POSTGRADUATE STUDIES –

EUROPEAN REFINERY BUSINESS

Robert Uberman

for the Prof. Nela Vlahinić- Dizdarević's Class

4th of April, 2014

AGENDA

- Overall view
- Shifts on the demand side
- Supply side evolution
- Ownership (NOCs vs IOCs vs Independent)

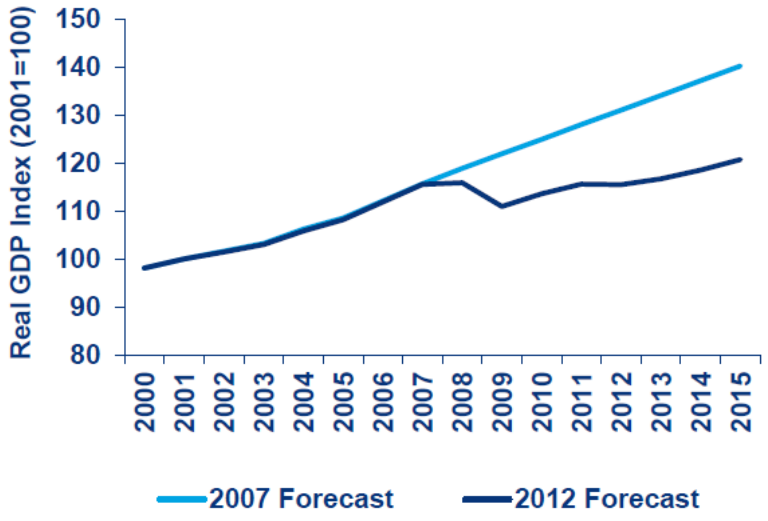
OVERALL VIEW

- Refining as a mature business
- Downstream as a poor cousin of upstream
- Complexity of the refining business – joint product issue
- Refining as an object of global oil policy

FALLING DEMAND FOR OIL BASED PRODUCTS

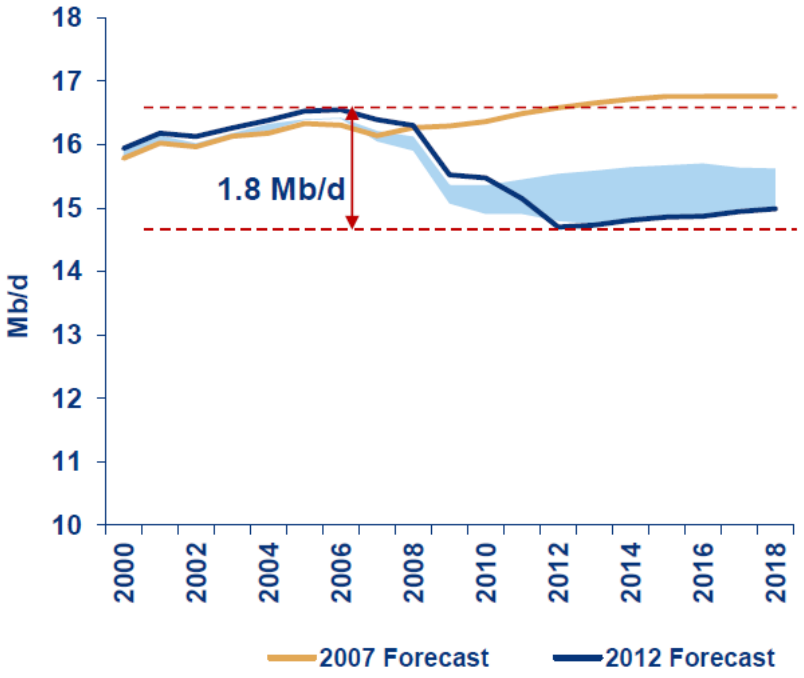
Demand in Europe has fallen and will not recover to pre-recession levels

Europe GDP forecast, 2007 and 2012



Source: Wood Mackenzie

Europe Demand forecast, 2007 and 2012

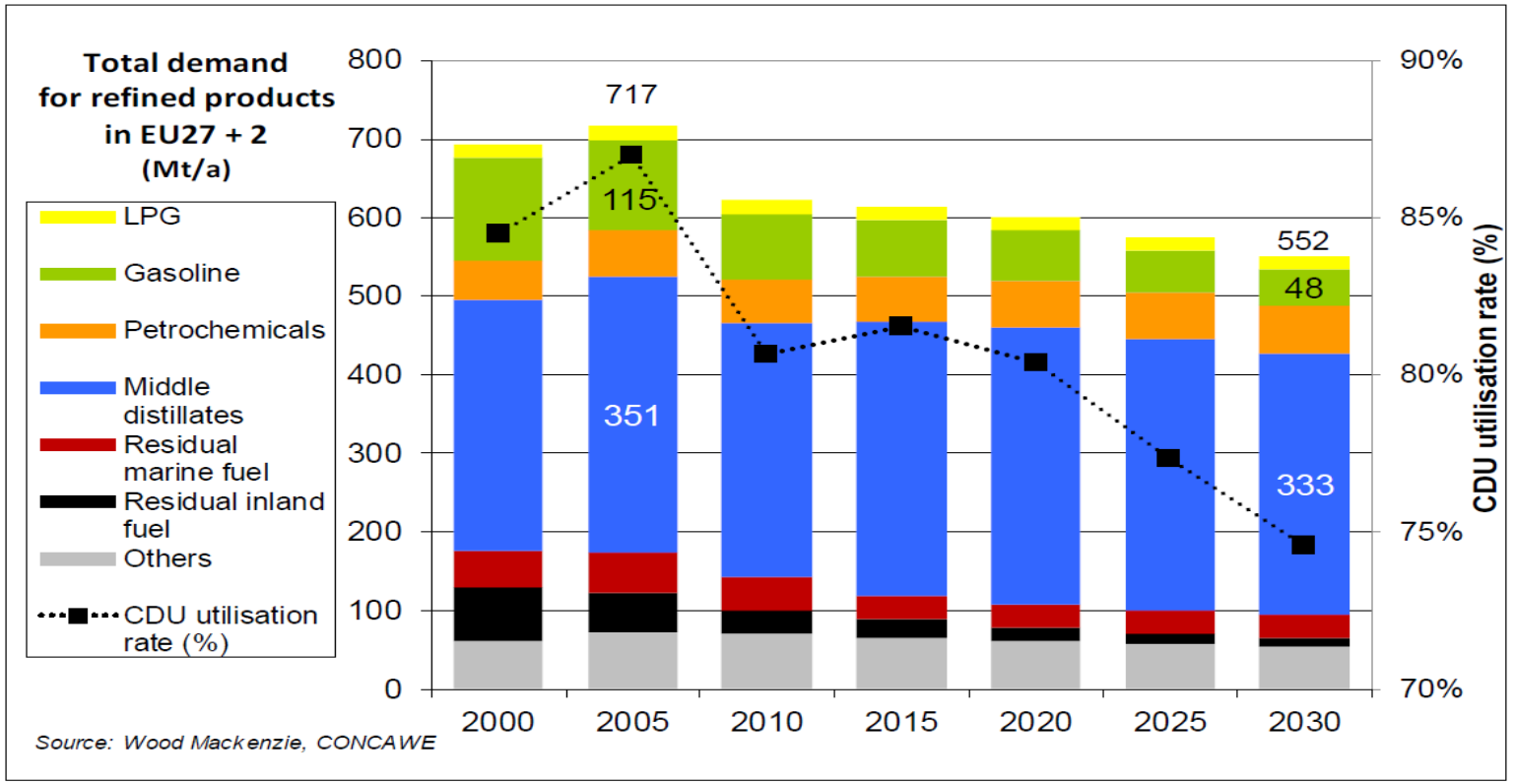


Source: History IEA, Forecast Wood Mackenzie

Steve Cooper, „Crude Oil in Europe: Production, Trade and Refining Outllok", WoodMckenzie, London, 2013, p. 14.

