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CORRIGENDUM:
This document corrects document SWD(2015) 284 final of 7.12.2015
Typing mistakes + white space p 19 + mixted paragraphs p 41.
The text shall read as follow:

COMMISSION STAFF WORKING DOCUMENT

Sectoral fitness check for the petroleum refining sector

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Contents

0. Executive Summary

This Staff Working Document presents the results of an evaluation carried out by the European Commission of the impact on the petroleum refining sector of ten pieces of the most relevant EU legislation drawn from the policy fields of environment, climate action, taxation and energy. The analysis covers a wide range of important aspects including five key evaluation criteria (effectiveness, efficiency, coherence, relevance and EU added value). Consideration has also been given to the sector's competitiveness position from 2000 to 2012 as well as to issues such as excessive regulatory burden, overlaps, gaps inconsistencies or obsolete measures. Given its concentration on a specific sector, this report does not attempt to provide an exhaustive overview or cost-benefit analysis of the broader impact of the relevant legislation. It also does not take into account the impacts of national legislation or the provision of EU funding to the sector. This Staff Working Document builds on a Science and Policy Report of the Joint Research Centre of the European Commission (JRC, 2015).

The analysed legislation is expected to provide general benefits for society. For example, by driving changes in certain inputs, legislation can increase energy security and foster innovation; pollution should decrease by changing the output mix. The legislation can also have specific impacts on the refining sector through three main channels: by requiring specific limits on the operation of a refinery (i.e. by limiting the amount of pollutants to be discharged into the environment), by imposing quality requirements on products (i.e. maximum sulphur levels for fuels) or by changing demand for refined products (i.e. shifts from one product to another, decrease in overall demand). The analysed legislation can positively impact the sector by:

- harmonising product specifications and taxation rules thus creating a level playing field in the internal market;
- harmonising and simplifying emergency stockholding rules and increasing the reliability of crude oil supply;
- providing emergency stockholding services and renting out industry storage facilities;
- incurring potential benefits from emission trading; and by
- improving the environmental performance and energy efficiency of the industry and increasing innovation.

Based on the analysis undertaken it can be concluded that the legislation is broadly on track to reach its objectives (i.e. reduction of sulphur content on fuels, reduction of green-house gas (GHG) emissions, reduction of industrial emissions). No inconsistencies or lack of integration between policies have been identified. The only trade-off between some of the objectives concerns the target of lowering the sulphur content of fuels because this requires higher energy consumption, with the inevitable repercussions in terms of higher emissions.

No regulatory gaps, overlaps, inconsistencies or obsolete measures leading to excessive administrative burdens have been identified. Evidence of synergies have been noted with the reporting obligations under the fuel quality legislation that are in line with the other reporting obligations part of the enforcement system for the air quality of road transport emissions.

Comparing costs and benefits, on the basis of the data obtained for the sector, the costs can be considered proportionate relative to the benefits achieved. Nonetheless, the average cumulative cost resulting from the impact of the legislation considered is not negligible and is estimated to account for up to 25% of the total net loss of competitiveness of the sector in terms of the decline in the observed net margin. This indicates that there are other factors present that taken together had a stronger influence on the economic performance of the refining sector. Some of these factors are plant-specific such as the configuration, size and location of refineries. Other factors include the relatively high level of input costs of refineries and in particular, energy costs and the high variability of the relative quantities of petroleum products produced by refineries as well as diverse input costs such as revenues, operating costs, and, therefore, net margins.

Over the period studied it can be seen that regulatory costs increased from 2000 to 2008 and appear thereafter to have stabilised until 2012. The identified impact of regulation on the costs of the performance of refineries primarily implies the diversion of some revenues towards regulatory compliance investments and operating costs rather than towards other investments and operational adjustments to improve competitiveness. Some of the more efficient refineries have been able to absorb these costs and remain profitable, but this has not been the case for the others.

This fitness check focuses on the impact of a number of EU legislative measures on the petroleum-refining sector. Therefore, these results cannot be extrapolated to draw conclusions on the broader impact of those measures on other sectors. Further evaluative work on the broader impacts of the EU measures in question would be necessary before broader conclusions could be reached on other impacts of the measures in question. The results of this fitness check not only provide confirmation of the impact of these measures on this sector, but can feed broader evaluations of the overall performance of the relevant EU measures.

I. Introduction

As part of its Smart Regulation[1] policy the Commission has initiated a programme for Regulatory Fitness and Performance (REFIT). This is a continuous process, affecting the whole policy cycle – from the design of a piece of legislation to implementation, enforcement, evaluation and, where justified, revision.

Under the first stages of this programme, the Commission has reviewed the entire stock of EU legislation and decided on follow-up actions, one of which is a 'Fitness Check' involving a comprehensive policy evaluation aimed at assessing whether the regulatory framework for a particular policy sector is 'fit for purpose'.

In this context, Fitness Checks[2] provide an evidence-based critical analysis of whether EU actions are proportionate to their objectives and delivering as expected. A Fitness Check pays particular attention to identifying any synergies (e.g. improved performance, simplification, lower costs, reduced burdens) or inefficiencies (e.g. excessive burdens, overlaps, gaps, inconsistencies and/or obsolete measures) within the group of measures which may have appeared over time, and help to identify the cumulative impact of the EU actions in question, covering both costs and benefits.

In 2012 the Industrial Policy Communication[3] highlighted the fact that the planned fitness checks were lacking a sectoral dimension with an overview of the main policies affecting a single economic sector. It announced the intention to carry out a pilot horizontal sectoral fitness check on the petroleum-refining sector. The choice of the petroleum-refining sector for this pilot exercise was driven by two main considerations. Firstly the relative homogeneity of products and production processes of the sector facilitates a detailed analysis. Secondly, on 15 May 2012 at the EU Refining Roundtable the Commission indicated that it would be appropriate to monitor current EU legislative measures for any negative impacts on the competitiveness of the EU refining sector as a response to the increasing number of shutdowns of refining operations at a growing number of plants in the EU, with subsequent job losses and increased risks to security of supply.

The mandate for this sectoral fitness check was approved in June 2013[4].Due to its novel sectoral nature, efforts have been made to align the content/analysis of this sectoral fitness check to the requirements of legislative fitness checks, i.e. focusing the analysis around the evaluation criteria to be able to conclude on the effectiveness, efficiency, coherence and relevance/EU added value of the acts in the sector. The exercise was included in the REFIT programme of the Commission in 2013[5].

The aim of this Commission Staff Working Document is to estimate the quantitative impacts (both positive and negative) of the different acts on the sector and to assess and present in a transparent manner the research, analysis, findings that lead to conclusions on how coherently the relevant EU legislative measures work together in this sector; whether the objectives are delivered in an efficient way; how they impact on the performance of refineries; to look for any excessive regulatory burden, overlaps, gaps, inconsistencies and obsolete measures; and whether they are relevant and have EU value added for the sector. It needs to be noted that the report did not attempt to perform an exhaustive overview or cost-benefit analysis of the relevant legislation, as it concentrated on its

[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Smart Regulation in the European Union. COM(2010)543, 08.10.10

[2] The concept of a Fitness Check was introduced in COM(2010)543 final – Smart Regulation in the European Union

[3] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Stronger European Industry for Growth and Economic Recovery Industrial Policy Communication Update COM(2012)0582 10.10.12

[4] Available here http://ec.europa.eu/smart-regulation/evaluation/docs/2014_refining_fc_mandate_final_en.pdf

[5] COM(2010)543

application to a specific sector. This report is based on an extensive supportive study carried out by the Commission's Joint Research Centre (JRC, 2015).

The fitness check covers the period 2000 to 2012 and the EU28 Member States. The pieces of EU legislation, identified as the most relevant for the sector and therefore included in the mandate of the fitness check, were:

- Renewables Energy Directive (RED)[6];
- Energy Taxation Directive (ETD)[7];
- EU Emissions Trading System (EU ETS)[8];
- Fuels Quality Directive (FQD)[9];
- Directive on Clean and Energy Efficient Vehicles (CEEV)[10];
- Industrial Emissions Directive (IED)[11];
- Strategic Oil Stocks Directive (SOSD)[12];
- Marine Fuels Directive (MFD)[13];
- Energy Efficiency Directive (EED)[14];
- Air Quality Directive (AQD)[15].

Within the above directives, all provisions of significant relevance for the petroleum refining sector were taken into account for further analysis.

II. Method

This fitness check has quantitatively assessed the impact on the petroleum refining sector of legislative measures at EU level during the period 2000 to 2012. The selected legislative measures considered were identified as a result of European Commission analysis and stakeholder consultations prior to the approval of the Fitness Check´s mandate based on their relevance for the sector. The quantitative assessment considered the impact of the legislation on costs and revenues of the EU petroleum refining industry and therefore on its capacity to remain internationally competitive. As a general rule, the analysis in this report was retrospective, however where it was

[6] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[7] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

[8] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC and subsequent amendments.

[9] Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.

[10] Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles.

[11] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and its predecessors Integrated Pollution Prevention and Control Directive (IPPCD, 96/61/EC and codified version 2008/1/EC) and the Large Combustion Plants Directive (LCPD).

[12] Council Directive 2009/119/EC of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products.

[13] Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels.

[14] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

[15] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

clear that significant changes in the legislation taking place after 2012 could lead to a new assessment of the impacts on the oil refining sector in the near future, some relevant qualitative considerations were presented. Any formal analysis of impacts beyond 2012 is, however, not covered in this report. Additionally, where relevant impacts of the respective directives could stem from previous pieces of legislation, such measures were also taken into account for the assessment.

This fitness check identified theoretical impact channels through which the legislation analysed affects the petroleum refining sector. As far as costs are concerned, the analysis considers three main channels through which the legislation could potentially impact the sector: one direct channel and two indirect. The most direct way by which a piece of legislation imposes costs on the refining sector is by impacting the way a refinery operates. Examples of such a direct impact include the absolute limits on how much certain substances can be discharged into the air, water or soil, or the requirement to purchase permits for the release of such substances under cap-and-trade mechanisms. The impact of such legislation can be expressed by the implied increase in variable and fixed (including investment) costs (for example, the one-off costs for a new filter or the price of required emission permits). It should be pointed out that different refinery products may be affected differently by such regulation, such as when energy generation processes become more strictly regulated and some of the refinery products inherently require more energy than others. In the same way, different types of refineries, such as more or less complex refineries, may also be affected differently.

Moreover, the legislation can impact refineries by imposing quality requirements on refined petroleum products. It may prescribe minimum or maximum concentrations of wanted or unwanted fuel components. The legislation's economic effect on refineries is in this case indirect, i.e. it occurs only by means of changes in the demand function the refinery faces[16]. The economic impact here is the additional variable and fixed costs (including investments) incurred by the refinery for meeting the required product specification. An important difference between the first and second impact channels is that in the first case, legislation can only impose additional costs on producers located in the EU, while in the second case, production costs for all the firms selling in the EU refined petroleum product markets are affected.

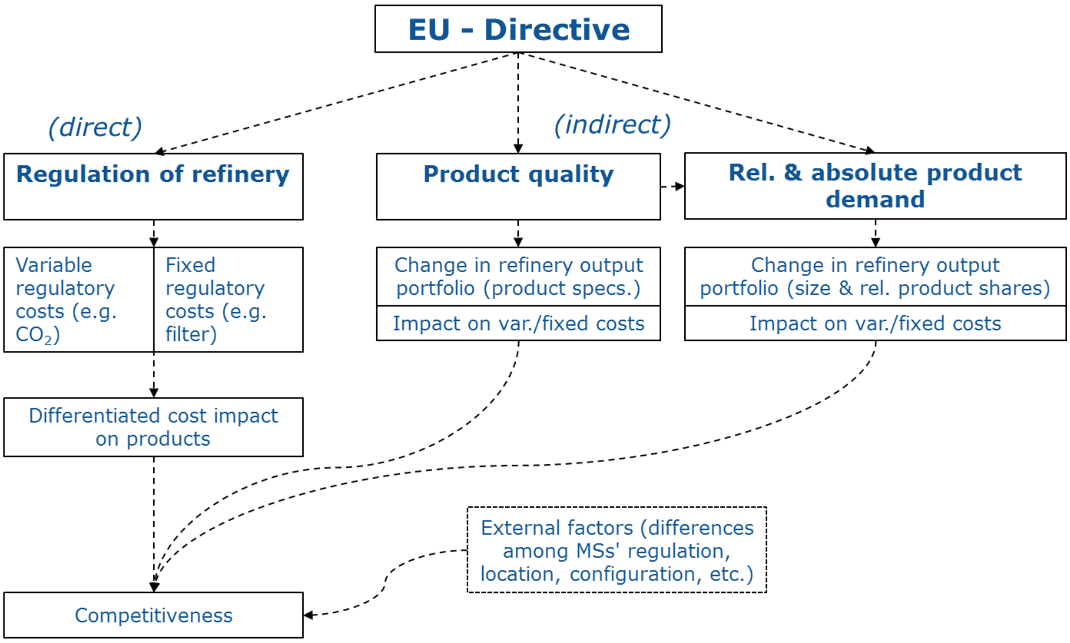
Thirdly, and again representing an indirect effect, legislation can cause shifts in the relative and absolute demand for existing petroleum products. For example, the legislation on energy efficiency standards may lead to an absolute decrease in demand for fuels, but also to shifting of demand from one type of fuel to another. The demand shifts of this type might also arise as a secondary effect of legislation on product quality, when a new quality requirement drives up the product price and leads to substitution. Economically speaking, the changes in absolute and relative demand can cause a costly loss of efficiency for a refinery, at least in the short term, in terms of utilisation rate and product mix. In the case of relatively minor shifts in demand, this might lead to only small increases in variable costs, but to keep up with larger market shifts sizeable investments in additional units might be needed (for example, an increase in secondary conversion capacity).

It should be noted that while this classification is well-suited to capture and formalise the primary channel through which the immediate impact of the different pieces of the legislation occurs, longer-term impacts will spread across all three categories because of the general equilibrium effects. Therefore, the three types of impacts are not mutually exclusive. For instance, the regulation that sets pollution limits and impacting the refinery directly can also have an indirect impact through a longer-term reduction in demand due to increased prices. On the other hand, there can be direct costs associated with legislation on product quality if the refinery is forced to change its operations. Conversely, changed operations and a higher product quality may also create a competitive

[16] One could argue that this impact is not as binding as the direct one as a refinery could legally choose to only produce for foreign markets not covered by similar legislation.

advantage and result in benefits like an increased turnover and higher product margins. Figure 1 summarizes the conceptual framework, showing how a generic directive translates into the three cost impact channels, with the implications in terms of refining costs, and ultimately, in terms of competitiveness.

Figure 1. Conceptual representation of legislation's cost impact channels.



Source: Own elaboration

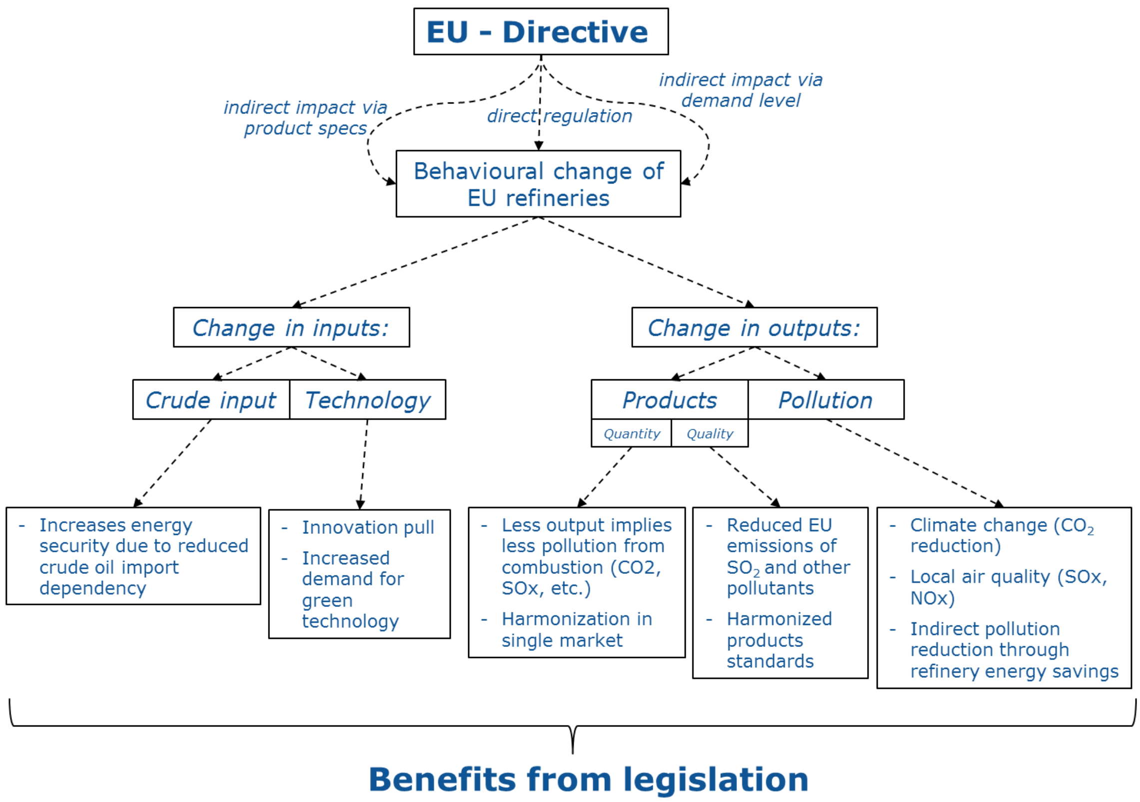
Overall, the economic impact of legislation may not only be judged relevant on the basis of whether it leads to a significant increase in unit costs. It may also be judged relevant with regard to international competitiveness only if the cost increase cannot be passed through the value chain. Cost pass-through is more difficult in a market where consumers can buy perfect substitutes from non-regulated outside suppliers and which is very sensitive to transport and transaction costs or where consumers are not willing to buy the good at higher market prices (i.e. their demand is strongly price elastic). It is important to identify whether either of these two cases hold, as the regulation's effectiveness might be impaired in their presence if pollution could just be displaced without being necessarily reduced (leakage effect). In addition, short- and long-term impacts need to be differentiated, since costs might be successfully passed through in the short-run, but in the longer-term a negative demand-side reaction to higher prices may occur and lead to a contraction of the sector's home (EU) market and thereby impair its competitive position. In order to discern the impact of EU legislation on the refining sector, it was necessary to analyse other factors and wider conditions potentially affecting the sector's competitiveness.

This fitness check assesses the effect of the European regulation on the refining sector in addition to the effects of the corresponding national regulation measures. In cases where national regulation imposes stricter norms or higher goals than the corresponding measures at the EU level, the additional effect of the EU legislation is considered to be negligible. The actual interactions between the national and EU-level legislations are handled in detail in the analyses of individual measures. The focus of the fitness check is the period 2000 to 2012 in the EU28 with references to other world regions when comparing the impacts.

To assess the competitiveness implications where feasible and meaningful, regulation-related costs are presented alongside relevant and generally accepted cost and profitability indicators. Where possible, the analysis of impacts was carried out taking into account differences between the regions in Europe in order to capture the specificities related to emission abatement potential or energy costs.

The fitness check also looked into the benefits related to the implementation of relevant legislation in the sector. Importantly, while certain benefits may relate to the refining sector itself, positive impacts of the environmental legislation predominately occur for society as a whole and not at the sector level. For example, reduced pollution levels have direct environmental and health benefits such as reduced occupational diseases and less (air) pollution related public health costs. Consequently, this report did not intend to perform a cost/benefit analysis of the relevant legislation. This would have required a systematic quantification of the benefits to this sector and to the economy in general, presenting a challenge which is beyond the scope of this sectoral fitness check. To mitigate this issue, an assessment was performed of whether the regulatory framework for that period was fit for purpose specifically for the sector, coherent and whether it achieved its objectives effectively and efficiently. Where possible, benefits of the legislative measures were reported. Some of these benefits could be quantified based on existing studies and available data; wherever a quantitative approach was not possible, a qualitative approach relying on existing research was applied. Figure 2 illustrates how different types of benefits from legislation could eventually be conceptually linked to the petroleum refining sector.

Figure 2. Conceptual representation of legislation's benefits impact channels.



Source: Own elaboration

It needs to be highlighted that this sectoral fitness check did not attempt to perform an exhaustive evaluation or cost/benefit analysis of the relevant legislation, as it focuses on its application to a specific sector. The full cost benefit analysis of a piece of legislation should comprise benefits and costs across all sectors, a task clearly beyond the scope of this fitness check. The sectoral nature of this fitness check precludes reporting on all sectors impacted by the analysed legislation[17]. However the fitness check has reviewed the existing literature on positive benefits produced by legislation and presents them in the context of the refining industry.

Data for this study has been obtained from different sources including commercial providers (Solomon Associates and IHS), an ad-hoc questionnaire to industry and existing studies (see annex I for details) which provide direct measurement of the costs of the impact of legislation via the direct and first indirect channel. In addition, the same type of information has been obtained for other world regions in order to measure impacts on competitiveness. Further insights on the impact of the considered legislative acts on the performance and international competitiveness of the EU oil refining sector were obtained from assessments carried out with the OURSE model[18]. This was mainly used for the second indirect channel and also to cross check the data obtained for the other two channels. Where possible the data from different sources were compared and cross-checked to ensure robustness of the corresponding results.

The data used is the most reliable available for analysis at the level of the sector. With regards to the data acquired from Solomon, refineries have an incentive to provide good quality and representative information that is used as a benchmarking management tool on the basis of which decisions are taken which affect their profitability based on how their data compares to the best performers. However the database did not contain any data on refining revenues or on refining margins either for the EU or for the competing regions. Furthermore, given the level of aggregation in the database, the data was available at the level of the EU, EU regions and refining complexity groups, but not at individual refinery level.

With regards to the data provided by individual refineries via the CONCAWE administered questionnaire this was cross-checked when possible with data from the Solomon database to assess the robustness of the corresponding results. No major discrepancies were found between both data sets and thus the data from this second source is also considered reliable and of good quality.

Whenever the analysis needed fine-tuning at the level of the individual refineries, the study employed the data of IHS (2014). While this database provides very detailed information at the refinery level, an important limitation is that it relies to a large extent on simulations (with the use of IHS's proprietary Refinery Simulation Model) and therefore on certain restrictive assumptions regarding the parameters of operation of refineries. Potential limitations of IHS (2014) data were taken into account for the analysis and reporting of results. In particular, this data was not used in the assessment of overall regulatory costs for the sector.

In some of the cases where no direct information was available about the attributed regulatory costs, they were assessed by means of counterfactual scenarios modelled within the OURSE (2015) framework or within the refining industry model of IHS (2014). This mostly concerned indirect impacts that affected the refining sector via shifts and product demand.

