Oil Refining Fitness Check

Preliminary results

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Content

- *Economic impact on refinery sector of directives analysed in Fitness Check*
- *International competitiveness of EU refining: trends 2000 to 2012*

Directives analysed in Fitness Check

1. *The Renewables Energy Directive (RED);*
2. *The Energy Taxation Directive (ETD);*
3. *The EU Emissions Trading System (EU ETS);*
4. *The Fuels Quality Legislation (FQD);*
5. *The Directive on Clean and Energy Efficient Vehicles (DCEEV);*
6. *The Industrial Emissions Directive (IED);*
7. *The Strategic Oil Stocks Directive (SOSD);*
8. *The Marine Fuels Directive (MFD);*
9. *The Energy Efficiency Directive (EED);*
10. *The Air Quality Directive (AQD).*

Impact of directives: (i) on refinery operations

	Associated capital investments	Associated operating costs	Cost per barrel of throughput
Emissions Trading (EU ETS)	No evidence for investment specifically targeting CO_2 emissions	• No direct impact (permit costs for CO_2 emissions) until 2012, because sector received on average more free permits than verified emissions • Indirect: higher price for purchased electricity	Until 2012 only indirect effect, but purchased electricity represents <10% of average refining energy
Industrial Emissions *	Annual average of 5 Mio EUR per refinery, higher (6.4 Mio) after 2006	Estimated as 6.3% of capital investments, yielding 1.8 Mio annually per refinery	0.13 Euro per barrel over 2000 to 2012
Air Quality	Impact on refinery cannot be disentangled form impacts of IE / IPPC / LCP Directives		
Strategic Oil Stocks	Depends on MS implementation: sometimes no involvement of industry, but where obligations are imposed on industry cost-pass through seems very likely		

* Understood as *Industrial Pollution and Prevention*, as well as *Large Combustion Plant Directive*

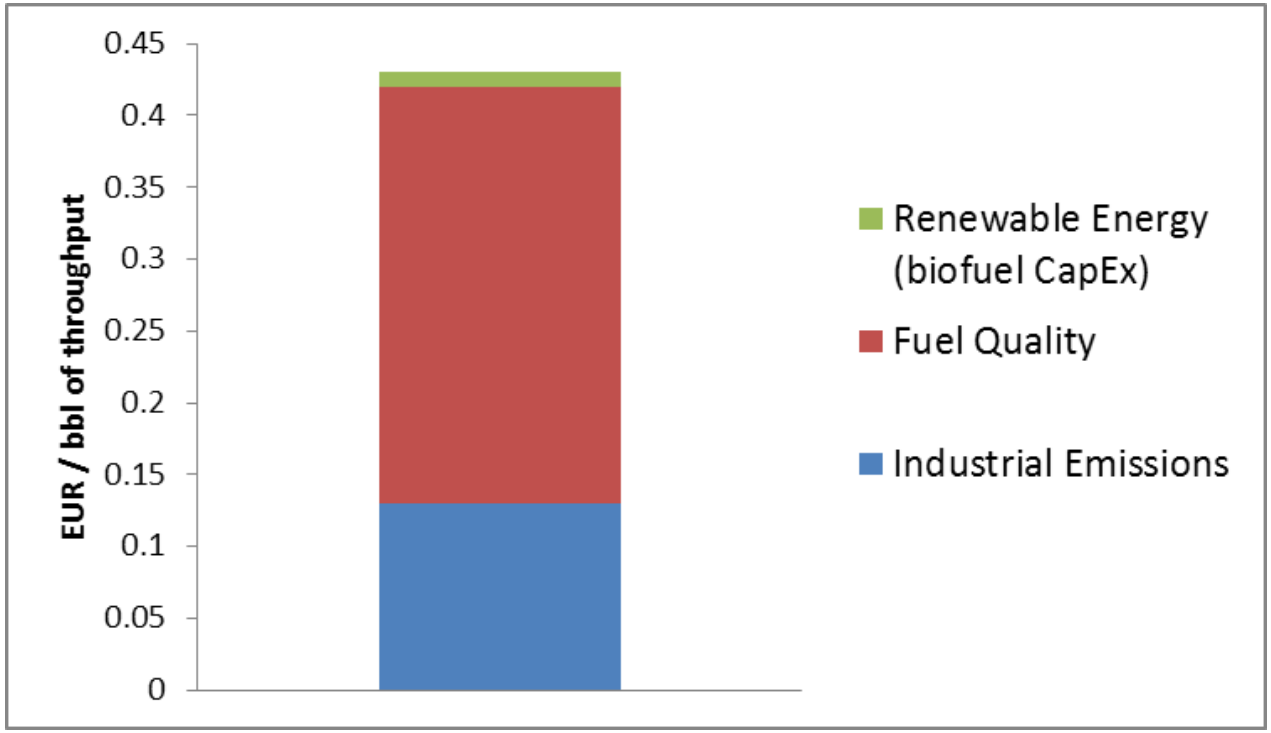
Impact of directives: (ii) through product specification

	Associated capital investments	Associated operating costs	Cost per barrel of throughput
Fuels Quality Legislation	8.5 Mio EUR reported investments per year per refinery.	Estimated 8.9 Mio EUR annually per refinery over 2000 to 2012	0.29 EUR per barrel over 2000 to 2012.
Marine Fuels	None, fuel specifications achieved by low-sulphur crude oil and re-blending.	Only logistical costs associated with re-blending.	Likely negligible
Renewable Energy	New blending, storage, and transport facilities: 0.5 Mio EUR per year per refinery (CONCAWE 2014)	Not estimated	0.01 EUR per barrel over 2000 to 2012

Impact of directives: (iii) demand reduction

	Demand impact	Contributed to 'Dieselsation' ?	Impact on refineries
Renewable Energy	-1% gasoline demand reduction during 2000-12, -3% in 2012	No (but has helped to reduce EU diesel deficit)	During 2000-2012 could have marginally contributed to utilization rate reduction.
Energy Taxation	Estimate of 0.1% demand reduction for gasoline, 0.2% for diesel	No (but neither did it help to work against it)	Likely negligible due to a very small effect on fuel demand
Industrial Emissions	Reduction of fuel oil demand from power sector		Impact cannot be quantified directly as refineries react differently: deeper conversion, orientation towards marine fuels, or shut down.
Clean and Energy Efficient Vehicles	No observable effects until 2012		
Energy Efficiency	No observable effects until 2012		

Quantified Impact of directives: total cost impact (*preliminary findings*)



Additional analysis being considerd for other effects based on modelling (e.g. indirect demand effects)