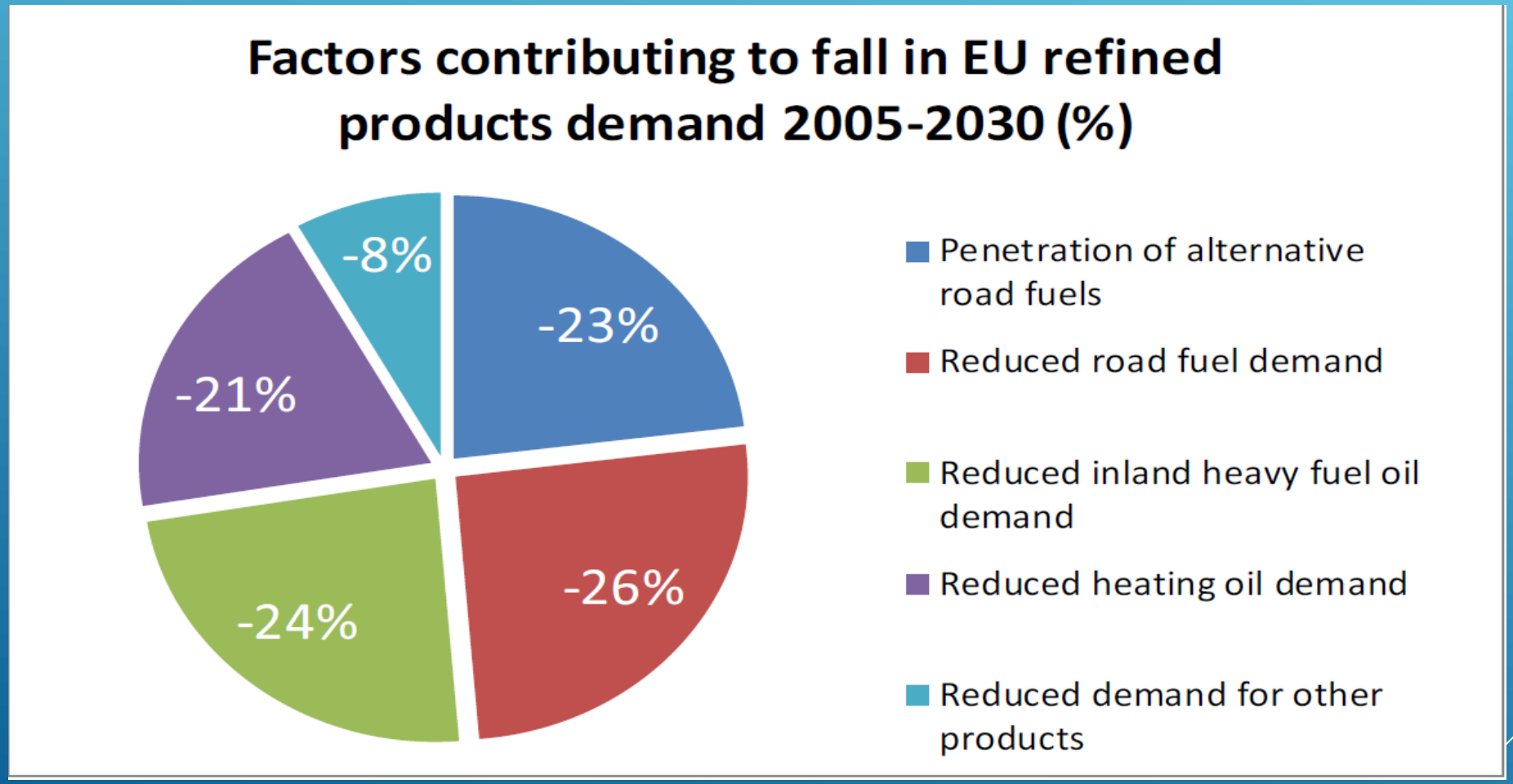
EVOLUTION OF THE EUROPEAN DEMAND SIDE – CUTTING ON EDGES

Figure 3.5.1 EU27+2 Refined products demand (Mt) and CDU utilisation rate (%) trends



„Oil refining EU in 2020, with perspectives to 2030", Concawe Report 1/2013, p. 21.

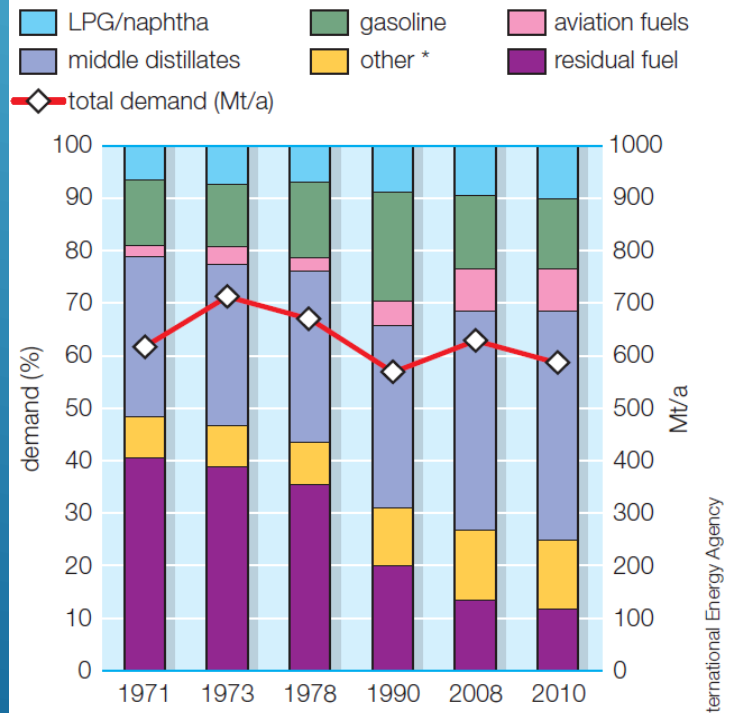
EVOLUTION OF THE EUROPEAN DEMAND SIDE – GASOLINE TO DIESEL



„Oil refining EU in 2020, with perspectives to 2030", Concawe Report 1/2013, p. 19.

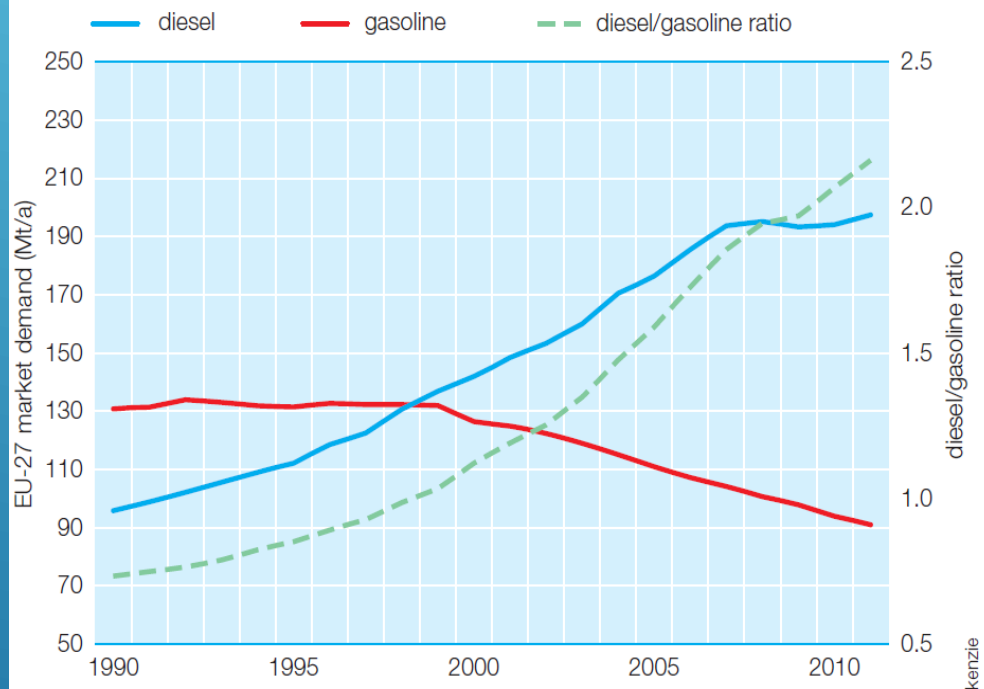
EVOLUTION OF THE EUROPEAN DEMAND SIDE – GASOLINE TO DIESEL

Figure 1 The evolution of petroleum product demand in what was to become the EU-15 over the past 40 years



* The 'other' category mostly consists of speciality products such as lube oils, bitumens, solvents, etc.