The involvement of stakeholders in the sectoral fitness check was organized via two fora. The Commission had previously established the EU Refining Forum[19] to discuss planned regulatory

[17] There is one exception to this rule, fuel quality legislation. Here costs are borne only by the refining sector and benefits provided by the lower pollutant content of fuels. Nevertheless, a fully fledged evaluation of this legislation is currently being undertaken by the Commission and this fitness check just reports estimates available of benefits and provides new data on costs.

[18] For a more detailed description of the OURSE model and its use in the context of the fitness check, please see Annex I.

[19] https://ec.europa.eu/energy/en/topics/oil-gas-and-coal/oil-refining

proposals which may impact the refining industry and the EU's secure supply of petroleum products. All Refining Forum meetings had an agenda item devoted to the sectoral fitness check process. In addition to this formal consultation an ad-hoc steering group was set up to discuss preliminary outputs with targeted stakeholders. These included FuelsEurope, Concawe, national refining associations, individual refining companies, as well as the NGOs Transport and Environment (T&E) and International Council on Clean Transportation (ICCT). Following a request by 10 Member States this ad-hoc working group was extended to include Member States Representatives. A more detailed description of the consultation process can be found in Annex II.

III. Background to the initiative

Intervention logic

The way the different pieces of legislation interact with the petroleum refining sector is summarised in the intervention logic presented in Figure 3. By addressing various environmental, energy security and market harmonization issues, the ten directives considered in the fitness check contribute through different channels to the long-term goals of green, sustainable and inclusive economic growth, effective internal market and improved industrial competitiveness in the EU. Below we consider specific measures introduced by each of the directives and their respective contribution to the above long-term objectives in more detail.

The **Energy Efficiency Directive** pursues as its main objective the promotion of energy efficiency in order to ensure the achievement of the Union’s 2020 headline target on energy savings and further energy efficiency improvements. The main contribution of the directive was to reinforce and consolidate previous regulatory efforts to improve energy efficiency. While providing for a common framework of improving energy efficiency at the EU level, the directive left significant flexibility to Member States with respect to specific measures to be implemented.

As a result, the following main outputs could be expected from the implementation of this directive: Member States (MS) set indicative national energy efficiency targets and achieve a certain amount of final energy savings; MS ensure efficient and free-of-charge access to data in real-time and historical energy consumption; large enterprises carry out energy audits at least every four years; MS perform monitoring and assessments of potential of new energy generation capacities; and MS include environment and energy considerations in public procurement (the latter output, with respect to the procurement of transport vehicles, is also targeted by the Directive on Clean and Energy Efficient Vehicles).

These outputs, by introducing additional incentives for using more energy efficient technologies and processes, contribute towards a number of achievements such as the EU 2020 energy efficiency goals, technological developments and innovation, increased security of energy supply, and in the long-term, towards green and sustainable growth of the EU economy and improved international competitiveness of the EU industry.

The **Directive on Clean and Energy Efficient Vehicles** states as its main objective the promotion and stimulation of the market for clean and energy-efficient vehicles, and to improve the contribution of the transport sector to the EU's environment, climate and energy policies. To this end, the directive applies specific requirements with respect to the public procurement procedures in order to incentivize production of vehicles with low levels of energy consumption and emissions. Namely, the Directive requires "contracting authorities, contracting entities as well as certain operators to take into account lifetime energy and environmental impacts… when purchasing road transport vehicles"[20]. The direct expected output from the implementation of this directive is inclusion of environment and energy considerations in public procurement of transport vehicles at the MS level. In the long-run, general cultural shifts towards greater role of energy efficiency concerns and environmental awareness in public procurement can be expected to lead to energy efficiency and environmental performance improvements. This would in the longer term contribute to the green and sustainable economic growth in the EU.

The **Strategic Oil Stocks Directive** imposes an obligation on Member States to maintain specified minimum stocks of crude oil and/or petroleum products. Its immediate expected output is that at the Member State level provisions for holding, monitoring and reporting of emergency oil stocks are implemented, and that their correct composition and accessibility at all times are ensured. The directive also provides for the EU-wide harmonized emergency reaction procedures to ensure smooth release of the stocks in case of a disruption. It thus aims at minimizing negative impacts of an energy supply disruption on the EU economy and increasing credibility and security of the emergency stockholding system. In addition, the directive aimed at simplifying compliance through harmonizing the EU strategic stockholding rules with those of the International Energy Agency, which obliges its members (including the majority of MS) to hold emergency oil stocks. In turn, the above measures in the long run contribute through the increased security of energy supply to the green and sustainable economic growth and industrial competitiveness in the EU.

The **Renewable Energy Directive**'s overarching objective is to contribute to the European Union's climate and energy '20-20-20' package. In particular, the directive prescribes a 20% minimum share for renewables in EU-wide final energy consumption by 2020, as well as a specific 10% target for renewable energy in transport (RES-T), where the latter has to be achieved in every Member State.

As a result, the following main short-term outputs were expected: MS regularly prepare National Renewable Actions Plans (NREAP) with annual trajectory of renewables shares in electricity, heating (incl. cooling) and transport; sufficient capacities and processes for blending of refined oil products with renewable-source fuels need to be ensured. In turn, by enabling the sustainable use of biomass for energy purposes, this becomes an additional channel for increasing security of the EU energy supply, as well as stimulating technological developments and innovation. In the long-term, these outputs are expected to add to the green and sustainable economic growth and industrial competitiveness in the EU.

The **Energy Taxation Directive** establishes the EU-wide minimum rates of energy taxation, with the objective of providing a framework for aligning the energy excise tax systems. As a result of its implementation, Member States were expected to adapt national taxation in line with EU-wide minimum rates for a range of energy products. Through harmonizing taxation rules, the directive contributed to smooth functioning of the internal market for energy products, reduced administrative burden and simplified compliance and thus, in the long-run, to effective internal market and improved competitiveness of the EU industry.

The **Fuels Quality Directive** and the **Marine Fuels Directive** regulate EU-wide specifications for transport fuels, such as the maximum content of sulphur. They thus lead to the following immediate outcomes: sufficient capacities and production processes for meeting fuel specifications (sulphur, aromatics, metallic additives, fatty acid methyl ester (FAME), etc.); sufficient capacities and processes for blending of refined products; effective product quality control and standard enforcement practices. In addition, the Fuels Quality Directive contains provisions establishing

[20] Energy and environmental impacts to be taken into account include: energy consumption; emissions of CO_2; and emissions of NOx, non-methane hydrocarbons (NMHC) and particulate matter (PM) (purchasers may also consider other environmental impacts).

greenhouse gas (GHG) emission reduction targets (per unit of fuel consumed), contributing to the goals of reducing GHG emissions.

Overall, in the long-run these directives are instrumental for ensuring the levels of environmental pollutants within health and safety norms, as well as for harmonisation of product specifications in the internal market, which enables smooth functioning of the market and simplifies compliance. Through these channels, they contribute to the long-term objectives of green, sustainable and inclusive economic growth, effective internal market and improved competitiveness of the EU oil refining industry.

The **Air Quality Directive**, which sets maximum ambient concentrations for a range of parameters and defines the standards for assessing and managing air quality, is a key component of the current EU air quality policy. By specifying maximum ambient concentrations of certain pollutants[21], the directive ensures that measures for compliance with maximum ambient concentration of air pollutants are put in place at the Member State level. This contributes to health and safety of the EU citizens and the quality of the environment.

In a similar way, the **Industrial Emissions legislation**[22] requires industrial installations to be operated in accordance with permits setting conditions based on the application of the Best Available Techniques (BAT) and additionally, it specifies emission limits for certain plants, such as large combustion plants and waste incinerators. These measures prevent and reduce industrial pollution and thus contribute to health and safety of EU citizens (in a similar, but more targeted way than the Air Quality Directive), and stimulate green, sustainable and inclusive economic growth.

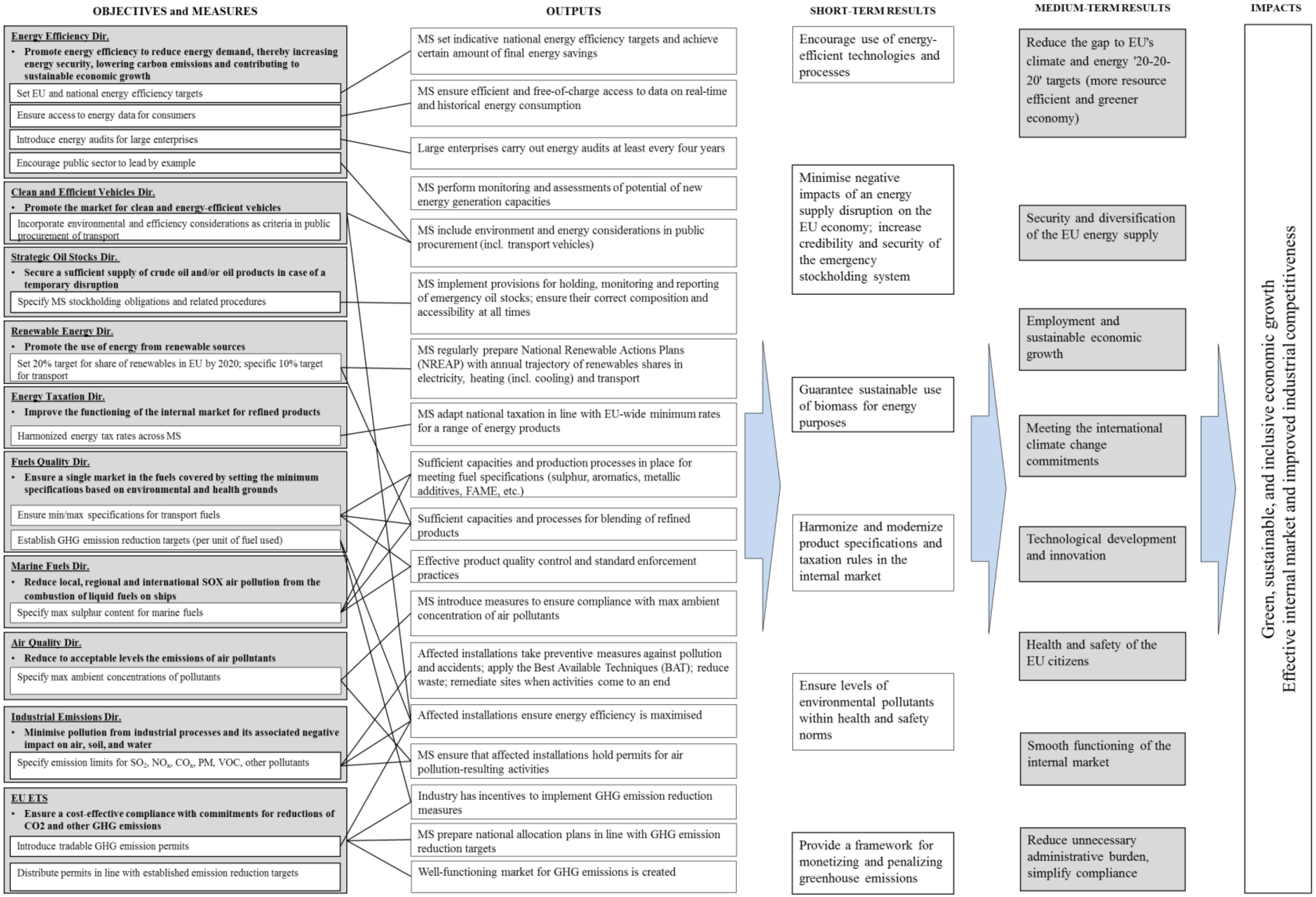
The **EU Emissions Trading System** employs market-based mechanisms to reduce GHG emissions in line with the EU 2020 GHG emission reduction target, as well as long term climate and energy goals. It does so through introducing tradable GHG emission permits and distributing these permits among the affected installations in line with the established emission reduction targets. The following immediate outcomes can be expected: MS prepare national allocation plans in line with GHG emission reduction targets; a well-functioning market for GHG emissions is created; the industry has incentives to implement GHG emission reduction measures, including improved energy efficiency.

By establishing a framework for monetising and putting a price on GHG emissions following the Polluter Pays Principle, and encouraging the use of energy and GHG efficient technologies and processes, the directive contributes to the achievement of the EU2020 GHG emission reduction target, as well as long term climate and energy goals, security of energy supply, meeting the international climate change commitments, technological development and innovation and, more broadly, towards green, sustainable and inclusive economic growth and improved industrial competitiveness.

[21] Particulate Matter, SO_2, NO_x, Volatile Organic Compounds (VOC) and Ozone. See also Directive 2004/107.

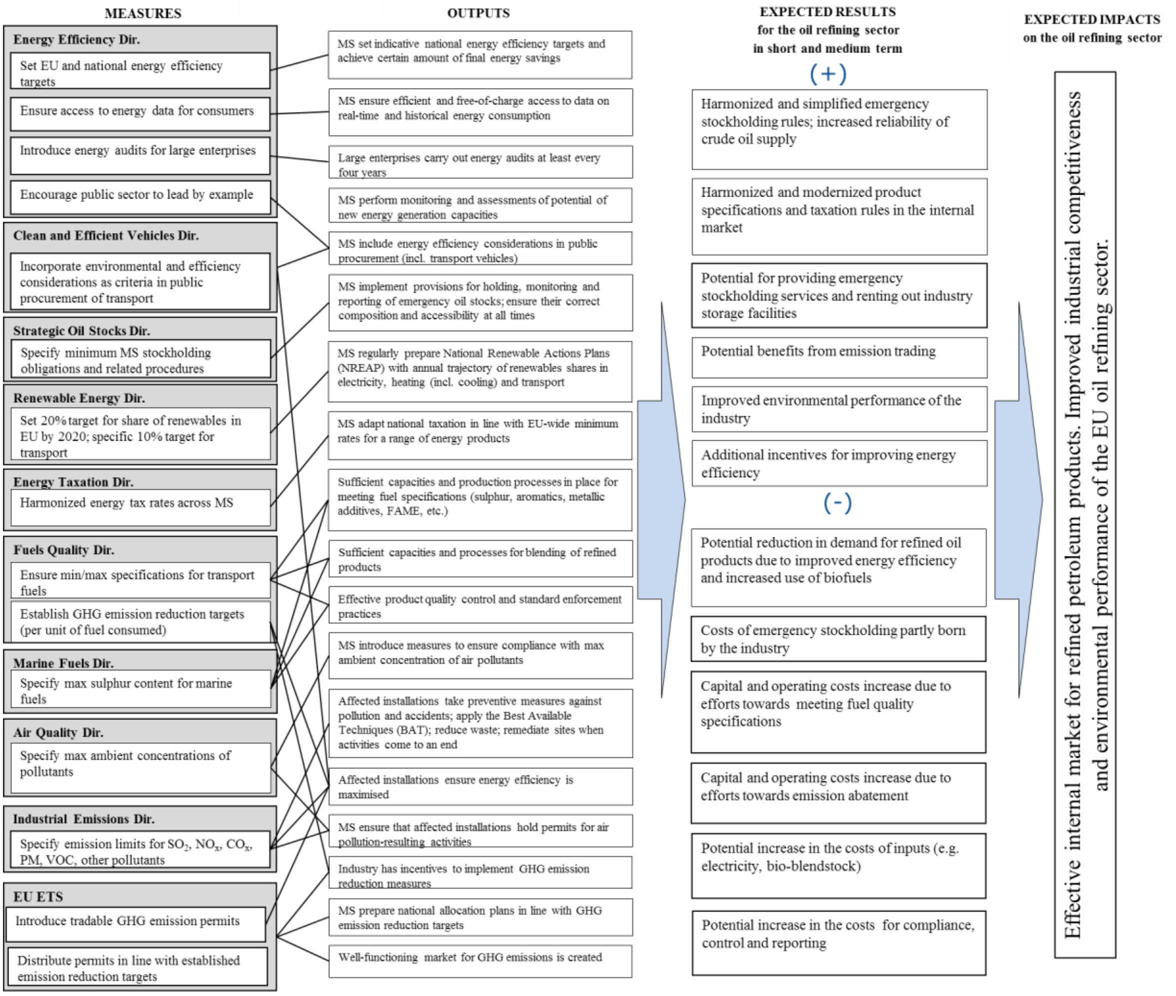
[22] The Industrial Emissions Directive (IED) 2010/75 required transposition by January 2013 and hence is–formally speaking– not included in the scope of the fitness check. However, given that the IED is a recast of seven pre-existing directives, large parts of it were actually established earlier. In view of this, the present section focuses on such preceding legislation with relevance for the EU refining sector. In particular, this includes the Integrated Pollution Prevention and Control Directive 2008/1 (IPPC, codified version of 96/) and the Large Combustion Plants Directive 2001/80.

Figure 3. Intervention Logic of EU regulation assessed in the context of the Petroleum Refining Sector Fitness Check.



As this fitness check focuses on a specific sector, a sector specific intervention logic has also been developed (Figure 4**)**. This sector specific intervention logic focuses on how the legislation specific measures are expected to affect the sector both in a positive and negative manner. The intervention logic for the impact on the sector has been grouped along the three impact channels defined in the methodology sector**.**

Figure 4. Intervention logic of the different EU regulation assessed with regards to their effects on the refining sector**.**



Firstly, legislation has a direct impact when a piece of legislation affects the way a refinery needs to be operated. In this respect, for example: the energy efficiency directive requires refineries to improve their energy consumption management; the strategic oil stocks requirements may be associated with the need for increased storage capacities; and the air quality directive, industrial emissions directive and EU emissions trading system impose requirements on the amount of harmful substances produced and emitted during the refining process. Such measures can be associated with increased capital and operating costs related to installing more energy efficient and environmentally friendly equipment, as well as additional storage space. They can also have an indirect impact through the costs of inputs to refining processes, such as electricity, as providers of such inputs can be subject to the same legislative measures and include the costs of compliance into their prices. At the same time, by providing additional incentives for improving energy performance and environmental image of the industry, they may bring certain cost management and marketing benefits to refineries. Moreover, strategic oil stocks improve continuity of crude oil supply during a potential supply shock, thus providing for increased stability of refining processes. In addition, by creating a market for tradable emission allowances, the EU ETS can, under certain circumstances, provide refineries with benefits from emission trading.

Secondly, legislation has an indirect impact through imposing quality requirements on refined petroleum products. Examples of such legislation include fuel quality and marine fuels directives, setting EU-wide standards for refined oil products such as maximum or minimum concentration of certain substances in fuels. Compliance with such standards may be very costly for refineries, creating the need for additional processing capacities and associated increase in both capital and operating (energy) costs. On the other hand, the harmonized specifications for refined petroleum products facilitate cross-border trade and increase the possibilities for refineries to expand their product markets abroad.

Another indirect effect may occur through shifts in relative and absolute demand for existing petroleum products. In this group of impacts, the energy efficiency and clean and energy efficient vehicles directives may, for example, reduce demand for all kinds of fuels by decreasing the overall energy consumption in the economy. The renewable energy directive may, on the other hand, reduce demand for refined oil products through their substitution with biofuels. In the same way, the energy taxation directive may be associated both with reduced overall demand for fuels and/or demand shifts from one type of refined oil products to another. This, in turn, may lead to a loss of efficiency in a refinery optimized to serve the former demand, decreasing refining profits to a different degree. On the other hand, in the same way as fuel standards, harmonized taxation rules facilitate EU-wide trade in refined oil products thus benefitting the refineries aiming at expanding their markets.

The role of the petroleum refining sector in the EU economy[23]

The EU oil refining sector[24] accounts for a visible share of the EU's manufacturing value added, contributes to employment, and produces a substantial turnover. According to the latest available data[25] the EU oil refining sector directly contributed around 1.2% to manufacturing Gross Value Added (GVA). The sector directly employs around 119 thousand people and spends around 6.3 billion euros in wages and salaries annually. Wages accounted for 43.4% of the total value added, the remaining 56.7% included capital consumption and other taxes on production net of subsidies and profits. The EU refining industry has a total annual turnover of around 686 billion euros or around 5.8 million euros per employee[26]. The EU refining industry represents an important part of the world's total refining capacity. There are currently around 100 petroleum refineries operating in the EU. The EU total crude refining capacity is around 14.7 million barrels per day, which is around 15.5% of the total world refining capacity and the combined throughput of EU refineries amounted to 11.6 million barrels per day (mb/d) in 2013 (BP, 2014). The EU refining industry contributed 104 billion euros of value added (0.9% of total GDP) and 1.32 million jobs (0.6% of total employment) in

[23] A more detailed analysis of the petroleum refining industry´s role in the European economy can be found in chapter 2 of JRC (2015).

[24] The macroeconomic indicators in this section are based on the data published by Eurostat, for 4-digit sector NACE Rev 2.0 19.20 ("Manufacture of refined petroleum products"), which has a wider coverage than "refineries" as industrial installations. The 1000 plus enterprises reported under this statistical category include manufacturing enterprises such as biofuels blenders and manufacturers of hard-coal fuel briquettes, lignite fuel briquettes, peat briquettes, petroleum briquettes and various speciality products such as lubricants, greases, vaseline, etc. The exact number of refineries reported varies depending on the chosen definition of a refinery and reporting methodology. According to CONCAWE there were 95 mainstream refineries operating in the EU in 2008, of which 82 are still operating in 2014. In addition, CONCAWE reports that there are 15 small non-mainstream refineries currently operating in the EU, dedicated to the production of bitumen and lubricants or processing petroleum condensates. The analysis in the Fitness check relates to these 95 mainstream refineries.