Content

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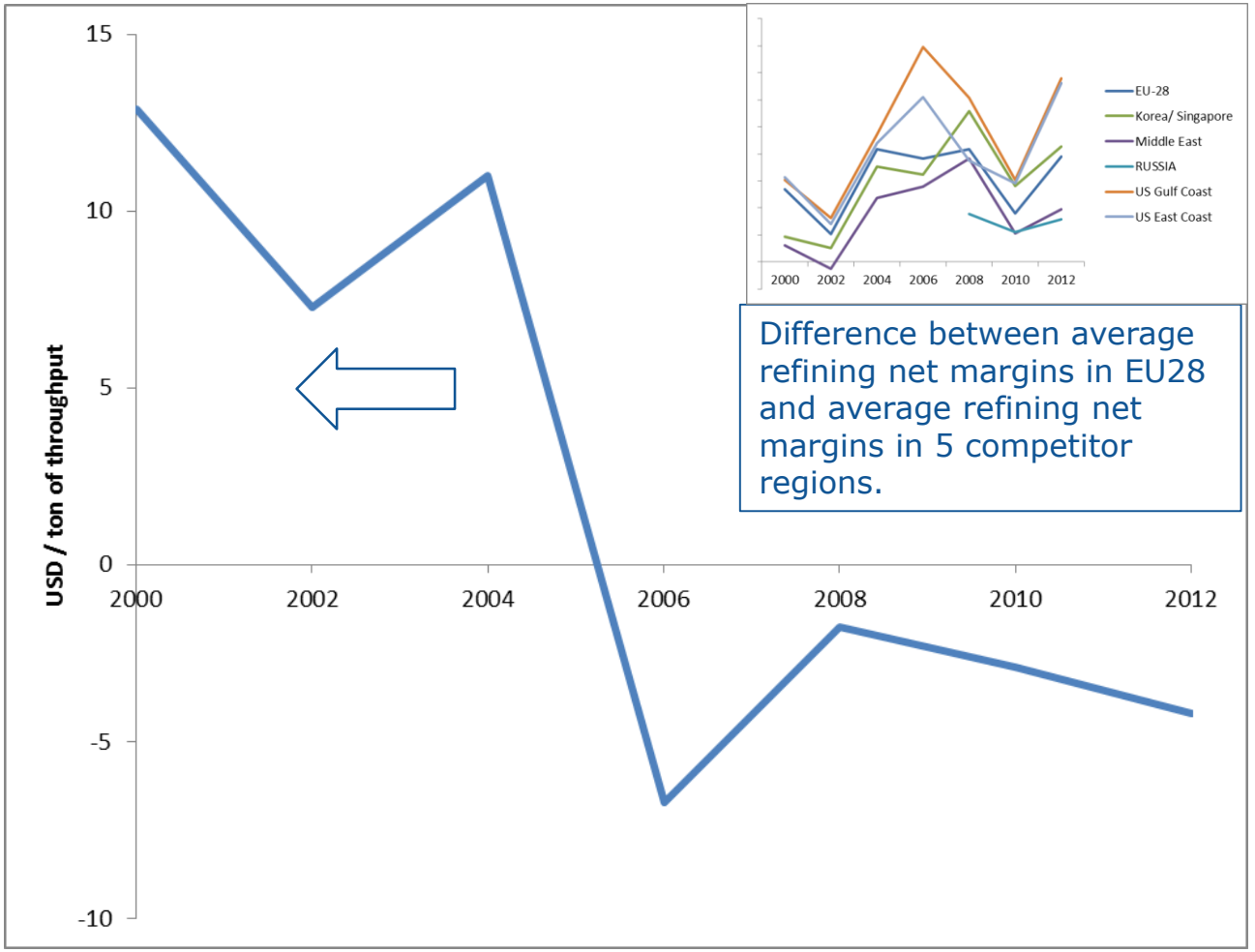
Refining margins in EU28 vs. US/ME/Russia/South Korea & Singp.

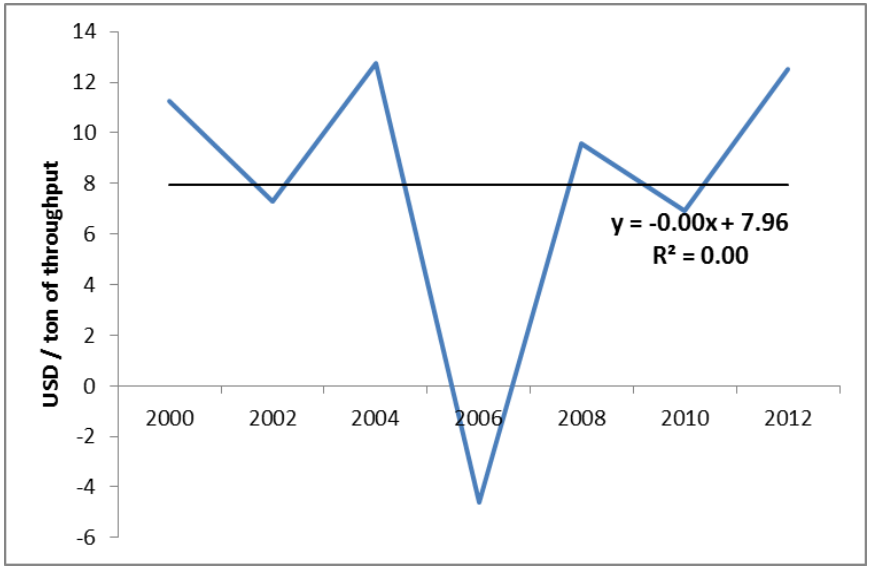
- **By 2006 average EU28 net margins have fallen below those of the competitor regions**
- **EU28 net margins have lost 1.5 USD/ton per year against the competitors', i.e. <u>2.5 USD/bbl over 2000-12</u>.**



Source: own estimates based on Solomon Associates (2014,2014a) data

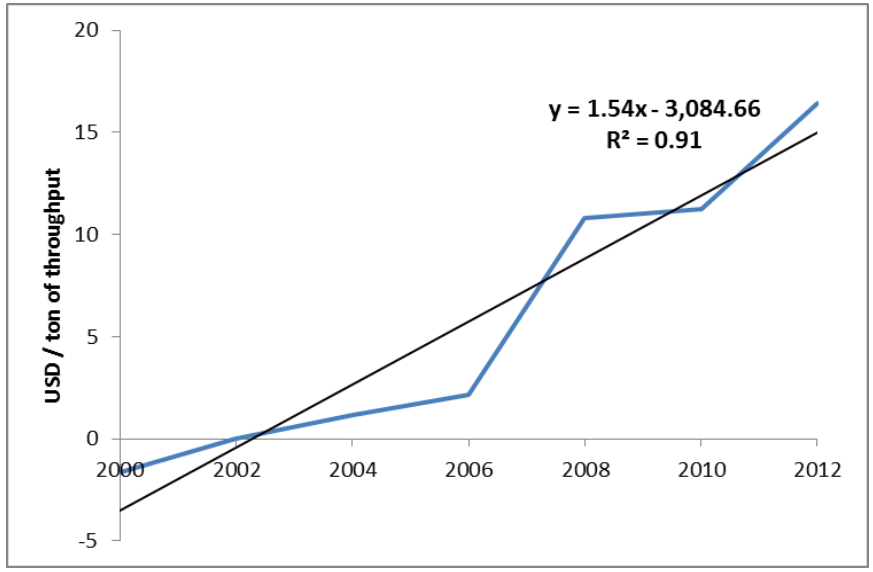
Refining margins in EU28 vs. US/ME/Russia/South Korea & Singp.

