Development of the Marine Fuel Market
- An Overview -

Topics

Introduction

Environmental aspects

Possible alternatives to oil products

Marine fuels for shipping in ECAs after 2015

Global shipping after 2020/2025

Developments in oil refineries

Availability and prices of future LS heavy fuel oils

Summary

Influences on Future Marine Fuel Market

- Environmental aspects
- Availability
- Costs

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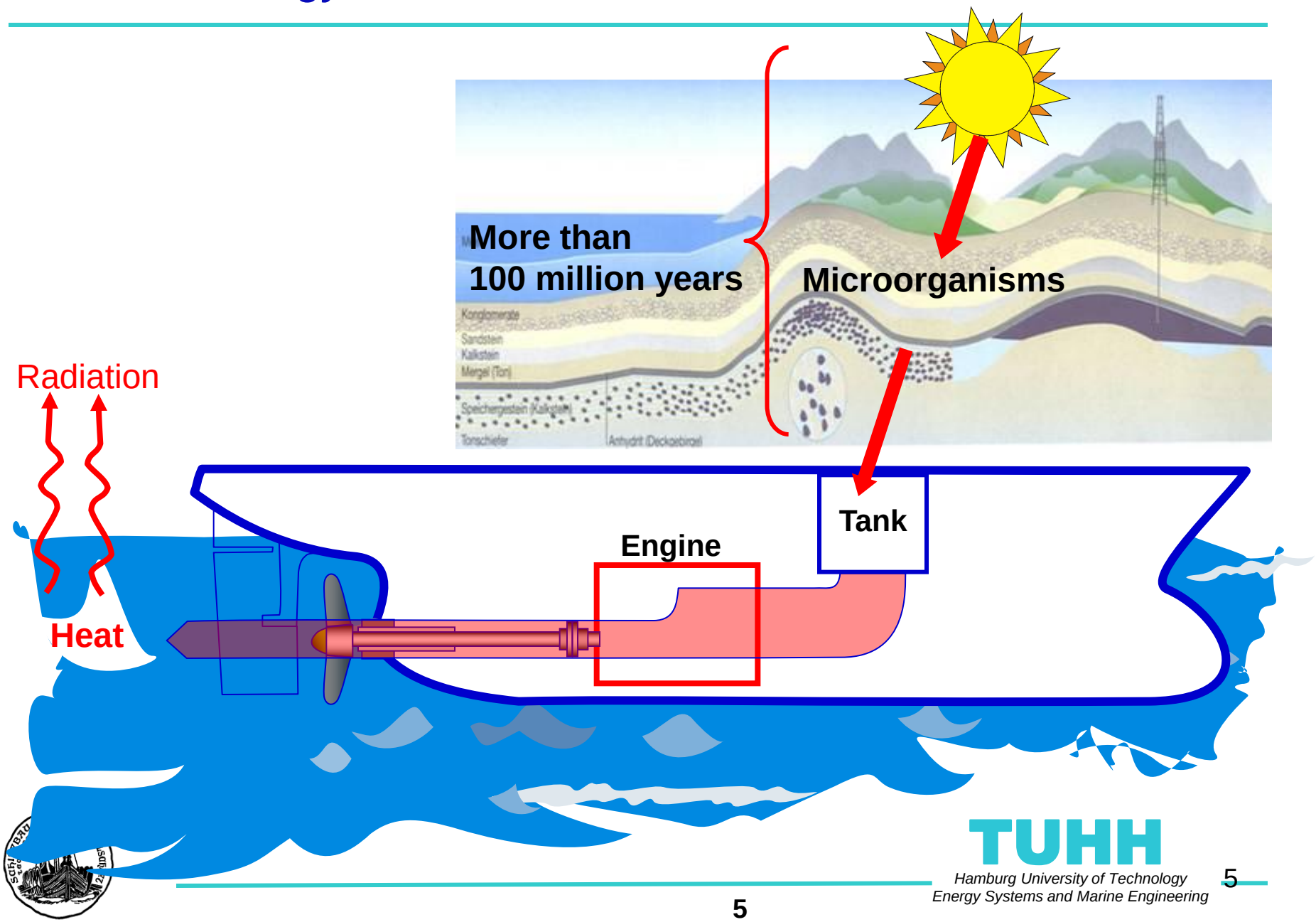
Eco-friendly Ship Propulsion in 2030 ???