Figure 2 The diesel to gasoline ratio in EU-27 countries, 1990–2011



Above: the high uptake of diesel passenger cars and strong road freight growth have caused the diesel to gasoline ratio in EU-27 countries to triple over the past two decades.

„The evolution of oil refining in Europe", Concawe Review, vol. 22/1, 2013, p. 32.

EVOLUTION OF THE EUROPEAN DEMAND SIDE – FUEL QUALITY

Table 1 The quality requirements of EU road fuels have been fundamentally changed in the past two decades

		Year	1994	1995	1996	2000	2005	2009
Unleaded gasoline (standard grade)					**EN228**			
Sulphur	ppm m/m	max	1000	500		150	50/10	10
Benzene	% v/v	max	5			1		
Aromatics	% v/v	max	Not specified			42	35	
Olefins	% v/v	max	Not specified			18		
Oxygen	% m/m	max	2.5[a]			2.7		
Vapour pressure (summer)	kPa	max	up to 80			60[b]		
Diesel (standard grade)					**EN590**			
Cetane Index		min	46					
Cetane Number		min	49			51		
Sulphur	ppm m/m	max	2000		500	350	50/50	10
Density	kg/m	min	820					
		max	860			845		
T95	degrees C	max	370			360		
Polyaromatic hydrocarbons	% m/m	max	Not specified			11		
Lubricity	µm @ 60°C	max	Not specified		460			

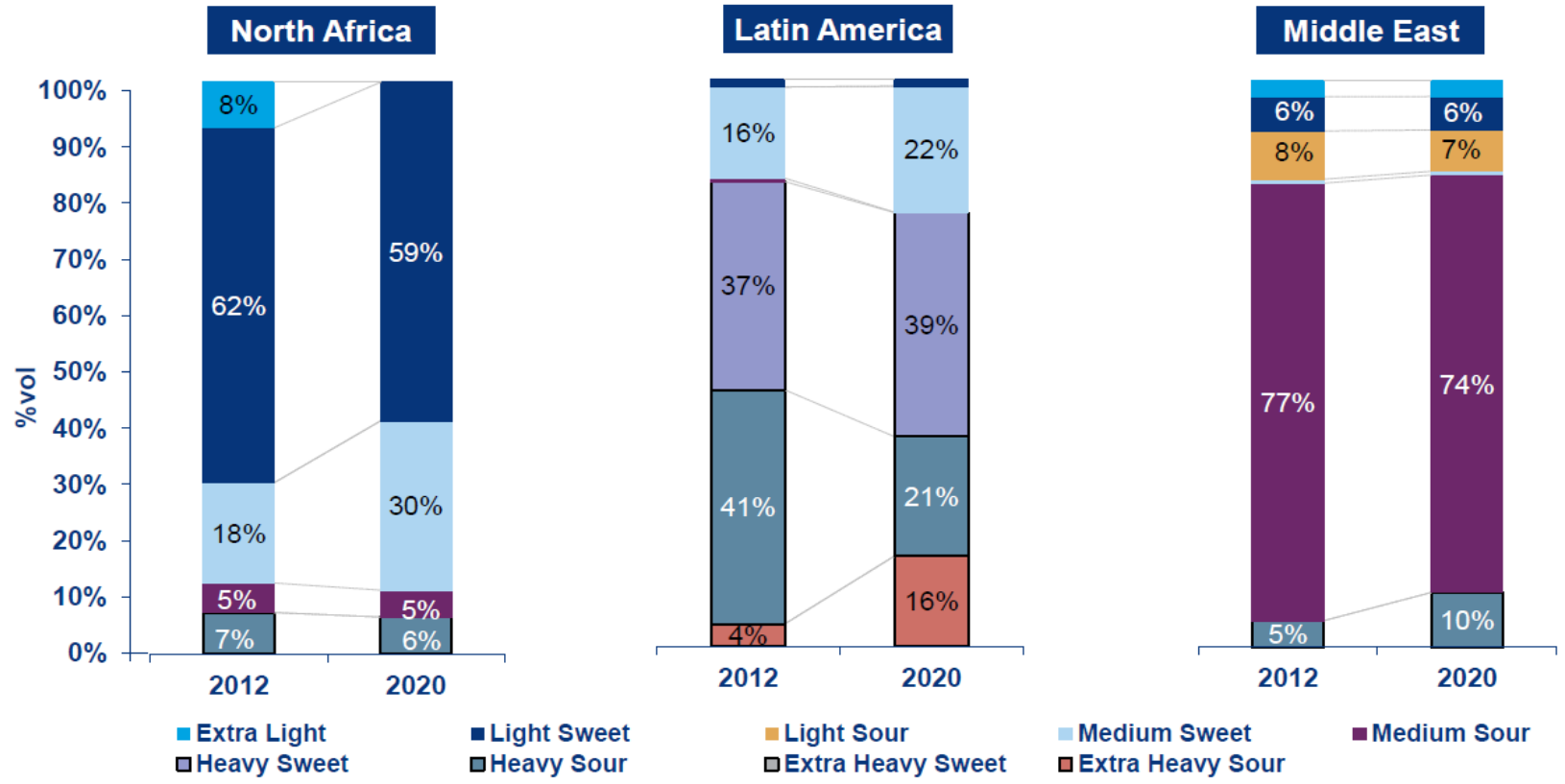
[a] Up to 3.7% at Member State discretion. Individual limits apply to specific compounds.

[b] 70 kPa maximum allowed in Member States with arctic or severe winter conditions.

„The evolution of oil refining in Europe", Concawe Review, vol. 22/1, 2013, p. 33.