Gross margins: no trend, EU28 consistently above others



Difference between *gross margins* in EU28 and average *gross margins* in 5 competitor regions.

Operational costs: EU28 increasing



Difference between *operational costs* in EU28 and average *operational costs* in 5 competitor regions.

The relative decrease of EU net margins* is due to the relative increase of *operational costs* in the EU

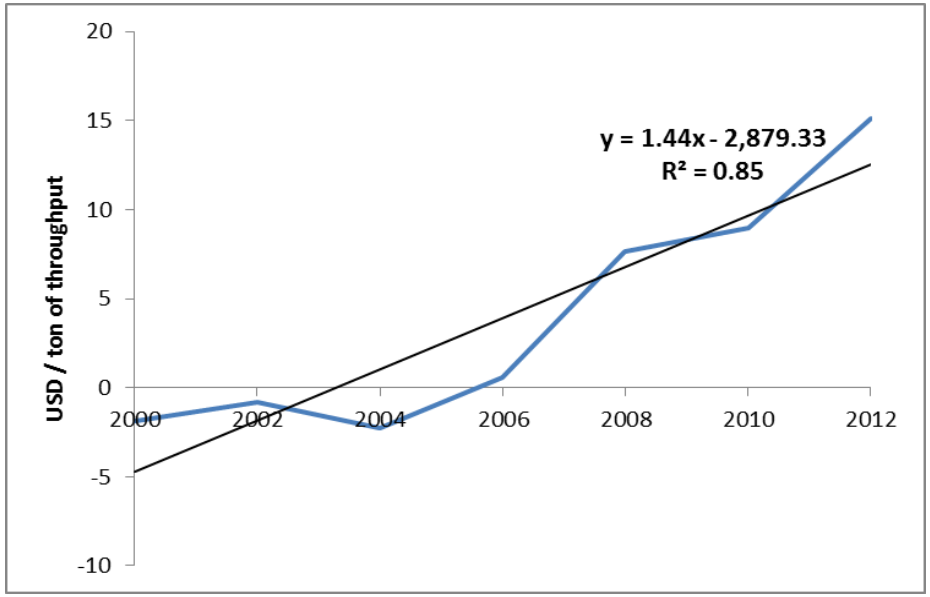
Source: own estimates based on Solomon Associates (2014,2014a) data

Preliminary Findings

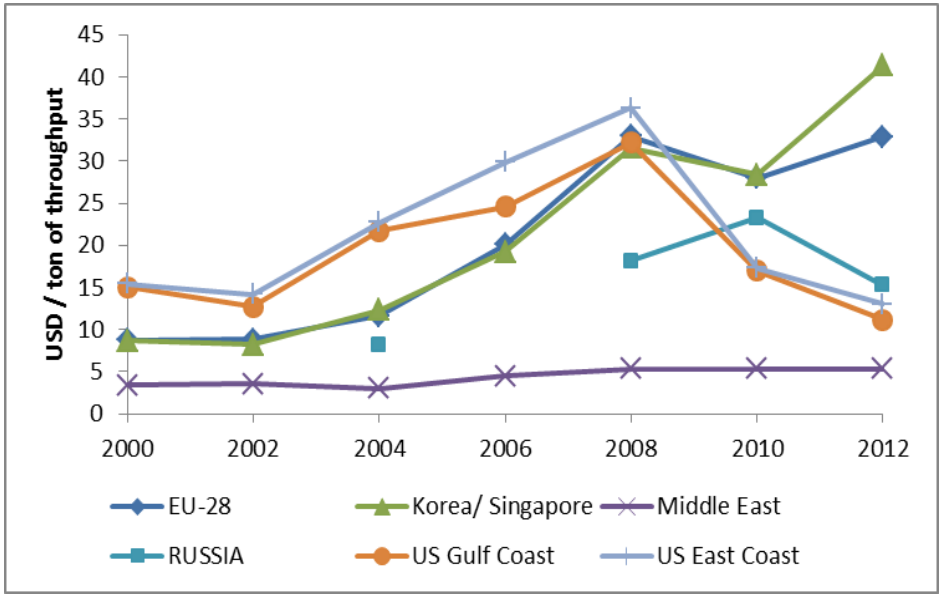
* NET margins = GROSS margins – Operating Costs

Refining margins in EU28 vs. US/ME/Russia/South Korea & Singp.

Difference between *energy costs* in EU28 and average *energy costs* in 5 competitor regions.



Average energy costs in EU28 and 5 competitor regions.



More specifically, it is due to the relative increase of *energy costs* in the EU

- Nearly 4-fold increase in EU vs. less than 2-fold increase for competitors
- US Gulf and East Coast: costs in 2012 lower than in 2000
- Middle East: slight increase (1.6-fold), low absolute level
- Russia: doubled from 2004 to 2012, but at the same time EU tripled
- Korea/Singapore: similar as EU, worse in 2012

Source: own estimates based on Solomon Associates (2014,2014a) data

Explaining EU energy cost deterioration

Energy costs in Europe may have increased because:

1) **Decreasing – relative to competitors – energy efficiency (= use of energy per throughput)**

2) **Cost increase in Europe – relative to the competitor regions – of 1 unit of energy**

