Refining Fitness Check

Update on Results

21 November 2014

Robert Marschinski / Ruslan Lukach (JRC)

Content

- *Fitness Check: objective, methodology, data*
- *Overview EU oil refining sector*
- *Analysis of specific pieces of legislation*
  - Renewable Energy Directive
  - Marine Fuels Directive
  - Industrial Emissions Directive
  - Clean & Energy Efficient Vehicles
  - Strategic Oil Stocks
  - Energy Efficiency
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- *OURSE numerical model*
- *Next steps*

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Objective

European Commission

Fitness Check - Petroleum Refining Sector

Review of EU environmental and energy legislation affecting the European refining sector during the time period 2000-2012:

1. **Assess impacts of legislation ('effectiveness')**
   - impact with regard to legislation's objectives
   - cost impact on EU refineries
   - oil products market impact
   - international competitiveness impacts

2. **Identify policy inconsistency, redundancy, excessive burden**

Methodology: 4 data sources

European Commission

1. *Actual data on EU refining at aggregated level (for 9 regions) provided by Concawe/Solomon Associates*
   - **configurations, investments, operational costs**
   - **no information on prices or margins**
   - **Access to raw data bound by confidentiality agreement**

2. *Actual and estimated data on all individual EU refineries purchased from IHS*
   - **includes data on prices, margins, yields, cost structure**
   - **includes averages for outside EU regions**

3. *Aggregate data on biofuel infrastructure and pollution abatement investments from refinery survey conducted by industry (Concawe)*

4. *Aggregate data on outside EU investments into pollution control and fuel quality purchased from Solomon Associates*
   - **Access to raw data bound by confidentiality agreement**

Methodology: conceptual issues

European Commission

1. *Attribution of impacts to specific pieces of legislation*
   - **Sometimes ambiguous, e.g. are sulphur recovery units for IPPC or FQD compliance?**
   - **Emission limits specified in operating permits might be influenced by IPPC, LCPD, National Emissions Ceiling (NEC), Air Quality Directive**
   - **We try to pursue pragmatic approach, focusing on impacts, with ‚joint attribution‘**

2. *International vs. EU legislation*
   - **Strategic Oil Stock Directive -> mostly transposes IEA accords into EU legislation**
   - **IMO MARPOL vs. EU legislation for sulphur limits in marine fuels**
   - **We try to assess impacts, even if legislation might be triggered by int‘l treaty**

3. *Incremental vs. total impact of regulation*
   - **Do we want to assess current ‚regulatory pressure‘ on the sector? Or the incremental effect of most recent pieces of regulation?**
   - **Both can be considered as valuable, but separating out the ‚incremental‘ effects can be difficult in terms of methodology**

4. *Benefits of regulation*
   - **Fitness Check with focus on Oil Refining Industry**
   - **But benefits typically occur outside of this sector, affect society at large**
   - **Need to include them as background info as they constitute raison d‘etre of regulation**

Structure of report

Introduction with purpose of study, methodology, data description
Refining Overview
- *Renewables Energy Directive (RED)*
- *Energy Taxation Directive (ETD)*
- *EU Emissions Trading System (EU ETS)*
- *Fuels Quality Directive (FQD)*
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Analysis of cumulative legislative cost impacts
Assessment of impacts on international competitiveness of EU refining
Assessment of EU and global impacts by means of the OURSE model
Summary and conclusion

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Overview chapter: EU petroleum refining sector

MAIN CONCEPTS AND DEFINITIONS

- the 'economics' of refining

ECONOMIC CONTRIBUTION OF THE EU PETROLEUM REFINING INDUSTRY

- key statistics (labour, GDP, ..), EU's energy security

THE EU OIL REFINING LANDSCAPE

- geography and structure
- crude oil sources
- refining capacity and complexity
- capital investments
- operating costs, margins, and throughputs
- refined product markets
- international competition

European Commission

ECONOMIC CONTRIBUTION OF THE EU PETROLEUM REFINING INDUSTRY

Key statistical facts

- The EU oil refining sector accounts for a visible share (1.2%) of the manufacturing value added, contributes to employment (119 000 employees), and demonstrates a substantial turnover (600 billion euro)

- Constitutes a substantial part of the world's total refining capacity (15.5%)

- Refined petroleum products are an important element of extra-EU trade accounting for the major part of the EU energy exports

European Commission

ECONOMIC CONTRIBUTION OF THE EU PETROLEUM REFINING INDUSTRY

Direct and indirect economic contribution of the refining sector

- The total direct and indirect contributions via Input/Output links in 2011 were ca. 1.2% of the EU GDP and 0.8% of the total employment of the EU economy.

- The EU refining industry puts considerable effort into process and product innovation activities and employs mostly high and medium skilled labour

THE EU OIL REFINING LANDSCAPE

- Refining is a mature industry, rather evenly distributed across the territory of EU

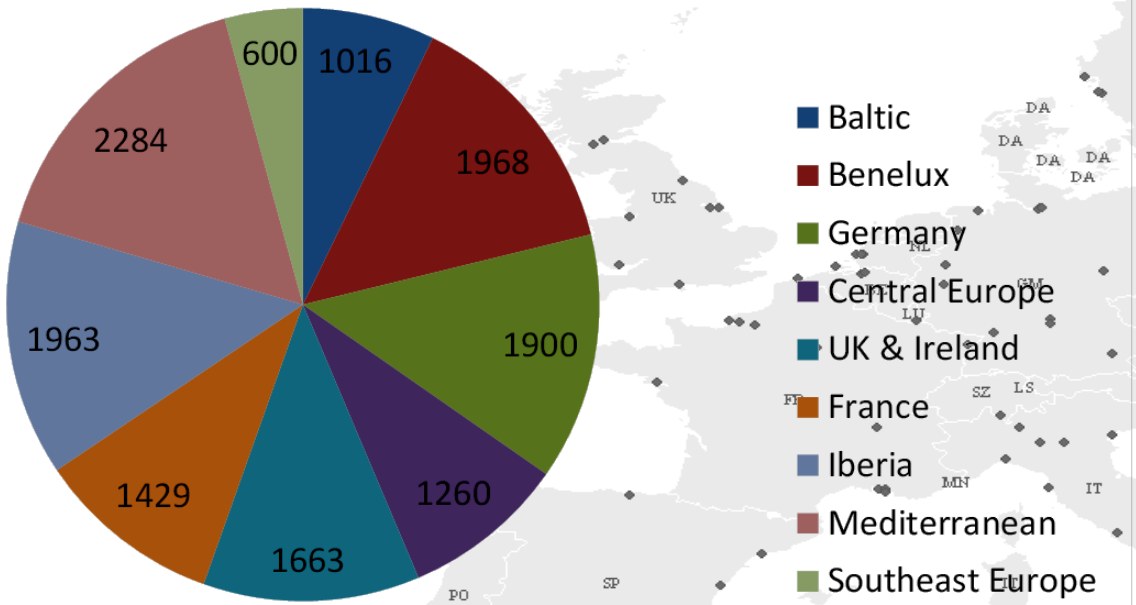

Figure 1: Refining capacity in the EU by region, 2012, Kb/day.
Source: Solomon Associates (2014).

