HELLENIC PETROLEUM

Oil Refining, Storage & Retail
in SE Europe

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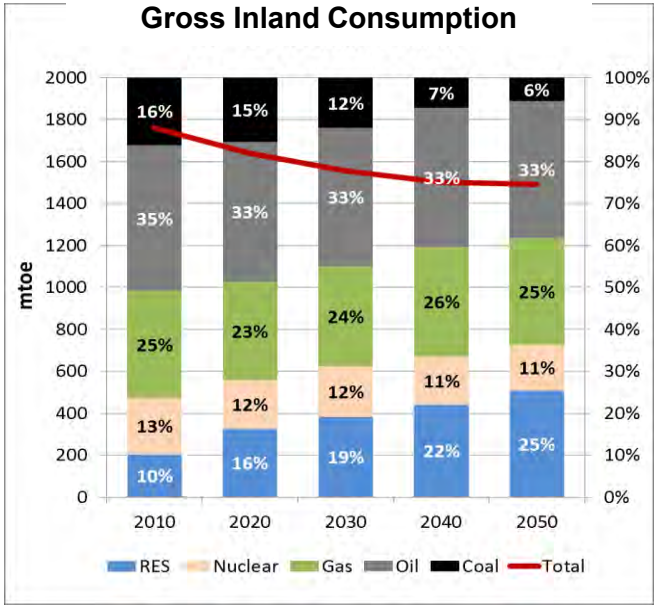
European Energy Demand Forecast

based on EU-28 Reference Scenario 2016

EU-28 Ref. Scenario 2016:

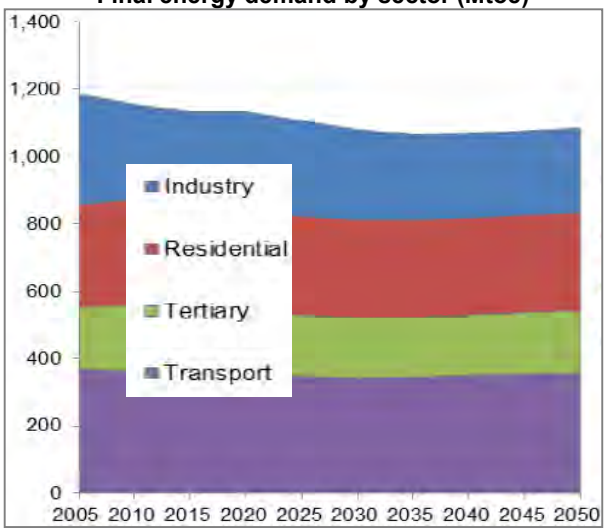
- Projecting energy, transport and greenhouse gas emission trends based on adopted policies.
- It assumes relevant binding 2020 targets (reduction of greenhouse gas emissions and the penetration of renewable energy sources) are met.

Gross Inland Consumption

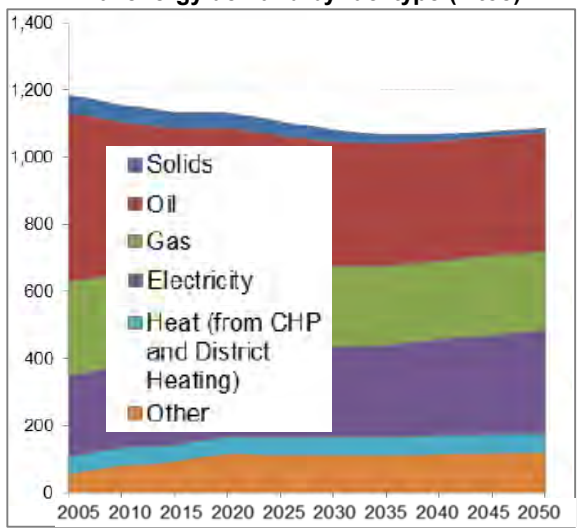


- Total energy demand is projected to decline.
- Share of coal in the energy mix is declining through 2050.
- The exact opposite occurs for Renewable Energy Sources.
- The share of oil in the energy mix will not suffer substantial change.
- Same goes for respective shares of natural gas and nuclear power.
- Transport and residential sectors represent the lion's share of final energy demand
- Gradual penetration of electricity in fuel mix.
- Some electrification of heating (heat pumps) and of transport (passenger cars and trains).