EVOLUTION OF THE CRUDE SUPPLY AROUND EUROPE

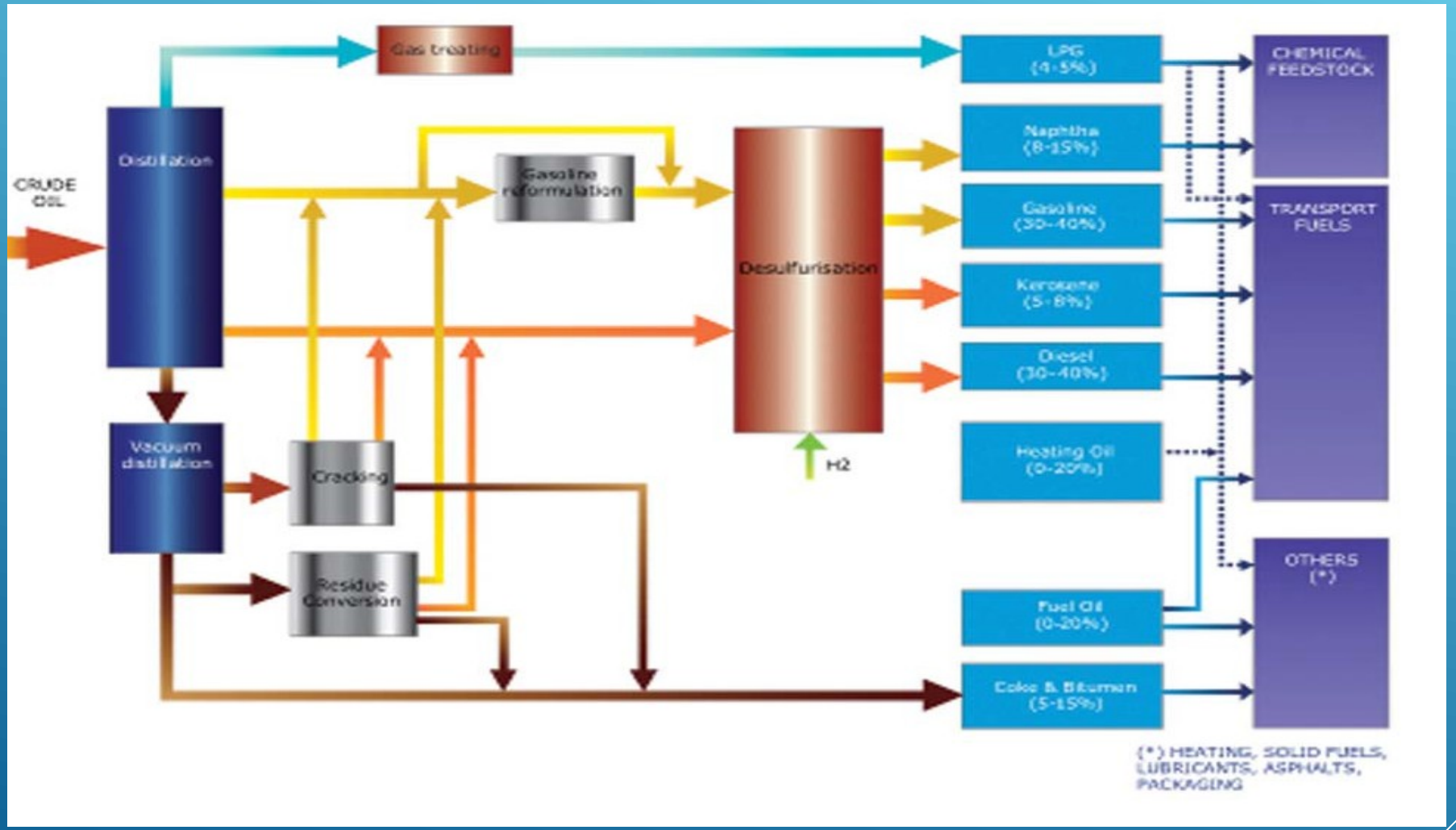
Changing quality of crude will determine future trade flows into Europe; this will be necessary to offset declining long-term domestic supply



Source: Wood Mackenzie

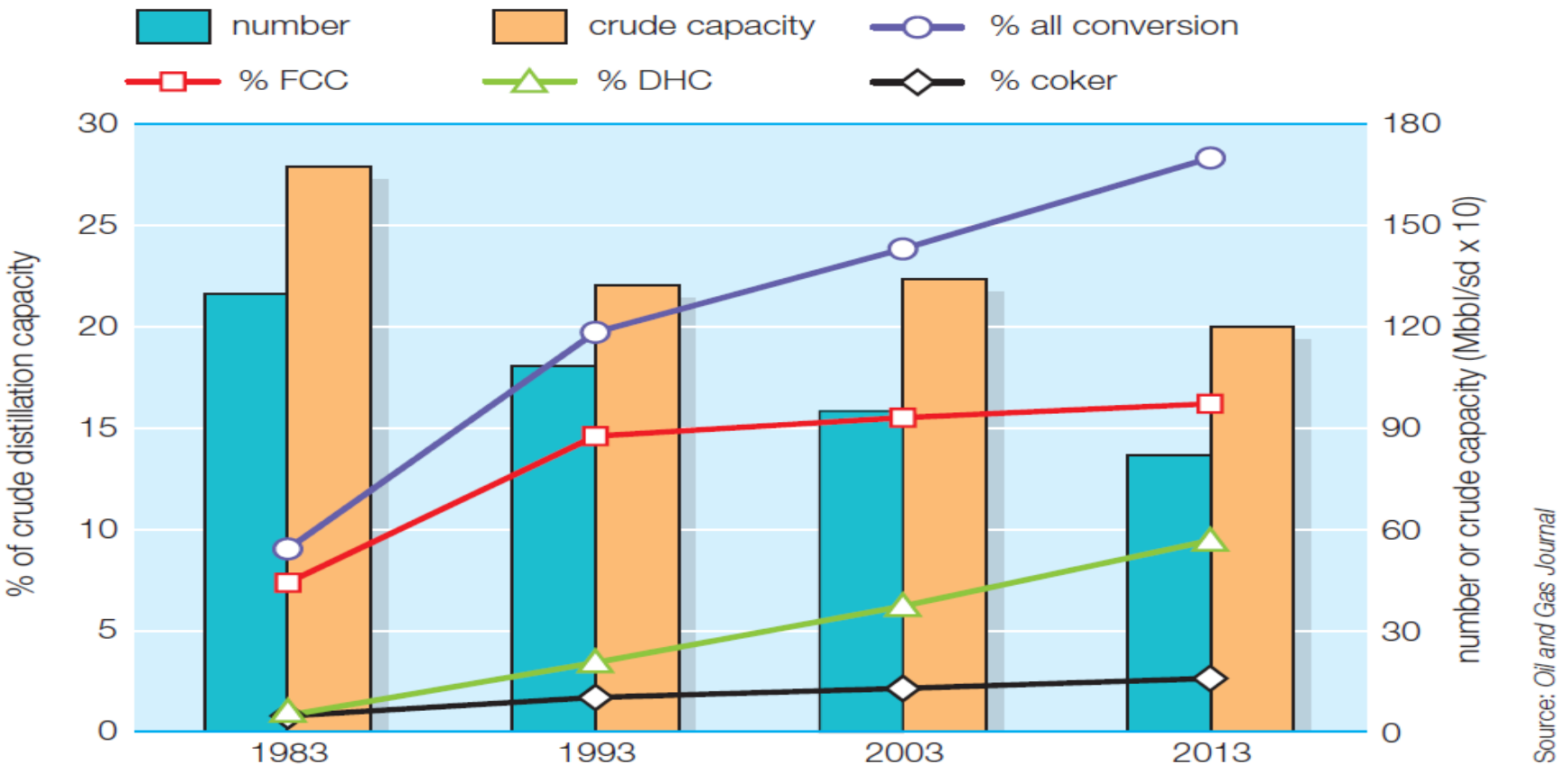
Steve Cooper, „Crude Oil in Europe: Production, Trade and Refining Outllok", WoodMckenzie, London, 2013, p. 12.