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THE EU OIL REFINING LANDSCAPE

Crude oil sources

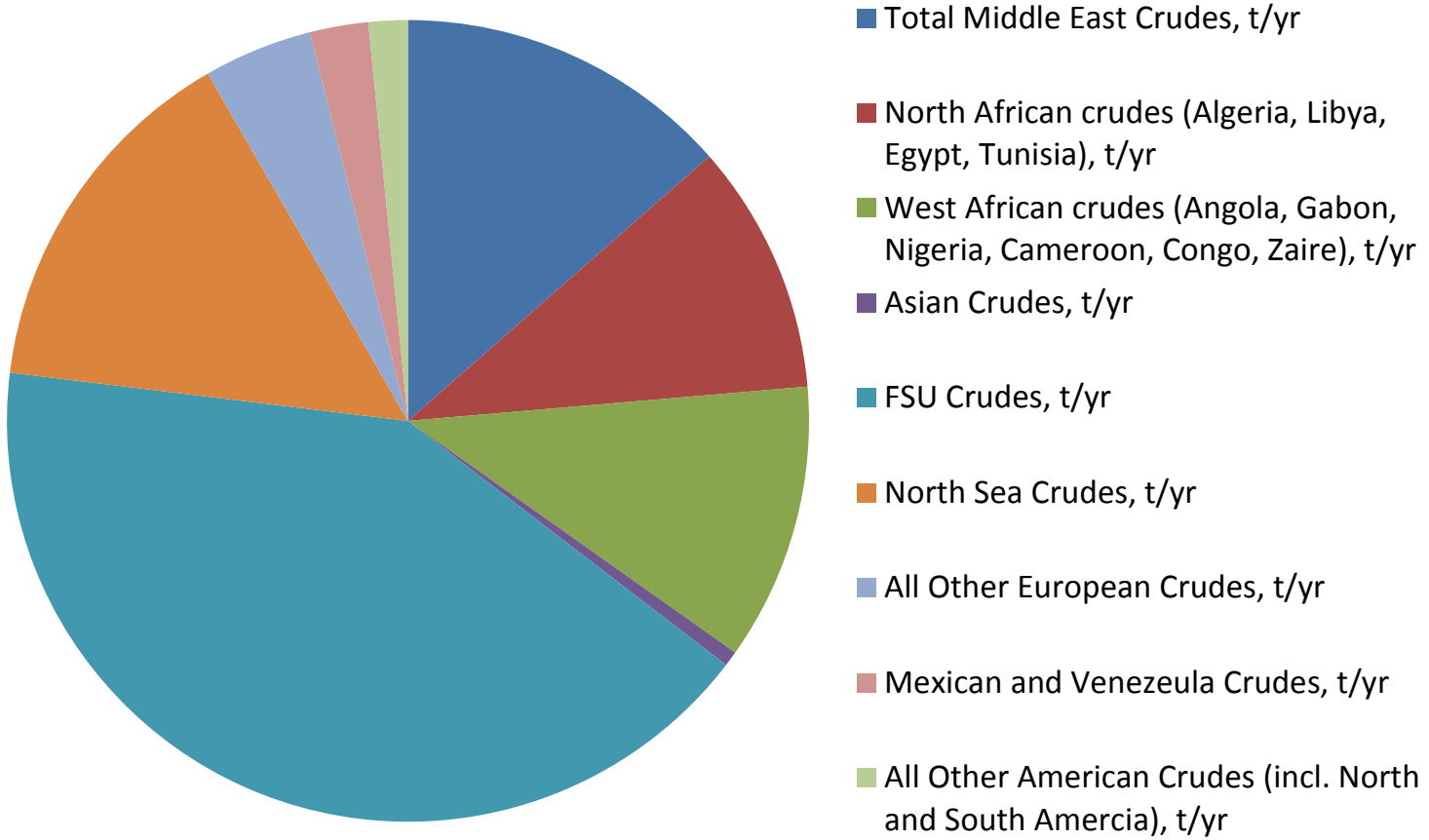


Figure 1: Breakdown of crude oil used in the EU by origin, 2012. Source: Solomon Associates (2014).

THE EU OIL REFINING LANDSCAPE

Crude oil sources

- Four regional clusters can be identified based on the used crude mix. The relative shares of North Sea, FSU and Middle East crudes are the main drivers.

- A visible shift towards greater use of the FSU crudes by European refineries

- Clear observed tendency towards greater use of non-crude oil inputs (ethanol, biodiesel, natural gas, etc.)

European Commission

THE EU OIL REFINING LANDSCAPE

Refining capacity and complexity

- By 2012 the most complex refineries are located in Germany, Benelux, UK and Ireland, while the least complex in Iberia, Central Europe and France
- The average complexity of oil refineries in Europe has visibly grown since 2000
- The strongest complexity growth observed in the regions that have on average higher share of FSU crudes
- Hydrocracking, coking and hydrotreating units appear to be the main drivers of increasing complexity in European refineries

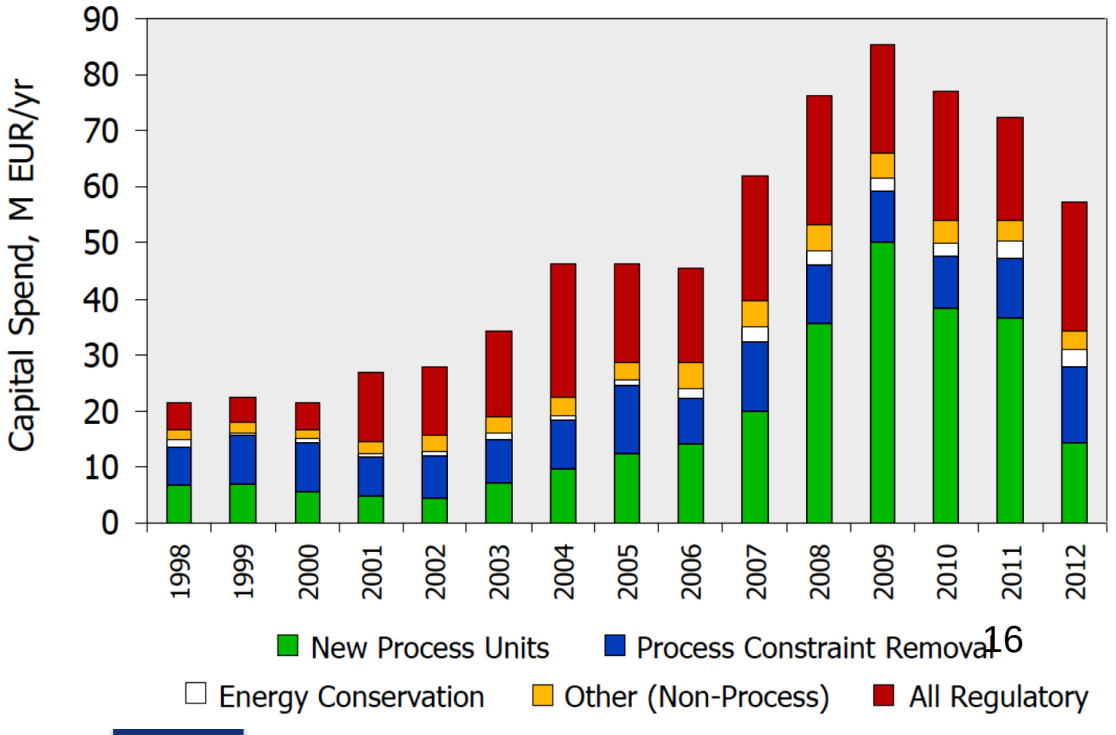
European Commission

THE EU OIL REFINING LANDSCAPE

Capital investments

- Steady growth in capital investments during the pre-crisis (pre-2009) period in absolute volume and per ton of net raw material input

- Increasing share of regulatory/environmental investments in total in the aftermath of the economic crisis, while non-regulatory investments decreased



Data source: Solomon Associates (2014)

European Commission

THE EU OIL REFINING LANDSCAPE

Operating costs

- A visible increase in both fixed and variable operating expenditures
- Rather stable levels of energy consumption with an increasing share of gaseous fuels
- The weight of energy costs in the total expenditures has been to be increasing in the past decade
- Growing complexity is accompanied by the increase in energy use per ton of processed crude and other inputs
- The energy use per ton of processed crude appears to be stronger (positively) associated with the refineries complexity than with the crude sulphur content or the crude gravity

