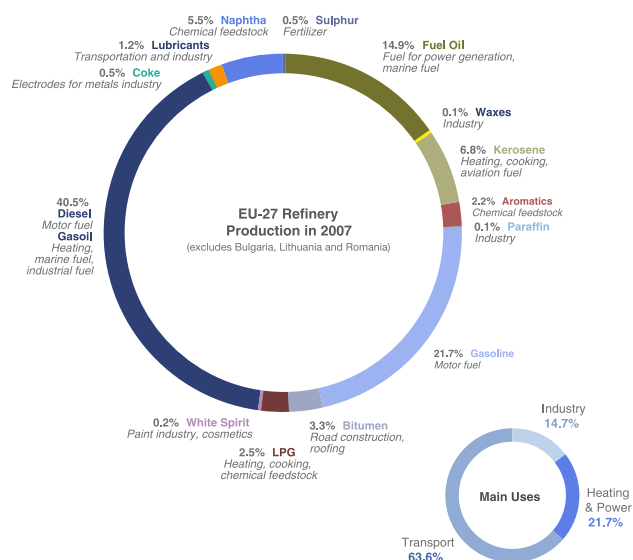
### Dealing with decreased profitability

While there’s nothing new about global competition in the oil business, as costs for oil rise, and logistics of moving crude and its byproducts become more complex and more expensive, EU refineries may also be faced with new, aggressive competition.

During the mid 1990s, EU refineries’ margins were above historical average; however, profitability has started to decline based on foreign demand from other sources. Capacity utilisation dropped by more than 8% compared to recent years and by 6% in 2009 from the year before. Even with a stronger economy and a significant industrial rebound, margins are likely to remain under pressure, thus profitability during the next 10 years will be a challenge. Also, North Sea crude production, which represents 30% of EU refineries’ supply, is expected to drop to approximately 15% of the EU’s crude imports by 2020.

### Foreign competition

In addition to Middle Eastern and Indian refineries, competition from



**Figure 4.** Refined products from EU refineries and their uses (source IEA).

other foreign, non-member state refiners will also negatively affect EU refineries in the years ahead, as these ‘foreign’ refineries add capacity and enter the Eurozone at the refining level. For example, the Russian government encourages export of refined oil products over crude exports; as a result this had led to integrated Russian refiners processing crude and exporting large volumes of gasoil and fuel oil into European markets. In fact, some international oil companies have reduced their refining capacity in Europe, despite growth of some independent refiners there (Figure 2).

Consider, for example, that some Central Eastern European refineries are located close to Eastern EU member states. This logistics proximity offers convenient markets for fuel imports from countries where there is less pressure from environmental legislation, in contrast to the EU producing countries. Other logistical issues include EU refineries sourcing crude oil from outside of EU member states, which could represent greater transport risks. These refiners may face reliability issues tied to pipeline links from Russia and the Caspian Sea, or shipping from Russia’s Baltic ports and through the congested Bosphorus Straits. Also, suppliers in Russia and Kazakhstan are planning pipelines to the East and may instead prefer shipping crude to Asia.

### Impact of global and regional forces

The future of EU refining will be shaped by a complex and challenging interplay of global and regional forces. EU refining is exposed to international competition as it operates between two global, open and transparent markets for crude and its byproducts. The EU refining industry will also have to adapt to decreasing demand and lower utilisation rates.

It goes without saying that there is a direct relationship between the hydrocarbon processing and chemical processing industries. According to the European Chemical Industry Council (CEFIC), in 2007 the EU region accounted for nearly 30% of global chemical sales of € 1820 billion, and was second only to the Asia Pacific region (Figure 3). Of these sales, nearly 45% accounted for base chemicals or petrochemicals and their respective derivatives; as a result, this sector represents € 241 billion in sales and employs

an estimated 778 000 people.

EU refineries typically produce hydrogen, low sulfur fuel oil, and raffinate; petrochemical plants also produce ethylene, propylene, butadiene, benzene, toluene and xylene from EU refineries' feedstock, which are used in other manufacturing processes. Refineries typically supply approximately 77% of the feedstock for off gases and LPG, propylene, naphtha, and vacuum gas oil (VGO), gasoil and fuel oil (Figure 4).