REFINERY PROCESS SCHEME



THE EUROPEAN REFINERIES – EVOLUTION OF CAPACITY

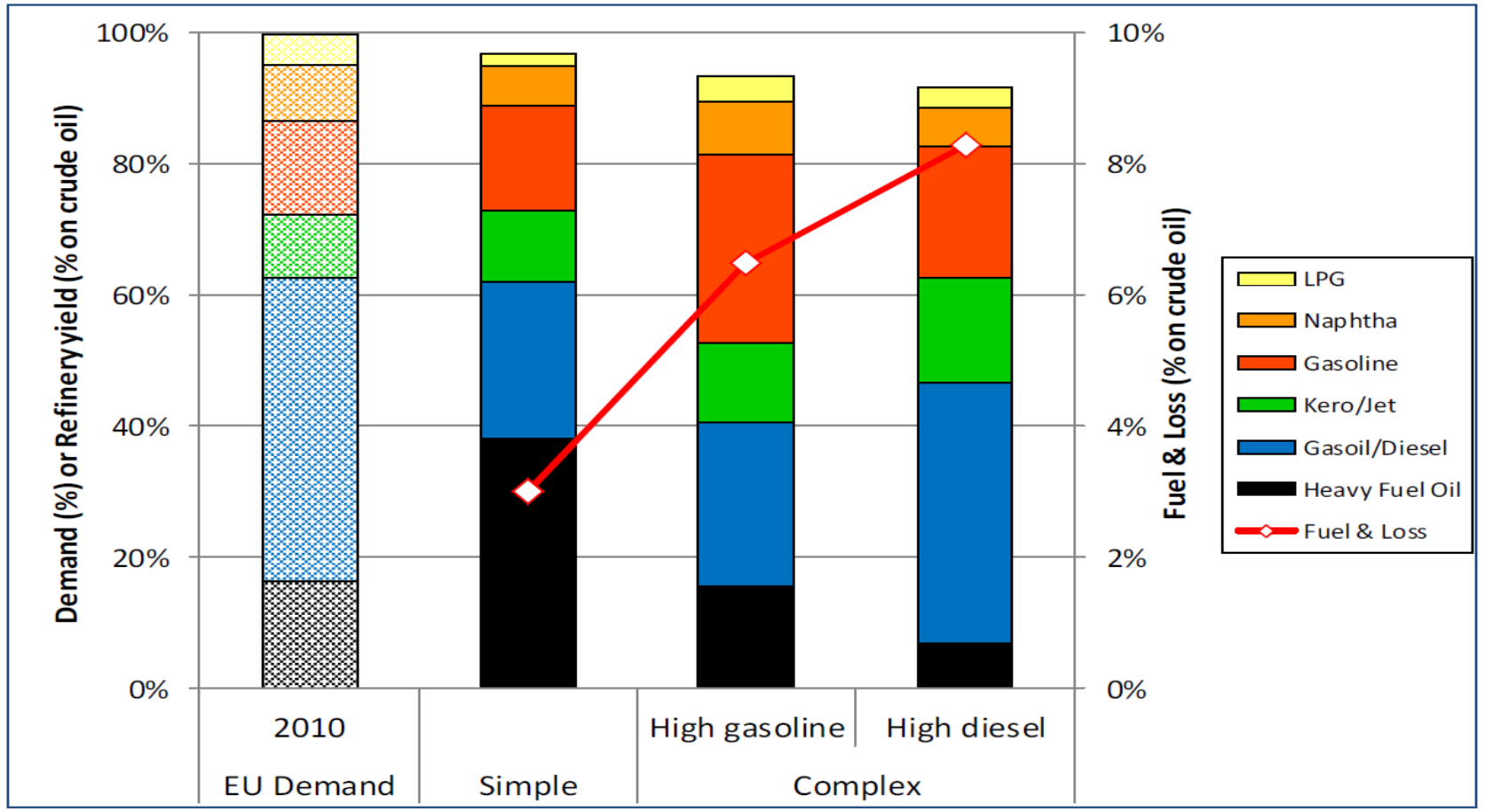
Figure 3 Population, capacity and complexity trends of EU-15 refineries, 1983-2013



„The evolution of oil refining in Europe", Concawe Review, vol. 22/1, 2013, p. 34.

REFINERIES AS ENERGY CONSUMERS

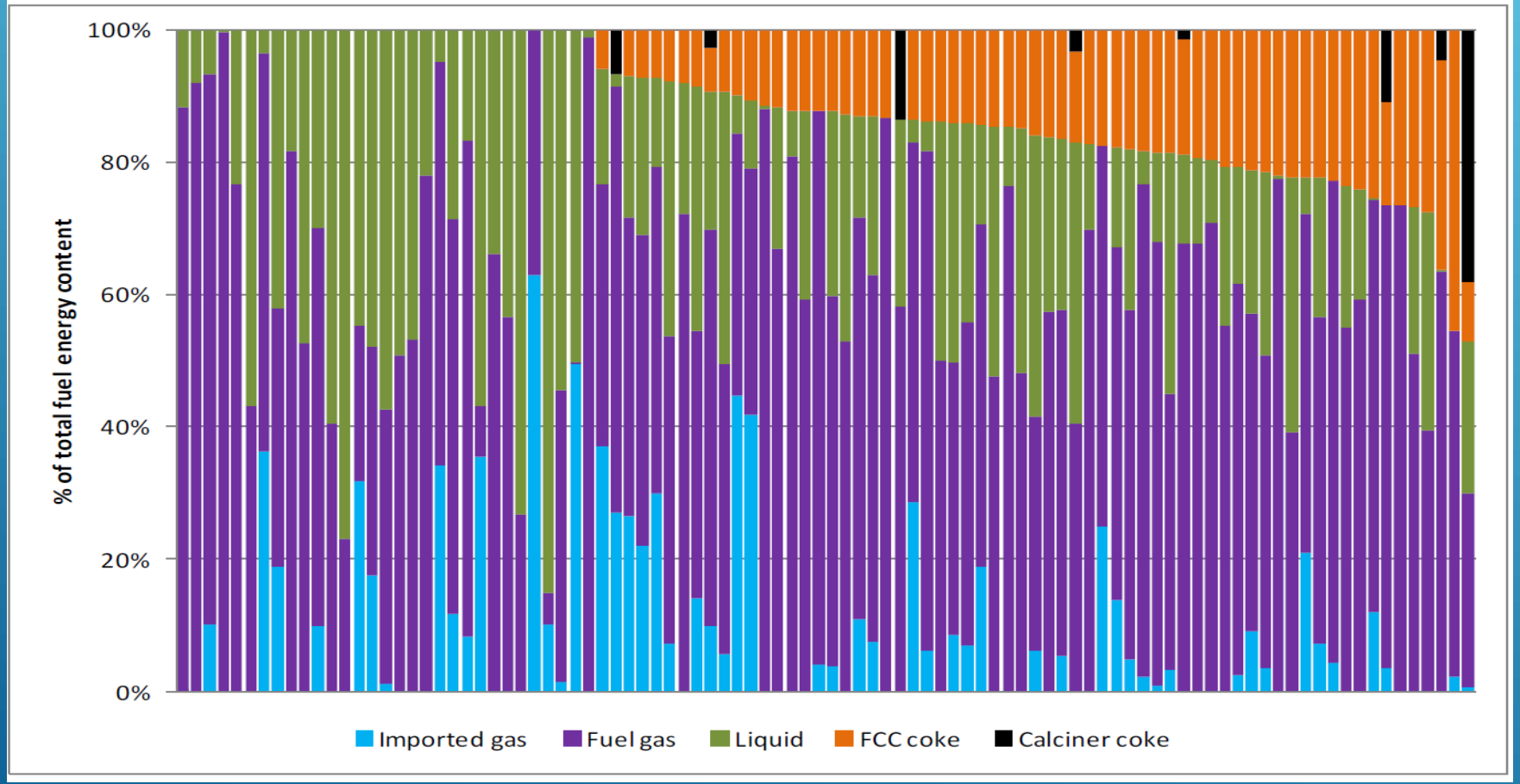
Figure 3 Typical EU refinery fuel consumption as % of yield in simple and complex refineries



„EU Refinery Energy Systems and Efficiency", Concawe report no 3/2012, p. 4.