European Commission

THE EU OIL REFINING LANDSCAPE

- The European refineries' capacity remains underutilized

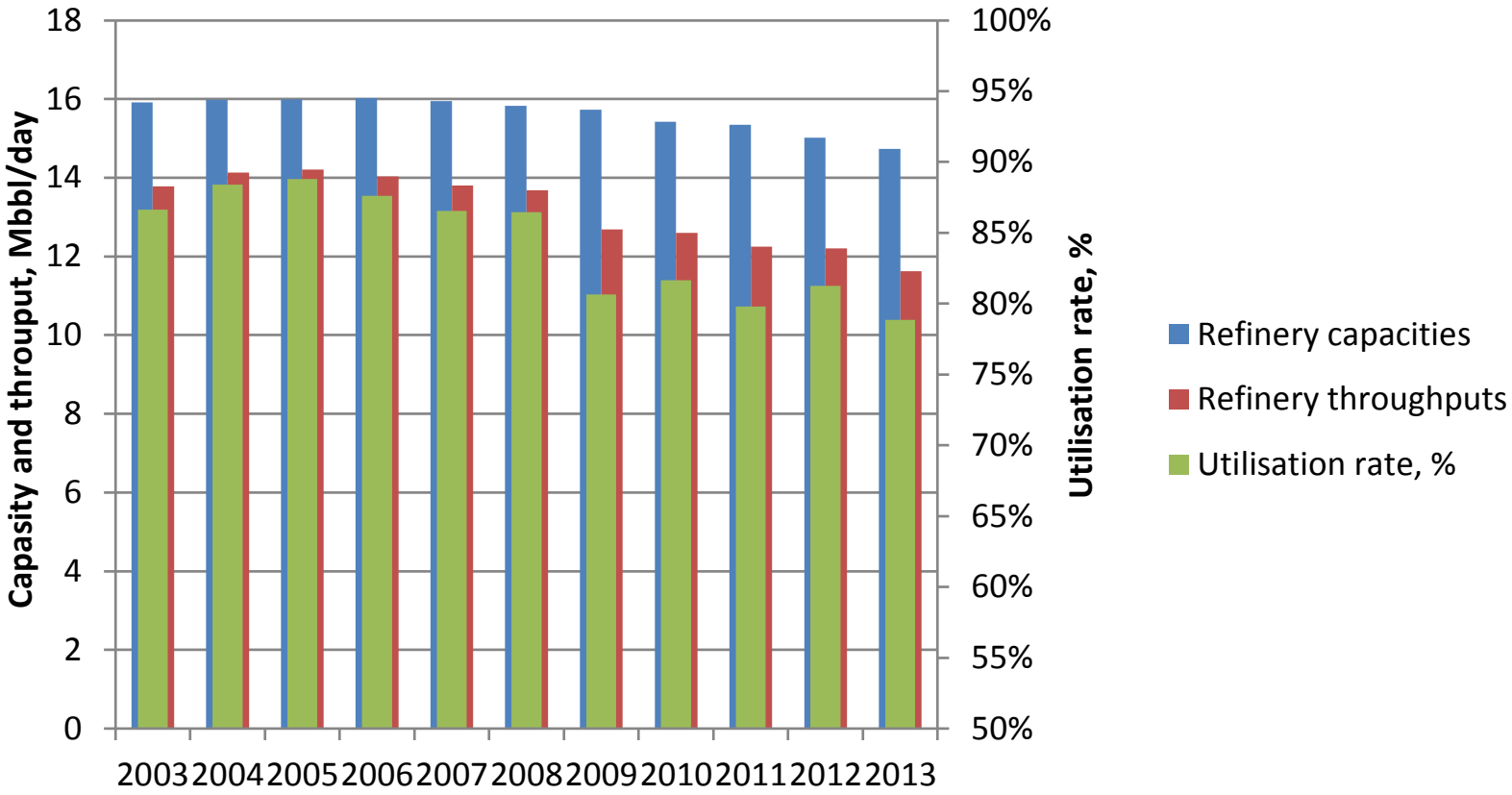
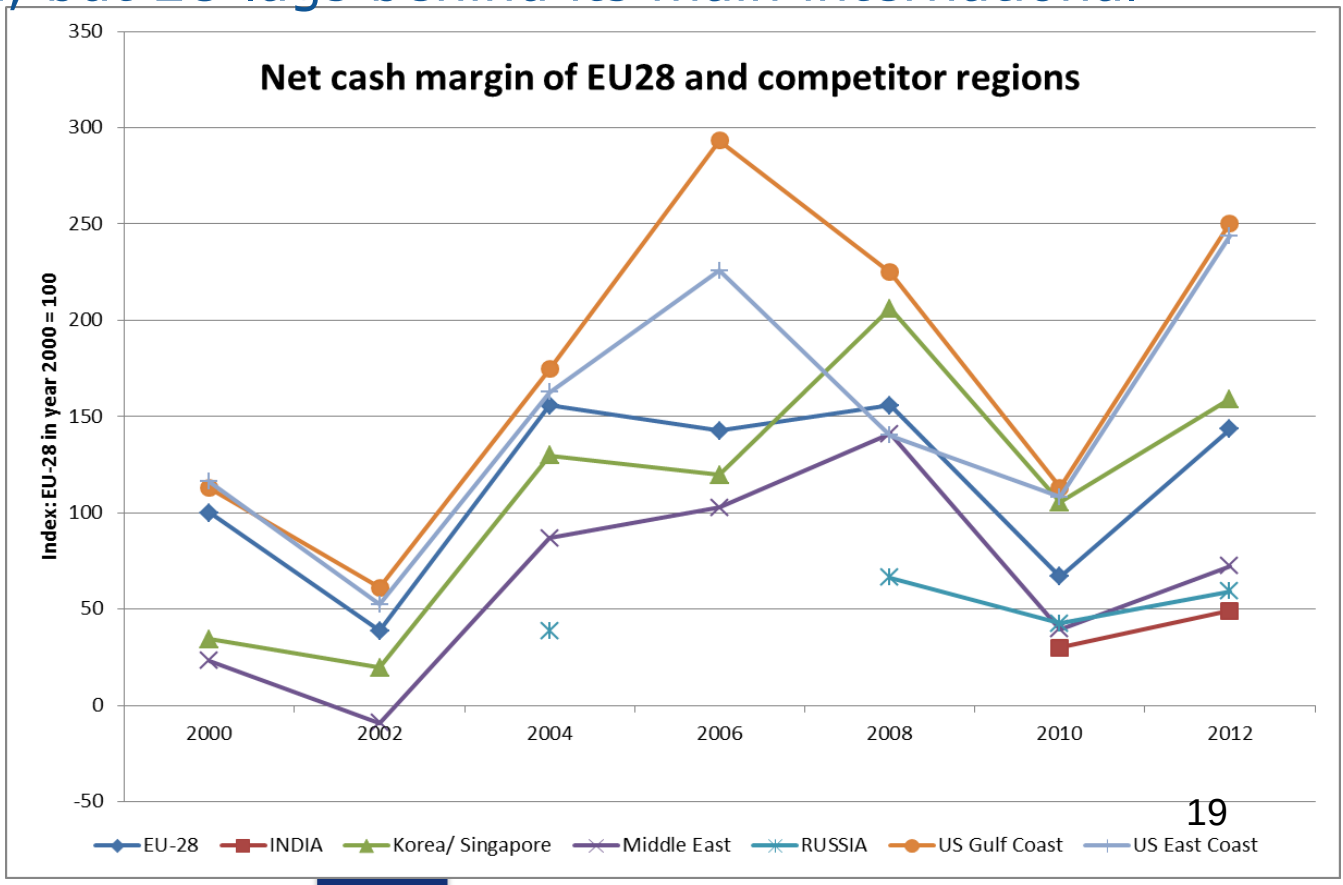


Figure 1: Refinery capacities and throughputs in the EU in 2003-2013, million barrels daily.
Source: Based on BP, 2014.

European Commission

THE EU OIL REFINING LANDSCAPE

- The **margins indicators** for the EU refineries show a slightly positive general dynamics in the period between 2000 and 2012, but EU lags behind its main international competitors.