## Legislative outcomes

Another issue to consider is compliance with future EU regulations for new specifications and new biofuels, which will require considerable long term investments and commitments along with the financial capacities to support these investments. To that end, EU refiners must work closely with lawmakers in order to develop practical economic solutions for the years ahead. It is likely that this will require many new and uniform laws throughout the EU community.

While the demand for fuel oil is expected to remain flat for the foreseeable future, with lower expectations all the way out to 2050,<sup>3</sup> in reality the 'transition to a lower carbon economy will not happen overnight', according to the European Petroleum Industry Association (EUROPIA), adding that the industry will 'rely

on conventional energy, including oil, along the way'. Commenting on its position with regard to policy and legislation allowing the EU refining industry to 'play a vital role' while supporting economical activity and enabling the transition to a lower carbon economy, the organisation also points out that it is in Europe's best interest that the EU refining industry 'is not pushed into an irreversible decline'.

## Meeting these challenges

A June 2011 white paper published by EUROPIA offered clear direction on how its refiner members could meet the challenges ahead. In its summary of policy recommendations, the white paper suggests that EU policy makers and EU member states should 'design a policy and legislative framework that enables [the industry] to continue to play a vital role in supporting economic activity' while simultaneously 'enabling the transition to a lower carbon economy'.

The document puts forth specific suggestions, which include legislative proposals that consider 'an international and competitive context and which are based upon comprehensive, rigorous impact assessments; the optimum use of existing infrastructures, equal energy taxation in direct proportion to energy content and based upon CO<sub>2</sub> emitted when the product is consumed; more investment in research and development to work towards commercialisation of advanced technologies, and other positive suggestions'.

Even in the most advanced scenario, the International Energy Agency (IEA) projects that refined oil products will still account for 80% of transport fuels in Europe by 2030, and more than a third of EU energy demand by that time as well <sup>2</sup> (Figure 5).

Looking forward, there will always be strong demand for EU crude oil products, whether from the discovery of new uses for its refined products, 'turnabout' growth in demand from existing users, or new markets in emerging nations. Additionally, there is always the possibility of market expansion caused by global supply instability from major producers in the Middle East, Africa and Latin America.

## The rule of precious metals

Virtually all EU refiners use catalysts containing platinum group metals (PGMs) to facilitate and/or speed chemical reactions, and for end of pipe pollution abatement. PGMs are comprised of platinum, palladium, ruthenium and rhodium. Costs for these metals are extremely high (platinum at the time of publication was US\$ 1628 /tr. oz.; and the price for palladium was US\$ 651 /tr. oz.). In many instances, rhenium (also expensive at US\$ 4500 /tr. oz.), while not considered a PGM, may also be present in spent hydrocarbon processing catalysts.

Once hydrocarbon processing catalysts lose their efficacy, they must be sent to a precious metals refiner for recovery and refining. It is not uncommon that a

## the white paper

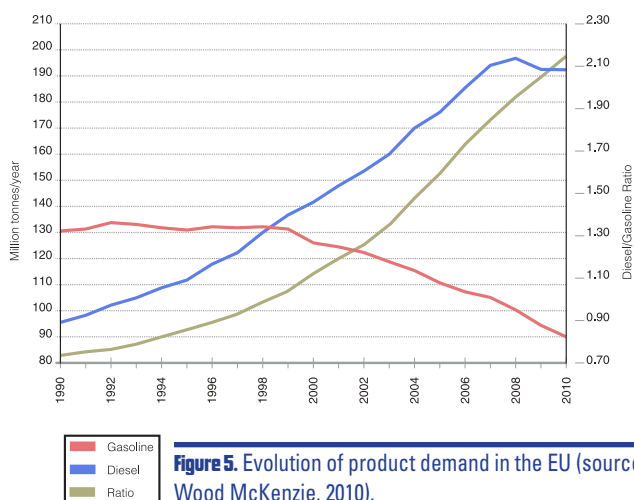
Much of the information discussed in this article was derived from a 2009 white paper presented by EUROPIA, a trade group composed of approximately 20 member organisations. A recent white paper called '2011 - 2020 Energy Strategy' has also been published by this organisation, detailing many of the challenges mentioned in the original white paper and offering positive suggestions to meet the challenges faced by its refiner members.<sup>5</sup>

The official position of EUROPIA is that 'a strong domestic refining industry is a key asset to access the increasingly sought after crude oil resource in an increasingly competitive and resource hungry global environment, thereby supporting energy security in Europe'.