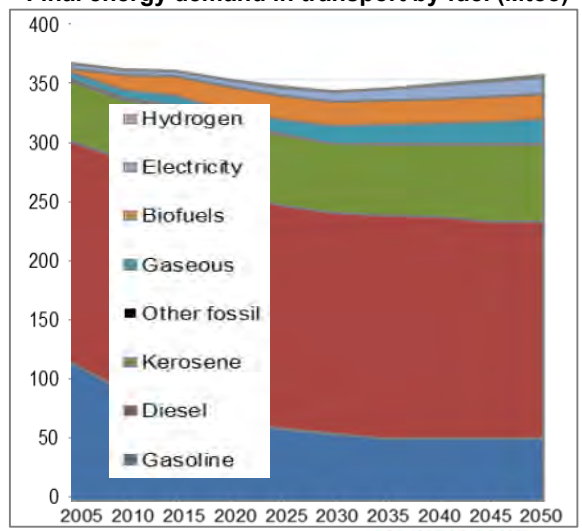
Final energy demand by sector (Mtoe)



Final energy demand by fuel type (Mtoe)



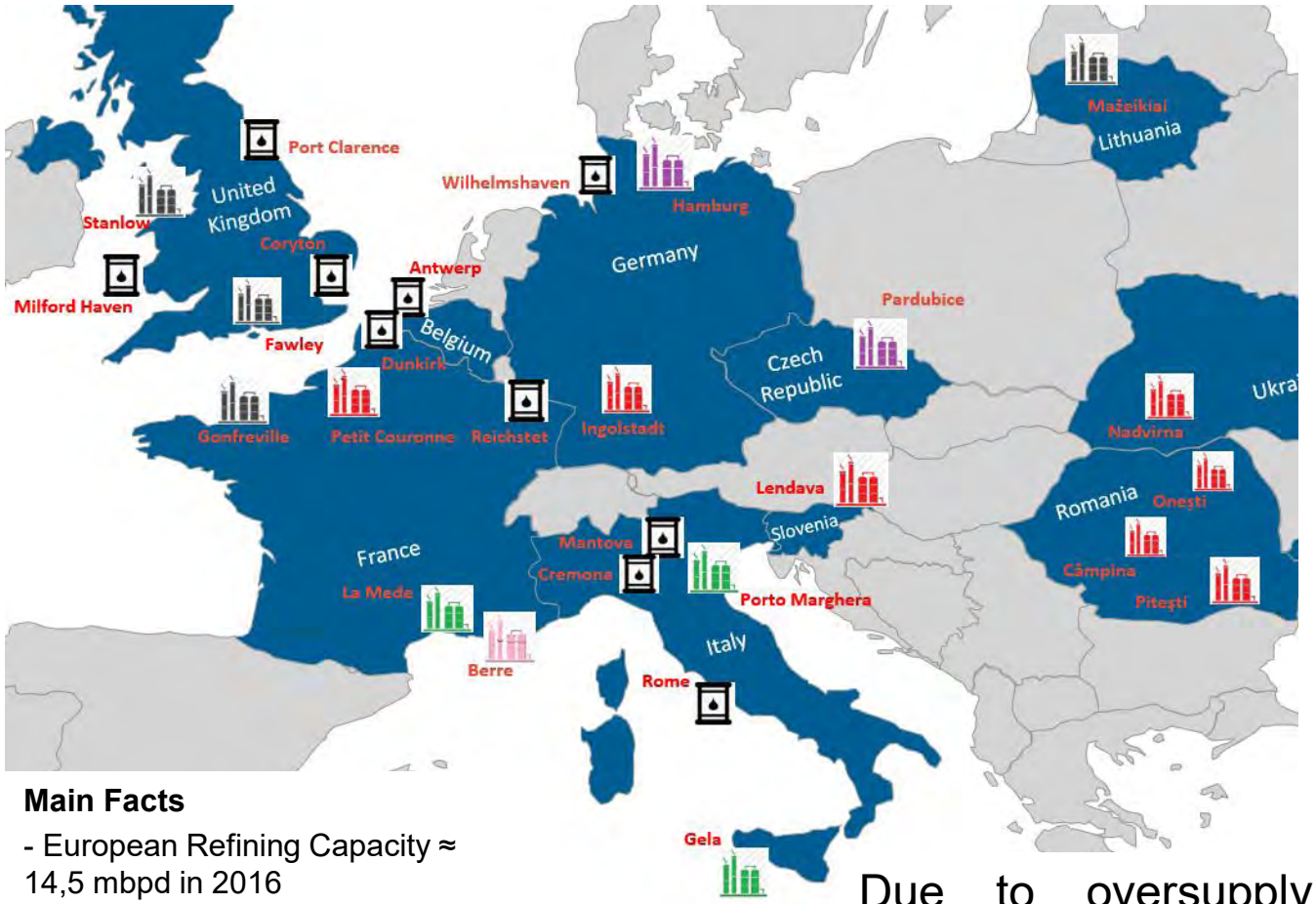
Final energy demand in transport by fuel (Mtoe)