Data source: Solomon Associates
http://ec.europa.eu/energy/observatory/oil/doc/refining/20140522_3nd_meeting_solomon.pdf

THE EU OIL REFINING LANDSCAPE

Developments in refined product markets

- Marked trend for dieselisation of road transport and greater demand for jet fuel on the background of declining general demand for fuels
- Persistent imbalance between domestic production and consumption of gasoline and middle distillates
- Expanding refinery conversion unit capacity to boost the production of middle distillates
- There are doubts about sustainability of external trade channels, in particular, trade in gasoline with the US to compensate for excess gasoline production in Europe

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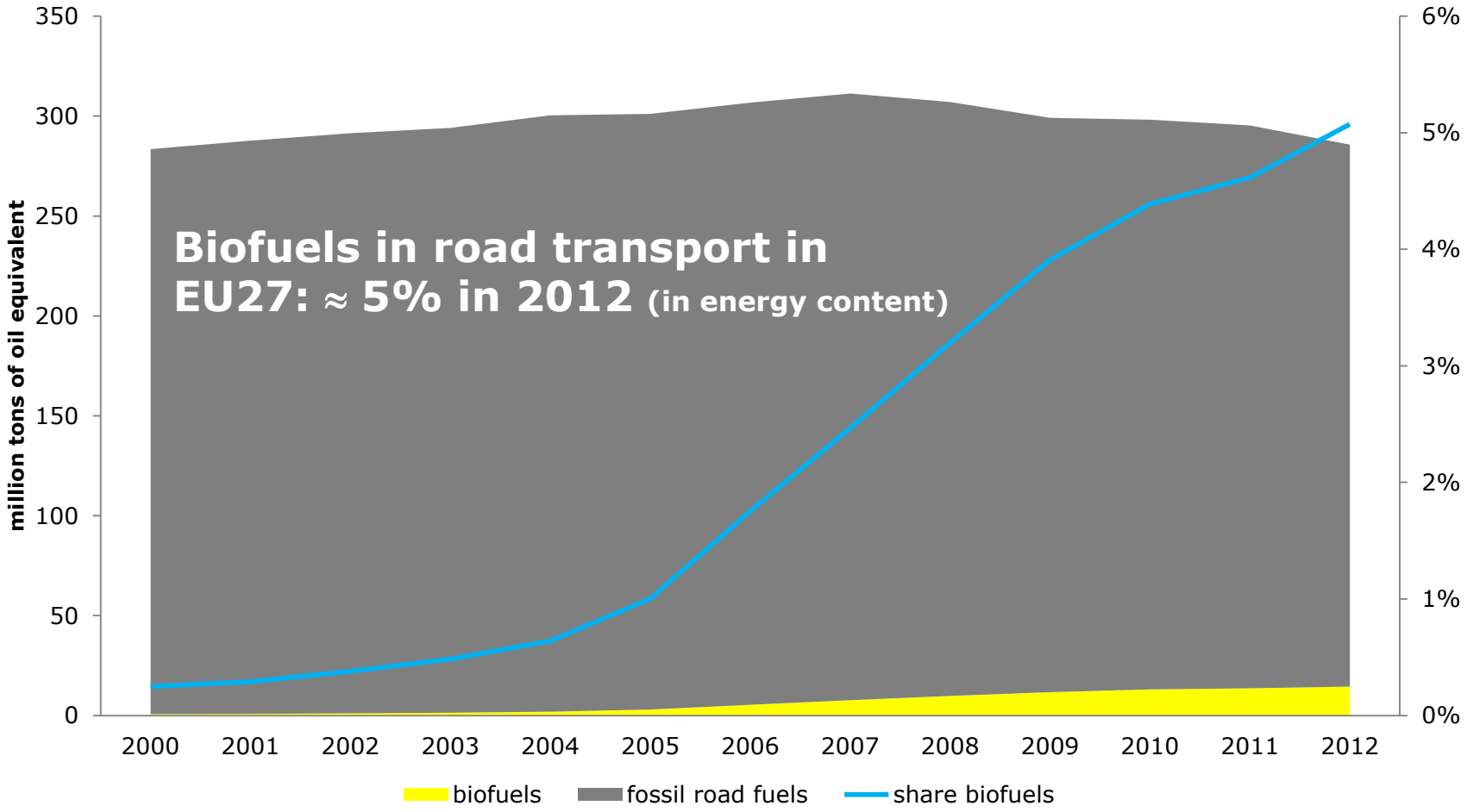
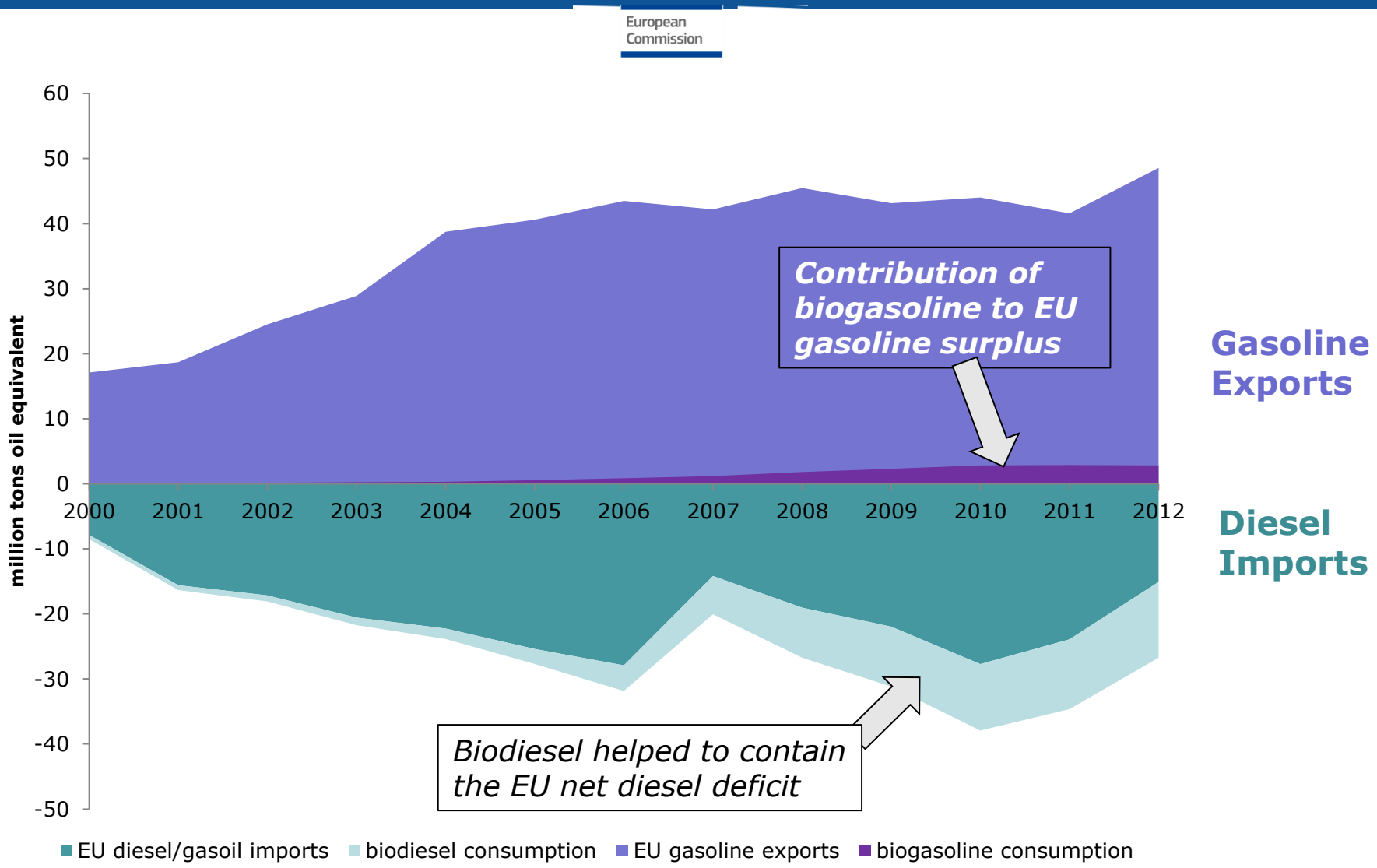
Renewable Energy Directive

European Commission



Data source: Eurostat

Renewable Energy Directive (RED)



Data source: Eurostat

Renewable Energy Directive (RED)

European Commission

Effect of EU biofuel policy on petroleum sector ambiguous:

- *No impact for Bio-Diesel*[‡]
- *but with benefits for society at large because*
  - **reducing EU diesel deficit and dependence on imports (~80% of EU biodiesel is produced domestically)**
  - **without biodiesel, EU conventional diesel imports would have had to be 50% higher during 2010-2012**

- *Negative for Bio-Gasoline*
  - **-3% gasoline demand reduction during 2010-12, reinforcing EU gasoline excess capacity problem**
  - **EU utilization rates could have been up to 3 percentage points higher**

‡ *Caveat: some individual EU refineries with limited access to international product markets – e.g. landlocked and strongly dependent on local markets – might still be negatively impacted. Also, few EU countries – mainly Netherlands and Italy – were net exporters of Diesel.*

Renewable Energy Directive (RED)

European Commission

Main benefits associated with RED:

- *Reduced dependency on crude oil / oil product imports*
- *Reduced EU demand for crude oil expected to result in lower crude oil price, leading to considerable savings on imports for Europe (even if effect is very small)*
- *Reduced CO_2 emissions*
  - **Real achievement questioned, due to indirect land use change effect**

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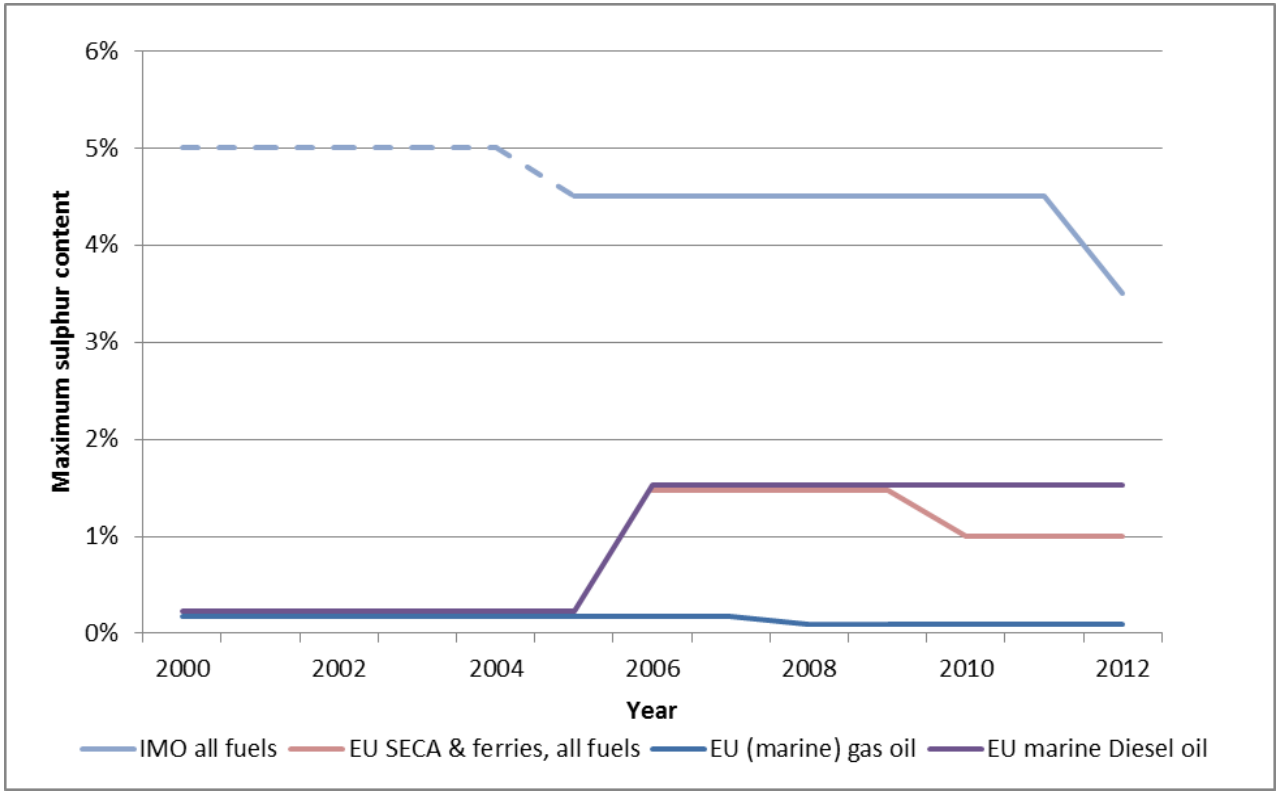
Marine Fuels Directive (MFD)

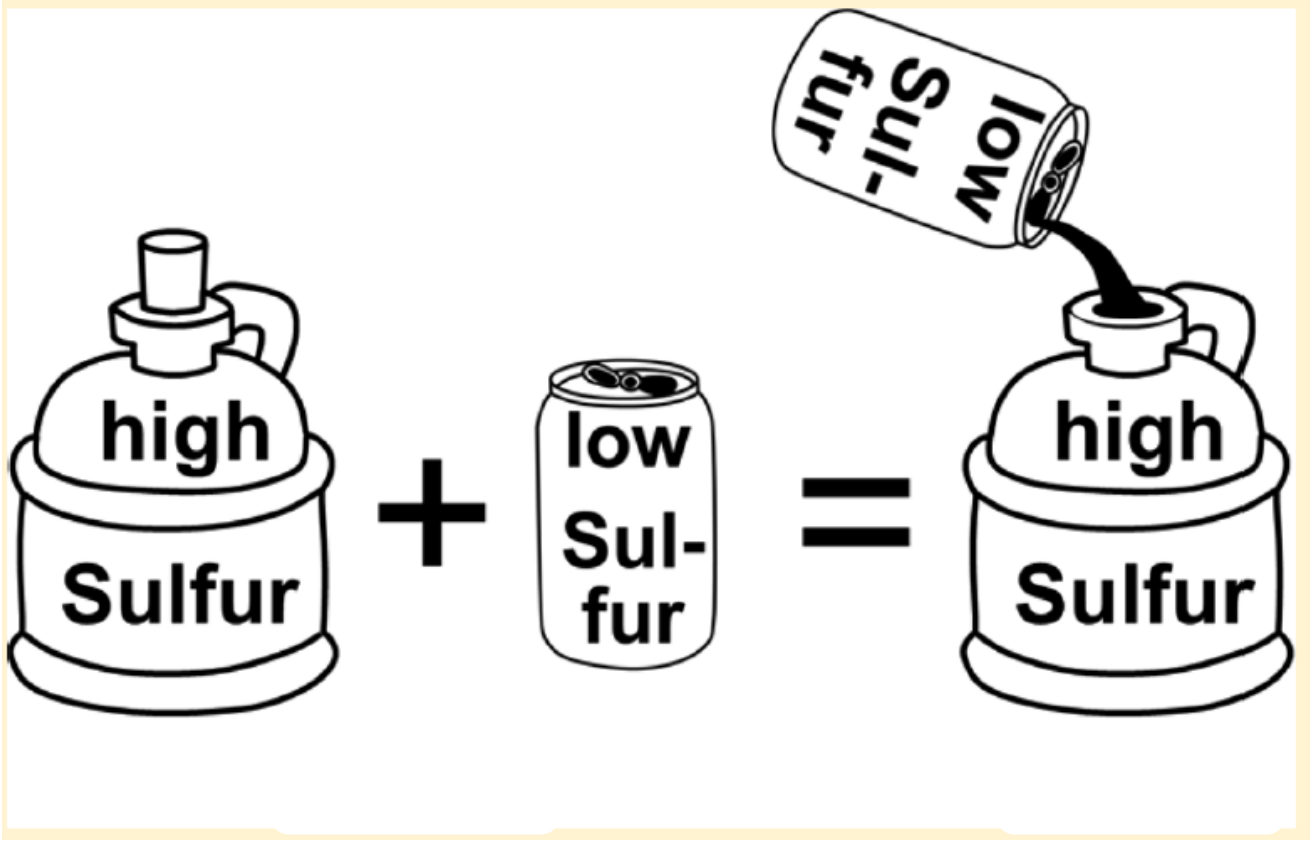
European Commission



Sulphur limits for marine fuels: relevant legislation*

* Not including inland navigation & at berth

Marine Fuels Directive (MFD)



Regulatory requirements for SECA and IMO global achieved by re-blending; average sulphur content of heavy bunkers hardly affected.