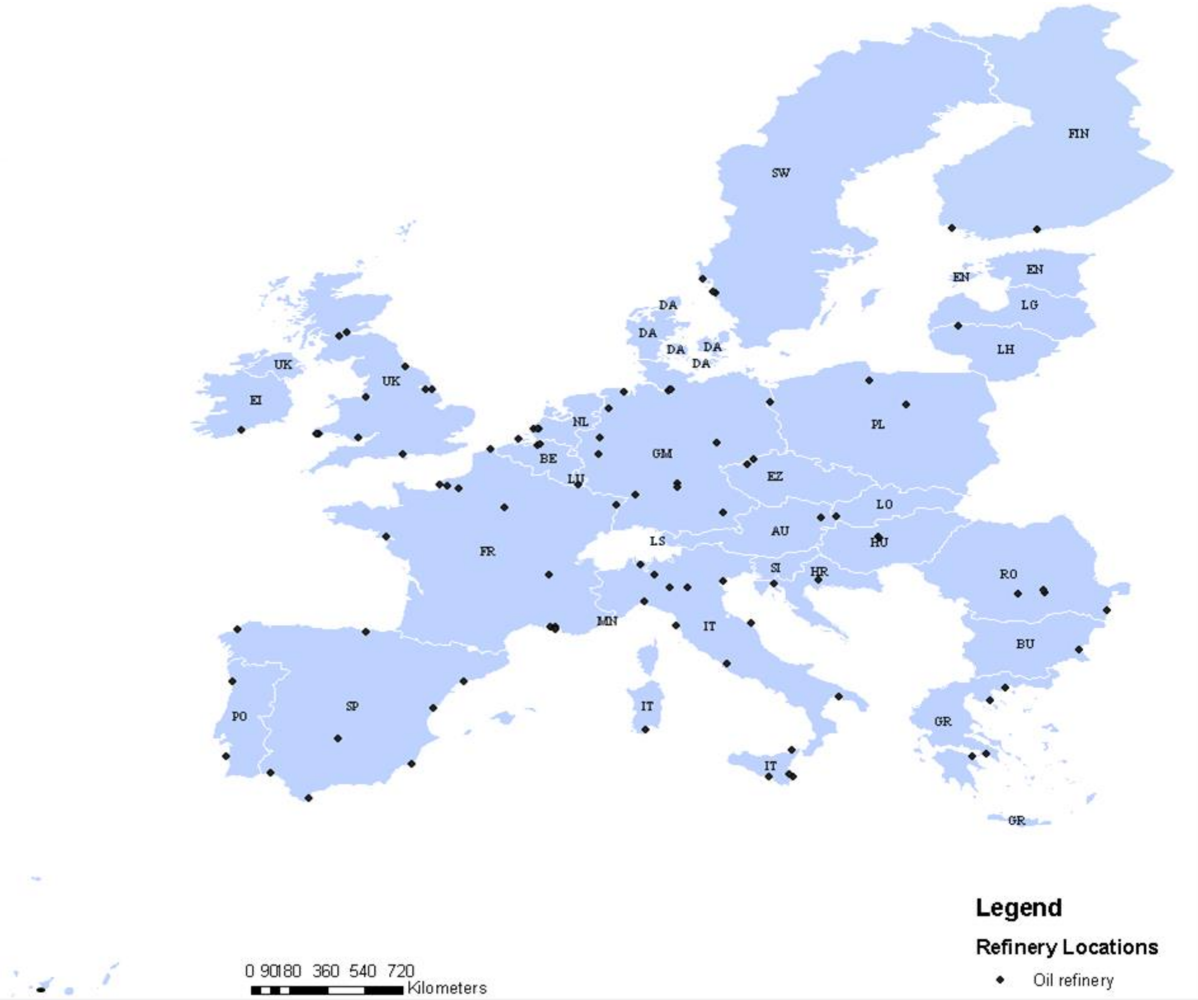
[25] Data on value added is only available up to 2011 as data for more recent years is classified as confidential.

[26] This data refers to 2013.

2011 taking into account its total direct and indirect contributions[27] calculated from Input / Output relations in 2011.

In recent years, there has been a growing number of stand-alone refineries,[28]distributors, transportation and storage companies in the refining sector, which in the past were typically parts of vertically integrated oil companies. Moreover, all types of companies are increasingly active in product markets beyond their national borders. The EU refining market thus seems to have evolved into an oligopolistic structure, with the significant presence of several large companies and a large number of smaller players. There are refineries in 22 EU Member States[29] (Figure 5). They are often concentrated near major sea ports, large rivers or pipelines. Although refineries are evenly distributed across the EU as shown in the figure, refining capacity is slightly more concentrated in the North-Western part of the EU (NWE), close to the North Sea crude oil sources.

Figure 5. Refineries in the EU (situation by 2012).



Source: Own elaboration

The EU refining sector has been characterized by significant under utilisation of capacity during the last decade largely as a result of domestic and global demand dynamics (Figure 6). At the same time

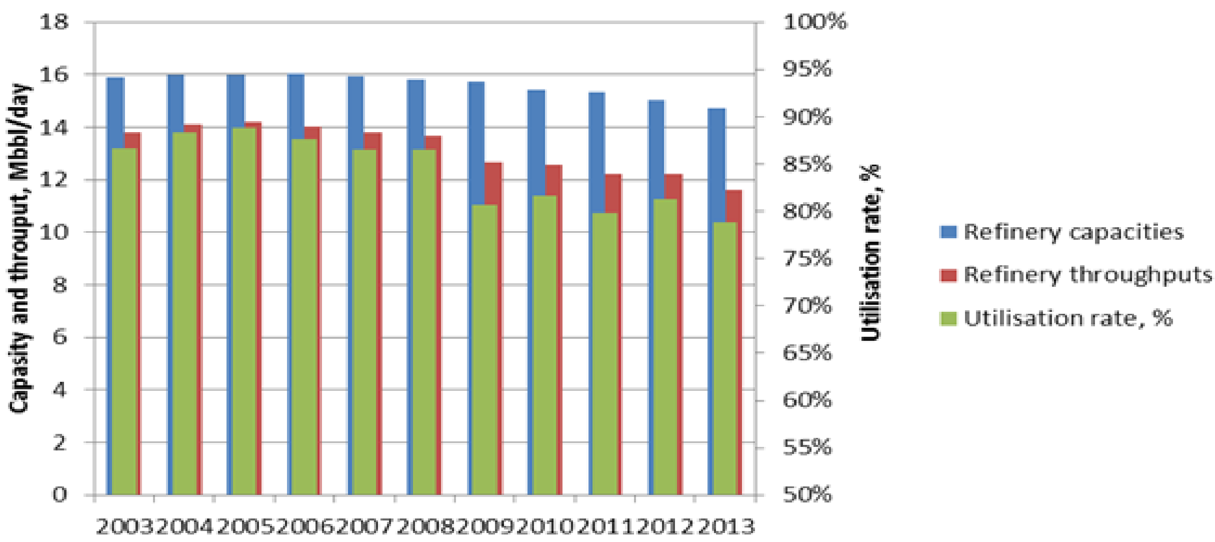
[27] Direct effects include the impacts on employment, value added and production to satisfy the final demand for refinery products. They include the so called initial and first round effects, where we consider inputs delivered to the refining sector from other sectors of the economy. Indirect effects refer to second, third and subsequent rounds (following the inter-industry links upstream). Furthermore, the induced effects refer to the response of an economy to changes in the household expenditures attributable to the income generated by the direct and indirect effects.

[28] I.e. refining companies that are not part of vertically integrated corporations.

[29] Cyprus, Estonia, Latvia, Luxembourg, Malta and Slovenia are the only MS without a refinery in their territory.

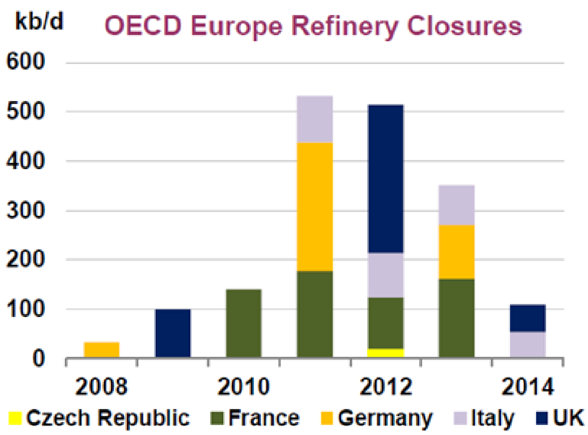
there was a significant reduction in installed capacity due to refinery closures. In the period 2007-2013, operations at 13 refineries with a total of 1.7 mb/d of capacity in the EU were shut down (Figure 7). In particular, during that period closed refining capacity amounted to 585 thousand barrels/day (kb/d) in France, 400 kb/d in Germany, 455 kb/d in the UK and 320 kb/d in Italy.

Figure 6. Refinery capacities and throughputs in the EU in 2003-2013, million barrels daily.



Source: BP (2014)

Figure 7. Closures of refining capacity in OECD Europe.



Source: IEA.

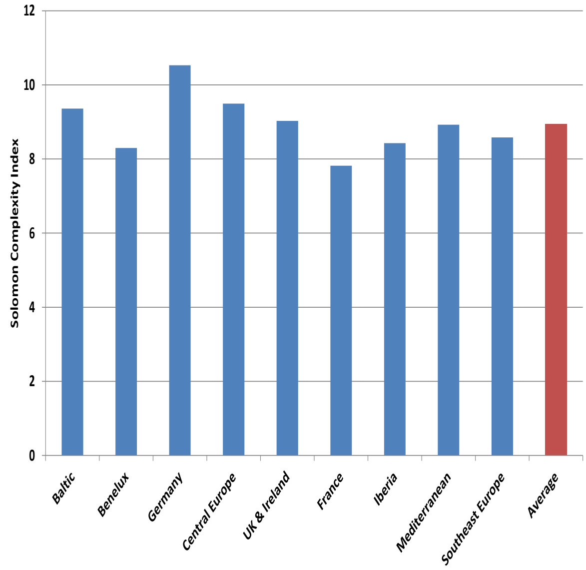
As of 2012, the average complexity index[30] of EU refineries was reported at 9.0 (Figure 8), having grown significantly from 7.3 in 1998 (Figure 9)[31]. Based on the available data, in 2012 the highest refining complexity was observed in Germany, the Baltic region and Central Europe, while refineries with the lowest average complexity were observed in the Iberian region, Benelux and France. In general, complexity has increased across the entire EU regions. The highest growth of the complexity

[30] For details on how complexity is measured please refer to chapter 2 of JRC (2015).

[31] Increase in complexity is the result of both upgrading of existing refineries and closures of less complex ones. To the extent in which regulation was an incentive to technological change, the increase in the complexity of equipment reflects a potential benefit from regulation.

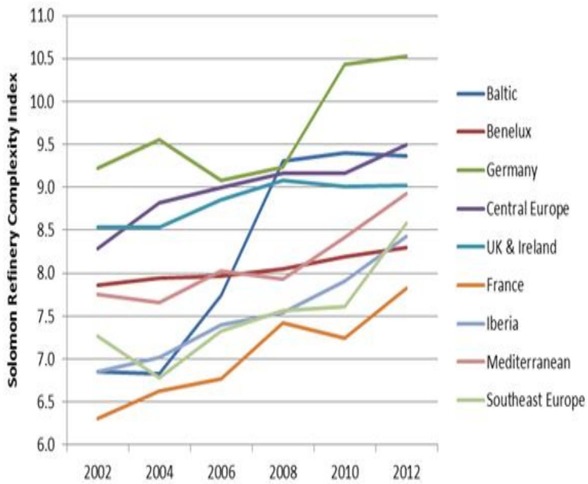
index was observed in Central Europe, while it remained relatively stable in Benelux and UK & Ireland. The highest complexity growth in Central Europe appears to have been related to the increasing share of the processed Former Soviet Union crudes.

Figure 8. Average index of complexity by region in 2012



Source: Solomon Associates (2014a).

Figure 9. Development of complexity by region, 2002-2012

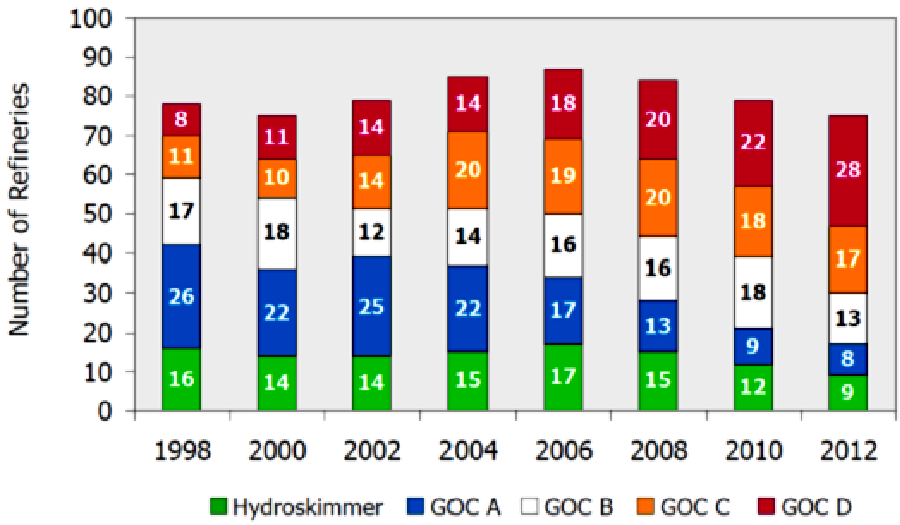


Source: Solomon Associates (2014a)

Over the last decade we have noticed continuous progression in the number of refineries in the higher complexity groups (GOC)[32] (Figure 10). This led to a change in the transformation output of EU refineries towards the production of a higher yield of middle distillates. While gasoline constitutes a significant proportion of refining output, it fell slightly from 21.7% of total transformation output in 2000 to 19.8% in 2012. This decrease however has been slower than the rapidly declining gasoline demand inside and outside of the EU. Moreover, the pressure to find export markets has risen due to the increasing self-sufficiency of the US, traditionally a key export market for gasoline produced in the EU. The other important refined products in terms of output are gas/diesel oil, fuel oil, kerosene/jet fuel, and naphtha. With the increasing demand for gas/diesel oil and kerosene/jet fuel, both products recently increased in volumes of production (from 35.4% to 40.2% and from 6.3% to 7.2%, respectively). At the same time, the proportion of fuel oil decreased from 15.7% to 11.8%, reflecting the expanding capacity of conversion units.

[32] For the purposes of this analysis, Solomon Associates defined five complexity groups based on the Solomon Refinery complexity Index (as defined above): 1. Refineries with hydroskimming and thermal units; 2. Gas Oil Conversion (GOC) A – Complexity Factor <6.9; 3. GOC B – 6.9 ≤ Complexity Factor <8.0; 4. GOC C – 8.0 ≤ Complexity Factor <9.5; and 5. GOC D – 9.5 ≤ Complexity Factor.

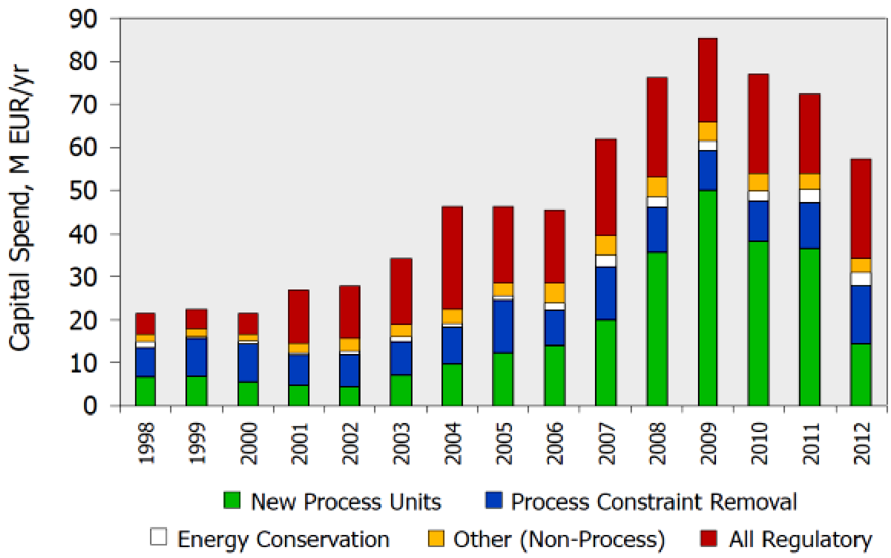
Figure 10. Development of complexity groups (GOC)[32], 1998-2012



Source: Solomon Associates (2014a).

During the period 1998-2002, refineries in the EU invested over 50 billion euros, approximately 620 million euros per refinery. Figure 11 shows the breakdown of investments by the refineries covered by the Solomon *Fuels Study* into several categories: new process units, process constraint removal, energy conservation, non-process related, as well as capital spending related to regulation. As can be observed, investments in the sector grew steadily up to 2009 after which total investments decreased. In terms of investments per tonne of input these have more than doubled from 2000 to 2012.

Figure 11. Capital investment (average per refinery) 1998-2012

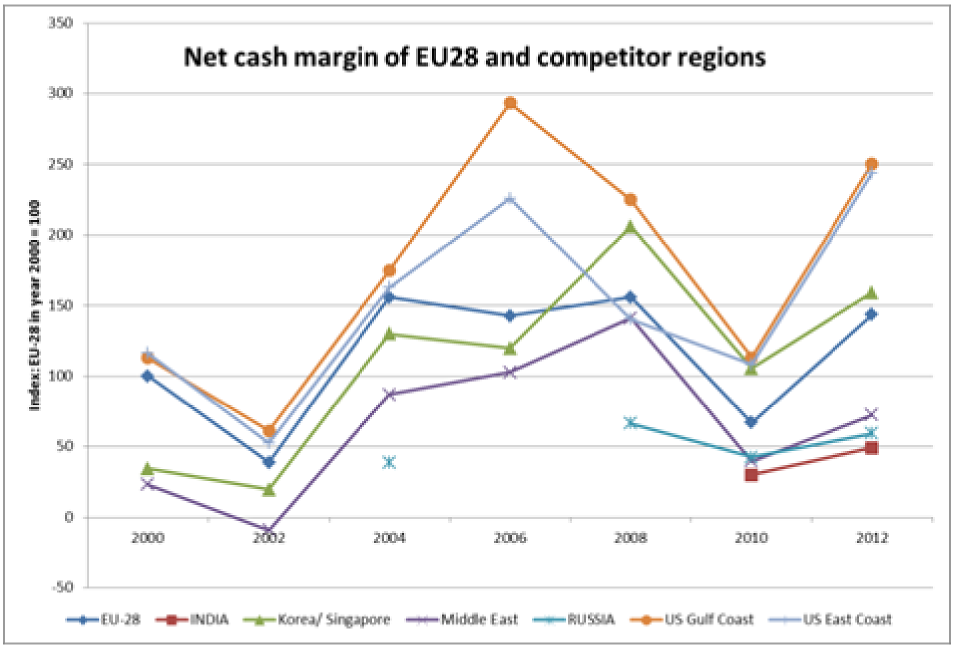


Source: Solomon (2014a)

Given that the overall capacity of the EU refining sector did not increase over the study period (see above), it would appear that the growth in capital investment which took place before the 2008-2009 economic crisis, especially in new process units, reflects upgrading in complexity of European refineries. Also, taking into account that investment in new hydrocracking capacity is included in the category of new process units, such profit-improving investments can have some effect on the fuel quality as well. Regulation-related investments are a substantial part of overall capital spending and such investments have increased significantly over the study period. In the period before the economic crisis of 2008-2009, non-regulatory and regulatory investments showed similar growth trends. However, after 2009 non-regulatory investments declined much faster than regulatory ones, resulting in a greater relative share of regulatory investments in total investments. This is an indication that under changing economic conditions, refineries probably have less freedom in down-scaling regulatory investments than non-regulatory ones.

During the study period, the fixed and variable operating costs per ton of net material also increased, both at EU level and across all EU Member States considered. Variable costs increased as a result of higher energy costs which now represent 60% to 70% of the total operating costs. This is coherent with the increasing complexity of EU refineries, as with growing complexity, refineries tend to use more energy per ton of processed crude. Observing the growing share of gas and electricity in the refineries' energy consumption mix, the stable level of total energy consumed, and the tendency for increasing energy intensity with growing complexity of refineries, there is evidence of increasing pressure on the industry's profitability with increasing total energy costs. Gaseous fuels and electricity constitute the largest part of the energy consumption of EU refineries and their share of the total cost has grown over time. Since 2006, gas prices in the US have been consistently lower than those in the EU and electricity prices have been lower in the US for even longer than that. Furthermore, the relative difference in price level and, therefore, the US's energy price advantage, has been growing. Thus, the proportion of energy costs in the total expenditures' structure of European refineries seems to have increased in the past decade, with a higher energy price advantage for refineries in the US.

Figure 12. Evolution of net cash margins of refineries in different world regions.



Source: Solomon Associates (2014a)

The evolution of net cash margins in the EU28 refining sector was volatile during the 2000-2012 period (Figure 12)[33]. US and EU dynamics were rather similar in terms of increase and decline, but

[33] We do not present point estimates of margins due to the diversity of sources which make it difficult to assess what is the "actual margin" of a refinery. Rather we use the Solomon Associates margin index. We are confident that analysis based on changes in margins is sound. This is due to the fact that while the different sources produce margin estimates that are different in absolute terms, they still follow the same trends. See chapter 5 of the JRC (2015) for a more detailed discussion on margins.

the US net margin in 2012 was much higher. Compared to competitors in other parts of the world, refineries in the EU have some of the highest operating costs driven mainly by energy costs, which are among the highest in the world. Further analysis in this report shows that the net cash margins in recent years for EU refiners have been lower than for refiners in the US and South-East Asia solely as a consequence of high operating costs.

EU refineries supplied intermediate products to other sectors of the EU economy amounting to 29.7 billion euros of value added in 2011. This represented 8.1% of the total output volume of the EU refining sector for that year. Around 96.2% of the value added generated by EU refineries was linked to refined petroleum products while the remainder was linked to other products that indirectly influenced the production of refinery products (e.g. transport services).

Refined petroleum products are an important element of extra-EU trade accounting for the major part of EU energy exports. The total consumption of oil products in the EU in 2013 was 12.8 mb/d compared to 11.6 mb/d of production, such that the EU is a net importer of refined oil products. In 2013, imports of refined oil products into Europe[34] totalled 159.0 million tonnes, or 3.3 mb/d . In the same year, Europe exported 96.6 million tonnes, or approximately 2 mb/d of refined products, resulting in net imports of 89.4 million tonnes (BP, 2014). The main petroleum products traded outside the EU in terms of volume are gasoline and gas/diesel oil, including heating oil. Gas/diesel oil is the main petroleum product imported in the EU (mainly from the Former Soviet Union (FSU) and the United States), while gasoline accounts for the largest share of exports (mainly to the US, although this export outlet has significantly decreased in recent years with the development of US light tight oil production). The EU is also significantly import-dependent on jet fuel and kerosene, for which it mainly relies on a number of Middle East countries.

Given its limited natural reserves (0.4% of the proved world oil reserves at the end of 2013), the EU is a large net importer of crude oil. In 2013, net imports of oil into Europe amounted to 445 million tonnes or 8.9 mb/d (BP, 2014). Suppliers of crude oil to the EU are diverse, with important trade partners in the FSU, OPEC countries and Norway.