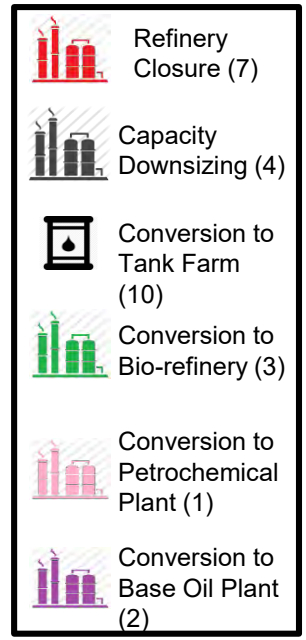


Source: EC - DG for Energy, Climate Action, Mobility and Transport

Overcapacity for European Refineries

Since 2008, the refining capacity in Europe has been reduced by 2,6 million b/d ~ 40% of the capacity withdrawn worldwide.





Main Facts

- European Refining Capacity ≈ 14,5 mbpd in 2016
- Utilization ≈ 80% in 2016 (expected to decline to 75% in the next 3-4 years)
- Average Complexity: 8,0 (as compared with 10,0 in the US)

Due to oversupply of capacity, 27 refineries in Europe have terminated their operations or converted into tank farms or other types of factories.

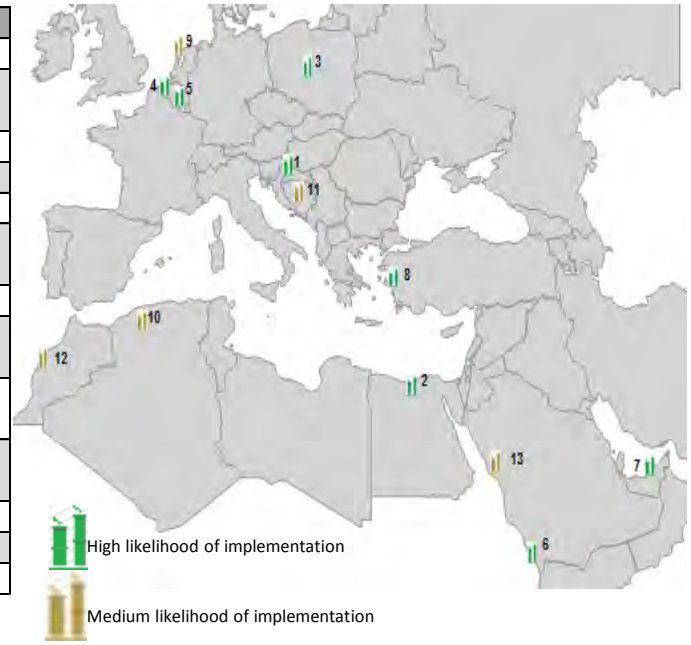
New refining capacity of 1,7 mbpd

coming online in the next 5 years in Europe, North Africa and the Arab Gulf.