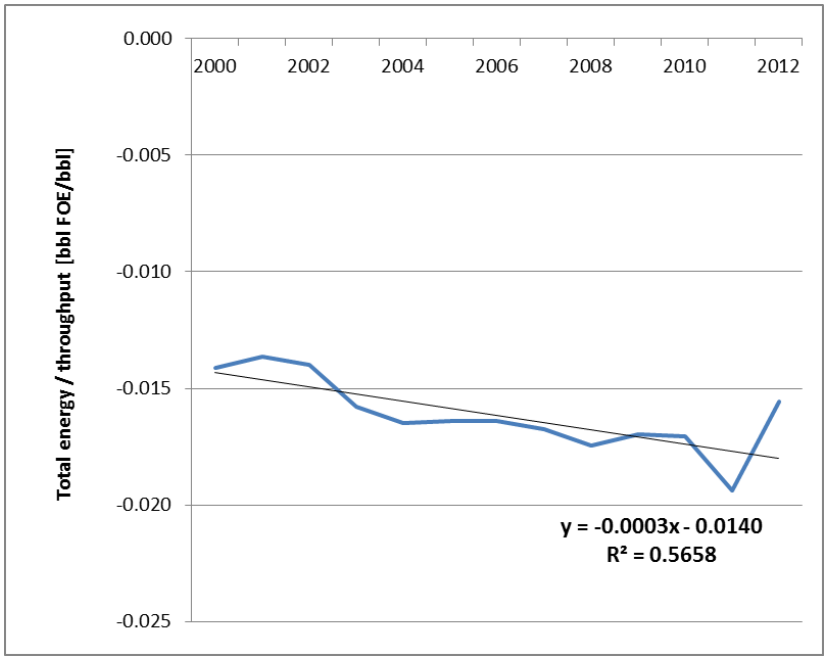
   i. **due to price increases**

   ii. **due to composition effect, i.e. switch towards more costly forms of energy (e.g. purchased electricity rather than fuel oil)**

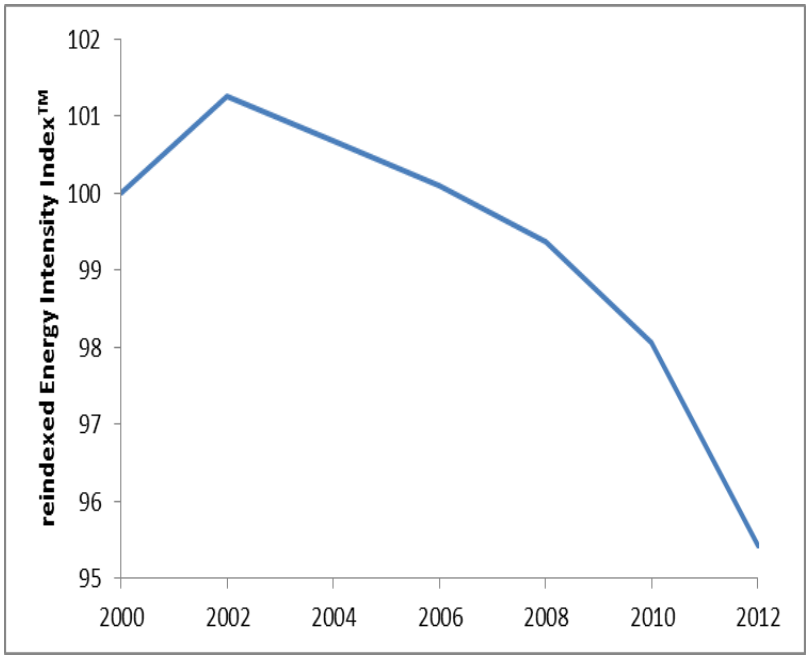
Explaining EU energy cost deterioration

Energy costs in Europe may have increased because:

~~1) Decreasing – relative to competitors – energy efficiency (= use of energy per throughput)~~



Difference between average refining energy per throughput (barrels of fuel oil equivalent per barrels of throughput) in Europe and 5 competitor regions.

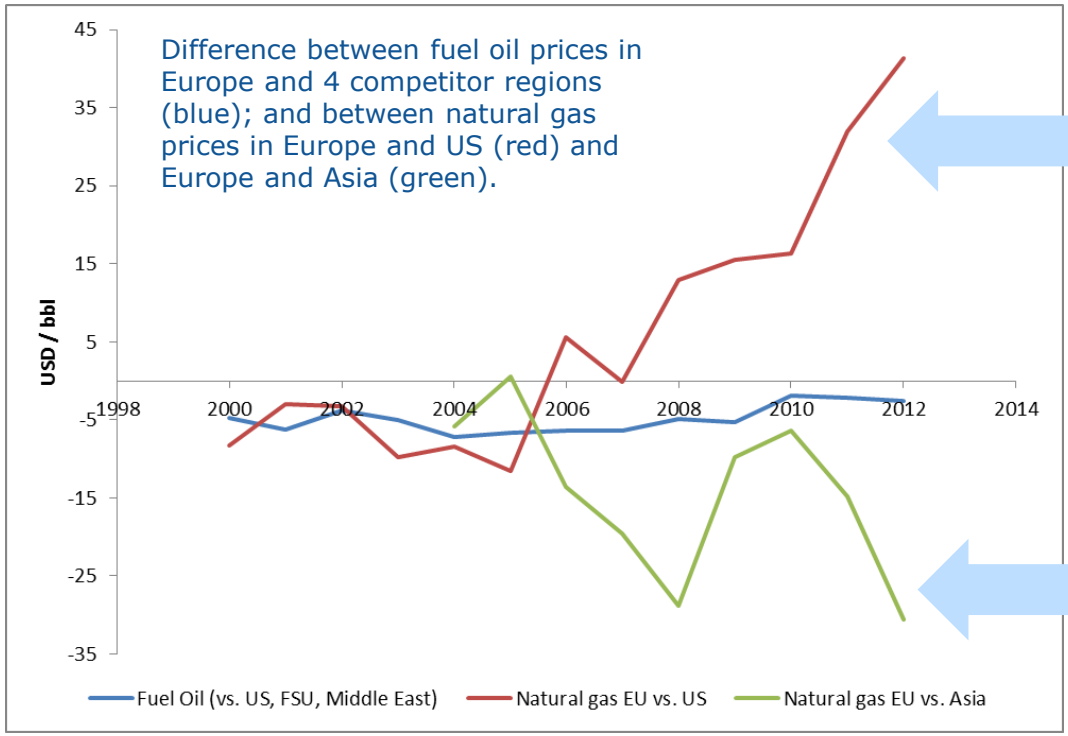


Solomon Energy Intensity Index™ (EII™) for EU28, re-indexed to year 2000 value.
[caveat: other regions even more improved?]