One important aspect of the economic contribution of the EU oil refining sector is in terms of the secure supply of energy. The EU being a major net importer of energy sources, energy security runs high on the EU political agenda. In the EU, along with natural gas, oil continues to be one of the crucial components of domestic energy demand. In 2013 it represented around 36% of total energy consumption and the EU was the second largest consumer of oil products in the world after the US, with about 14.5% of global consumption (BP, 2014). According to the International Energy Agency (IEA) risk assessment methodology for energy security[35], none of the products are at high risk for import dependency (Table 1). However, the gap between domestic production and consumption of important products has recently grown. As can be seen in the table below refining cover (the ratio of production to consumption) in the EU during the period under observation has decreased quite considerably for kerosene/jet fuel, naphtha and LPG. Reliable sources of crude

[34] BP reports Europe as a region which includes EU-28 minus Latvia and Lithuania together with Iceland, Norway, Switzerland, Turkey, Albania, Bosnia-Herzegovina, Former Yugoslav Republic of Macedonia, Gibraltar, Serbia and Montenegro.

[35] For a definition of this indicator see Jewel (2011).

oil supply into the EU, as well as sustainable export outlets, are also of crucial importance.

Table 1. Production to consumption ratios for some refined oil products in the EU in 2000 and 2012

Refined product	Refining cover in 2000	Refining cover in 2012
Gasoline	117%	159%
LPG	88%	65%
Naphtha	92%	71%
Kerosene and jet fuel	91%	75%
Gas/diesel oil	98%	96%
Fuel oil	106%	169%

Source: Eurostat [series nrg_102a]

While intangible and therefore difficult to measure quantitatively, there can be important positive externalities associated with the oil refining industry, such as knowledge spill-overs from research and innovation. In this sense it is important to highlight that the refining sector is the first sector in the EU in terms of process innovations and the fourth in terms of product innovation just behind pharmaceuticals, computers and chemicals (EC, 2013a). As regards the knowledge intensity of the sector, refining is included in the list of "Knowledge Intensive Activities", which are identified on the basis of the share of tertiary educated persons in the sector employment, as its share is above 33%.

The sector is also responsible for a notable proportion of emissions of certain pollutants. In particular, 12% of SOx emissions and 5.6% of NOx emissions of the 30,000 industrial installations in the EU-27 that were listed in the European Pollutant Release and Transfer Register (E-PRTR) in 2012 come from refineries (up from 5.4% and 9.6% respectively in 2007)[36]. Concerning CO2, the share of the refining sector in total CO2 emissions registered at E-PRTR was around 6.6% in 2012. According to a study of the European Environmental Agency,[37] out of 100 most polluting industrial installations in the EU27, 11 are refineries and the aggregated costs attributed to their emissions in the 2008-2012 period is estimated to be between 10.5 and 27 billion euros.

IV. Evaluation questions

Given that this is the first sectoral fitness check undertaken by the Commission, efforts have been made to align the content/analysis of this pilot sectoral fitness check with the requirements of legislative fitness checks i.e. focusing the analysis around the evaluation criteria in force within the Commission to be able to conclude on the effectiveness, efficiency, coherence and relevance/EU added value of the acts in relation with their impacts on the sector. These evaluation requirements were therefore included in the fitness check mandate. [38]

Regarding effectiveness, the fitness check had to identify whether the achievements of the identified legislation with regard to the refining sector are in line with the stated objectives; how the progress has been made over time towards achieving the objectives; which are the main factors affecting the level of achievement of these objectives; and whether legislation achieved any other significant results.

As far as **efficiency** is concerned, the fitness check had to assess the costs and benefits associated with the implementation of the relevant legislation and assess whether there are any costs that can

[36] E-PRTR database: http://prtr.ec.europa.eu/IndustialActivity.aspx
[37] http://www.eea.europa.eu/publications/costs-of air-polution-2008-2012
[38] https://ec.europa.eu/energy/sites/ener/files/documents/oil%20refining%20fitness%20check%20mandate.pdf

be considered out of proportion with the benefits achieved. The assessment for the possibility of regulatory gaps, inconsistencies, overlaps or evidence of excessive administrative burdens for the refining sector was also targeted.

With respect to **coherence** the fitness check had to evaluate the degree of integration of all the pieces of legislation being assessed, in particular whether additional integration is still possible and if there were unintended consequences. In addition, consideration was given to the consistency of the different pieces of legislation as well as the cumulative impact of the legislation on the performance of the sector.

As regards **relevance**, the fitness check had to evaluate the impacts of the selected pieces of legislation on the competitiveness of the sector as well as their wider economic, social and environmental impacts and EU added value.

V. Results – state of implementation

Effectiveness of the legislation[39]

In this section we review how legislation performed with regards to its stated objectives in the broader sense. In order to evaluate legislation adequacy for a specific sector it is necessary to check first whether the legislation is meeting its general objectives as recommendations will be different depending on whether non-performance relates to legislation in general or to its application to the sector. This section is not intended as an evaluation of the individual pieces of legislation, rather it takes stock of the existing evidence with regards to the performance of each piece of legislation.

As far as the **Renewable Energy Directive** is concerned, it has been successful in increasing the share of biofuels in transport from virtually zero in 2000 to 5.1% in 2012. However, due to indirect land-use effects, the expected benefits in terms of GHG reductions could only be partly realised (during the evaluated time period). The Directive has contributed positively in terms of lower import dependence on oil and oil products, given that 82% of EU biofuel was produced in the EU in 2012, and given that 64% of the feedstock used in making it was of EU origin.

The **Energy Taxation Directive (ETD)**'s main objective of reducing divergent tax rates across the EU countries was largely achieved by 2010 for gasoline and diesel oil used as propellant, as measured by the observed decrease in cross-country excise tax variability. Thus, the ETD played a positive role in improving the functioning of the internal market by reducing distortions of competition between Member States due to their divergent gasoline and diesel tax rates. Given that the overwhelming majority of the excise duties for heating gasoil (business and non-business use), heavy fuel oil (business and non-business use), and LPG used for motor fuels were relatively stable over the 2002-2013 period, they contributed much less to the narrowing of the differences of these taxes across the EU countries than those of petrol and diesel oil. The European Commission proposed a revision of the ETD in 2011[40] which attempted to improve the effectiveness of the ETD in relation to its two other objectives of encouraging more efficient use of energy and improving the functioning of the internal market by reducing distortions of competition between mineral oils and other energy products. The proposal, finally dropped by the Commission in 2015 after many fruitless attempts at getting Member State approval, sought to change the current method of setting minimum energy

[39] A more detailed description of the effectiveness of each of the ten pieces of legislation can be found in chapters 3.1 to 3.10 of JRC (2015).
[40] Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity, COM(2011) 169/3.

tax rates on the basis of volume and to instead reflect the CO_2 emissions and energy content of these products.

The environmental benefits of the **EU Emission Trading Scheme** are guaranteed by the cap on total emissions from the sectors which are part of it. The average greenhouse gas emission levels of EU refineries were relatively stable between 2006 and 2012, even as increases in average complexity could be observed. This suggests that emission levels were influenced by some off-setting factors, such as energy consumption management and fuel switching by refineries, which is further supported by additional data. It cannot be precisely determined to which extent the EU ETS contributed to preventing potential growth in emissions, given the multiplicity of factors at play and difficulties of constructing a suitable baseline scenario. The available assessments and empirical data indicate that during the first two phases of the EU ETS, improvements in carbon emission performance were due to energy efficiency and fuel switching, and were more driven by cost optimisation considerations than by emission trading. On the basis of statistical data analysis, it can be concluded on the one hand that carbon emission abatement scope and options differed between EU regions and were determined by region-specific factors, and on the other hand that across all the EU regions the emission performance of refineries was linked to refining complexity.

The continuous decline in average sulphur content in road fuels in the EU27 countries suggests that the objectives of the **Fuel Quality Directive** with regards to road fuel quality were met. It is suspected that it will also have had an impact on exhaust emissions. The two most important thresholds were met, namely the 50ppm threshold for diesel and gasoline fuels in 2005, and the 10ppm threshold in 2009, showing that the sector complied in a timely manner with the requirements of the legislation. The objectives with regards to the greenhouse gas content of road fuel were also met. The effects of the Fuel Quality Directive in terms of the GHG emissions are less straightforward. In general, meeting the stricter fuel quality standards involves more processing capacity and stricter modes of operation for the existing units. Almost all of these changes imply more energy use (assuming no other energy efficiency improving measures are undertaken) and, hence, more carbon dioxide emissions. At the same time, these emissions are covered by the EU ETS, where the outcome in terms of emissions is determined by an EU-wide cap on all sectors covered. So this does not imply more greenhouse gas emissions in total.

The **Directive on Clean and Energy Efficient Vehicles** has had little impact on the market for cleaner vehicles during the study period. Indeed, in 2012 none of the stakeholders participating in the survey on the Directive's implementation were able to provide evidence of its direct impact on the market (Ricardo-AEA, 2012). This is largely because the Directive has only been in force for a short period of time, with delayed implementation in the majority of Member States (only three Member States had met the transposition deadline of December 2010). Moreover, in Member States where a relatively low number of vehicles are purchased by public authorities, it may not be possible to observe a non-negligible impact even after a longer period of time. While it could have a stronger effect in the long run through general culture shifts, these would be very difficult to detect. In addition, since the Directive is only one part in a set of policy instruments targeting energy efficiency and emission reduction in the EU, discerning its specific impacts is further complicated.

The **legislation related to industrial emissions**[41] has led to a decrease in SO2 and NOx emissions from the EU refining sector both in absolute terms (data for 2007 to 2012) and in terms of average emission intensity (emissions per throughput, data for 2004 to 2012). An important secondary

[41] The Industrial Emissions Directive (IED) 2010/75 required transposition by January 2013 and hence is formally speaking-not included in the scope of the REFIT. However, given that the IED is a recast of seven pre-existing directives, large parts of it were actually established earlier. In view of this, the present section focusses on such preceding legislation with relevance for the EU refining sector. In particular, this includes the Integrated Pollution Prevention and Control Directive 2008/1 (IPPC, going back to 1996/61) and the Large Combustion Plants Directive 2001/80.

impact from the sulphur in fuels[42] and the Large Combustion Plants (LCP) Directives is their contribution to a 39.3% demand drop in inland heavy fuel oil used by power plants[43] observed between 2000 and 2012, amounting to between 30 and 45 million tons in absolute terms. The concomitant reduction of supply was achieved through – in decreasing order of importance–(i) increased conversion capacity, (ii) increased uptake of fuel oil by the marine fuels market, and (iii) shut-down of EU refining capacity. Whether there is a negative impact from this secondary legislative effect could not be established in net terms because the contribution of the Integrated Pollution Prevention and Control Directive 2008/1 (IPPCD) and of the LCPD in the reduced demand for fuel oil and the economic impacts of this on the refining sector could not be quantified.

Stockholding obligations applied by the EU as a policy instrument in the field of oil supply security in application of the **Strategic Oil Stocks Directive** have been fulfilling their main objective. According to a recent study by the European Commission (EC, 2014), most of the Member States hold sufficient oil stocks to meet the minimum requirements of the current Directive or are close to reaching that target. This seems to provide for an adequate buffer to cope with potential supply disruptions and contribute in a meaningful way to the EU's enhanced energy security. The current Directive also seems to have struck the right balance between guaranteeing the short-term availability of refined products and leaving a sufficient degree of flexibility in terms of the stock composition to the Member States. While obliged to hold a minimum of one third of its emergency stock in the form of refined products, it is at the discretion of each Member State to decide on the exact composition of the stocks, taking into account its geographical positioning, refining facilities and consumption patterns. Moreover, by inviting Member States to maintain stocks of specific pre-defined products, in proportions determined by their domestic consumption patterns, the Directive reinforces short-term availability of finished refined products in case of emergency.

The direct effectiveness of **Marine Fuel Sulphur Regulation** consists of its impact on the sulphur content observed in marine fuels. According to data reported by the International Maritime Organisation, the global average sulphur content of marine bunkers has indeed decreased after the onset of sulphur regulation in 2005, from a long-term average of 2.7% to 2.35% in 2009 (EC 2011, p.74). With a corrected approach, IMO monitoring data shows a value of 2.51% sulphur for the year 2012 (fuel-oil based bunkers), hence demonstrating a slight downward trend (IMO 2013, p.31).

The two directives previously addressing energy efficiency in the EU – **the Energy Services Directive[44]** and **the Co-generation Directive**[45] – were admittedly not sufficiently effective in reaching their objectives, and their impact was marginal. This could be attributed to their open wording and non-binding nature of the obligations. The current directive on energy efficiency was due to be transposed into national legislation by June 2014. Due to the insufficient time since transposition, the effectiveness and impacts of the sets of specific measures implemented by the national governments cannot be meaningfully measured. As a general observation, the Directive has a potential to reach its objectives more efficiently than the previous directives as it introduces binding measures together with indicative targets towards energy efficiency, and the possibility of recourse to binding national targets in the future.

The effectiveness in achieving the objectives of the **EU air quality policy** could be evaluated via the effectiveness of EU-level source control measures including, most importantly, fuel quality policies and instruments addressing large emission sources such as the Large Combustion Plants Directive,

[42] Council Directive 93/12/EEC of 22 March 1993 relating to the sulphur content of certain liquid fuels and its amending acts: Directive 98/70/EC; Directive 1999/32/EC and Directive 2005/33/EC.

[43] "JRC(2015) EU Petroleum Refining Fitness Check: Impact of EU Legislation on Sectoral Economic Performance".

[44] Council Directive 93/76/EEC of 13 September 1993 to limit carbon dioxide emissions by improving energy efficiency (SAVE).

[45] Directive 92/42/EEC of 21 May 1992 on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels.

the Waste Incineration Directive, and the Integrated Pollution Prevent and Control Directive, all currently consolidated in the new Industrial Emissions Directive (EC, 2013b). For the EU source controls, both the scope and objectives were concluded to be broadly valid. Updated emissions data and projections confirmed that the sectors driving the relevant pollutant emissions were correctly identified. Evaluation of the emission reductions achieved under the National Emissions Ceiling Directive (NECD) also showed that best compliance was achieved where a substantial proportion of emissions was regulated by EU source legislation (e.g. for SO2). The potential for cost-effective reductions was argued to be greater from the sectors where emissions had been reduced less, i.e. the ones not subject to strict source control measures.

As mentioned in the introduction, the fitness check does not aim to perform a detailed and comprehensive costs-benefit analysis of the legislation relevant for the EU refining sector. However it has reviewed the existing literature on positive benefits produced by legislation and presented them in the context of the refining industry in accordance with the identified impact channels (as shown in Figure 2). It should be noted that it has been possible to identify quantified estimates of benefits only for some individual legislation packages, while for the rest only qualitative insights from previous assessments are available. It is therefore possible to aggregate those individual effects and present a reliable generalised view on the beneficial impacts of the observed legislation included in this analysis, as a whole. A summary of the benefits which were identified and their quantification when available is presented in Table 2 in order to provide the necessary context for assessing the effectiveness of the analysed legislations.

Table 2. Overview of benefits of legislation which were identified.

Legislation	Identified benefits
The Renewable Energy Directive (RED)	• biofuels are estimated to generate less greenhouse gas emissions than a comparable amount of conventional fossil fuels, however this does not take into account additional emissions from indirect land-use changes or agricultural intensification. • positive effect in terms of a reduced crude oil and oil product import dependency.
The Energy Taxation Directive (ETD)	• additional tax-related income that could be used for a "growth-friendly tax-shift". • reduced demand for private transport, with corresponding increased demand for public transport. • contributes to development of a more uniform common EU market for refining products that can also have positive effects on refining sector.
The EU Emissions Trading System (EU ETS)	• limiting amount of GHG emissions for the sectors covered • creating markets and infrastructure for emissions permits trading. • Embedding the polluter-pays principle in steering the incentives of potential polluters and making implementation of emission-reducing technologies attractive. • providing a valuable learning experience in the initial phases.
The Fuels Quality Legislation (FQD)	• decreasing the damage from the SO2 emissions avoided by complying with the transport fuel sulphur standards. The estimated benefits amount to around 16.2 billion euros in total between 2001-2011, this is equivalent to 30 euro cents per barrel of throughput. • reduction of the emissions of particulates from the older (pre 2005) vehicles without retrofitting them with additional scrubbers or filters. • decreasing the damage from the GHG emission avoided by complying with the transport fuel GHG rules.

Legislation	Identified benefits
	• development of a more homogeneous EU market for refining product.
The Directive on Clean and Energy Efficient Vehicles (DCEEV)	• no measurable impact during the 2000-2012 period.
Integrated Pollution Prevention and Control Directive (IPPCD) and the Large Combustion Plants Directive (LCPD)	• from 2005 to 2012 the average EU15 refinery abated nearly 12,000 tons of SO2 and 4,000 tons of NOx emissions (data for EU13 accession countries too scarce for quantification), corresponding to an estimated monetary benefit of 108.4 Mio EUR (equivalent to 22 Euro cents per barrel of throughput). • subtracting the average abatement costs of 34.3 Mio EUR and multiplying by 63 – which is the total number of sampled EU15 mainstream refineries operating at the end of 2011 – yields total net benefits of 4.7 Billion EUR. If similar abatement took place in all 90+ refineries in EU27, total net benefits would be around 7 Billion EUR.
The Strategic Oil Stocks Directive (SOSD)	• most of the Member States hold sufficient oil stocks to meet the minimum requirements or are close to reaching that targets. This seems to provide for an adequate buffer to cope with potential supply disruptions and contribute to the EU's enhanced energy security. • theoretically, the benefits to society of strategic stockholding in terms of oil supply safety are considered to be high. These benefits result, in particular, from reducing GDP losses and import costs in the event of a supply shock.
The Marine Fuels Directive (MFD)	• sulphur reductions allow reductions in SO_2 emissions.
The Energy Efficiency Directive (EED)	• in the Commission's impact assessment of the EED, the potential energy savings resulting from the current system of legislations were estimated as significant; however, the scale of the actual savings, depends on specific national implementation and individual reactions of consumers. • it can be expected that growth in EU energy saving progress would to an extent be determined by emission reduction and renewable energy targets rather than energy efficiency measures alone; the Energy Efficiency directive is meant to overcome other market and non-market barriers. • contributes to energy security
The Air Quality Directive (AQD)	• reduced pollution levels and health benefits • wider benefits of air quality regulation have a wide range of values. They include both direct health costs and indirect losses for the economy, such as workdays and productivity decreases. • it is likely that these benefits would be to a large extent determined by more targeted measures (such as FQD, IED, etc.) rather than AQD measures on their own.

Impacts of the selected legislation on the petroleum refining sector[46]

This section assesses in more detail how the specific pieces of legislation have impacted the economic performance of the petroleum-refining sector. This enables an approximation of the efficiency of legislation by estimating the cost of legislation applied to the sector. In the next section, an assessment of how these costs affected the competitiveness of the sector is undertaken. Note however that the impacts described below focus only on the ten selected pieces of legislation and the impacts of national legislation or the provision of EU funding to the sector are not taken into account.

[46] A more detailed description of the effectiveness of legislation can be found in chapters 3.1 to 3.10 of JRC (2015).

Where possible, the fitness check results were compared to initial expectations about the regulation's impact formulated in the relevant Commission's ex-ante impact assessments. Such a comparison was not possible for all directives and was mostly qualitative in nature due to the fact that many impact assessments considered the impact of regulation on the economy or society as a whole, but not at the sector-specific level.

Following the methodology presented above we first describe the impacts that legislation has on the sector following the impact channels depicted in Figure 2. In the first instance, harmonizing product specifications (via **the Fuel Quality Legislation** and the **Marine Fuels Directive**) has contributed to creating a level playing field and to developing a more uniform common EU market for refining products that can also have positive effects on the refining sector. The **Energy Taxation Directive** has largely reduced the difference between divergent tax rates across the EU Member States by 2010 in the case of gasoline and diesel oil used as propellant and has played a positive role in improving the functioning of the internal market by reducing distortions of competition between Member States due to their divergent gasoline and diesel tax rates. The **Strategic Oil Stocks Directive** has contributed to harmonizing and simplifying emergency stockholding rules and increasing the reliability of crude oil supply to petroleum product producers. Furthermore, some European refining operators benefit from the provision of emergency stockholding services and renting out industry storage facilities. The main positive effects of the **EU Emission Trading System** come from creating markets and infrastructure for emission permits trading which embed "the polluter-pays principle" and steer the incentives for potential polluters towards development of emission-reducing technologies. Moreover, during the first phases of the implementation of the EU ETS the sector was allocated more emission allowances than actual emissions (see below). Similarly the efforts to comply with the **Fuel Quality Legislation** and the **Energy Efficiency Directive** stimulate the industry to innovate and improve its environmental performance and energy efficiency.

We now describe the negative impacts that legislation has had on the petroleum refining sector following the impact channels depicted in Figure 1. As far as impacts derived from the **Renewable Energy Directive (RED)** are concerned, three main channels have been considered: one direct impact related to investments needed for blending and two indirect impacts related to demand shifts and increased energy prices. Additional expenditures associated with blending, storage, and transportation of biofuels amounted to 0.5 million euros annually per refinery during 2000-2012, and 0.9 million euros annually during 2008-2012 (Concawe, 2014a). In relative terms, both of these numbers correspond to about 0.01 euro per barrel of throughput from EU refineries.

With regards to demand shifts driven by the RED the main impact is the potential reduction of EU demand for fossil-based fuels due to their substitution by biofuels. However, at the aggregate EU-wide level this was very probably not the case for biodiesel – which accounted for 80 % of all EU biofuels during 2000 to 2012 – because the EU is a net importer of diesel. EU diesel net imports have always exceeded EU consumption of biodiesel. Thus, the presence of biodiesel has diminished the EU's dependence on diesel imports and on energy imports in general, given that (in 2012) 64% of the biodiesel consumed in the EU was produced from feedstock of EU origin. If the production of biodiesel had not been promoted by EU and Member State policies, and had EU biodiesel consumption remained at its year 2000 level, EU imports of fossil diesel in 2012 would have had to be 74 % higher, and 23 % higher cumulatively over 2000-12.

On the other hand, EU refineries are negatively impacted by the demand-reducing impact of bio-gasoline, as there is a surplus production of conventional gasoline at the EU-wide level. If, hypothetically, bio-gasoline consumption had remained at its year 2000 level, then EU demand for conventional gasoline in transport would have been 3.4 % higher in 2012, and 1.1 % higher cumulatively over 2000-2012. A model-based analysis by IHS suggests an associated impact on average EU refining margins between 0.01 and 0.20[47] euros per barrel of throughput between 2006 to 2012, and between 0.01 and 0.35 euros in 2012. Nevertheless, the overall drop in EU gasoline demand exceeded the policy-driven increase of bio-gasoline consumption by a factor of more than ten. Bio-gasoline has, consequently, only added to a small extent to the current EU gasoline oversupply issues.

EU bio-gasoline decreases demand, but as refining is a joint production, the product yields of existing refineries cannot easily be shifted towards more diesel optimisation. It can be done to some extent by shifting to heavier crudes and higher conversions (with associated incremental costs), since a direct transformation of gasoline into diesel is not possible. As an alternative way of adjusting to the increased gasoline surplus, the oil refining industry could restructure either by disinvesting gasoline units (FCC and reformers) or by shutting down complete refineries. But a reduction of EU overall refining capacity would also increase the EU's diesel deficit and thus its dependence on third countries for such imports.