Source: Mestl et al., Environ. Sci. Technol. (2013)

Marine Fuels Directive (MFD)

European Commission

- *Global cap of 4.5%S and later 3.5%S did not have any discernable impact on refineries as it was achieved by re-blending*
- *SECA limit in EU of 1.5%S and later 1.0%S was achieved by drawing on low sulphur crudes*
  - **Observed price difference between SECA and non-SECA bunkers of 20-80 USD per ton in line with price difference between low and high-sulphur crudes**
  - **Sulphur regulation has not driven fuel oil out of the EU bunker market**
- *Marine gasoil shift from 0.2%S to 0.1%S: small price impact of about 10 USD per tonne.*
- *Benefits of local rather than global nature (sulphur emissions displaced, not necessarily eliminated)*

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Industrial Emissions Directive (IED) [incl. IPPC/LCPD]

European Commission

On average EU refineries have **lowered their SO2 and NOx emissions significantly** over 2000-2012; assuming that without regulation EU15 refineries' SO2 and NOx emission intensities (kg per ton of net input) would have stayed constant at year 2004 level implies **net benefits in the EU15 from refineries' abatement of around 7.5 billion** EUR over 2005 to 2012.

Each EU refinery has on average incurred capital expenditures of **5 Mio EUR per year** for compliance with emissions and effluents regulation, with a moderately increasing time trend. These investments accounted for a fairly constant share of 10% of refineries' total annual capital investments.

On average, the cost burden from these capital and estimated associated operational expenditures is **0.13 EUR/bbl of processed input** (crude oil and other feedstocks). As this represents about 3% of total operational costs, the impact is **judged as moderate**.

For the considered years the resulting **impact on competitiveness is assessed to be low**, because of the moderate incremental costs, and because refineries in important competitor regions have had higher (USA) or not much lower (Middle East) capital expenditures of the same type. Russia represents an important exception.

Industrial Emissions Directive (IED) [incl. IPPC/LCPD]

European Commission

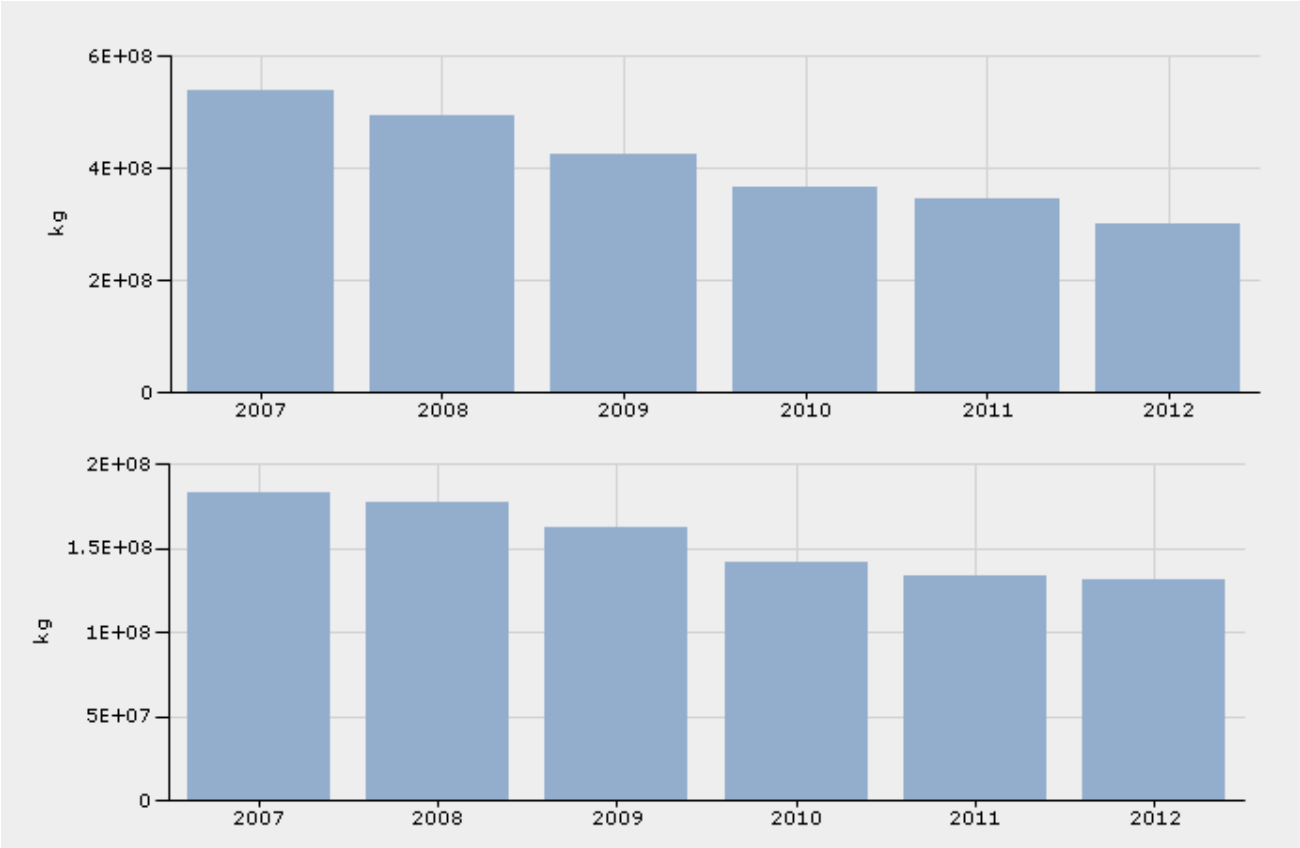


Figure 6.3: EU27 total emissions from mineral oil and gas refineries of SO_2/SO_x (top panel) and NO_2/NO_x (bottom). Source: European Pollutant Release and Transfer Register database (E-PRTR).

Industrial Emissions Directive (IED) [incl. IPPC/LCPD]

European Commission

Year	Emission & Effluents CapEx, Ø [Mio €]	relative to total CapEx	CapEx per barrel processed input [€/bbl]	Implied OpEx [Mio €]	relative to total OpEx	OpEx per barrel processed input [€/bbl]
2000	5.3 [3.3]	19%	0.09	0.2	0.1%	0.00
2001	2.7 [3.3]	10%		0.4		
2002	2.6 [2.5]	9%	0.05	0.6	0.4%	0.01
2003	2.6 [1.3]	8%		0.8		
2004	4.1 [2.1]	9%	0.07	1.0	0.6%	0.02
2005	4.5 [1.6]	10%		1.2		
2006	4.5 [3.5]	10%	0.08	1.5	0.7%	0.03
2007	7.8 [7.2]	12%		1.9		
2008	7.0 [8.4]	9%	0.12	2.4	0.8%	0.04
2009	5.8 [7.9]	7%		2.8		
2010	6.0 [7.3]	8%	0.10	3.1	1.1%	0.05
2011	5.5 [7.4]	8%		3.5		
2012	6.0 [6.2]	12%	0.10	3.9	1.1%	0.06
cumulative	64.5 [61.8]			23.2		
average	*5.0 [4.8]*	*10%*	*0.09*	*1.8*	*0.8%*	*0.03*

Table 6.1: Overview over refineries' expenditures related to emissions and effluents regulation. Numbers represent averages across all EU28 refineries for which data was obtained. The annual average capital expenditures obtained from CONCAWE (2104) are reported in brackets. Operational costs are estimated by assuming them to be 6.3% of capital costs per year. A factor of 7.33 was used to convert tons into barrels of input. Caveat: Assuming all operational costs to be additional most likely introduces an upward bias. Data source: Solomon Associates (2014).