	Refinery	Country	Company	nvestment Type	Unit	Start-Up
1	Rijeka	Croatia	INA	upgrade	COK (17.4 kbpd)	2016
2	Mostorod	Egypt	EGPC	upgrade	HCU (40 kbpd), COK (25 kbpd)	2017
3	Gdansk	Poland	Grupa Lotos	upgrade	DCOK (45 kbpd)	2017
4	Antwerb	Belgium	Exxon	upgrade	COK (40kbpd)	2018
5	Antwerb	Belgium	Total	upgrade	MHCU (28 kbpd)	2018
6	Jazan	Saudi Arabia	Saudi Aramco	new refinery	CDU (400 kbpd), HCU (106 kbpd)	2020
7	Fujairah	UAE	IPIC	new refinery	CDU (200 kbpd)	2016
8	Aliaga Star	Turkey	Turcas / Socar	new refinery	CDU (214 kbpd), HCU (66 kbpd), DCOK (40 kbpd)	2018
9	Rotterdam	Netherlands	Exxon	upgrade	HCU (expan by 30 kbpd to 70 kbpd)	2018
10	Tiaret	Algeria	Sonatrach	new refinery	CDU (304 kbpd), HCU (75 kbpd), DCOK (75 kbpd)	2018
11	Brod	Bosnia	Zarubeshneft	upgrade	HCU (14 kbpd)	-
12	Jorf Lasfar	Morocco	Jorf Lasfar Energy (IPIC)	new refinery	CDU (200 kbpd)	2020
13	Yanbu	Saudi Arabia	Saudi Aramco	new refinery	CDU (400 kbpd)	2023

CDU: Crude Distillation Unit
HCU Hydrocracking unit
DCOK: Delayed Coker
COK: Coker

Source: KBC Energy Economics



European Refineries operate in a highly competitive global market of petroleum and refining products.

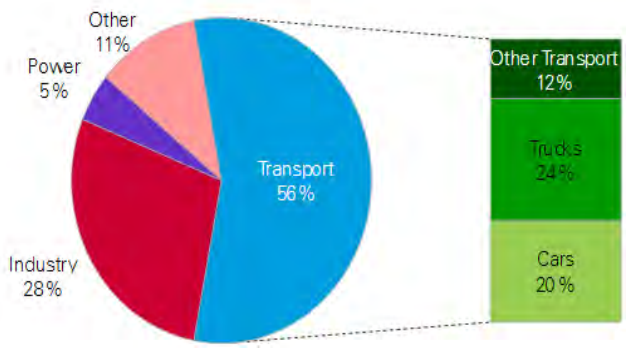
- High energy costs and compliance with the legislation creates significant disadvantage compared to refineries outside the EU.
- Moreover, refineries operating outside the EU have higher CO2 emissions, lower labor costs and maintenance costs.
- The EU refineries lacking in gross margin by almost $ 4 / bbl compared to refineries in the Middle East*. The cost of complying with regulation* is estimated at $ 0,5 / bbl.
- CO2 price is expected to rise under ETS IV, increasing cost for European refiners. Today ≈ 5 $/tn CO2, expected to rise to above 30 $/tn CO2 after 2020.

(*) Solomon, Fuels Europe

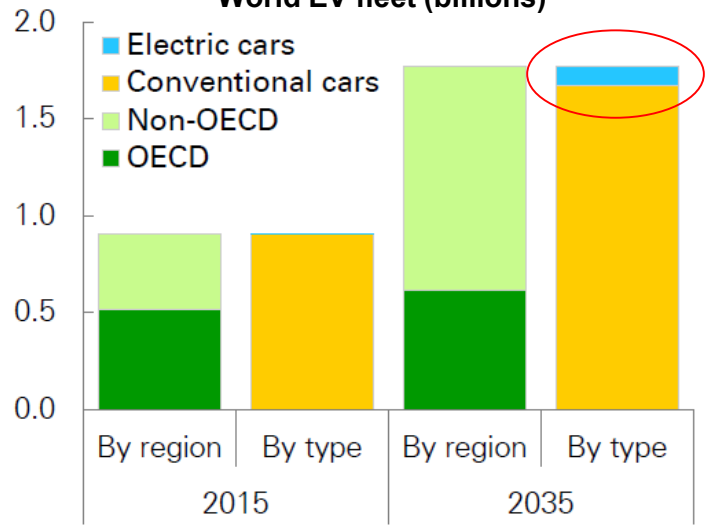
Challenges for Refining Industry - Electrification