Source (left): own estimate based on IHS (2014)

Source (right): Solomon Associates (2014)

Explaining EU energy cost deterioration



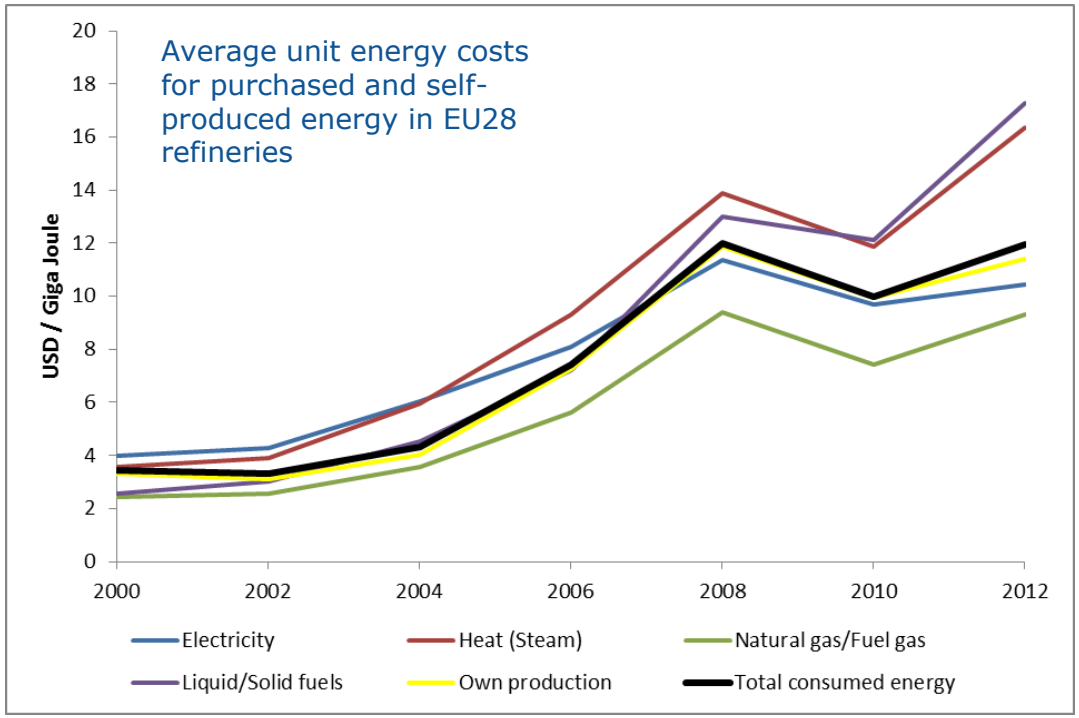
EU with *higher* natural gas prices than US

EU with *lower* natural gas prices than Asia

- Slight appreciation of fuel oil prices in Europe vis-à-vis competitors (against background of 4-fold increase in int'l crude oil prices).
- Natural gas prices increased almost 4-fold in Europe, while in the US the price of 2011 equals that of 2001. But prices in Asia are even higher than in Europe.

Data source: IHS (2014)

Explaining EU energy cost deterioration



- **3.5-fold increase** in the cost for 1 unit of refining energy,
- **All forms of energy with similar trend**: 3-fold increase for price of electricity, 4-fold for natural gas, 5-fold for heat/steam, 7-fold for liquid/solid fuels, 3.5-fold for own-produced energy
- Natural gas always cheapest form of energy
- **No composition effect**: Main change grown share of natural gas and of electricity (+ 4 Mio GJ/yr per refinery over 2000 to 2012), which has cost-decreasing effect

Preliminary Findings

Data source: Solomon Associates (2014)

Explaining EU energy cost deterioration

Energy costs in Europe may have increased because:

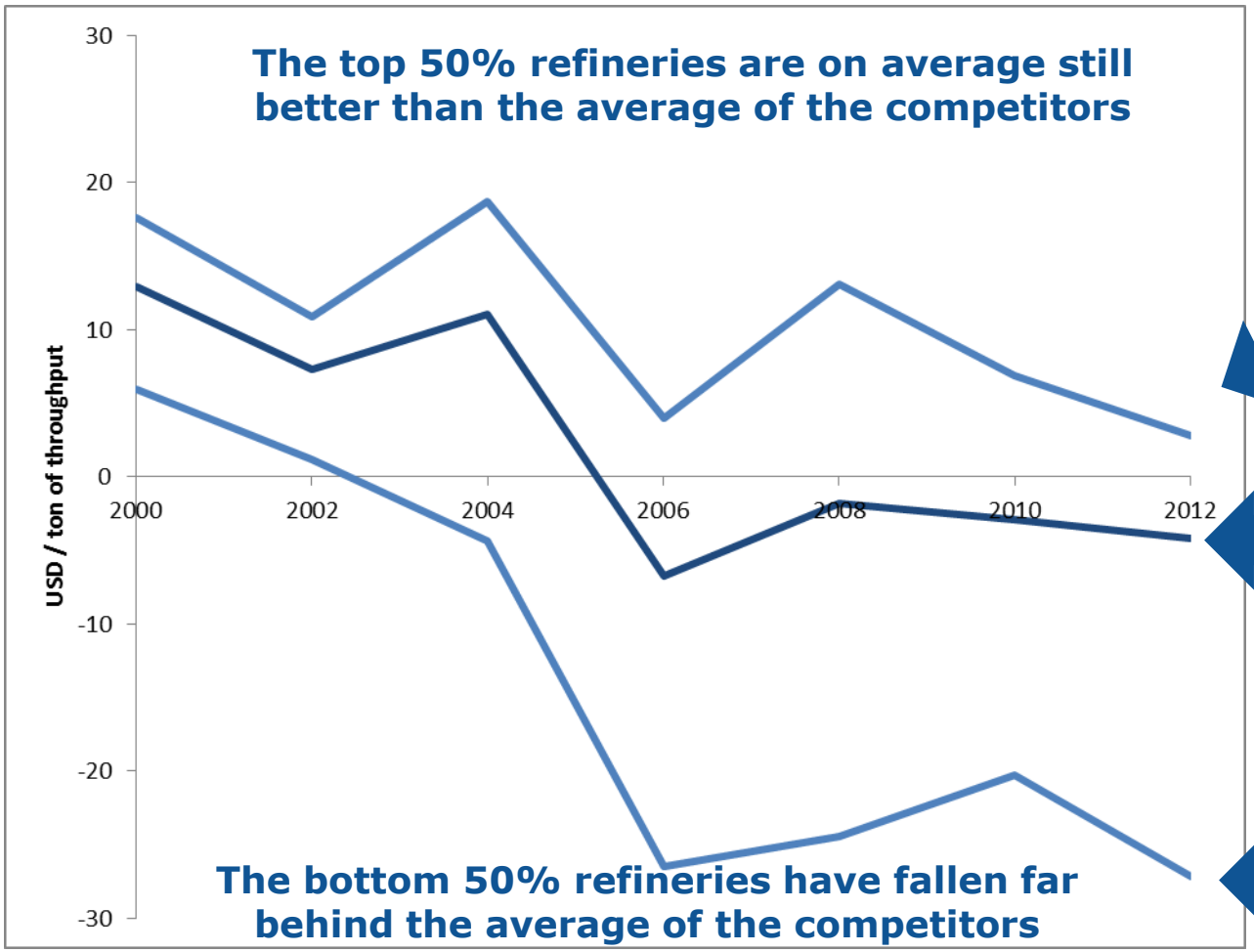
~~1) Decreasing – relative to competitors – energy efficiency (= use of energy per throughput)~~