Industrial Emissions Directive (IED) [incl. IPPC/LCPD]

European Commission

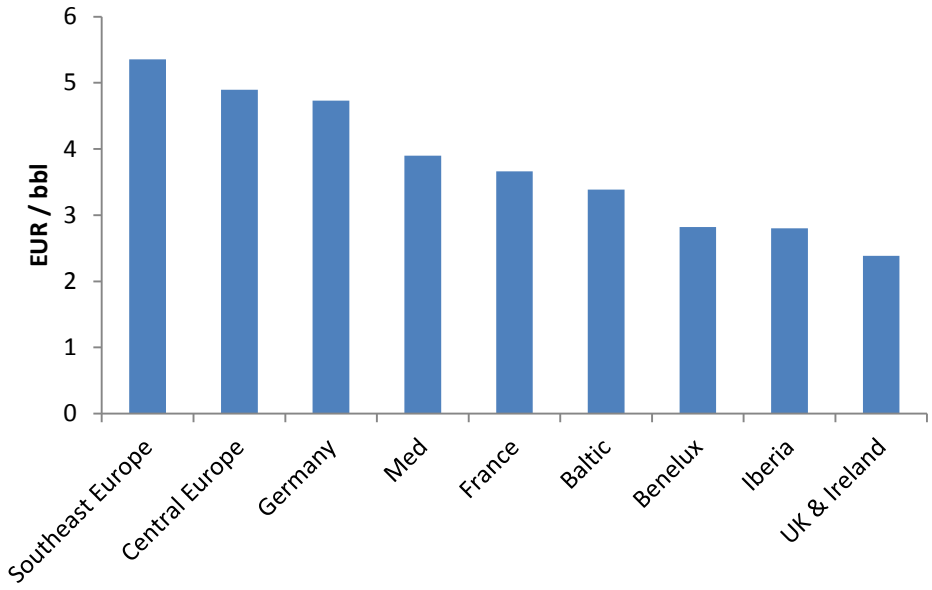


Figure 6.6: Capital expenditures related to pollution regulation per barrel of equivalent distillation capacity (= capacity times complexity). Average annual figures for 2000-12. Data source: Solomon Associates (2014).

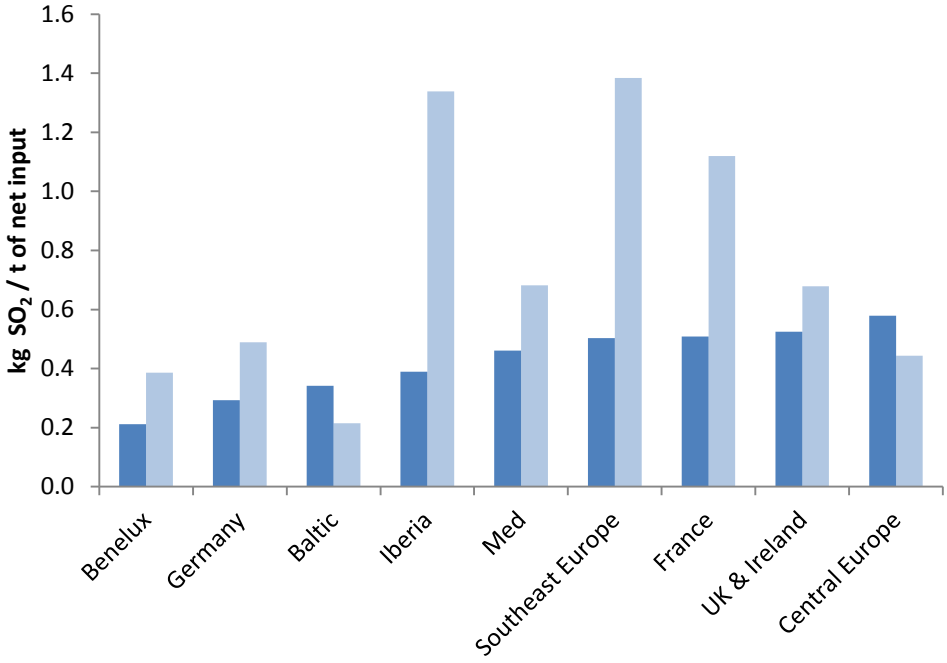
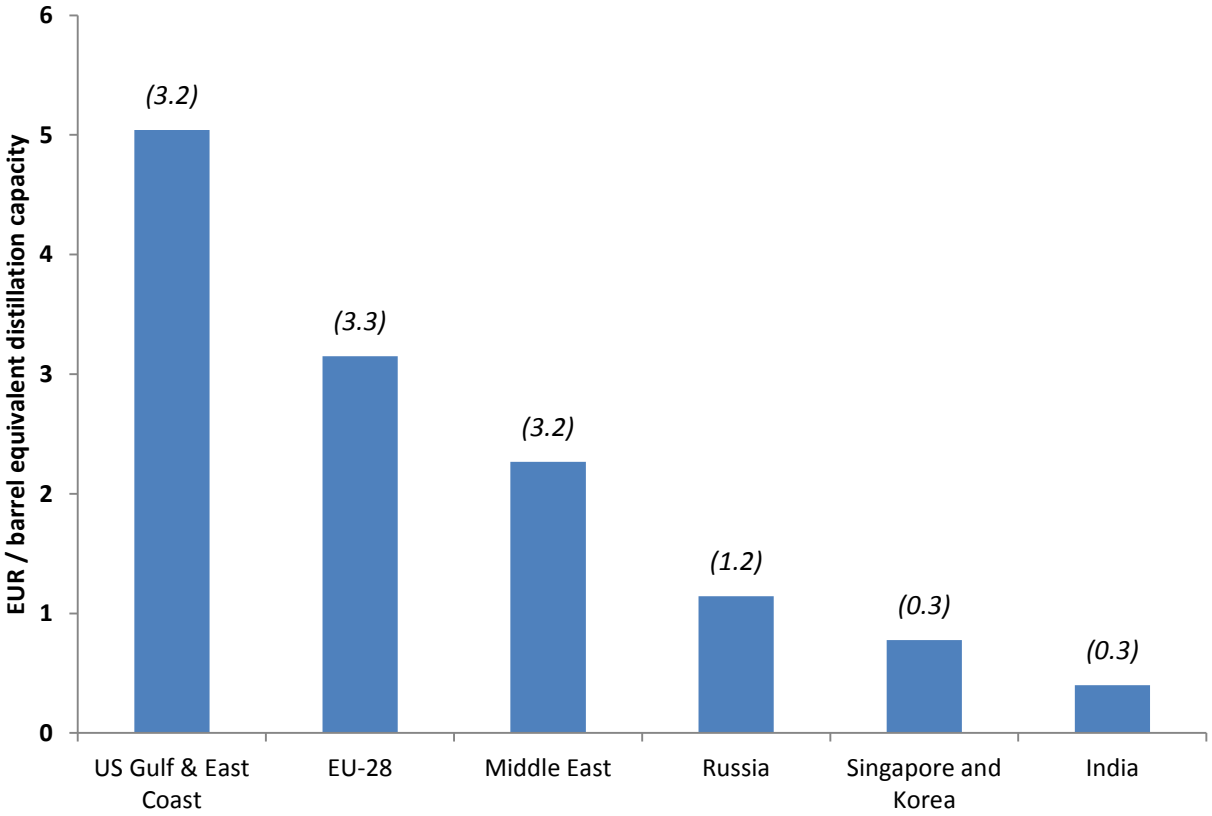


Figure 6.2: SO2 emissions per net input in 2012 (dark), and 2004 (light). Note: (i) 2004 is the earliest available data. (ii) Variable sample composition, especially in EU13 accession countries. Source: Solomon Associates (2014).

Industrial Emissions Directive (IED) [incl. IPPC/LCPD]



Who are the EU's most important competitors? On domestic market:

- EU diesel/gasoil imports mostly from Russia and US (80% together)
- Middle East most important source of EU jet fuel imports

Figure 6.12: Capital expenditures related to refinery pollution regulation per barrel of equivalent distillation capacity. Average annual figures for 2000-12, except for India (from 2007 on), Russia (from 2005 on). Shown in parenthesis are the averages for 2011-2012. Data source: Solomon Associates (2014a).