World Electric Vehicle fleet (EV) will reach 6% of total global fleet by 2035, reducing oil product demand by ~1.2 mbpd

Oil demand for passenger cars: 19 mbpd

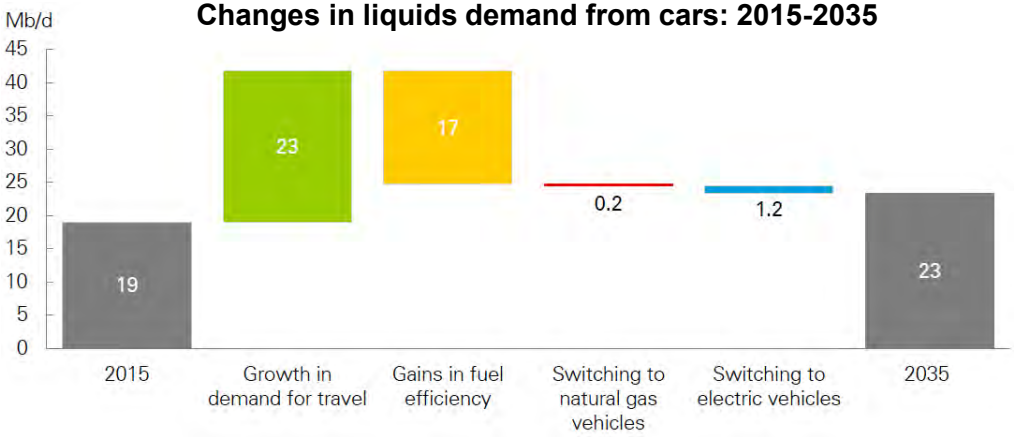


World EV fleet (billions)



- The world passenger car fleet today consists of around 900 million, consuming 19 mbpd of oil, representing 1/5 of total global oil demand (93 mbpd).
- The number of EV's is predicted to rise significantly, from 1.2 million in 2015 to around 100 million by 2035 (6% of the global fleet). Around a quarter of these electric vehicles (EVs) are Plug-In Hybrids (PHEVs), which run on a mix of electric power and oil, and three quarters are pure Battery Electric Vehicles (BEVs).

Changes in liquids demand from cars: 2015-2035



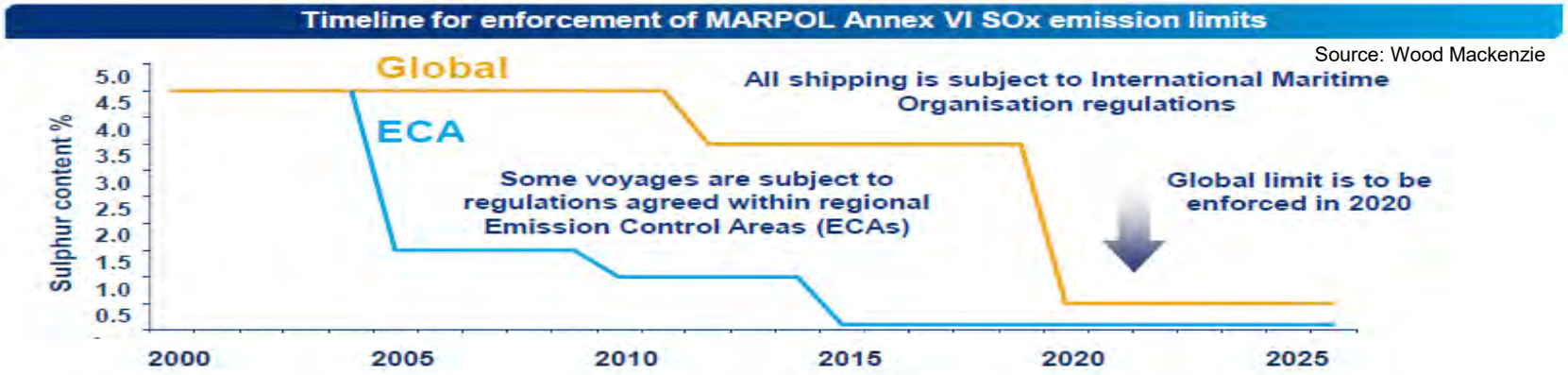
Efficiency of internal combustion engines will continue to improve over the next 20 years, with a scope to further reduce pollutants and greenhouse gases.