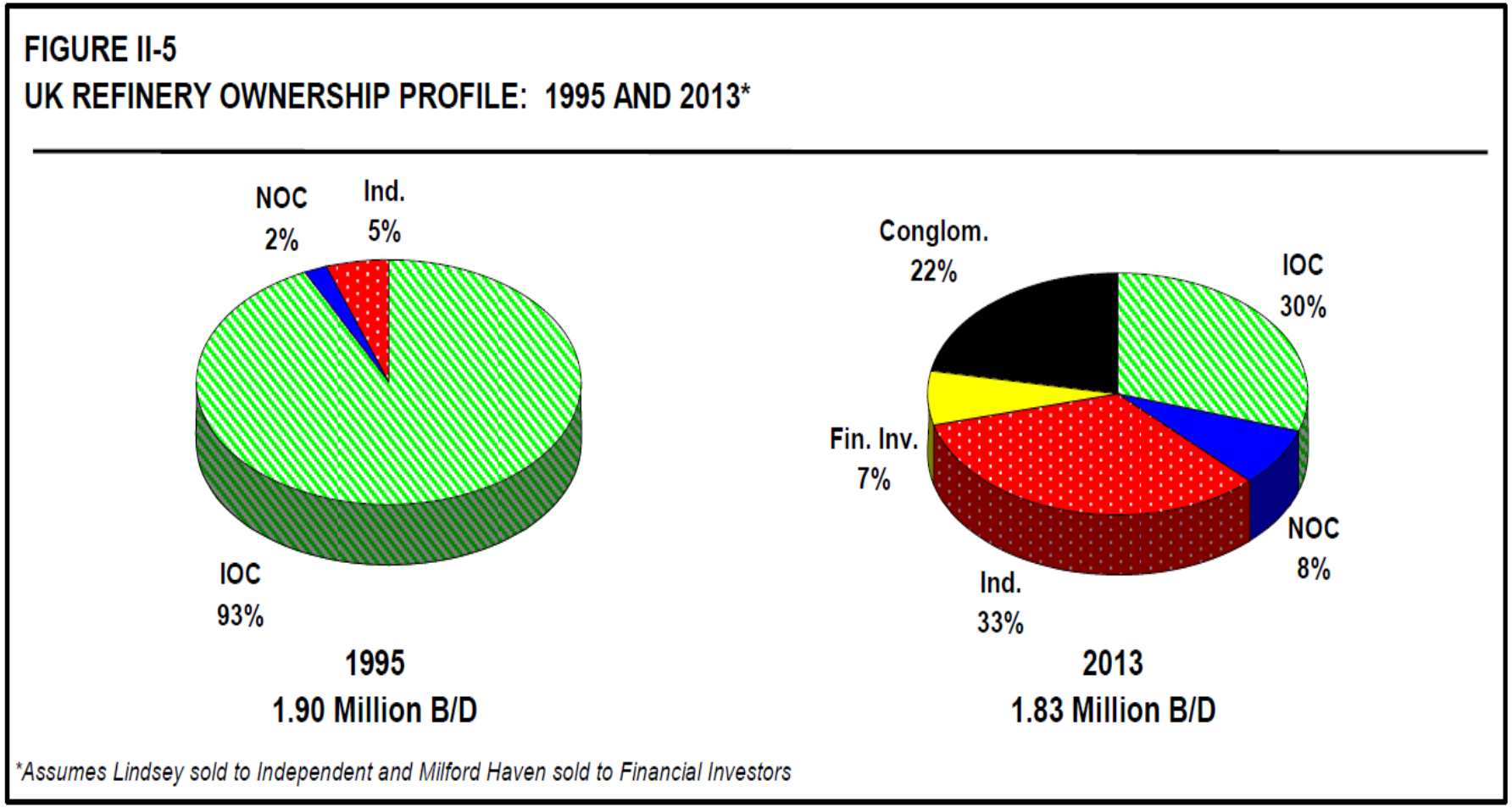
NATURAL GAS AS A KEY EXTERNAL ENERGY SOURCE FOR REFINERIES

Figure 7 Refinery fuel mix in 2007-08 for 96 mainstream EU refineries
(Source: CONCAWE)



„EU Refinery Energy Systems and Efficiency", Concawe report no 3/2012, p. 11.

IOCS LEAVING DOWNSTREAM IN EUROPE



Cuthbert, Leavens et el: „Developments in the International (...)", Purvitz & Gertz report for UK Gov. June 2011, p. II/9.

DIFFERENT OWNERSHIP STRATEGIES

- IOCs focusing on upstream (responsible for 60-90 % of their total profits)
- NOCs from European countries expanding regionally with limited resources and political support
- NOCs from China, Russia (and some other countries) expanding intensively with a global focus and strong political support
- Independents trying to find niches and cut operating costs
- Conglomerates (Essar Oil, Ineos) pursuing particular strategies, sometimes with government support

CONCLUSIONS

- Refining in Europe - a mature business with declining demand
- Key pressures, beyond falling demand:
  - Diesel/Gasoline ratio forcing conversion up
  - growing energy costs pushing conversion costs up
  - both driven by EU policies
- Majors leaving the business
- Independents too weak to hold pressure
- NOCs ready to step in

POSTGRADUATE STUDIES – ROLE OF RESEARCH AND DEVELOPMENT IN THE OIL AND GAS BUSINESS

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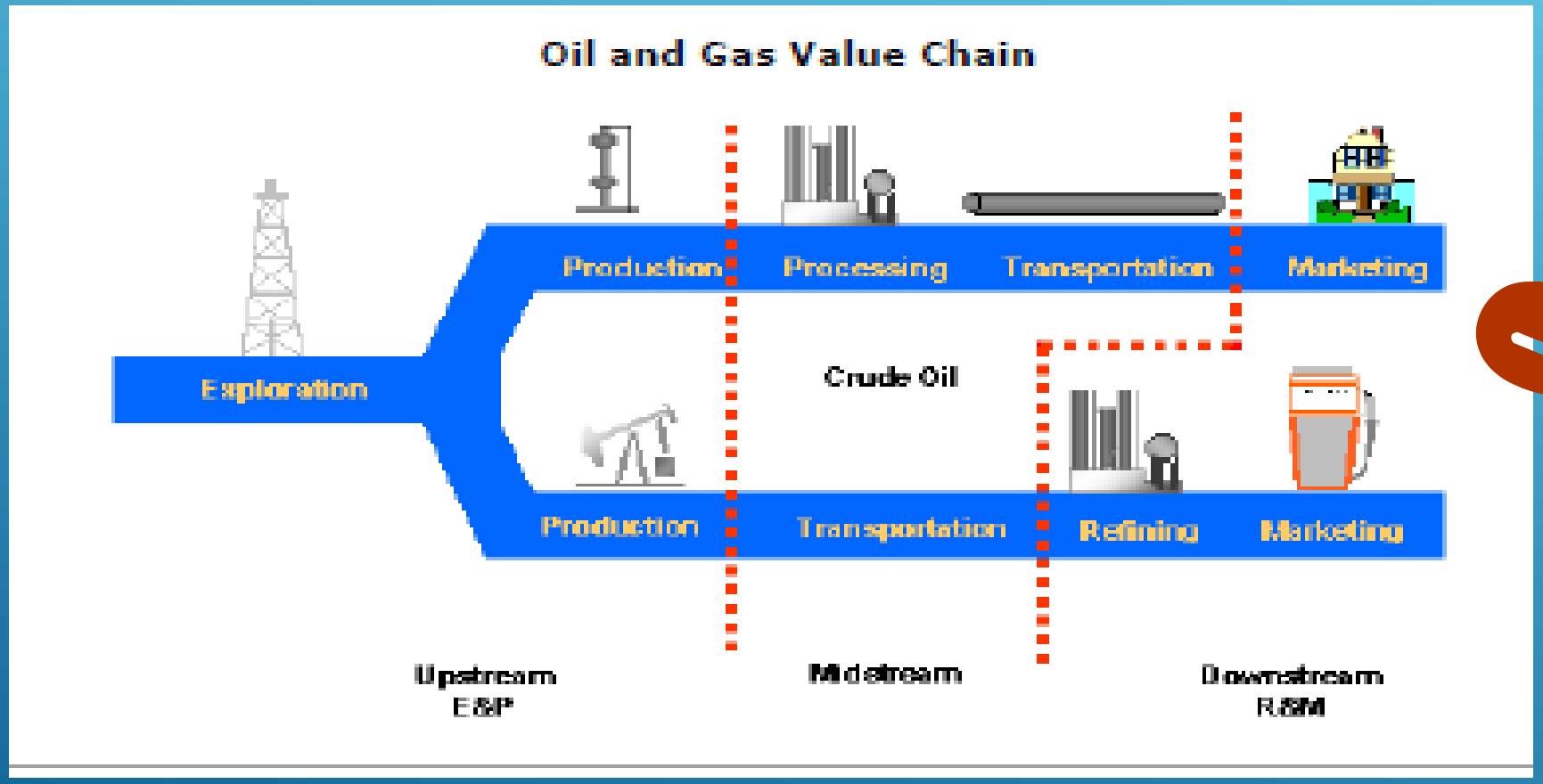
4th of April, 2014