2) Cost increase in Europe – relative to the competitor regions – of 1 unit of energy

   i. due to price increases

   ~~ii. due to composition effect, i.e. switch towards more costly forms of energy~~

Variation within EU28 refining sector



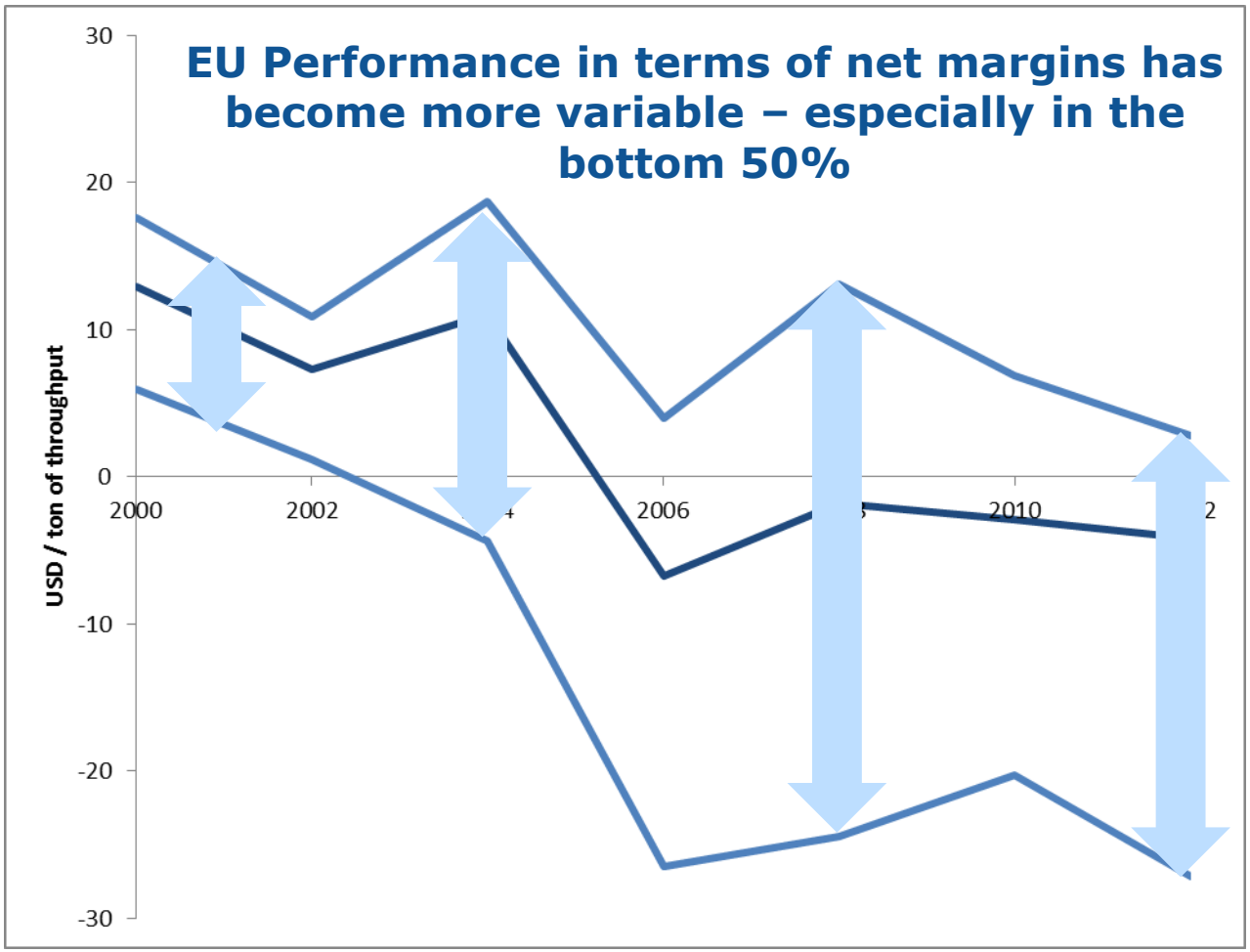
Top 25% percentile of EU28 refineries vs. average of competitor regions

Difference of average refining net margins in EU28 and average refining net margins in 5 competitor regions.