The final indirect impact would be an increase of the refineries' electricity costs due to the EU-wide expansion of electricity from renewable sources, as mandated by the RED. However, lacking the required Member-State specific information on applicable electricity surcharges and relevant derogations, a quantitative estimate could not be made.

Regarding the negative impacts of the **Energy Taxation Directive (ETD),** there is a negligible indirect effect due to a decrease in total EU demand for gasoline and diesel. The gasoline and diesel tax levels of, respectively, 17 and 16 Member States, representing 85-88 % and 77-78 % of the total EU-27 gasoline and diesel markets, were not affected by the ETD, because their tax levels were already higher than the minimum ETD levels before these minimum excise rates were adopted.

Relative to the observed EU27 consumption, the estimates of average demand reductions for the 2004-2008 period are 0.17% for gasoline and 0.10% for diesel, while those for the 2009-2013 period are 0.27% and 0.32%, respectively. This rather limited effect is because the gasoline and diesel tax levels in several Member States affecting the bulk of product markets were not affected by the ETD, as their tax levels were already higher than the minimum ETD levels before these were adopted[48]. The assessed average Member State-level demand reductions for gasoline and diesel account only for up to 3.3% and 2.2%, respectively. The largest reduction is obtained for Bulgaria in the case of gasoline consumption during the 2009-2013 period with a 4.4% fall.

As Member State taxation levels are higher than the minimum set by the Directive, at the EU level no discernible impact of the ETD in terms of the European consumption switch from gasoline to diesel was identified. However, for seven Member States (Bulgaria, the Czech Republic, Lithuania, Latvia, Malta, Poland and Romania) the ETD seems to have marginally contributed to their diesel-gasoline demand switch, given that their diesel-to-gasoline demand ratios in the counterfactual environment (estimated by OURSE model) without the ETD were estimated to decrease, on average over the two periods, by 0.63% to 2.07%.

Taken together, the reduction in demand due to RED and ETD caused an estimated average decrease of the crude distillation unit (CDU) utilisation rates of EU refineries, of between 0.9% to 1.9% over the entire 2000-2010 period. These reductions are larger in North Europe (NE) than in Southern Europe (SE) by an average factor of between 1.8 to 2.2, mainly due to higher penetration of biofuels

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[47] Estimates for, correspondingly, 'min' and 'max' scenarios. The actual (estimated) refinery margins were compared with those of: (i) 'max' scenario, in which EU biogasoline consumption during 2000-2012 is eliminated and substituted by additional production from EU refineries; (ii) 'min' scenario, in which the EU biogasoline consumption is eliminated and replaced by EU gasoline that otherwise would have been exported.

[48] Twelve Member States (Bulgaria, Cyprus, Czech Republic, Estonia, Spain, Greece, Lithuania, Luxembourg, Latvia, Malta, Poland and Romania) were found to be affected by the ETD's minimum tax levels of gasoline and diesel excise duties.

in NE than in SE and also due to larger demand changes in NE as a result of the ETD . The maximum reduction of 3.1% CDU utilisation rate is observed in the second sub-period of 2005-2010 in NE, which is due to larger relevant changes in demand.

Further, it is estimated that in the counterfactual situation without the RED and ETD in place, European imports of diesel oil (from Russia) would have increased, on average over the 2000-2010 period, by 1% to 6.3%, with an upper bound of 8.9% increase. Thus, if one focuses on the trade dependency issues, reduction in diesel imports dependency of the EU (from Russia) can be considered as the most noticeable EU-wide benefit that the RED and ETD directives brought about. The fuel demand shift due to the Renewable Energy Directive's impact could have contributed to decreasing utilisation rates at European refineries and some foregone revenues, estimated as 3.7 euro cents per barrel of throughput.

Empirical analysis of the EU refineries emission trading positions during the first two phases of the **EU Emission Trading Scheme** indicates that allowances provided to the sector in total exceeded its total verified emissions in both phases (by 6.1% in the 1st phase and by 7.6% in the 2nd)[49]. This does not mean that all refineries were over allocated as we observe that in both trading periods slightly more than one quarter of installations (27.2% and 28.3% correspondingly) in the refining sector were short of emission allowances based on EUTL data. Statistical analysis of the emission trading data, matched with the characteristics of respective refineries, suggests that while operational characteristics and emission levels of refineries played a role in determining resulting emission trading positions, 'shortage' of emission allowances was also the result of initial allocation of allowances. This suggests that approaches to emission allowance allocation by national regulatory authorities are an important consideration for the analysis of the two initial phases of the ETS.

The immediate impact of the EU ETS on refinery margins depends on the sector's ability to pass the associated costs through to fuel consumers. As mentioned above, the ability to pass the costs through depends on such factors as product price demand elasticity and the ability of actors to adjust the product supply in the short and in the long-term. While refined oil products are typically characterized by relatively inelastic demands, their high international mobility and substantial product uniformity can constrain the extent of the cost pass-through when the incremental costs are not equally incurred by market participants. Pass-through may be limited both through the potential loss of exports and through displacement of domestic production by imports from countries with less stringent environmental regulations. Based on the available estimates, it would appear that EU refineries can, at least in the short term, pass the ETS-associated costs through to final consumers (however not to the same extent in different markets, as it depends on various factors such as market structure and degree of exposure to international trade for a particular product, resulting in a wide range of possible pass-through rates)[50]. Since the free allocation under the EU ETS is based on a hypothetical assumption of no carbon cost pass-through, if full cost pass-through were possible, the impact of the EU ETS on the refining sector would be smaller than looking purely at allocation numbers might imply. Overall however, the available empirical evidence is not conclusive with respect to the degree of ETS-related costs pass-through actually exercised.

On the whole, during its first two phases, the EU ETS did not impose significant costs on the oil refining sector, as the sector was endowed with a surplus of emission allowances which they could have sold (allowances for the 1st and 2nd phases) or banked into the 3rd phase (allowances from the

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[49] This is not a sector specific shortcoming of the ETS. In relative terms, the refining sector was not among the sectors with most allowances in excess of its verified emissions. According to the EUTL, allocations to the ETS industrial sectors were above their verified emissions by 9.75% and 32.5% during the 1st and 2nd trading periods, respectively.

[50] The recent Commission's Impact Assessment for the revision of the EU ETS (published on 15.07.2015 http://ec.europa.eu/clima/policies/ets/revision/docs/impact_assessment_en.pdf) estimates the possible cost pass-through in refining as reported in studies on the statistical relation between the carbon price and the final products' prices. These studies do not consider possible shifts in producers' market shares in the long term.

2nd phase). The theoretical value of those allowances is estimated at 1.1 billion euros, approximately 11 million euros per refinery considering the average price of emission allowances during each of the phases. Naturally, this implies that excess permits could be sold at the assumed prices, while in reality it was determined by the market prices of CO_2 at each particular point of time. The limited impact of carbon trading on emission abatement investments was to a certain extent explained by overall allocation of allowances in the first two phases, together with lower than expected levels of economic activity and a resultant low emission allowances price.

Table 3. Estimated costs of fuel quality requirements on refineries (2000-2012)

Concept		Total cost per refinery and year (Million euros)	Cost per barrel of throughput (euro)
Investment	Meeting gasoline specifications [1]	3.4	0.06
	Meeting diesel and gasoil specifications [2]	4.9	0.08
	Meeting specifications or all clean fuels [3]	8.5	0.14
Operating costs	All fuel quality specifications [4]	8.9	0.15
TOTAL [5] = [3] + [4]		**17.4**	**0.29**

Source: Solomon Associates (2014a)

Fuel Quality Legislation has had an indirect effect on refineries via the specifications that products need to meet. Measures for meeting fuel quality requirements were quantified using the declared investment costs for fuel specifications compliance during 2000-2012 provided by Solomon Associates (2014a). The estimated additional costs per refinery are summarized in Table 3.

The data show that the actual expenditures of the industry in the framework of Fuel Quality Directive compliance are comparable to the expected expenditures estimated in ex-ante impact assessments. The economic impact is to a great extent associated with the directive's limits on the sulphur content of fuels. Other provisions of the Fuel Quality Directive did not result in tangible economic impacts during 2000-12 as investments for meeting vapour pressure requirements occurred before 2000; the reduction of the content of polycyclic aromatic hydrocarbons took place at the same time as hydrodesulphurization, resulting in negligible additional costs; lead-based additives to gasoline were phased out before 2000; the use of methyl cyclopentadienyl manganese tricarbonyl (MMT) in European countries was avoided as a result of a consensus among users and producers; and there is no reliable way of estimating any additional costs related to FAME regulation incurred within the main refineries' operations. It was observed that the largest part of the operating cost increase experienced by EU refineries was related to energy costs (regardless of whether it is fuel quality related or not), probably from growing energy prices.

As mentioned above, given that the **Directive on Clean and Energy Efficient Vehicles** has had little impact on the market for cleaner vehicles during the study period, its potential effect on the oil refining sector is deemed to have been negligible.

The impact of the **Industrial Emissions related Legislation** (see footnote 22) has followed two main channels: first refineries have had to change their configuration to meet emission levels and second they have seen a shift in demand for some of their products. With regards to direct impacts these are sizable and have increased with time. In the 2000-2012 period, each EU28 refinery had on average incurred capital expenditures of 4.29 million euros per year for compliance with emissions and effluents regulation, with a notable increase between the period 2000-2006 (average of 3.8 million euros per refinery) and the period 2007-2012 (average of 6.4 million euros per refinery). These investments accounted for a fairly constant share of 10% of EU refineries' total annual capital investments. Complexity and - to a lesser extent - capacity, influence a refinery's pollution regulation-related capital costs. Using the concept of equivalent distillation capacity[51] to adjust for these two factors shows that the average capital cost impact from pollution regulation differs by up to a factor of two between EU regions.

The cost burden from the observed capital and estimated associated operational expenditures is 0.13 euros per barrel of throughput during 2000-2012 (0.09 euros per barrel of throughput during 2000-2006 and 0.16 euros per barrel of throughput during 2007-2012). Contrary to capital expenditures and operational costs related to fuel quality specifications (based on additional fuel consumption of desulphurization units) the operational cost component related to this piece of legislation had to be estimated from the reported capital costs based on a rule-of-thumb percentage value, and hence has a relatively higher uncertainty. The cost impact from switching to cleaner refinery fuels (high-sulphur to low-sulphur fuel oil or natural gas) could not be analysed due to lack of data.

The indirect impact via demand shifts of sulphur in fuels and large combustion plants regulation is its contribution to the roughly 50% demand drop for inland fuel oil used in power plants observed during 2000 to 2012, or about 30 to 45 million tons in absolute terms. The concomitant reduction of supply was achieved through (in decreasing order of importance) (i) increased conversion capacity, (ii) increased uptake of fuel oil by the marine fuels market, and (iii) shut-down of EU refining capacity. A negative competitiveness impact from this secondary legislative effect seems likely, but could not be quantified in this study.

However, data for capital expenditure on pollution control in other global refinery regions indicates higher numbers than in the EU for the US Gulf and East Coast and similar numbers for the Middle East, with increasing convergence between these regions in recent years. For Russia the numbers were significantly lower at all times. Hence, the overall competitiveness impact vis-à-vis the US and Middle East is judged to be rather low. It appears to be more significant vis-à-vis Russia, where refiners have a capital cost burden from pollution regulation of about one third of that in the EU, and the associated operational costs are also be lower, e.g. due to lower energy prices. It should also be noted that comparatively higher investments in other world regions during the period under observation could reflect that much of the investments were undertaken by EU refineries before that period as the requirements in terms of level emissions being achieved by other regions between 2000 and 2012 were mostly in place before 2000 in the EU.

Analysing the Member State-specific arrangements for the implementation of the **Strategic Oil Stocks Directive**, we conclude that the obligation is generally financed in a competitiveness-neutral way and the level broadly consistent with the figure presented in the European Commission's impact assessment. Where the obligation is imposed on the industry, strong indications exist that the costs of stockholding can be (fully) passed through to end consumers. However, the full cost pass-through requires an environment of level-playing field competition as a necessary condition. Under certain national arrangements, the oil refining industry can benefit from stockholding obligations by renting out spare storage capacity and/or by selling "tickets". The latest Council Directive on Strategic Oil Reserves (2009/119/EC) aims at further optimizing the system with a number of specific measures. Since the Directive allowed for a transposition period until the end of 2012 with additional

[51] Equivalent Distillation Capacity (EDCTM) is a term developed by Solomon Associates. EDCTM provides a statistically tested method to compare cash operating costs of refineries of different types and sizes. Refer to section 2.1.1 in JRC (2015) for further details.

exceptions for certain Member States until the end of 2014, it is too premature to properly assess the impacts.

EU and international **sulphur regulation for marine fuels** did not result in significant additional investment costs for refineries. This was mainly because the supply of regulation-compliant residual marine fuels was achieved by drawing on the existing pool of fuel oils and blending high-sulphur variants with low-sulphur variants, rather than investing into new desulphurization capacity. It is also unlikely that European refiners invested in additional distillation capacity to meet marine diesel/gasoil demand over the period 2000-2012, given the very low production level observed (≈0.6% of refinery production and declining). Moreover, marine fuels sulphur regulation has not driven fuel oil based products out of the EU bunker market, as though their relative share stopped growing in 2008, there is no switch towards distillate grade marine fuels. Price impacts from the regulation have been absent or profit-neutral for refineries (i.e. costs for higher-priced inputs, like low-sulphur fuel oil, were passed on to markets). Given that no significant investment costs were incurred and that price impacts only reflected the natural scarcity of low sulphur crude oil (i.e. higher input prices that were passed on to markets), it can be concluded that the cumulative economic impact from marine fuel legislation during 2000-12 on the refining sector was minimal (apart from minor logistical costs related to transport and blending). This also confirms the Commission's own impact assessment of the second Sulphur Emission Control Area in the North Sea showing that this measure seemed not to have had any significant impact on marine fuel prices.

In addition, while EU refineries were negatively affected by declining demand for residual grade products in general, this was driven by lower inland industrial consumption from power plants (see section on IED), while, apart from a dip after the financial crisis in 2009, the demand for residual marine bunkers was growing overall. Independently from marine fuels regulation, the price of *all* residual grade bunker fuels (low and high sulphur) experienced a systematic rise in 2009, narrowing the gap to gasoil by about 15 percentage points, which should provide refiners with some financial compensation for the overall shrinking fuel oil market. While in steady decline on an EU average level, residual fuel oil remains important especially in the Baltic, Benelux, France, and Iberian regions, with shares from 16% to 20% of the refinery output per barrel in 2012. Refineries in these regions depend on marine fuel markets as an outlet for their residual fuel oil and are therefore potentially vulnerable if future legislation reduces its usability as a marine fuel.

The **Energy Efficiency Directive** was due to be transposed into national legislations by June 2014. Due to the insufficient time since transposition, the effectiveness and impacts of the sets of specific measures implemented by the national governments are difficult to assess correctly today. In the Commission's impact assessment, the potential energy savings resulting from the current system of legislation were estimated as significant; however, the scale of the actual savings depends on specific national implementation and the individual reactions of consumers. The impact of the Directive on the oil refining sector can potentially be two-fold and stem from the operational requirements and/or from the demand side. However, without the knowledge of specific energy saving measures at the national level and the related cost/benefit data, the magnitude, and even the direction, of the overall impact is at the moment impossible to assess. Moreover, it can be expected that the EU energy saving progress would be to a large extent determined by emission reduction and renewable energy targets rather than energy efficiency measures on their own – for this reason, the impact of the Energy Efficiency Directive would be inherently difficult to separate empirically.

The observed effectiveness in achieving the objectives of the **Air Quality Directive** was mainly attributed to the effective EU-level source control measures, in particular fuel quality policies and industrial emissions. We thus conclude that in the period 2000-2012, the above-mentioned fuel quality (FQD) and industrial emissions (IED) policy instruments addressed the air quality-related issues in the oil refining sector in a much more targeted way than the AQD. In our assessment, we therefore did not attempt to disentangle the analysis of AQD´s impacts from that of FQD and IED, described above. The impacts described above are summarized in tables 4 to 6 grouped by the three impact channels described in the methodology section.

Table 4. Summary of impact cost of legislation on the operations of refineries between 2000-2012 via direct regulation.

Legislation	Associated capital investments	Associated operating costs	Cost[52] per barrel of throughput
EU Emissions Trading System (EU ETS)	No evidence for investments specifically targeting abatement of CO_2 emissions	No direct impact at sector level (permit costs for CO_2 emissions) until 2012, because sector on average received more free permits than verified emissions. The theoretical value of the over allocation 1.1 billion euros or 11 million per refinery. Indirect impact: possibly higher price for electricity purchased by the refineries	Theoretical value of the allowance surplus estimated at 0.028 euro per barrel of throughput. Until 2012 the indirect effect could be experienced, but the purchased electricity is <10% of average refining energy consumption, and the electricity costs grew at the same (or slower) pace as for the other energy sources. Thus, attributable impact probably negligible.
Integrated Pollution Prevention and Control Directive (IPPC) and the Large Combustion Plants Directive	Annual average of 5 million euros per refinery, higher (6.4 million euros) after 2006	Estimated[53] as 6.3% of capital investments, yielding 1.8 million euros annually per refinery	0.13 euro per barrel over 2000 to 2012
Strategic Oil Stocks Directive (SOSD)	Implementation mechanisms differ strongly at national level. For the majority of Member States, impossible to disentangle from IEA requirements related costs. Majority of the costs incurred before 2000.	Considered of low relevance for refineries and affects them in a competitiveness-neutral way.	Own additional cost to that related to the IEA reserve requirements is negligible.
Energy Efficiency Directive (EED)	Only very recently transposed. The impact cannot be disentangled from that of other legislations, as well as cost optimization goals of refineries.		Own additional effect is negligible.
Air Quality Directive (AQD)	The impact cannot be disentangled from that of emissions and effluent regulation, FQL and MFD.		Own additional effect is negligible.

Table 5. Summary of cost impact of legislation on refineries between 2000-2012 through product specifications.

[52] Capital and Operating costs

[53] This estimate was derived by using the rule-of-thumb that the annual operating costs of the 'average' pollution control device amount to 6.3% of its capital costs and hence has a relatively higher uncertainty.

	Associated capital investments	**Associated operating costs**	**Cost per barrel of throughput**
Renewable Energy Directive (RED)	New blending, storage, and transport facilities: 0.5 million euros per year per refinery (CONCAWE 2014)	Not estimated	0.01 euro per barrel 2000 and 2012.
Fuels Quality Legislation (FQL)	On average 8.5 million euros reported investments per year per refinery.	Estimated 8.9 million euros annually per refinery over 2000 to 2012	0.29 euro per barrel between 2000 and 2012.
Marine Fuels Directive (MFD)	Negligible, given that the required fuel specifications were achieved by using low-sulphur crude oil and by re-blending.	Only logistical costs associated with re-blending.	Probably negligible due to use of existing blending capacities.

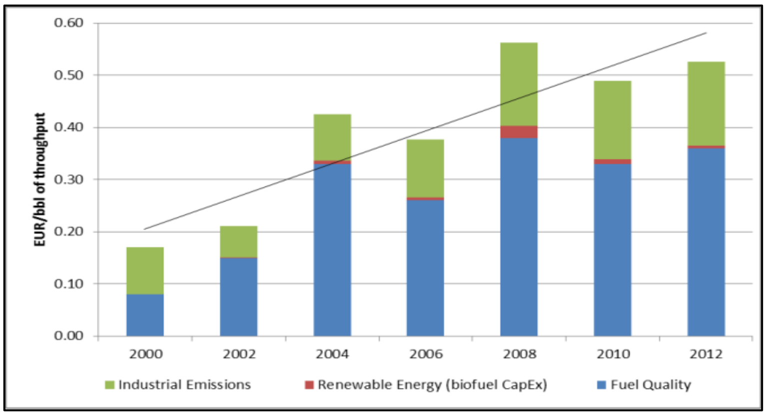
Table 6. Summary of cost impact of legislation on refineries between 2000-2012 via market demand related impact channels.

	Demand impact	**Contributed to 'Dieselisation'?**	**Impact on refineries**
Renewable Energy Directive (RED)	1% gasoline average demand reduction during 2000-12, 3% reduction in 2012	No. Has helped to limit an increase in EU diesel deficit.	Could have marginally contributed to utilisation rate reduction (between 0.9 and 1.9%). The OURSE model estimates the possible forgone revenues from utilisation reduction at 3.7 eurocent per barrel of processed crude.
Energy Taxation Directive (ETD)	Estimate of 0.2% average annual demand reductions for both gasoline and diesel	No. But not counterproductive either.	Probably negligible due to the very small effect on fuel demand.
Directive on Clean and Energy Efficient Vehicles (DCEEV)	During 2000-2012 the impacts on the car and, thus, the fuel markets were insignificant.	Unknown at present; evaluation study to be published Q4 2015.	The potential effect on the oil refining sector is less important and so far negligible as well.
Integrated Pollution Prevention and Control Directive (IPPC) and the Large Combustion Plants Directive	Reduction of heavy fuel oil demand from power sector (combined effect with sulphur content of fuels Directive)	No. Probably neutral as deeper conversion increases both gasoline and diesel production.	Requires refineries to react to reduced fuel oil demand: deeper conversion, orientation towards marine fuels, or shut down. The average effect cannot be quantified directly.
Energy Efficiency Directive (EED)	The impact cannot be disentangled from that of RED, ETD and IED.		Own additional effect is negligible.
Air Quality Directive (AQD)	The impact cannot be disentangled from that of FQL, MFD and IED.		Own additional effect is negligible.

As mentioned above, this exercise is focused on the impact of the legislation on the refining sector while many of the benefits presented in table 2 concern also other sectors and society in general. In that sense, it is not possible to present an overall view of the costs and the beneficial impacts of the observed legislation for the sectoral scope of this study. But at the level of individual legislation packages the information presented in Table 2 above gives an horizontal view of the economic impacts in terms of the legislations' effectiveness and the corresponding societal benefits.