As a result, oil demand reduction is expected ~ 17 mbpd, i.e. significantly greater than that from electrification.

Source: BP Energy Outlook 2017

Challenges for Refining Industry – Bunker Fuel Regulation

Bunker standards have tightened in recent years, under the framework of IMO



MARPOL Annex VI Global Sulphur Rule

The decision is a milestone: after sulphur removal in gasoline and diesel, now is the time of bunker fuel for further and significant reduction of SO2 emissions.

Jet fuel comes next?

Three compliance options:

- **New bunker fuel 0.5 wt.% S**
- **3.5% refined fuel + scrubber**
- **Switch to LNG**

However, regulatory uncertainties make it difficult for ship-owners and refiners to invest.

- Little/no incentive for either party to pre-invest
- Shipping sector in tight financial situation
- Fuel quality aspects will need attention: Flash Point, Stability, Compatibility, etc.
- Implementation uncertainty has limited scrubber investments to ECA compliance
  (To date only about 400 out of 50,000+ total ships have scrubbers, nearly all in ECA's)

More details on the approach to implementation will be forthcoming at the next IMO MEPC* meeting in **July 2017**.

* Marine Environmental Protection Committee

Challenges for Refining Industry – Bunker Fuel Regulation

Options for the Shipping Industry

No investment cost Available product (if refiners invest) Established infrastructure	1 Conventional lower sulphur fuels (LSFO, MGO)	Higher fuel cost
Lower fuel cost Available product Retrofitting of existing ships	2 HSFO / Invest in exhaust-gas scrubbers	Capital investment Operational complexity Handling of Chemicals

- Scrubbing technologies are still considered to be immature with a limited track record.
- Longer term operating & maintenance costs are still uncertain.
- Passing the regulatory cost burden on to customers is much less transparent for Capex compared to Opex / Leasing agreement, where ship operator pays a premium on top of HSFO price. The scrubber owned and maintained by a third party may be the answer to move forward.

Likely lower fuel cost Compliance with NOx specs	3 Invest in LNG	Capital investment Infrastructure not developed Expensive retrofitting

- LNG offers zero SOx and PM emissions, and 25% reduction in CO_2 emissions / Methane slip remains a concern.
- LNG pricing is favorable in the medium to long term, as gas prices are expected to remain low even when the oil price recovers / Port infrastructure and supply chain for LNG, however, remains limited.

No investment cost	4 Non-compliance	Dependent on enforcement & level of financial penalties

Challenges for Refining Industry – Bunker Fuel Regulation

Options for the Refining Industry

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No investment cost Allow markets time to develop	1 Maintain HSFO production	Uncertain demand and price Low refinery margins/competitiveness
Little/no investment cost Allow markets time to develop	2 Blend to produce LSFO	Uncertain demand and price Increased crude oil costs Increased blending costs
Independent of other refinery units Reduced FO diluent requirement	3 Desulphurize to produce LSFO	Uncertain demand and price High capital cost
More higher value light products, Reduced FO yield	4 Yield investments	High capital cost Extensive refinery modifications

- IMO ruling is expected to lead to short term sharp fall in fuel oil demand, largely replaced by MGO.
- Price signals are likely to spur scrubbing investments, and temporary rise in alternative uses for low cost fuel oil, maintaining some demand in the longer term.
- MGO demand increase could lead to supply pressure on unprepared refiners, all other things being equal.
- Excess fuel oil will be invested out in the longer term, after a window in which low cost product may be converted in more complex refineries, replace crude oil in power generation, or seek innovative uses as petchem feedstock.
- Refining industry can adapt to this structural change, at least in the medium term.

The greatest risk for the refining industry as a whole is to embark on an investment race with shippers, that could not justify the investments undertaken.

The focus should rather be on infrastructure to capture opportunity from their existing configuration and internal streams.