AGENDA

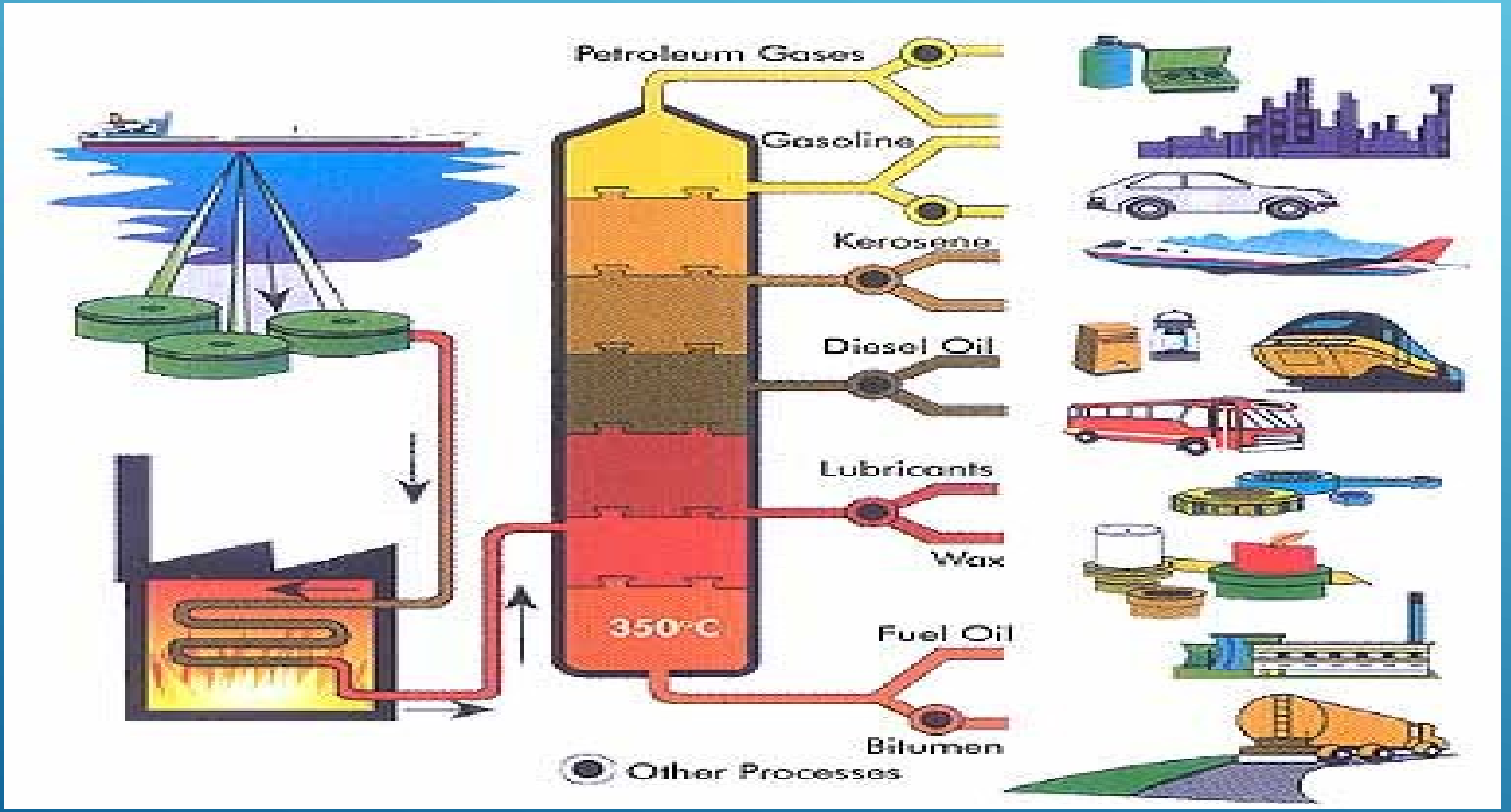
- Innovation in Upstream
- Breakthrough downstream innovations
- Research & Development
- Oil is natural but money made on it are anthropogenic

AT FIRST GLANCE OIL IS A VERY SIMPLE BUSINESS (...)



It's, after all, about converting crude in a field into a fuel in an engine.

(...) BUT MORE DEEPER INSIGHT REVILES SOME COMPLEXITY (...)



(...) CONTINUING DOWN TO THAT LEVEL

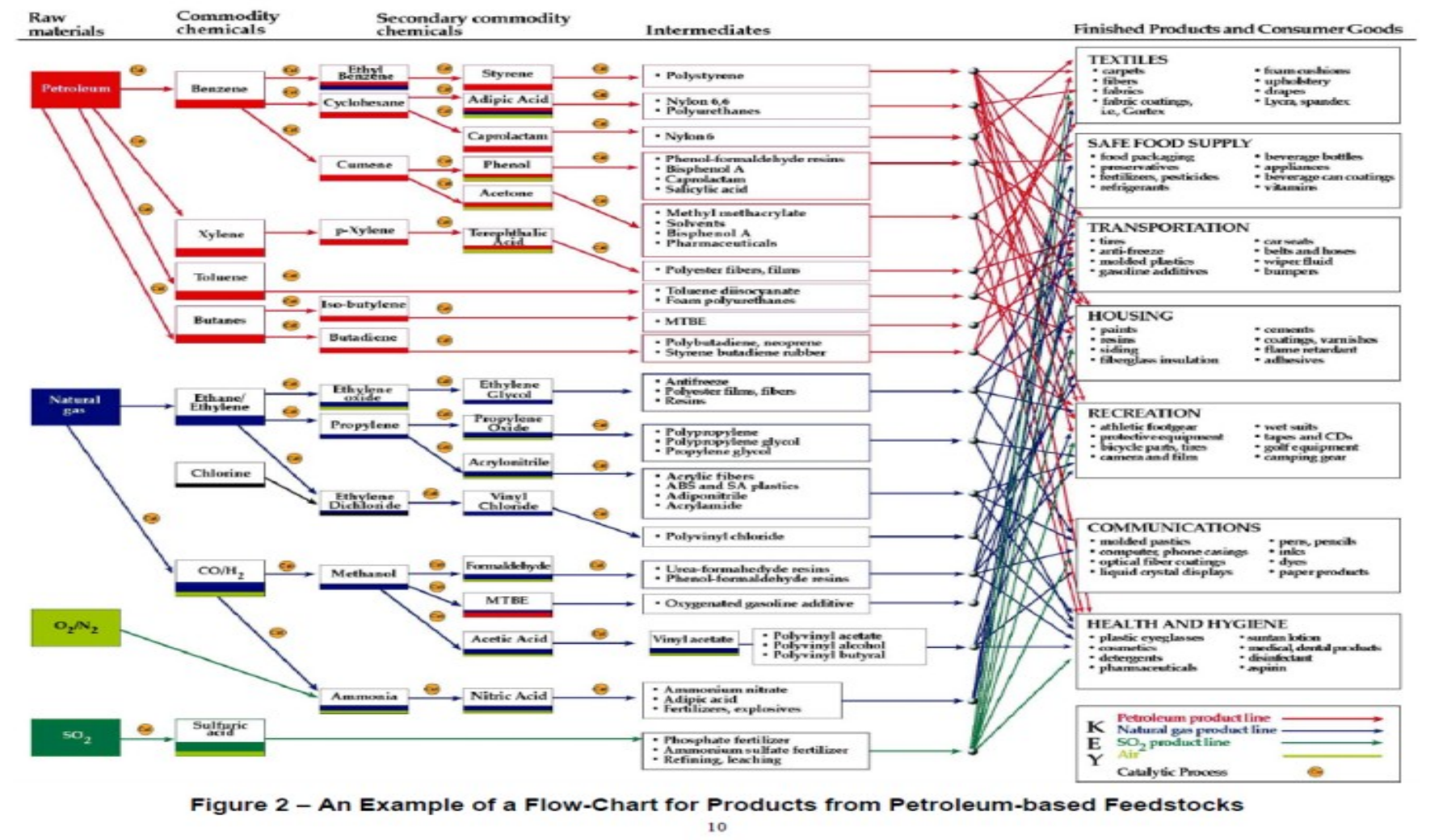


Figure 2 – An Example of a Flow-Chart for Products from Petroleum-based Feedstocks