Finally, we can cumulate these impacts for the measurement of additional costs derived from the legislation analysed during the period 2000-2012. Based on the Solomon Associates (2014a) dataset, in (Figure 13) the estimates of the total cost effect per barrel of throughput of the three pieces of legislation (IED, RED and FQD) are presented. These three pieces of legislation are responsible for the major part of the overall regulatory impact on European refineries in the form of additional capital expenditures and the corresponding additional operating costs according to our analysis. In addition, we estimated the contribution of fuel demand shift due to the Renewable Energy Directive's impact into the decreasing utilisation rates of European refineries and their associated foregone revenues. The modelling exercise within OURSE estimated the average effect at 3.65 eurocents per barrel[54] of processed crude oil. The total cost impact of the three main pieces of legislation exhibited an upward trend during 2000-2012 with a clear increase between 2000 and 2008 (from 17 to 56 eurocent per barrel of throughput) and appears to have stabilized afterwards at the level of 50 eurocent per barrel of throughput. These yearly figures do not contain the modelled effect of the demand shift due to RED, which was estimated over two aggregated 5 year periods and cannot be presented on a yearly basis. The total quantified average cost effect during 2000-2012 was assessed at 47 eurocent per barrel of throughput (Figure 14).

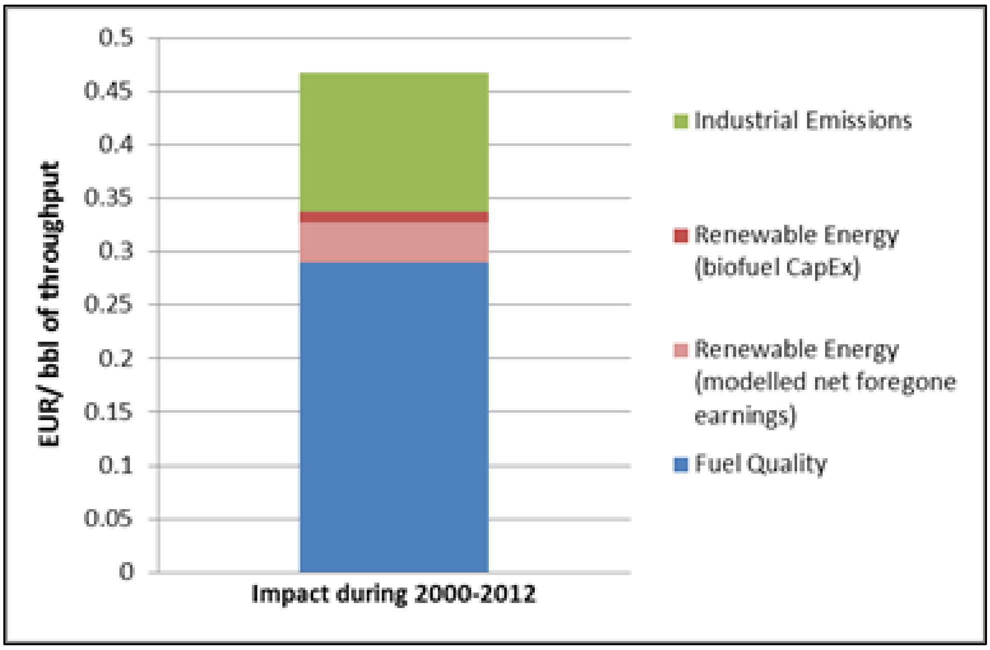
Figure 13. Estimated quantifiable impact of the legislation on EU refineries during 2000-2012 barrel of throughput.



Source: Solomon Associates (2014a)

[54] Ranging between 3.56 and 3.74 eurocents per barrel in different scenarios modelled by OURSE.

Figure 14. Average estimated quantifiable impact of the legislation on EU refineries during 2000-2012 barrel of throughput.



Source: Solomon Associates (2014a) and own elaboration using OURSE.

This estimate of costs reflects the total cost of legislation in the EU and does not provide an estimate of the additional cost compared to those in other world regions. While the competitiveness analysis below partly allows putting this cost and the evolution of margin differentials (which exclude investments) into perspective, the impact of the evolution of regulations in other parts of the world on non-EU refineries should also be taken into account. Evidence on operating regulatory costs in other world regions is not available for all the pieces of legislation analysed. Some data is available for one of the main components of the identified costs, fuel quality. Here we see a dual impact depending on whether we consider EU[55] or Extra-EU markets. Any non-EU refiner wishing to export fuels to the EU would have to meet the fuel quality standards. The cost of energy in other world regions is generally lower than in the EU and thus a major part of the 15 euro-cents of operating costs (mainly related to higher energy consumption) can be considered additional to the costs in other world regions. For extra-EU markets with lower quality standards, the identified costs can be considered as additional.

Further to the robustness assessment of the data sources described in the methodology section, the quantification of costs presented here has been cross-checked by comparing them to other existing estimates, further reinforcing their robustness. First, our estimates for fuel quality legislation are within or close to the interval bounds (mostly at the lower end) of ex-ante estimates (ICCT, 2012; Purvin and Gertz, 2000). It can therefore be argued that our estimates based on historical data are to be considered as describing the lower bound of the costs effects of fuel quality regulation on European refineries. Second, a recently published study undertaken by the Commission provides similar results with a different data source (Eurostat Structural Business Statistics and Environmental Protection Expenditure)[56].

It should be noted that specific data on the administrative burden associated with the legislations is not available within this fitness check. However, it was not mentioned as an area of special concern

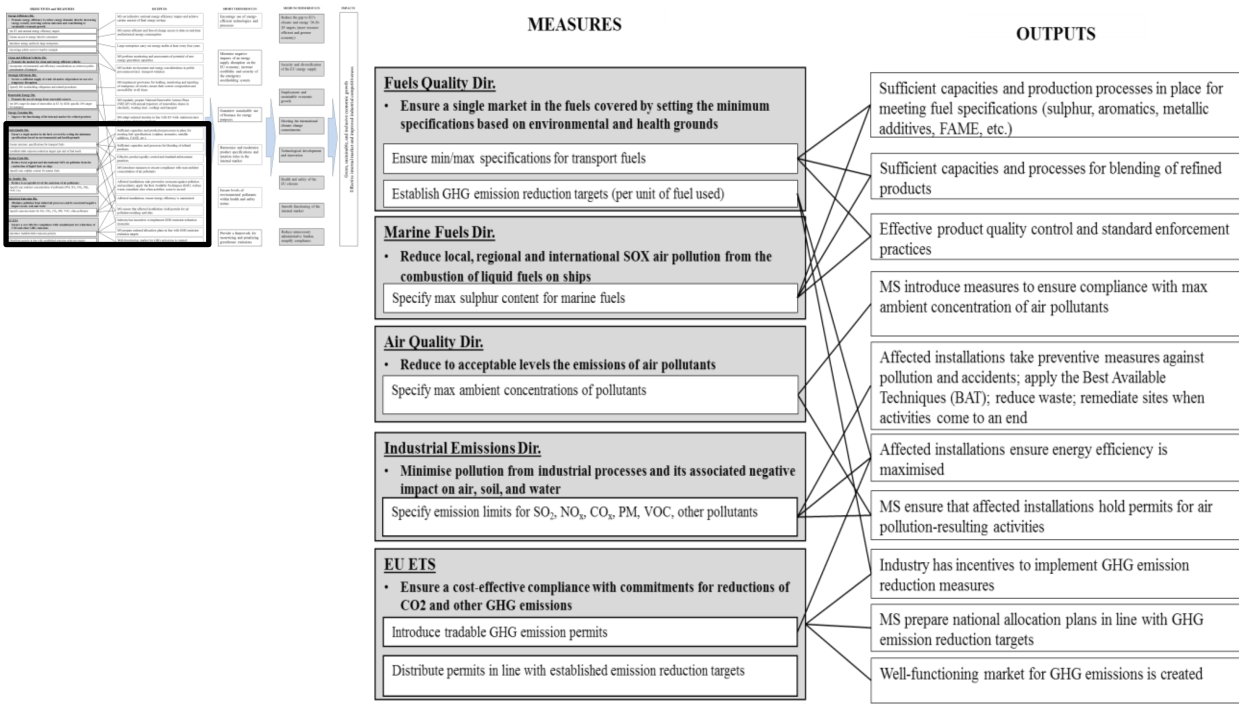
[55] Or regions with similar fuel quality legislation as the EU.

[56] Environmental expenditures in EU industries: Time series data for the costs of environmental legislation for selected industries over time.

either in the available studies or in the consultations with industry. Moreover, the **Fuel Quality related legislation** itself does not impose visible additional costs related to compliance enforcement and control. The actual measurements and fuel quality tests are in line with those already carried out as a part of the enforcement system for air quality of road transport emissions.

The results presented also include several several pieces of legislation the impact of which has been judged as unquantifiable or undistinguishable from the others even though it only covered four sets of legislation. As can be seen in Figure 15, the cost effect of the Fuel Quality Legislation implicitly contains the influences of Air Quality Directives, the Energy Efficiency Directive (by stimulating refineries to make additional effort to improve energy efficiency and mitigate effects of extra energy use to meet the fuel quality requirements), and Marine Fuels Directive (by helping achieve objectives impossible to achieve by re-blending and crudes switch). In addition, the capital cost effect of the Renewable Energy Directive partially covers the effects of the Energy Efficiency Directive related to the use of renewables. Lastly, the cost effect of complying with Industrial Emissions and effluents regulation also contains the implicit impacts from established objectives of the Air Quality Directive and the Energy Efficiency Directive, when applied to the European refining sector.

Figure 15. Enlarged section of the intervention logic (see Figure 3) representing the most interacted section.



To round up the discussion on the cumulative cost impact of EU regulation on the refining industry, it is necessary to review the issue of (regulation) cost pass-through possibilities. If there were such a possibility without loss of market share the direct and product specification impacts of legislation would not be relevant for the sector (i.e. consumers would be willing to pay higher prices that would cover the additional cost without reducing consumption levels and profit margins would remain constant). The current literature on this topic generally argues that the cost pass-through of domestic firms depends on the strategic interaction vis-à-vis foreign competitors. The stronger the foreign competition not subject to given policy measures in the market, the fewer the possibilities for cost pass-through a domestic company has. More specifically, the ability of the producer to pass through additional costs is determined by the competitors' expected reaction to the changes in the producer's own price or output.

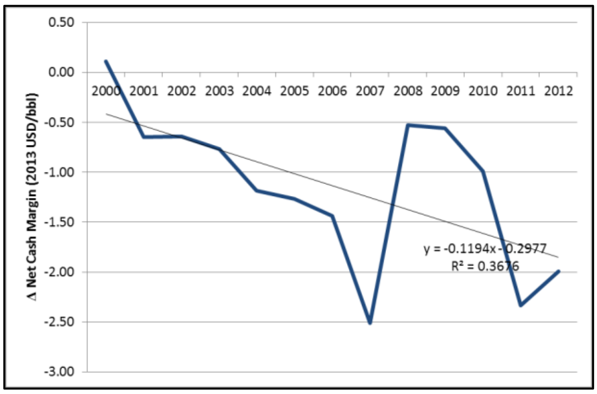
In general, in an oligopolistic market without strategic interaction the firms treat the output of the other firms as a given and, therefore, have the ability to fully pass through the incremental costs. In reality, the market for refining products in Europe is subject to foreign competition with different degree of intensity for different products. Thus, higher possibilities for cost pass through exist, for example, for low sulphur transport fuels, where all producers, both European and foreign, must comply with standards and incur additional compliance costs, than in others such as, for instance, all products affected by the industrial emissions regulation or emissions trading system which mostly affect European producers. It can be said that the strategic interaction between domestic and foreign firms limits the ability to pass through costs implied by the local (limited only to EU) policy. To determine the actual magnitude of the possible costs pass-through is an empirical task. In the scope of this study and with the available data it is not possible to make a comprehensive assessment of the cost pass-through issues faced by the EU refining industry and the available empirical evidence is not conclusive with respect to the degree of costs pass-through actually exercised. Thus our results show the impact when no cost pass-through is possible and no scenario using different value of cost pass-through has been made in this exercise.

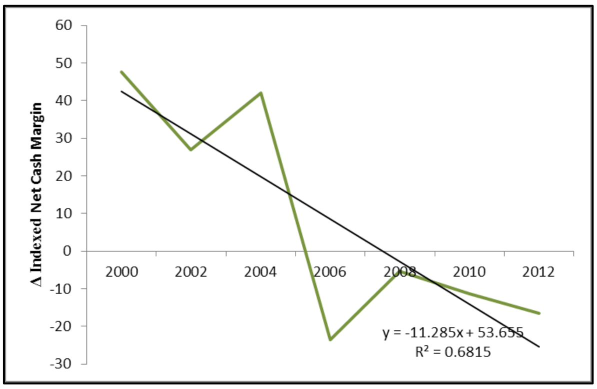
Competitiveness impacts

Net cash margins of EU refineries (see Figure 16) and their non-profit oriented regulatory (capital and operational) expenditures were deemed to represent accurate indicators of competitiveness of the sector. After assessing whether and how the competitiveness of EU refining had changed, the main driving factors were identified. The data from IHS (2014) (in levels) and the indexed data from Solomon Associates (2014b,c) suggest that in terms of net cash margins, the EU refining sector has lost substantial ground against its most important competitor regions between 2000 and 2012: US Gulf Coast, US East Coast[57], Middle East, South Korea/Singapore and Russia/FSU. As can be seen in Figure 16, there are differences between the data sources in terms of how the EU28 region fared against the competition. According to Solomon indices, the EU was performing better than the average of the five world regions in 2000, but its performance deteriorated around 2006. The data from IHS shows that between 2000 and 2012, Europe experienced a net margin advantage compared to other regions only in 2000 and then between 2007 and 2010.

Overall, European refining margins have declined at an estimated 0.12 USD per barrel per year compared to competitor regions. As a consequence, European margins have fallen below the average of its competitors. The two US regions of the Gulf Coast and East Coast are major drivers of this trend, together with some of the highly industrialized countries of the Far East. The Middle East region has not (or hardly) contributed to this trend while for the Former Soviet Union the two data sets are somewhat different.

Figure 16. EU28 net cash margin vs. average of competing regions[58].





Source: IHS(2014) on the left and Solomon Associates (2014b,c) on the right.

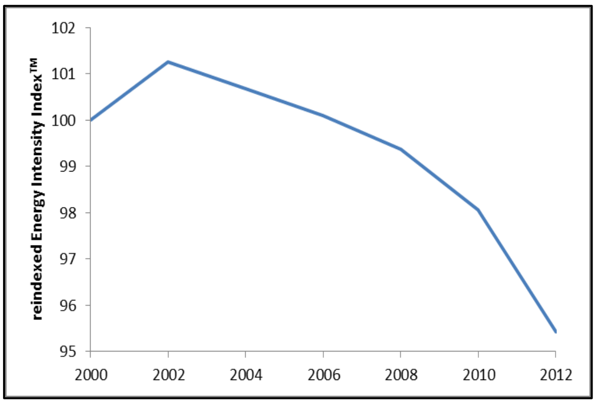
Refining net margins are defined as the difference between gross margins (revenues minus costs for all inputs) and operational costs. Hence, it is possible to identify the relative influence of these two components on the overall trend of net margins. According to the data from Solomon (2014b,c), EU gross margins have remained stable in comparison to its main competing regions. Further analysis reveals that the overall neutral trend is the combined effect of a strong deterioration with respect to

57 Competing regions include US Gulf Coast, US East Coast, Middle East, South Korea/Singapore and Former Soviet Union.
58 The dataset includes net cash margins also for India but only for 2010 and 2012. This is insufficient for a trend analysis.

South Korea/Singapore and a strong improvement with respect to the Middle East, as well as a slight improvement with respect to the two US regions and a slight deterioration with respect to Russia. The second component determining net margins are the operational costs. Computations based on Solomon (2014b,c) indicate that EU28 operational costs have steadily grown above the average observed for the competitor regions. In other words, the observed relative decline of net margins is due entirely to the relative increase of operational costs in Europe. The regions driving this trend are the Middle East and the two US regions. The latter two had a cost level persistently higher than the EU28's for the first few years of the period, but between 2006 and 2008 a new trend towards relatively lower costs started, eventually leading to similar and – after 2008 – lower cost levels than the EU28 level. After analysis of the different categories of operational costs, it can be observed that staff and other operating costs in the EU 28 increased by little compared to the average of the competitor regions, while a very robust result is that EU energy costs have deteriorated. Indeed, the linear regression suggests a relative deterioration of EU28 energy costs of 1.4 USD/ton per year (0.2 USD/bbl per year), which would explain almost all of the observed relative deterioration of EU28 overall operational costs and, consequently, net margins. Further data analysis shows that EU energy costs are deteriorating with respect to all of the competitor regions, except South Korea/Singapore, with which it roughly stayed on the same level. The worst deterioration is observed with respect to the Middle East, the US Gulf Coast, and the US East Coast. The impact of these additional costs is explained mainly by energy prices as energy intensity of the EU refining sector has been decreasing (Figure 17) and the difference in energy intensity with other world regions (Figure 18) have been increasing.

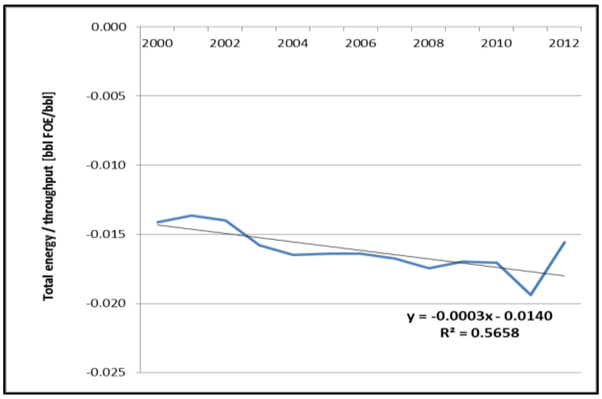
At the level of individual refineries there were increasing differences between the most and less performing refineries between 2000-2012. In general, the international competitiveness of the bottom 50% of EU refineries has declined by more than that of the top 50% (Figure 19). The observed performance gap (measured in terms of net margins) between the EU28 refineries has widened. The spread between the groups of the 20 top performing and 20 bottom performing refineries in the sample has increased more than 2-fold from about 2.7 to 5.9 USD/bbl of throughput despite the fact that the EU closed a number of refineries between 2000-2012.

Figure 17. Solomon Energy Intensity Index^{TM} for EU28.



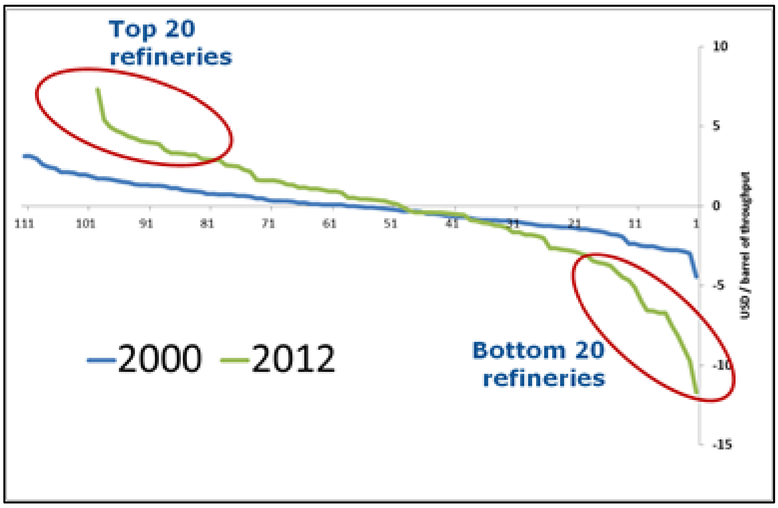
Source: Solomon Associates (2014a)

Figure 18. Difference in average refining energy per throughput (EU vs competing regions).



Source: Solomon Associates (2014a,b)

Figure 19. Net margins of individual EU28 refineries compared to EU28 average.



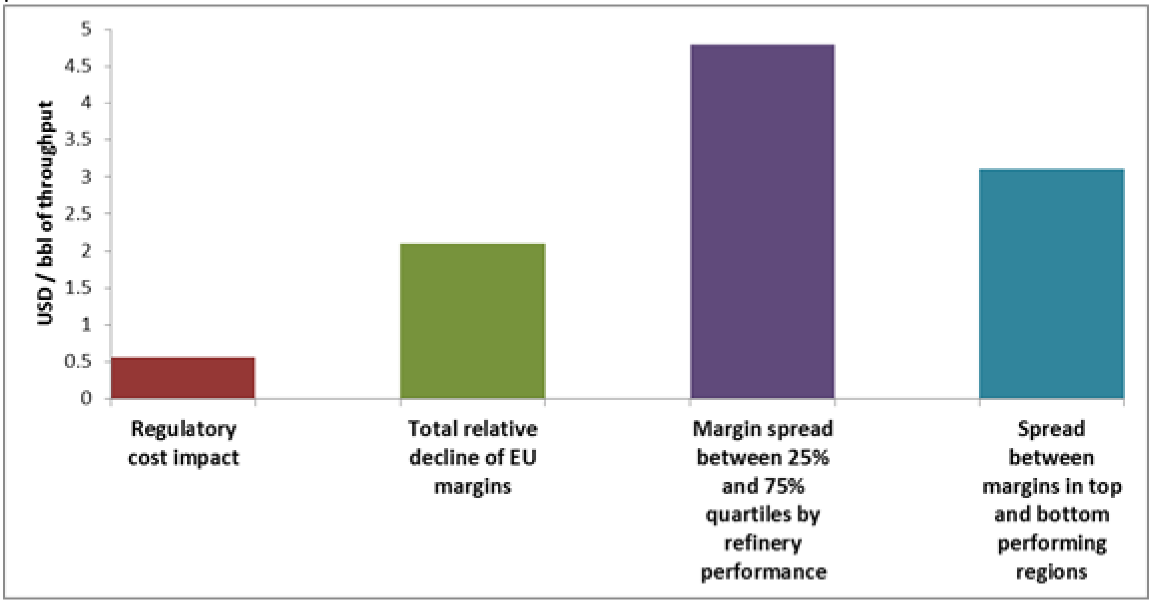
Source: IHS (2014)

Looking at the particular characteristics of EU refineries and comparing the top performers with the bottom ones, the top 20 EU refineries considered in this study are on average larger and have 65% more capacity than the bottom 20; and their product mix have a larger share of the middle distillates, including road diesel, for which there is a higher demand in the EU28. These refinery specific differences are reflected in large differences among regions in terms of net margins. These differences appear to be rather persistent for the bottom performing regions as they have average net margins below the EU average, while the performance of the top regions exhibited considerable shifts between 2000-2012.

Turning now to looking at the impacts of legislation on the loss of competitiveness of European refineries during the period 2000-2012, and as shown in Figure 14, the cumulative quantified cost impact per barrel of processed throughput from the investigated regulation packages is significant. The identified cost impacts of regulation on the performance of refineries primarily imply the diversion of revenues towards regulatory compliance investments and operating costs rather than making other investments and operation adjustments that improve competitiveness. In total, the cumulative impact of regulation explains 25% of the total loss of competitiveness (Figure 20).