Bottom 25% percentile of EU28 refineries vs. average of competitor regions

Source: own estimates based on Solomon Associates (2014,2014a) data

Variation within EU28 refining sector

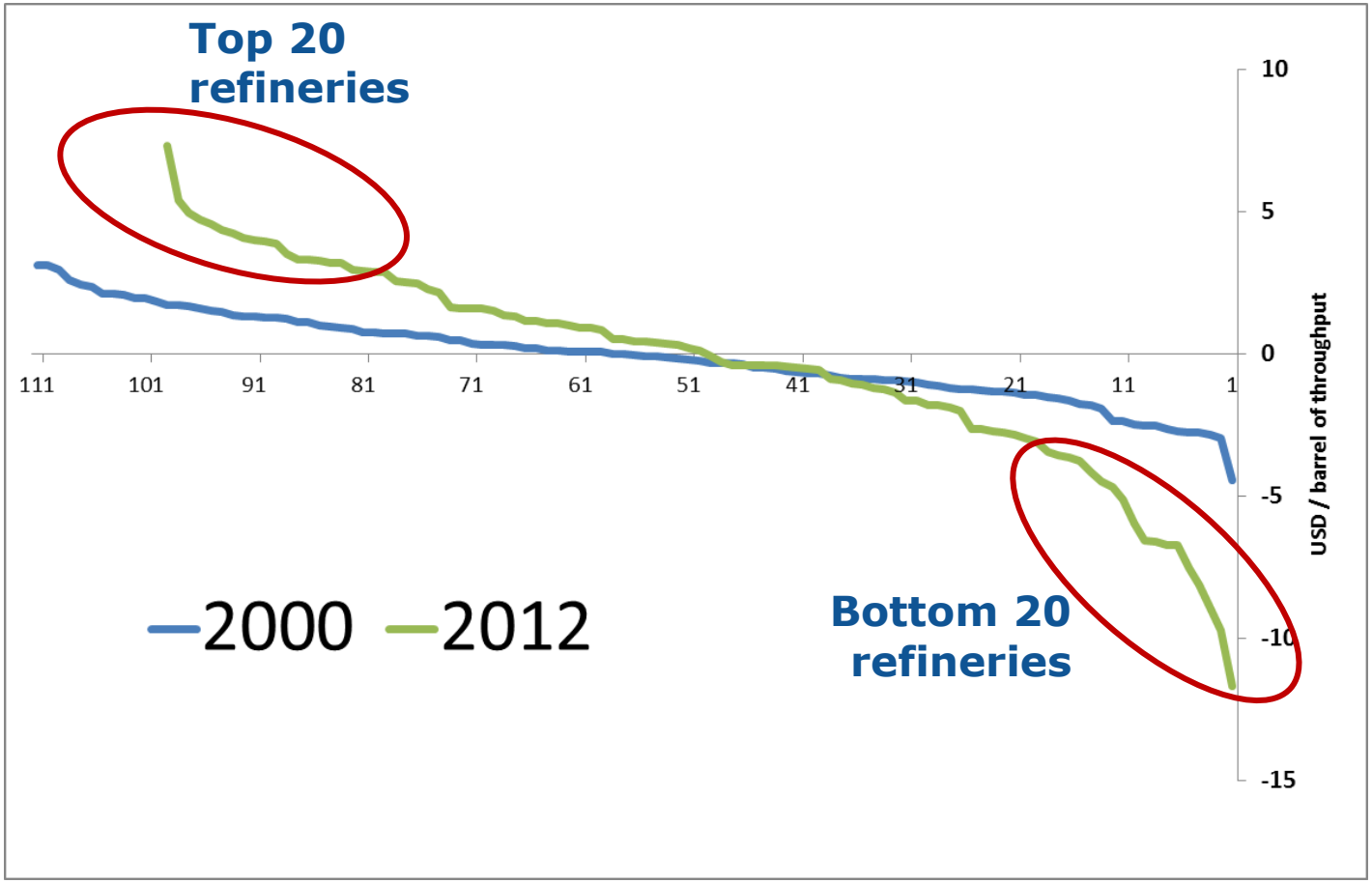


4 USD/bbl difference between top 25% percentile and bottom 25% percentile.

Source: own estimates based on Solomon Associates (2014,2014a) data

Variation within EU28 refining sector

0 ≡ average EU28 net margin



Net margins of individual EU28 refineries compared to EU28 average

Source: IHS (2014)

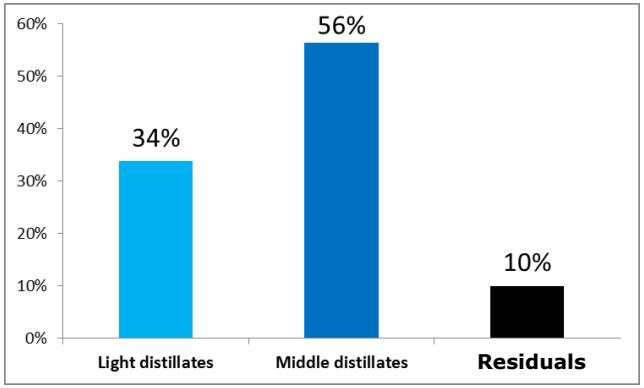
Data source: IHS (2014)

EU28 top vs. bottom refineries (2012)

Top 20 refineries

204.000 barrels/day
+ 80.0000 vacuum

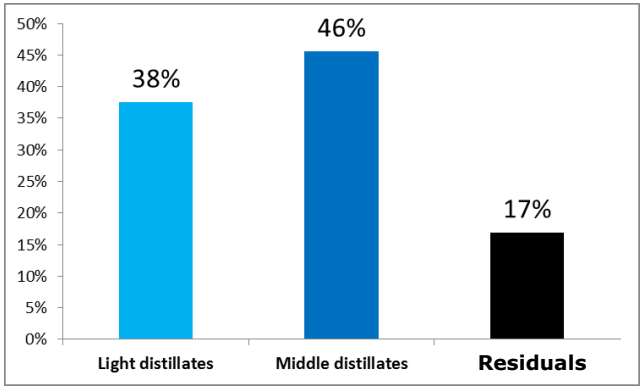
8.1 Nelson complexity



Bottom 20 refineries

124.000 barrels/day
+ 34.000 vacuum

7.9 Nelson complexity



3.2	**Replacement costs***	**2.2**
8.1	**Annual revenues***	**5.2**
0.38	**Annual OpEx***	**0.28**

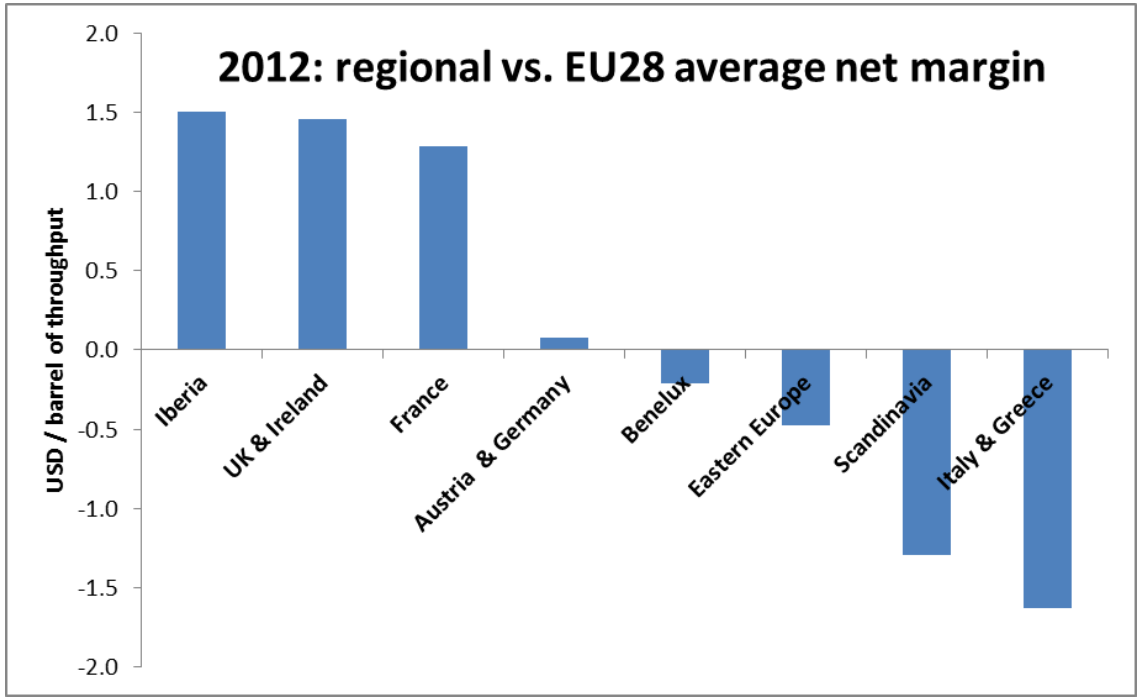
Preliminary Findings

*** in billion USD**

Data source: IHS (2014)