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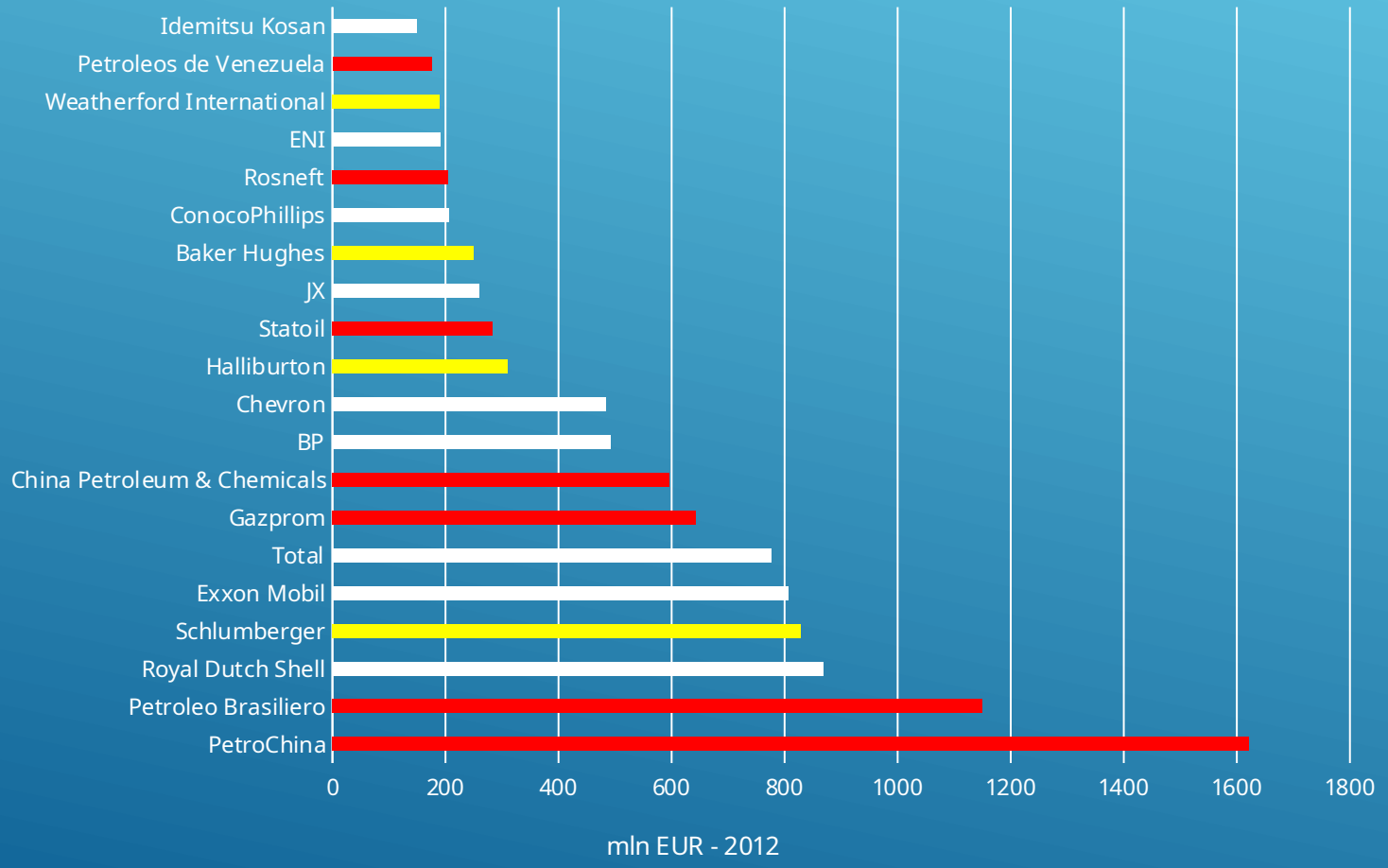
http://denmarkusmgreentour.wordpress.com/page/2/

R&D EXPENDITURES OF OIL & GAS INDUSTRY



http://www.oilgaspost.com/2013/05/21/top-40-oil-gas-companies-investment/

Service & independents

NOCs

IOCs

UPSTREAM INNOVATION

- „For the upstream exploration and production (E&P) industry, the story of the last decade has been one of remarkable resilience, extraordinary innovation (...)”:
- Increasing application of computing methods in seismic analyses
- Horizontal drilling (initiated at commercial scale in 80s)
- Sophisticated reservoir modelling and simulating
- Hydraulic fracturing

Kibsgaard Paal, „A decade of upstream technology innovation” in: „Addressing Global Energy Challenges” World Petroleum Council, 2013, page 74.

BREAKTHROUGH DOWNSTREAM INNOVATIONS: HYDROCRACKING

- Hydrocracking (eg. Converting heavy, long hydrocarbon strings into short light ones) was first patented in Russia in 1881
- Todays hydrocracking units are based on catalytic processes developed 1942-1947. These were first processes capable, at commercial scale, to change natural product structure as defined by crude
- There would be no diesel revolution without hydrocracking

BREAKTHROUGH DOWNSTREAM INNOVATIONS: GTL

- Origins of GTL technology can be traced to pre II World War period.
- Its first commercial debut after a long period in Shell's Bintulu GTL plant in Malaysia in the early 1990s.
- The Pearl Gas to Liquids (GTL) joint venture project of Shell and Qatar Petroleum - the world's largest GTL plant and in fact one of the biggest refineries though with a natural gas as a feedstock, started 2011/2012
- Consequences remain to be seen but definitely will be far going

BREAKTHROUGH DOWNSTREAM INNOVATIONS: SUMMARY

- Both Hydrocracking and GTL share some common properties:
  - inward process orientation;
  - customers needs definition developed without customers;
  - no new products as a direct result;
  - huge capital expenditures.

CUSTOMER RELATED INNOVATIONS

- Often developed outside industry (petrochemicals by IG Farben, Dow, ICI)
- Promoted by niche players
- Not obviously linked to the refinery business
- Relatively low volume
- Possible if focus of R&D is redirected from internal processes to customer needs

UNATTRACTIVENESS OF CUSTOMER RELATED INNOVATIONS FOR OIL MAJORS

- Low volumes:
  - even if margins per unit are high overall margins are low;
  - oil products are joint products – almost any change in one specification requires at least some alternations across the portfolio;
- Cost of managing risk is very high since applications are made in businesses distant from Oil & Gas: mechanical industries, pharmacy and food, packaging.

CUSTOMER ORIENTED INNOVATION – VGO SOLVENT EXTRACTION CASE

- Traditionally part of VGO has been converted into two external products: base oil Gr. I and waxes;
- Starting from 90s base oil Gr. I has been gradually replaced by Gr II and Gr III base oils which are derived from hydrocracking residue;
- Official reason: Gr II and III have many functional advantages over Gr. I (which is true, by the way)
- Real reason: the only way to increase Diesel output, all other things equal, is to divert VGO from solvent extraction to hydrocracking – consequently Gr I has to disappear;
- Proof: the other external products obtained from the solvent extraction are waxes – they in turn can not be obtained from hydrocracking – customers got informed: you will have less waxes and they will be more expensive. Any problem with that. Oh it's your problem !!!

CONCLUSIONS

- R&D in case of Oil Majors is a supplementary internally oriented activity – such is this business
- Product innovations are not on the top of priority lists
- Majors are very good in networking and taking advantages of various alliances
- NOCs have made heavy investments in R&D – results remain to be seen