The remaining 75% is explained by a myriad of other factors, among which are the characteristics of refineries themselves such as configuration, size and location, as well as the large variability in EU refining input costs, product slates, revenues, operating costs, and, therefore, net margins. As can be seen, the impact of legislation is smaller than the spread in margins between refineries or regions in the EU. A number of refineries have been able to overcome the regulatory impacts while maintaining healthy margins (Figure 19), while for a number of others, regulatory costs combined with high energy prices, might well have limited their capacity to invest in competitiveness enhancing technologies by diverting most of their capital into regulatory compliance.

Figure 20. Comparison of the quantified total cost effect of legislation with other performance parameters of EU refineries.



Source: IHS (2014), Solomon Associates (2014b,c) and own calculations with OURSE model.

Impact of legislation proposed or adopted after 2012

The focus of this fitness check is the ex-post assessment of the impact of legislation on the refining sector in the period between 2000 and 2012. Nevertheless, in line with the mandate for this fitness check, a commentary is warranted on those pieces of legislation the impacts of which are expected to be more significant beyond that period. This concerns in particular three directives, namely: the EU ETS Directive that has entered its 3rd phase with new provisions; the IED under which stricter limits have been approved for refineries; and the sulphur in marine fuels Directive, which has been implementing stricter sulphur limits in marine fuels. Below is a short overview of the expected impacts of these regulatory developments.

With the start of its third phase in 2013, the EU ETS underwent significant changes to its functioning. Instead of the Member State-driven allocation of emission allowances used during the earlier phases, this 3rd phase adopted Community-wide harmonised rules of allocation. Auctioning has become a more prominent method for allocating emission allowances. The overall emission cap is subject to the annual reduction factor of 1.74% from 2013 onwards. Beyond the third phase of the ETS, the European Council in 2014[59] endorsed a binding EU target of at least 40% domestic reduction in GHG emissions by 2030 compared to 1990, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. The annual factor to reduce the cap on the maximum emissions will go from 1.74% to 2.2% as from 2021.

Importantly, raising the share of auctioning in the third phase of the EU ETS has brought about concerns regarding the potential migration of production in the affected industries towards world regions with or without lower emission reduction commitments - so called 'carbon leakage'. As a means to prevent it, the sectors identified as being under significant risk of carbon leakage will continue to be entitled to receiving a higher share of free emission allowances until 2019. The free

[59] Conclusions of the European Council of 23 and 24 October 2014.

allocation is determined by an adopted efficiency benchmark, based on emission performance[60]. Manufacturing of refined petroleum products is included in the current list of sectors and subsectors deemed to be exposed to the risk of carbon leakage for the periods of 2013-2014 and 2015-2019[61]. The European Council (see previous reference) decided that existing measures will continue after 2020 to prevent the risk of carbon leakage due to climate policy as long as no comparable efforts are undertaken in other major economies in order to provide an appropriate level of support for sectors at risk of losing international competitiveness. It was also decided that the benchmarks for free allocations will be periodically reviewed in line with technological progress in the respective industry sectors. Amongst other factors, the consideration to ensure affordable energy prices and avoid windfall profits will be taken into account [62].

In view of these changes, the impact of the EU ETS on the competitiveness of the oil refining sector would need to be reassessed in the third and later phases. By gradually tightening the emissions cap[63], the third phase is expected to become more costly for the affected sectors. While this change is driven by the need to increase the effectiveness of the system in reducing GHG emissions and to drive innovation, this may be associated with an increasing cost pressure on the industries covered. It will therefore become increasingly important to achieve a balance between the protection of competitiveness in these industries with the overall goals of the ETS.

As a preliminary observation, looking at EUTL data[64] reveals that in 2013 the EU refining sector was allocated less than its verified emissions by 19.9 million EUA[65] overall, with 67% of EU refineries being short of emission allowances as a result (meaning much lower over-allocation than in the previous phases), which suggests that in the current period the sector is likely to face higher costs of emission trading than in the two initial phases of the ETS[66]. Were this trend to continue in the future, surplus allowances from the 2nd phase would run out before the end of 2015. Data from the European Environmental Agency (EEA) also supports the finding that the EU Refining Sector had free allocation to cover only 73.9% of its emissions in 2013. While these figures include emissions related to electricity production that are excluded from free allocation, they would also need to be considered in the context of all the relevant direct and indirect cost/benefit channels discussed above, and evidence sustaining the ability of cost pass-through, any formal analysis of the resulting impact on the sector being beyond the scope of this report[67].

As regards impacts from the IED beyond 2012, by October 2018 the refining sector will have to comply with the stricter emission limit values on the effluents of industrial installations to air, water and soil in order to achieve emission levels consistent with best available techniques (as included in the BAT conclusions adopted by the Commission in 2014). The industry expects that significant investments will have to be made to meet the air and effluent water emission levels and additional

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[60] The starting point to set ex-ante benchmark is the average performance of the 10 % most efficient installations in a sector or subsector in the Community in the years 2007-2008, see *Directive 2009/29/EC Article 10a / 2.* According to the *Commission Decision 2011/278/EU of 27.4.2011*, the benchmark value applied to the refined oil products was set to 0.0295 / year. In order to capture the differences in refinery configurations, a CWT (CO_2 weighted tonne) approach was adopted. Free allocation is subsequently corrected to exclude electricity use and production to achieve the consistency with Directive 2003/87/EC Article 10a (1).

[61] See *Decision 2010/2/EU* of 24.12.2009, *Decision 2014/746/EU* of 27.10.2014.

[62] European Council Conclusions of 23-24 October 2014.

[63] The tightening of the cap is the result of applying a cross sectoral correction factor to balance the initial draft allocation plans by the MS competent authorities, and introducing the benchmarking principle for free allocation excluding electricity related emissions.

[64] EUTL data only gives a partial view, since it includes all emissions but there is no free allocation for emissions from electricity production that is often part of the process.

[65] It should be noted that the EUTL data does not show electricity production and heat transfers.

[66] Note that the drop in coverage by freely allocated allowances in 2013 relative to 2005-2012 is due, among others, to the introduction of efficiency benchmarks and exclusion of emissions related to on-site electricity production in refineries from the free allocation.

[67] Concawe (2014b) provides a model based quantification of these costs.

operational costs will be needed for effluent water treatment (Concawe, 2014b). Furthermore, a national level study of the Greek refining sector (Danchev and Maniatis, 2014) qualitatively discusses the impact of entering into force of the IED in 2013, citing compliance costs estimated earlier by the industry association Europia (now known as FuelsEurope). Similarly, a study of the Italian refining sector (IHS, 2014b) estimates future costs incurred by refineries due to the IED for the time period 2013 to 2030, building on similar analysis carried out earlier for the UK refining sector (for more detail see IHS (2013)). Without assessing their degree of accuracy, the cost estimates are thought to be significantly higher than those estimated up to 2012. Moreover, the studies were undertaken before the final version of the Best Available Technology was adopted and do not reflect the costs of the final version adopted. One last caveat reported by ChemSec (2015) about ex-ante estimates of costs must be mentioned here. In some cases, reality proves that ex-ante cost estimates are disproportionate compared to the actual costs once the legislation is implemented. However, ex-ante evaluations of costs in the refining sector for the Fuel Quality Directive, which were provided by the refining industry, ended up underestimating the total costs of legislation[68] (EC, 2012).

CONCAWE (2013) provides an assessment of additional efforts by the industry related to compliance with the fuel quality specifications. The study states that the majority of the capital expenditures towards meeting the fuel standards in the post-2012 period will be represented by investments required to address the challenges imposed by the production of marine fuel to the new IMO sulphur specifications transposed into EU legislation in the latest Marine Fuel Directive in 2015 for the SOx emission controlled area and 2020 for the global cap. CONCAWE (2014b) argues that, although the marine fuel sulphur limits can be met by installing flue gas scrubbers on ships, it is still expected that new requirements will lead to significant changes in marine fuels markets with consequences for refineries in terms of additional capital expenditures as well as operating costs.

VI. Answers to the evaluation questions

As already noted above, efforts have been made to adapt the content/analysis of this sectoral fitness check to the requirements of legislative fitness checks i.e. focusing the analysis around the evaluation criteria in force within the Commission to be able to conclude on the effectiveness, efficiency, coherence and relevance/EU added value of the acts in relation with their impacts on the sector. To the extent possible, answers are provided below to the evaluation questions grouped under these four main domains.

(1) Effectiveness

Based on the analysis performed, it can be concluded that as far as effectiveness is concerned the legislation has proven so far to achieve its objectives when applied to the refining sector (i.e. reduction of sulphur content on fuels, of GHG emissions, and of industrial emissions). The only factor preventing the achievement of the objectives has been the conflicting targets of lower sulphur content and higher energy consumption which meeting this objective has necessarily led to. The additional energy required to remove sulphur grows exponentially (IEA, 2005) and from the available data, it can be seen that increases in energy consumption are indeed exponential in relation to the sulphur removed from fuels.

(2) Efficiency

[68] The impact assessment included an estimate provided by CONCAWE of 3.2 billion euro in order to move diesel specifications from 50 ppm of sulphur to 10 ppm. The actual data as reported by Solomon Associates (2014a) shows investment of 3.4 billion euro despite a 2% reduction in refining capacity (2 refineries).

The costs incurred by the sector due to selected legislation as well as the associated benefits have been estimated. The cumulative quantified cost impact per barrel of processed throughput from the investigated regulation packages is non-negligible. The regulatory cost effect increased from 2000 to 2008 and apparently stabilised thereafter until 2012. The identified cost impacts of regulation on the performance of the refineries primarily imply the diversion of revenues towards regulatory compliance investments and operating costs rather than other investments and operation adjustments that improve the sector's competitiveness.

Within this fitness check, the specific data on the administrative burden associated with the legislation is not available, however, neither in the available studies nor in consultations with industry was it mentioned as an area of special concern. The quantified average total cost effect during 2000-2012 was assessed at 47 eurocent per barrel of throughput. It was observed that the effects of more horizontal (i.e. cross-industry) pieces of legislation (such as the Air Quality Directive and the Energy Efficiency Directive) are likely to be implicitly covered within the impact of more focused regulation that establishes tangible norms and limits (such as, for example, Fuel Quality Legislation and Industrial Emissions legislation) that can be directly linked to particular changes in investment and operating expenditures. The efforts made by EU refineries to meet the requirements of Industrial Emissions legislation and the Renewable Energy Directive during the period under study have also contributed to meeting the objectives of the Air Quality Directive and the Energy Efficiency Directive that do not address the refining sector specifically.

The quantified average regulatory cost impact corresponds to up to 25% of the EU refineries' observed net margin decline during 2000-2012, indicating that there are other factors present that had a stronger influence on the economic performance of refineries. Some of these factors are plant-specific such as the refineries' configurations, sizes and locations associated. Other factors include the relatively high level of input costs of refineries and in particular, energy costs and the high variability of the relative quantities of petroleum products produced by refineries as well as diverse input costs such as revenues, operating costs, and, therefore, net margins.

In those few instances where it was possible to quantify the societal benefits of the EU refining industry's compliance with environmental regulation, it is observed that the incurred costs could not be judged as disproportionate towards reaching the legislations' objectives. In particular, this was clearly the case for Fuels Quality Legislation and the Industrial Emissions Directive that are responsible for the largest part of the incurred quantified costs.

Besides the wider societal benefits provided by legislation some sector specific benefits were identified. Harmonizing product specifications (via the Fuel Quality Legislation and the Marine Fuels Directive) and taxation (via the Energy Taxation Directive) contributed to creating a level playing field and to development of a more uniform common EU market for refining products that can also have positive effects on refining sector. In case of the Strategic Oil Stocks Directive the corresponding positive effects for the industry are considered to be in terms of harmonizing and simplifying emergency stockholding rules and increasing the reliability of crude oil supply to petroleum product producers. Furthermore, some European refining operators can benefit from providing emergency stockholding services and renting out industry storage facilities. During the first phases of the implementation of the EU ETS the sector was allocated with more emission allowances than actual emissions (see below). Similarly the efforts towards complying with the Fuel Quality Legislation and the Energy Efficiency Directive stimulate the industry to increase innovation and improve its environmental performance and energy efficiency. With the exception of the EU ETS it was not possible in this fitness check to provide quantitative estimates of the benefits of the legislation to the sector, while the over allocation of the sector during phases I and II of the EU ETS has been valued at 11 million euros per refinery or 0.03 euro per barrel of throughput.

Comparing costs and benefits, on the basis of the high reliability of the data obtained for the sector, the costs can be considered proportionate relative to the benefits achieved. There is no lack of integration between policies; however there is some conflict between the achievement of lower sulphur contents and energy efficiency targets as mentioned above. While individual costs do not seem disproportionate to the benefits provided, the cumulative impact of the different pieces of legislation is not negligible and explains up to 25% of the total loss of competitiveness of the sector as a whole. Some of the more efficient refineries have been able to absorb these costs and remain profitable but this has not been the case for the others.

(3) Coherence

Based on the available information we did not detect any other visible contradictions or non-productive redundancies in the prescribed legislation. In relation to priorities in other pieces of legislation on decreasing CO_2 emissions, it should be noted that given the current state of technology, improving fuel quality while leading to additional benefits from reduced air pollution will require more extensive and intensive processing, which is more energy intensive and, keeping all other parameters equal, will lead to additional GHG emissions.

The objectives and measures of the fuel quality legislation appear aligned with other directives directly or indirectly related to the quality characteristics of the refining products (for example, in the part where gasoil specifications in FQL may overlap with those imposed by MFD). Nonetheless, it should be pointed out that the measures for the required improvement of fuel quality and decreasing content of harmful substances in emissions have mixed effects in terms of the GHG related objectives (such as those envisioned by ETS and EED) due to the correlation between desulphurization and energy consumption mentioned above.

In conclusion, we have found neither the evidence of overlaps or inconsistencies that would have led to an excessive administrative burden nor regulatory gaps nor obsolete measures. Synergies have been noted with the reporting obligations under the fuel quality legislation that are in line with other reporting obligations which are part of the enforcement system for air quality of road transport emissions. Moreover, as there is no overlap of legislation affecting the same concept (as is the case on horizontal fitness checks), rather different pieces of legislation affecting different aspects in a single sector, we have not identified inconsistencies in definitions.

(4) Relevance and EU added value

Legislation must also be assessed in terms of its relevance, that is, whether or not it targeted objectives reflecting the actual needs of stakeholders, potential beneficiaries or other actors affected by the legislation. In this sense, it must be reminded here that the major objective of the legislative measures considered here is not enhancing the competitiveness of the refining sector. During the period analysed their impacts were not the main driver of competitiveness loss of the sector. This does not however guarantee that any future legislation will not have such an effect and therefore specific attention should be paid to analyse the sectoral impacts of existing and upcoming legislation.

Much of the legislation affecting EU refineries is set at the EU level, as is the case for the EU legislative acts included in this analysis. The advantage of such an approach, if successfully transposed at the level of Member States, is that it contributes towards a level playing field within the EU and to the smooth functioning of the internal market.

When considering competition between European refineries and refineries from other regions such as the United States and the OECD members from South-East Asia, the overall strictness of environmental legislation appears to be similar (see Legrand et al. (2012), Brunel and Levinson (2013)), but this is not the case with competitors from the FSU and the Middle East. Aiming for an overall level playing field with third countries would facilitate the competitiveness of the industry in particular for legislation addressing global public goods.

VII. Conclusions

This Staff Working Document presents the results of an evaluation carried out by the European Commission of the impact on petroleum refining of ten pieces of the most relevant EU legislation drawn from the policy fields of environment, climate action, taxation and energy. Consideration is given in particular to the sector's competitiveness position from 2000 to 2012 and issues such as excessive regulatory burden, overlaps, gaps inconsistencies or obsolete measures. This was done in response to the request of the Industrial Policy Communication of 2012.

Overall the analysis shows that the legislation delivered its objectives at the sectoral level. Comparing costs and benefits, on the basis of the data obtained for the sector, the costs can be considered proportionate relative to the benefits achieved, although at a cost to the sector which has been evaluated at 47 eurocents per barrel of throughput during the study period. The legislation was implemented during a period in which the EU petroleum-refining sector was losing competitiveness relative to other world regions. However, the cost of regulation of the sector was not the main driver of the loss of competitiveness. The data shows that this loss can be attributed mainly to the relative increase in energy costs in EU refining, the main driver. The effect of increasing energy prices adds to the effect of the increasing energy consumption of the European refineries.

It should be noted that the analysis is retrospective and that the results measured specific impacts during a specific period (2000 to 2012). This does not mean that future regulatory policy would not have more significant impacts on the sector´s competitiveness.

The results presented here can feed into upcoming reviews of the assessed legislative acts rather than themselves justifying any legislative revision.

VII. References

British Petroleum (BP), 2014. BP Statistical Review of World Energy.

Brunel, C.; Levinson, A. (2013), "Measuring Environmental Regulatory Stringency", OECD Trade and Environment Working Papers, No. 2013/05, OECD Publishing, Paris.

ChemSec 2015: Cry Wolf - Predicted costs by industry in the face of new environmental regulations.

CONCAWE, 2013. Oil refining in the EU in 2020, with perspectives to 2030, Report No. 1/13R. Brussels.

CONCAWE, 2014a. Survey of European refineries on costs related to pollution control and biofuels.

CONCAWE, 2014b. The estimated forward cost of EU legislation for the EU refining industry, Report 11/14. Brussels.

Danchev, S.; Maniatis, G., 2014. The Refining Sector in Greece: Contribution to the Economy and Prospects. Foundation for Economic and Industrial Research (IOBE).

Ecofys (2012). Renewable energy progress and biofuels sustainability. Report for the European Commission Directorate General for Energy.

European Commission (EC), 2010. Commission staff working paper Refining and the supply of petroleum products in the EU. COM(2010)677.

European Commission (EC), 2011. Commission Staff Working Document Impact Assessment. Accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/32/EC as regards the sulphur content of marine fuels. SEC(2011) 918 final.

European Commission (EC), 2012. Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. SWD(2012) 344 final.

European Commission (EC), 2013a. European competitiveness report. Towards knowledge driven reindustrialisation.

European Commission (EC), 2013b. Commission Staff Working Document Impact assessment accompanying the documents COM(2013)917, COM(2013)918, COM(2013)919, COM(2013)920, SWD(2013)532. SWD(2013) 531 final.

European Commission (EC), 2014. Commission Staff Working Document In-depth study of European Energy Security. SWD(2014) 330 final/3.

ICCT, 2012. Technical and Economic Analysis of the Transition to Ultra-Low Sulphur Fuels in Brazil, China, India and Mexico.

IEA, 2005. The European refinery industry under the EU Emissions Trading Scheme. Competitiveness, trade flows and investment implications. IEA Information Paper. November.

IEA, 2014. Recent Developments in EU Refining and in the Supply and Trade of Petroleum Products. Presentation at the Third Meeting of EU Refining Forum , May. 2014.

IHS, 2013. The role and future of the UK refining sector in the supply of petroleum products and its value to the UK economy. Study prepared for UK Petroleum Industry Association (UKPIA).

IHS, 2014a. Global refining database, years 2000 to 2013. Compiled for the JRC Directorate of the European Commission.

IHS, 2014b. An Assessment of the Contribution of the Italian Refining Sector to the Italian Economy and the Impact of Legislation on its Future. Prepared by IHS for Unione Petrolifera.

International Maritime Organization (IMO), 2013. MEPC 65/22. Report of the Marine Environment Protection Committee on its Sixty-Fifth Session.

Jewell, J. 2011. The IEA Model for short-term energy security (MOSES). Primary energy sources and secondary fuels. IEA Working Paper, Paris.

Lantz F.; Gruson, J.F.; Saint-Antonin, V., 2005 Development of a model of the world refining for the POLES model: the OURSE model, JRC Technical Report Series, EUR 21864 EN, European Commission, DG JRC-IPTS.

Lantz, F.; Saint-Antonin, V.; Gruson, J.F.; Suwala, W., 2012. The OURSE model: Simulating the world refining sector to 2030, JRC Scientific and Technical Report, EUR 25221 EN, Luxembourg: Publications Office of the European Union.

Legrand, H.; Guignard, P.; Subremon, A., 2012. Audit sur la législation environnementale applicable aux raffineries. Conseil General de l'Environnement et du Developpement Durable, Rapport n°: 007911-01.

Joint Research Centre (JRC), 2015. EU Petroleum Refining Fitness Check: Impact of EU Legislation on Sectoral Economic Performance. EUR 27262. Luxembourg (Luxembourg): Publications Office of the European Union.

Purvin and Gertz, 2000. ULS gasoline and diesel refining study. Prepared by the EC DG ENV.

Ricardo-AEA, 2012. Monitoring Report of the Directive 2009/33/EC on the promotion of clean and energy efficient road transport vehicles, Final Report.

Solomon Associates, 2014a. Data of EU refining industry, years 1998 to 2012. Compiled for Fuels Europe and the Directorate for Enterprise, Industry and SME of the European Commission.

Solomon Associates, 2014b. Regulatory investments in the European Union and in selected extra-European regions, years 1998 to 2012. Compiled for the JRC Directorate of the European Commission.

Solomon Associates, 2014c. Operating Expenses and Margin Analysis of the European Union (EU) Refineries vs Regional Peers. Prepared by Solomon Associates for CONCAWE. Figures presented by Tracy Ellerington at the Third Meeting of the Third Meeting of the EU Refining Forum, Brussels, 22 May 2014.

Temurshoev U, Mraz M, Delgado Sancho L, and P. Eder, 2015. An Analysis of the EU Refining Industry: OURSE Modelling and Results. EUR 27269. Luxembourg (Luxembourg): Publications Office of the European Union; 2015.

Annex I. Procedural information

Lead DG and internal references

The Sectoral fitness check was led by DG Enterprise and Industry (now Internal Market, Industry, Entrepreneurship and SMEs). It was included as item 2015/GROW/039 in the Agenda Planning and as Commission's Regulatory Fitness Programme item 46 in the CWP of 2015[69].

Organization and timing

An inter-service steering group (ISG) was set up with representatives from the Directorate Generals for Enterprise and Industry (now Single Market, Industry, Entrepreneurship and SMEs); Economic and Financial Affairs; Mobility and Transport, Energy; Environment, Climate Action; Joint Research Centre; and Taxation and Customs Union as well as the Bureau of Economic Policy Advisors and the Secretariat General. The ISG met seven times to discuss the developments of the project as summarized in tableI.1.