EU28 regional refining margins (2012)

0 ≡ EU average net margin



3.1 USD/bbl difference

Data source: IHS (2014)

Competitiveness analysis: conclusions

EU28 international competitiveness vis-à-vis US PADD 1 & 3, Middle East, Russia, S.Korea & Singapore:

1) **Loss of competitiveness: EU margin decrease of 2.5 USD/bbl against competitor regions over 2000-2012**

2) **Due to relative increase in energy costs in EU**

3) **In absolute terms, energy costs per barrel have increased almost 4-fold over 2000-12, while on average less than 2-fold in competitor regions**

4) **All forms of energy experienced similar strong cost increases**

5) **Related to 4-fold increase in crude oil price over same period**

6) **EU has no abundant domestic energy source, as e.g., US with non-conventional resources**

Competitiveness analysis: conclusions

Variation of competitiveness and performance within EU:

1) **International competitiveness of bottom 50% of EU refineries has suffered far more than that of top 50%**

2) **The performance gap between EU28 refineries has widened: spread between 25% percentile and 75% percentile has increased 3-fold from about 1.3 to 4.0 USD/bbl**

3) **Top 20 EU refineries**
   - **have 65% higher capacity than bottom 20 EU refineries**
   - **are geared more strongly toward mid-distillates**

4) **Regional net margins differ significantly**
   - **Some regions consistently have above EU average margins, others consistently below**

Regulatory impact on competitiveness?

- *Loss of EU28 competitiveness due to relative increase of per barrel energy costs*

- *Has EU legislation contributed to increased refining energy costs? Some working hypotheses:*

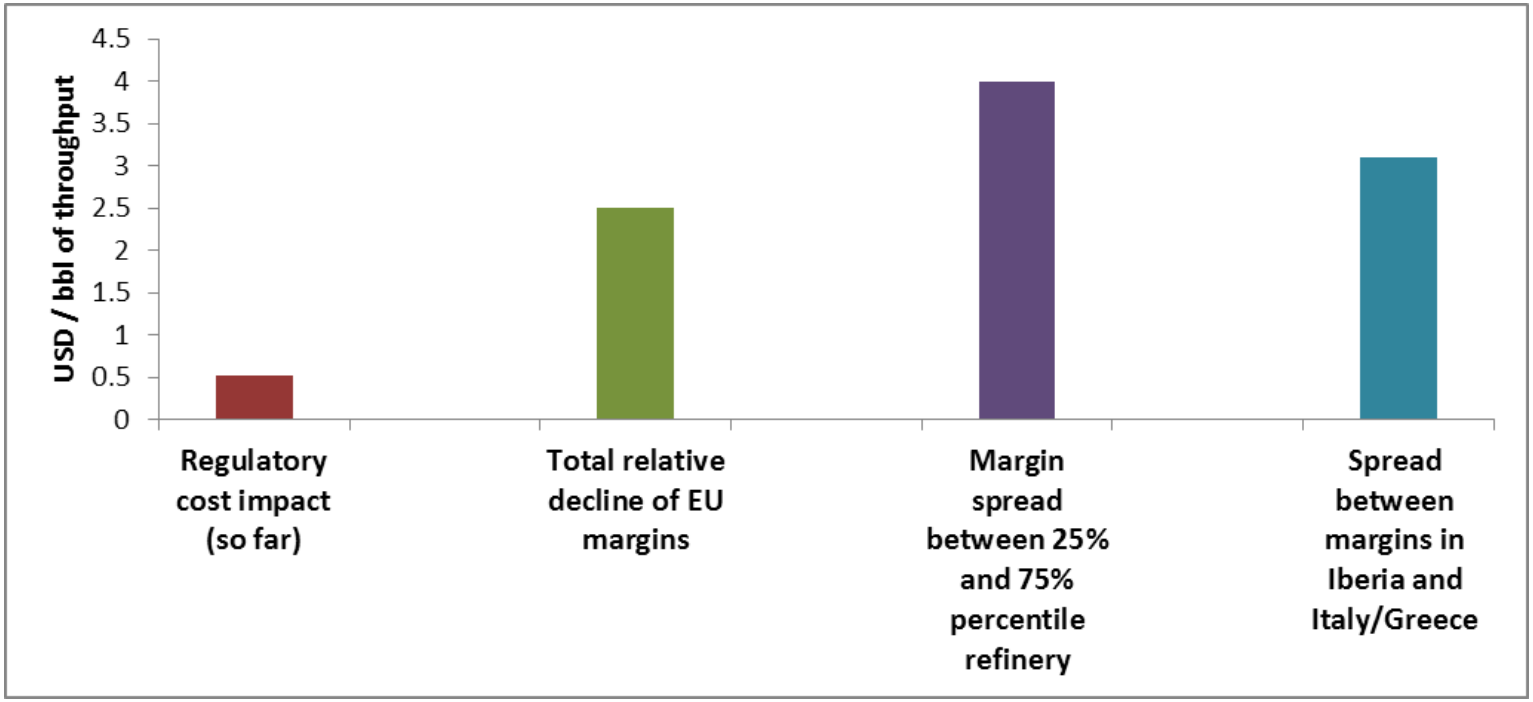
  1. Increased energy consumption due to FQD

  2. Switch to low-sulphur crude oil for refinery energy due to pollution legislation (IED/LCPD/IPPCD)

  3. Demand impacts (RED, ETD, IED) contribute to reducing utilization rate, which can negatively affect refineries' energy efficiency

  4. EU ETS increases costs of purchased electricity

Regulatory impact on competitiveness?



- **Cost impact from regulation significant**
- **But could explain (so far) at most 20% of EU margin decline** [‘at most’ because dependency on cost pass-through]
- **Other factors seem to have much larger impact on refining margins than regulation, e.g. size or location**

References

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IHS (2014). EU Refinery Fitness Check Data Set. Assembled for JRC.

Solomon Associates (2014). Data of EU refining industry, years 1998 to 2012. Compiled for Fuels Europe and the ENTR Directorate of the European Commission. September 2014.

Solomon Associates (2014a). Operating Expenses and Margin Analysis of the European Union (EU28) Refineries vs Regional Peers. Prepared by Solomon Associates for CONCAWE. January 2014.

Thank you

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