Certainly its member refiners are aware of the challenges they face to achieve this objective. Among these goals are research and innovation: the EU refiners intend to 'make more efforts to make sure that the companies are provided the right framework conditions that allow them to make the necessary investments to stay ahead of competitors, maintain their innovation leadership, and secure economic and social prosperity'.

Historically, the EU refining industry, according to the white paper, 'boasts worldwide leadership and expertise in a wide number of fields from energy efficiency technologies to expertise in extracting all the value possible from every drop of oil, every water resource we utilise, and every energy molecule we recover'. The organisation's goal is to assure investments in research, people, staff and researchers, require sufficient predictability and a degree of stability and clarity into the future, in particular 'regarding the legislative framework, policy options, and viable scenarios in Europe for our industry'. There are essentially three fundamentals that the Europa 20 Years white paper stresses which it calls, 'three pillars' of sustainability; these include environmental, social and economic demands.

There is no doubt that based on its past history and grasp of the challenges it faces, the EU refining industry in the decades ahead will be up to these challenges and will assure its sustained growth.



**Figure 5.** Evolution of product demand in the EU (source: Wood McKenzie, 2010).

spent precious metal bearing catalyst lot could weigh as much as a 500 000 lbs and contain many hundreds of thousands of dollars of precious metals that must be recovered. While it is true that expenses for PGM bearing catalysts represent a relatively small portion of overall refining operating and production costs, it is also true that when management looks at the bottom line it cannot ignore the financial resources invested in PGMs for its processing catalysts.

With all these challenges facing most EU refiners, another challenge (at least for the short term) is the escalating values of most PGMs used in hydrocarbon processing catalysts. Under these circumstances, it is simply prudent business practice to obtain the highest possible return value from spent precious metal bearing process catalysts.

In order to achieve this, the refiner should work closely with a reliable precious metals refiner. Selecting, and working with, a precious metals refiner is not a complex process, provided a few simple, common sense steps are adhered to. Essentially, it is just a matter of due diligence. It is highly important to choose a precious metals refiner carefully since the relationship with the refiner can be compared to a partnership.

### Evaluation of precious metals refiners

To ensure that the relationship with the precious metals refiner will be mutually profitable and based upon trust and fair treatment, several key issues should be addressed:


- Select a refiner that uses state of the art techniques and equipment.
- Select a refiner that has a long and successful history and good reputation within the industry.
- Discuss the refiner's performance and policies with its customers.
- Request appropriate reference material including environmental regulation documentation.

- Request the final destination for effluent leaving processing plants.
- Determine whether the refiner has the financial resources to pay in a timely manner.
- Select a refiner that has full in-house capabilities, without use of outside sub-contractors that might affect returns in values and timeliness.
- Ask if the refiner has its own internal, global logistics organisation.
- Ask the refiner for detailed weight and analysis reports on the materials shipment.
- Ask the refiner if sample materials are assayed in triplicate.
- Request to be present during sampling of materials and ascertain whether an additional independent analysis can be conducted if desired.

With the goal of working more closely with EU hydrocarbon processing refineries to help enhance profitability, Sabin Metal Corp. recently increased its commitment in the region with the establishment of Sabin Metal Europe B.V., a technical service division based in Rotterdam. In addition to working with EU refineries, the new organisation will also service hydrocarbon refineries in the Middle East and Africa.

### Conclusion

Based on past performance and predictions, there is no doubt that the EU refining industry will be up to the aforementioned challenges. It is clear that industry people understand what must be done to meet these challenges.

While PGMs employed in hydrocarbon refining processes are certainly not critical to the success or failure of a refinery operation, they do, however, represent a significant profit sector when managed properly. Clearly there are many variables associated with recovery and refining precious metals from spent hydrocarbon processing catalysts. While some of them may be more or less relevant to the idiosyncratic needs of a given facility, it is important to keep in mind that they are generally interrelated, so as to help paint an overall performance picture of a prospective precious metals refiner. In general, logistics, turnaround time, recovery/refining procedures such as sampling and assaying, and compliance with appropriate environmental regulations are probably the most critical issues to evaluate. Remember, any relationship with a precious metals refiner essentially constitutes a 'partnership', for better or for worse. 

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