Table I.1. Inter-Service Steering Group meetings dates and topics of discussion

Date	Topics of discussion
25-03-2013	Fitness Check Mandate
25-09-2013	Quantitative assessment methodology
13-03-2014	Intervention logic and methodological approaches
17-10-2014	Refining Overview and analysis of specific pieces of legislation (Renewables Energy Directive (RED); Directive on Clean and Energy Efficient Vehicles (DCEEV); Industrial Emissions Directive (IED); Strategic Oil Stocks Directive (SOSD); Marine Fuels Directive (MFD); Energy Efficiency Directive (EED); Air Quality Directive (AQD); Assessment of EU and global impacts by means of the OURSE model)
11-12-2014	Analysis of specific pieces of legislation (Emission Trading Scheme (ETS); Fuel Quality Directive (FQD) and Energy Tax Directive (ETD))
16-03-2015	Cumulative impacts of legislation on the sector and conclusions
16-06-2015	Draft Staff Working Document

The technical analysis underpinning this fitness check was undertaken by the Sustainable Production and Consumption unit of the Institute for Prospective Technological Studies of the Joint Research Centre following the signature of an Administrative Arrangement on November 2013. The original Administrative Arrangement duration was 10 months, however due to delays in the process of obtaining data (see below) the completion of the work was only achieved on May 2015. The results of the technical analysis have been published as JRC et al. (2015).

External expertise

A part from the technical back stopping for better understanding the 3rd party data sources purchased (see below) no external expertise was used to carry out the fitness check.

[69] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Commission Work Programme 2015 - A New Start. COM(2014) 910 16.12.2014

Evidence and data sources

The fitness check reviewed the existing evidence from similar initiatives taken at Member State level, summarised in table I.2.

Table I.2. Member State analysis of the impact of legislation on refineries consulted.

Member State	Year	Title	Main data source used
France[(c)]	2012	Audit sur la législation environnementale applicable aux raffineries – Conseil Général de L'environnement et du Développement Durable Rapport 007911-01	
Greece	2014	The Refining Sector in Greece: Contribution to the Economy and Prospects - Foundation for Economic and Industrial Research (IOBE)	IHS
Ireland[(b)]	2012	Study of the strategic Case for Oil Refining on the Island of Ireland - Department of Communications, Energy and Natural Resources	IHS
Italy[(a)]	2014	An assessment of the contribution of the Italian refining sector to the Italian economy and the impact of legislation on its future	IHS
UK[(a)]	2013	The role and future of the UK refining sector in the supply of petroleum products and its value to the UK economy	IHS
UK [(c)]	2013	UK Oil refining – House of Commons Energy and Climate Committee Report	
UK [(c)]	2014	UK Review of the Refining and Fuel Import Sectors – Department of Energy and Climate Change	

[(a)] Sponsored by industry associations
[(b)] Sponsored by MS Administration
[(c)] Carried out by MS Administration

In addition the different impact assessments for the pieces of legislation were revised to obtain ex-ante estimates of the benefits and costs of the legislation. Whenever possible ex-ante estimates of benefits and cost were compared to ex-post measures identified during the fitness check.

Table I.3. Impact assessments of specific pieces of legislation reviewed.

Legislation	Impact Assessment
Proposal for a COUNCIL DIRECTIVE amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity [*not adopted*]	SEC(2011)409 and SEC(2011)410
Proposal for a Directive of the European Parliament and of the Council modifying Directive 98/70/EC relating to the quality of petrol and diesel fuels	SEC(2007)55
Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/32/EC as regards the sulphur content of marine fuels.	SEC(2011) 918 final
Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and he Committee of the Regions a Clean Air Programme for Europe. Proposal for a Directive of the European Parliament and of the Council on the limitation of emissions of certain pollutants into the air from medium combustion plants. Proposal for a Directive of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC. Proposal for a Council Decision on the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Trans boundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone.	SWD(2013) 531 final

A more comprehensive list of evaluations and studies consulted for the purpose of this fitness check can be found in JRC (2015).

In order to measure the impact of legislation on the sector a survey of refineries was envisaged. However, due to the difficulty in obtaining the necessary data and to the fact that the sector counts with a highly regarded third party data provider, the data for the analysis was purchased from Solomon Associates[70]. Three tailor made data sets were purchased from this company: point estimates (i.e. averages) on key refinery operations for 13 geographical groupings in the EU[71] and six complexity groups[72] (cost financed by Fuels Europe); higher moment descriptive statistics (i.e. maximum, minimum, median and standard deviation) of key concepts of refinery operations (cost

[70] Solomon is the only organisation that collects refinery-wide data at the level of detail required by the original questionnaire developed for the Refining Sector Fitness check. The Solomon Fuels Study is regarded as the most reliable, and representative source of benchmark data in the refining industry worldwide, and the metrics are used widely within the industry to measure performance both internally in an organisation, as well as to benchmark against others in the study. http://solomononline.com/

[71] The regional grouping used are EU28, EU15, EU13 accession countries, Baltic, Benelux, Germany, France, Central Europa, UK & Ireland, Iberia, Mediterranean, South East Europe.

[72] See footnote 32.

financed by DG ENTR); and point estimates on key refinery operations for other world regions (cost financed by JRC-IPTS). Due to confidentiality agreements the raw data cannot be disclosed.

In order to complete the data purchased from Solomon Associates, CONCAWE and JRC-IPTS developed an ad-hoc questionnaire which was sent to 82 refineries operating in EU-28 which are members of CONCAWE. The questionnaire collected data on the Industrial Emissions Directive and Air Quality Directive (capital and operational expenditures related to the different pollution prevention and control measures) and the Renewable Energy Directive (costs for biofuel storage and infrastructure). Information was collected on a yearly basis for the years 1998-2012. The data points provided to JRC-IPTS were aggregated in the same way as in the Solomon Associates database above.

Lastly, data on margins was purchased from IHS[73] (cost financed by JRC-IPTS) because of the fact that Solomon does not provide information on margins for individual refineries.

The above three main sources of data were complementary and used in the report for different purposes. The most extensively employed throughout the report data source was Solomon Associates (2014) database. It was used for the analysis of the state of play and trends in the EU petroleum refining sector, and provided crucial inputs for assessing impacts of the legislation on the sector. However the database contained no data on refining revenues and margins neither in the EU nor in the competing regions. Furthermore, given the level of aggregation in the database, the data was available at the level of the EU, EU regions and refining complexity groups, but not at individual refinery level.

Whenever the analysis needed fine-tuning at the level of the individual refineries, the study employed the data of IHS (2014). While this database provides very detailed information at the refinery level, its important limitation is that to a large extent it relies on simulations (with the use of IHS's proprietary Refinery Simulation Model) and therefore on certain restrictive assumptions regarding the parameters of refineries operation. This does not concern the variables obtained from publicly available sources, such as capacities and throughputs of refinery units. Potential limitations of IHS (2014) data were taken into account for the analysis and reporting of results. In particular, this data was not used in the assessment of overall regulatory costs for the sector.

Finally, the survey of the EU refineries conducted by CONCAWE provided additional insights on the capital and operational expenditures related specifically to pollution prevention and control measures. This data was extensively used for the analysis of impacts of the Industrial Emissions Directive and the Renewable Energy Directive in the respective chapters of the report.

JRC-IPTS also further developed the OURSE model. OURSE is a global oil refining cost minimization model developed by IFPEN Energies Nouvelles (Paris, France) and JRC-IPTS in 2005, updated in 2012 (see Lantz et al., 2005; 2012), and further improved by JRC-IPTS for the purposes of this fitness check. It models nine aggregated world regions (North and Central America, Latin America, North Europe, South Europe, CIS, Africa, Middle East, China, and Other Asia and Oceania), which are allowed to trade crude oil and refined products with each other. A representative refinery characterizes the refining industry in each region, taking into account the main techno-economic characteristics of the region's refining sector. Within the current study, OURSE model was transformed by JRC-IPTS from a linear programming optimization problem into a quadratic programming model, guaranteeing calibration of the base-year observed data and allowing for more realistic (smoother) output responses in any simulation environment. A detailed technical description of the model is presented in the Temurshoev et al (2015). This model is used to assess ex post the likely impact on the performance and international competitiveness of the EU refineries of the fuel quality specifications

[73] https://www.ihs.com/products/downstream-oil-refining-consulting.htm

change due to the Fuels Quality Directive (FQD) and Marine Fuels Directive (MFD); demand levels and composition change due to the requirements of the Renewable Energy Directive (RED) and Energy Taxation Directive (ETD); and sulphur dioxide emissions limits change as implied by the requirements of the Large Combustion Plants Directive (LCPD), Integrated Pollution Prevention and Control Directive (IPPCD) and Air Quality Directive (AQD).

Annex II. Stakeholder consultation

The involvement of stakeholders in the sectoral fitness check was organized via two fora. DG Energy established the so-called "Refining Forum" to discuss planned regulatory proposals which may impact the refining industry and the EU's secure supply of petroleum products. It brings together representatives from the industry, EU countries, the European Parliament, and the European Commission, as well as other stakeholders[74]. All Refining Forum meetings had an agenda item devoted to the Sectoral fitness check process as summarized in table II.1. Presentations and minutes of these meetings are available here.

Table II.1 Consultations on the Petroleum Refining Fitness Check at the Refining Forum

Date	Topic
12-04-2013	Scope and contents of the refining fitness check [presentation by F. Caballero-Sanz DG ENTR]
27-11-2013	Progress on refining fitness check [presentation by P. Eder JRC-IPTS]
22-05-2014	Progress on refining fitness check [presentation by R. Marschinski JRC-IPTS]
11-12-2014	Presentation of preliminary results of the oil refining fitness check [presentations by F. Caballero-Sanz DG ENTR and R. Marschinski JRC-IPTS]
15-06-2015	Presentation of final results of the oil refining fitness check [presentations by F. Caballero-Sanz DG GROW and R. Lukach JRC-IPTS]

In addition to this formal consultation an ad-hoc steering group was set up to discuss preliminary outputs with targeted stakeholders. These included Fuels Europe[75], Concawe[76], national refining associations, individual refining companies, Transport and Environment (T&E)[77] and the International Council on Clean Transportation (ICCT)[78]. Following a request by 10 Member States[79] as of November 2014 this ad-hoc working group was extended to include Member States Representatives. The ad-hoc steering group met four times to discuss the developments of the project as summarized in table II.2]

[74] On the 15th of May 2012, Commissioner Oettinger organised an EU Refining Roundtable, at which representatives of all 21 EU Member States with an oil refining presence, Members of the European Parliament as well as representatives of the EU refining industry and of trade unions were convened to share views on the difficulties faced by the EU oil refining sector and to assess the need for coordinated action at the EU level to deal with the sector's difficulties. In response to requests by industry and Member States at the Refining Roundtable, the Commission then organised an EU Refining Conference on the 26th of November 2012. The Refining Forum was established following the broad support for a continued discussion on the developments in the EU refining sector.

[75] Fuels Europe represents with the EU institutions the interest of 42 Companies operating refineries in the EU. Members account for almost 100% of EU petroleum refining capacity and more than 75% of EU motor fuel retail sales (www.fuelseurope.eu).

[76] CONCAWE was established in 1963 to carry out research on environmental issues relevant to the oil industry. Its current membership includes most oil companies operating in Europe. Its mission is to conduct research programmes to provide impartial scientific information in order to improve scientific understanding of the environmental health, safety and economic performance aspects of both petroleum refining and the distribution and sustainable use of refined products; assist the development of cost-effective policies and legislation by EU institutions and Member States; and allow informed decision making and cost-effective legislative compliance by its members (www.concawe.eu).

[77] Established in 1990, T&E represents around 50 organisations across Europe, mostly environmental groups and campaigners working for sustainable transport policies at national, regional and local level. Its mission is to promote, at EU and global level, a transport policy based on the principles of sustainable development (www.transportenvironemnt.org).

[78] The International Council on Clean Transportation is an independent non-profit organization founded to provide first-rate, unbiased research and technical and scientific analysis to environmental regulators. Its mission is to improve the environmental performance and energy efficiency of road, marine, and air transportation, in order to benefit public health and mitigate climate change (www.theicct.org).

[79] Letter addressed to DG Daniel Calleja and Dominique Ristori by Director Generals responsible for refining in different Ministries of FI, FR, DE, GR, IE, IT, NL, PL, ES and UK.

Table II.2 Meetings of the Ad-hoc steering group with stakeholders

Date	Topic
10-04-2014	Methodological approach, modelling and scenario design and data collection
21-11-2014*	Refining Overview and analysis of specific pieces of legislation (Renewables Energy Directive (RED); Directive on Clean and Energy Efficient Vehicles (DCEEV); Industrial Emissions Directive (IED); Strategic Oil Stocks Directive (SOSD); Marine Fuels Directive (MFD); Energy Efficiency Directive (EED); Air Quality Directive (AQD); Assessment of EU and global impacts by means of the OURSE model)
05-02-2015*	Analysis of specific pieces of legislation (Emission Trading Scheme (ETS); Fuel Quality Directive (FQD) and Energy Tax Directive (ETD))
27-04-2015*	Cumulative impacts of legislation on the sector and conclusions

* Meetings to which Member States representatives were also invited.

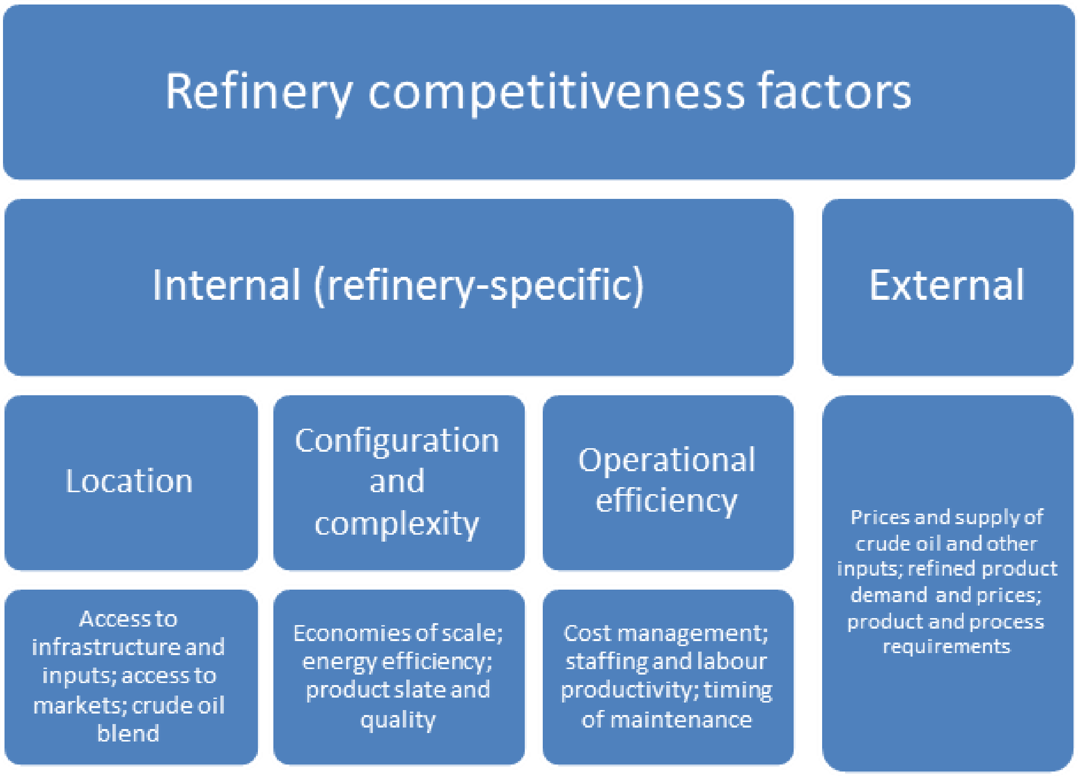
During the whole process input from stakeholders, if relevant and within the scope of the mandate, was incorporated into the final documents.

Annex III. Methods and Analytical models used in preparing the Fitness Check

The refining industry is a link between crude oil and refined product markets, which means that it builds its profits on margins between the prices in these two markets. Naturally, refineries incur different types of costs in the process, starting from the purchase of feedstock through actual refining operations to the distribution of final products. Although this is the case for all refineries, in reality profits can vary profoundly from one refinery to another as they differ in their configuration, location, process management and other characteristics. As such, refining profitability is a dynamic outcome of the interplay of multiple drivers.

Among the factors that influence a refinery's competitiveness, one can distinguish between variables that are within the control of an individual refinery and those that are external and apply to any refinery, independently of how it is constructed and managed. Among such external factors are, for example, are the general requirements on product and process specifications, or the global market conditions determining the prices of crude oil and refined products. In turn, in the factors that can be controlled by the refinery, some are related to logistics (access to infrastructure and relevant markets; costs of inputs such as labour and energy; crude oil blend), others to refinery's configuration and complexity (economies of scale; energy efficiency; product slate and quality achievable), and some fall under operational efficiency (cost management; staffing levels and labour productivity; timeliness of maintenance). These factors are schematically summarized in Figure III.1. Factors are presented in the increasing order by the degree of control that a refinery can exercise over these factors. For instance, the location of the refinery is practically impossible to change and can only be decided if and when a new refinery is constructed. Adjusting configuration and complexity of the refinery is theoretically possible, although it is a long-term project involving significant capital expenditures. At the same time, operational efficiency is something that can be improved in a refinery over a reasonably short period of time.

Figure III.1. Main factors of a refinery's competitiveness.



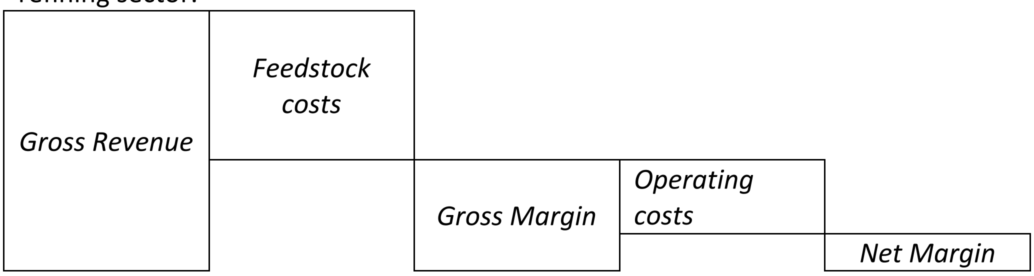
Source: own elaboration.

Oil refining is very capital intensive, and the building or upgrading a refining unit is normally a high-scale and expensive project. Larger refining facilities allow for better spreading fixed costs over outputs, and are more efficient and flexible with respect to changing product specifications or cyclical shifts in business activity. However, large-size refineries sometimes tend to duplicate units, which adds to their flexibility, but somewhat negates the economies of scale. Together with the size, configuration and complexity of a refinery, location is one of the most important determinants of profitability. The most basic division here is between coastal and inland plants. Most importantly, the type of location determines the freight costs for crude oil and product dispatch, whereby coastal refineries often have low crude supply costs, better access to export markets, and are also primary access points for product imports. A separate point can be made for refineries associated with petrochemical plants. Given the strong process interrelationships between the two, such choice of location eliminates transport costs for the refined products used as petrochemical feedstock and for backflows from petrochemical processes to refining. Refineries that are part of a petrochemical complex have better flexibility in optimizing their intermediate product streams, as well as benefit from shared operating costs. Such integration may thus significantly improve refining profitability.

Operational efficiency of a refinery essentially refers to the optimization of its *fixed* and *variable operating costs*. *Variable costs* are those that are needed to support the operation of a refinery. The main components in this category are energy, chemicals and water. Given that refining involves complex separation and upgrading processes, which can be very energy-intensive, by far the most important element of variable costs is *energy*. Energy efficiency is thus a very important point in optimising a refinery's design and operation. A substantial proportion of the energy used by the refineries is usually self-generated within the refining process. Part of it needs to be purchased externally (electricity, natural gas, and/or steam), implying that the local energy prices might have a major influence on refining profitability. *Fixed costs* are independent of throughput and are a necessary overhead - they include, most importantly, equipment maintenance and personnel costs, as well as insurance, administration and depreciation. Fixed costs per unit of output can be reduced by increasing efficiency, economies of scale and investment in automation.

To assess the competitiveness of the refining industry margins are compared. Given that the crude oil and refined product prices are readily visible, it is straightforward to obtain an indication of the gross profit margin that can be achieved at any moment. Referred to as an *"indicator" margin* or more commonly *crack spread*, this measure represents the revenue that can be generated from turning a barrel of crude into products without taking into account the costs of doing so. In order to account for costs, and therefore the actual refining profits, the performance of refineries is measured in terms of *net cash margins reduced* by *feedstock costs*, *variable* and *fixed costs*. Refining margins are extensively used for business decisions by the industry and published in specialized sources. Definitions of profitability indicators commonly used in the sector are schematically presented in Figure III.2.

Figure III.2. Schematic presentation of profitability indicators commonly used in the petroleum refining sector.



Note: the representation of costs and margins is not to scale. Source: Own elaboration

A detailed description of the methods and analytical models used in preparing the Fitness Check are available in the following publications:

Joint Research Centre (JRC), 2015. EU Petroleum Refining Fitness Check: Impact of EU Legislation on Sectoral Economic Performance. EUR 27262. Luxembourg (Luxembourg): Publications Office of the European Union.

Temurshoev U, Mraz M, Delgado Sancho L, and P. Eder, 2015. An Analysis of the EU Refining Industry: OURSE Modelling and Results. EUR 27269. Luxembourg (Luxembourg): Publications Office of the European Union; 2015.

Annex IV. Evaluation questions included in the original fitness check mandate (June 2013).

Main questions to be addressed

The list of questions for which the Fitness Check should contribute to provide an answer can be established as follows:

(1) Concerning **effectiveness**, are the achievements of the identified legislation with regard to the refining sector in line with the stated objectives? What progress has been made over time towards achieving the objectives? Which main factors (e.g. implementation by Member States, action by stakeholders, cooperation between producers) have contributed to – respectively stood in the way of – achieving these objectives? Beyond these objectives, did the legislation achieve any other significant results?

(2) Concerning **efficiency**, are there regulatory gaps, inconsistencies, overlaps or evidence of excessive administrative burdens for the refining sector? To what extent do Member States and industry respond to the requirements of different policies in terms of administrative co-operation and policy coordination? What are the policies in place in Member States and at the EU level to support the sector? Is availability of and access to funding a constraint in the implementation of the relevant legislation? What are the costs and benefits associated with the implementation of the specific legislation? Can any costs be identified that are out of proportion with the benefits achieved?

(3) Concerning **coherence**, what is the degree of integration of all instruments covered by the FC? Is the scope for integration fully exploited? Have there been unintended consequences and collateral effects? Can any specific inconsistencies and unjustified overlaps (e.g. in terms of definitions and key concepts,) across the legislation concerned and between them and other parts of EU law be identified? What is the cumulative impact of the measures on the performance of refining sector?

(4) As regards **relevance**, to what extent do the policies covered by the fitness check and their objectives address the challenge of competitive and sustainable EU refining industry along with their wider economic, social or environmental challenges? What is the value added of the EU legislation?