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Clean and Energy Efficient Vehicles (DCEEV)

European Commission

- In force since June 2009, and by now successfully transposed. However, only in three MS by the due date of 2010;

- Addresses environmental and energy security issues in an indirect way, as a complementary demand-side measure;

- Targets vehicle procurement in the public sector - impact on the overall vehicle market not significant in the short run;

- Impact on the oil refining industry second-order through reduction in overall transport fuel demand; presumably not significant to date and practically indiscernible empirically.

  EC (2013): "Although the market for low emission vehicles is expanding, it is difficult to attribute this to the implementation of this Directive, and it is more likely to be due to other factors. … Belated transposition of the Clean Vehicle Directive by most Member States has limited the experience with this Directive to date..."

We conclude that until 2012 the DCEEV had **no tangible impact on the oil refining sector** and **do not consider it relevant for quantitative analysis in the fitness check**.

Strategic Oil Stocks Directive (SOSD)

European Commission

- In force since 2009, transposition until December 2012 (extension until 2014 for certain MS); amends the obligations of 1968, 1973 and 1998;
- Stockholding costs were mainly incurred as a result of previously existing obligations and membership in the IEA before 2000 (except new MS);
- Actual stockholding arrangements by MS differ, together with the degree of industry's involvement;
- Obligation mostly financed in an competitiveness-neutral way; in certain cases the industry benefits by providing stockholding services;
- Where obligation is imposed on the industry, strong indications of a (full) cost pass-through to final consumers (Purvin and Gertz 2013).

We conclude that the SOSD had **no tangible impact on the oil refining industry** in the period concerned and **do not consider it relevant for quantitative analysis in the fitness check**.

Energy Efficiency Directive (EED)

European Commission

- In force since 2012, with transposition by June 2014;
- Previous legislation on energy efficiency not sufficiently effective – unspecific targets and non-binding nature of the obligations;
- Current directive introduces binding measures together with indicative targets, with the possibility of recourse to binding national targets – likely more effective;
- Impact on the oil refining sector potentially two-fold: on the operational requirements and/or on the demand side;
- Still, the overall impact on the refining sector during 2000-20012 indiscernible.

We therefore **do not consider the EED relevant for quantitative analysis in the fitness check**.

Air Quality Directive (AQD)

European Commission

- In force since 2008, transposition until 2012 (certain provisions needed to be implemented sooner);
- An impact assessment published in 2013 confirms overall compliance with prescribed pollutant levels;
- The observed effectiveness mainly attributed to the EU-level "source controls" measures: IED/IPPC/LCP and FQD;
- IED/IPPC/LCPD address the air quality issues in the oil refining sector in a more targeted way than AQD – their impacts presumably dominate.

We therefore **judge it as impossible to disentangle the impact of AQD from the impacts of IED/LCPD/IPPC in the fitness check**, and thus **do not conduct a separate quantitative analysis**.

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Preliminary results from global refining model OURSE

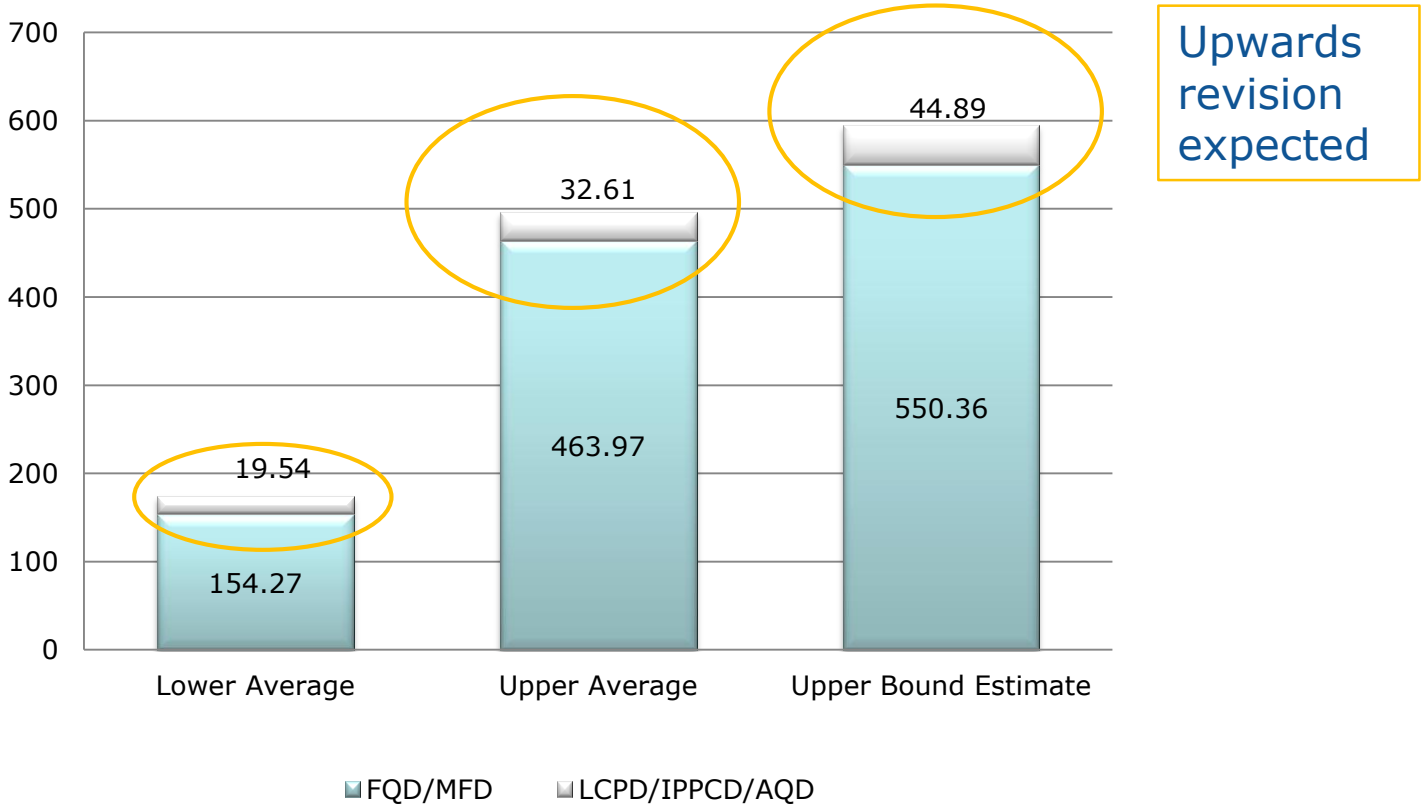
European Commission

- *Model runs currently being redone*
- *Ongoing revision of model taking into account received comments*
  - incurred costs on sector from lower demand for oil products (lower utilization rates, efficiency loss) need to be captured
  - need to include switch to low sulphur crude oil as SO_2 abatement measure
  - recalibration to obtain more realistic global trade patterns

Preliminary results from global refining model OURSE

European Commission

Total sector-wide annual costs (CapEx $ OpEx) over 2003-2012 in Mio USD due to (i) FQD/MFD product regulation and (ii) LCPD/IPPCD/AQD SO_2 emission regulation



Preliminary results from global refining model OURSE

European Commission

FQD & MFD:

- Reduced international competitiveness of EU refining sector (measured in terms of *relative trade balance* indicator)

RED & ETD :

- Average reduction of 0.9% to 1.9% in the EU refineries' utilisation rates over 2000-2010 period
- Larger impact on refineries in North Europe by average factor of 1.8 to 2.2 (due to higher penetration of biofuels)
- Larger reduction in utilisation rates in 2005-2010 due to larger demand impact (maximum 3.1% in NE)

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Summary and conclusion

Timeline

- *End of November/December: EU ETS, FQD, ETD presented and discussed in internal and external ISSG*
- *11 December – presentation of results at Refining Forum*
- *Beginning 2015 – dedicated REFIT meeting (same audience as Refining Forum)*

Thank you

JRC Seville Refining Fitness Check:

- **Dilyara Bakthieva**
- **Luis Delgado**
- **Peter Eder**
- **Ruslan Lukach**
- **Marian Mraz**
- **Robert Marschinski**
- **Umed Temurshoev**