Flow of Energy



History of Combustibles for Internal Combustion Engines

- Hydrogen (1807; de Rivaz)
- Coal gas (1858; Lenoir)
- Kerosene (1873; Brayton)
- Gasoline (1885; Daimler)
- Petroleum (1893; Diesel)
- Biofuel (Peanut oil) (1898; Diesel)
- Coal dust (1899; Diesel)
- Residual fuel (1909/ 1912; MAN / Junkers)
  (1948; Lamb)

Characteristics of Future Oil Market

Worldwide oil consumption will grow significantly.

Most of the oil reserves were found in politically unstable regions.

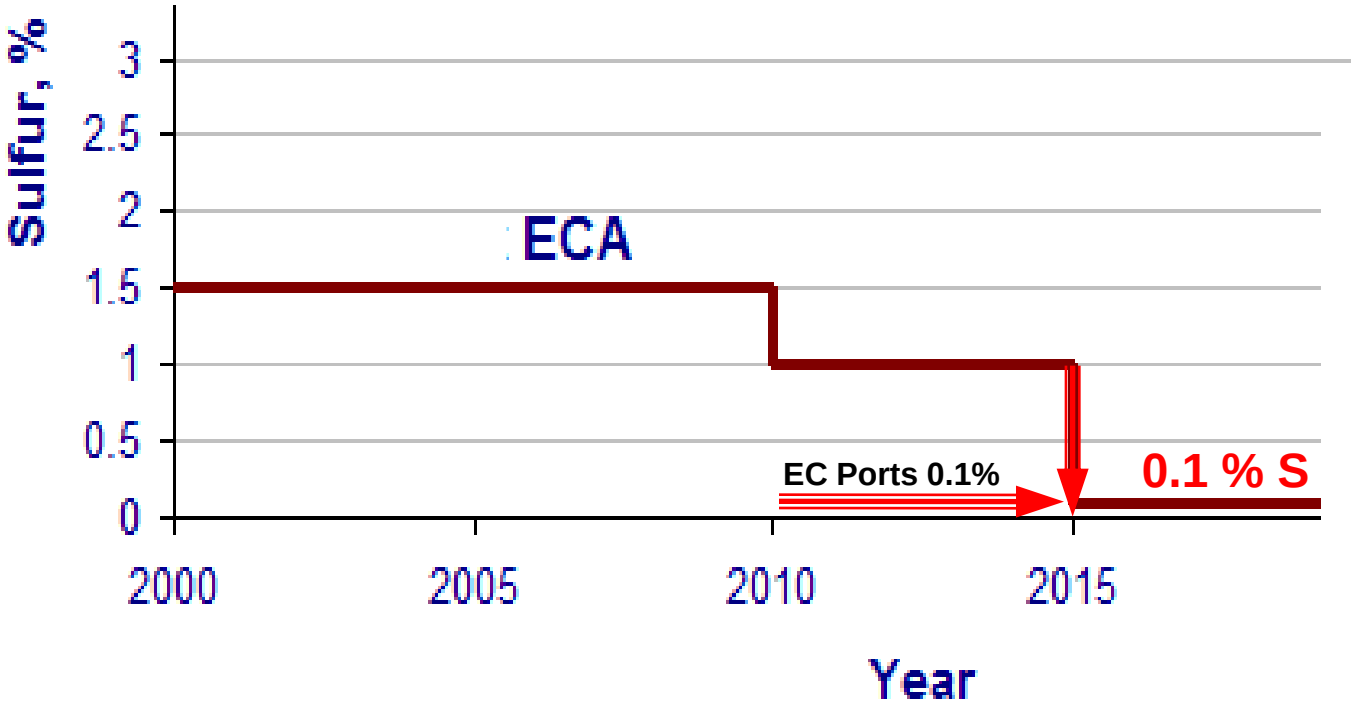
Prices of oil products will increase substantially.

Serious conflicts are most likely.

- What are the consequences of IMO regulations in ECAs after 2015 ?

- Is enough low-sulfur heavy fuel oil available for global shipping after 2020 ?

IMO Sulfur Limits in ECAs



Consequences after 2015 in ECAs

1. Majority of marine engines will burn low-sulfur marine gas oil.

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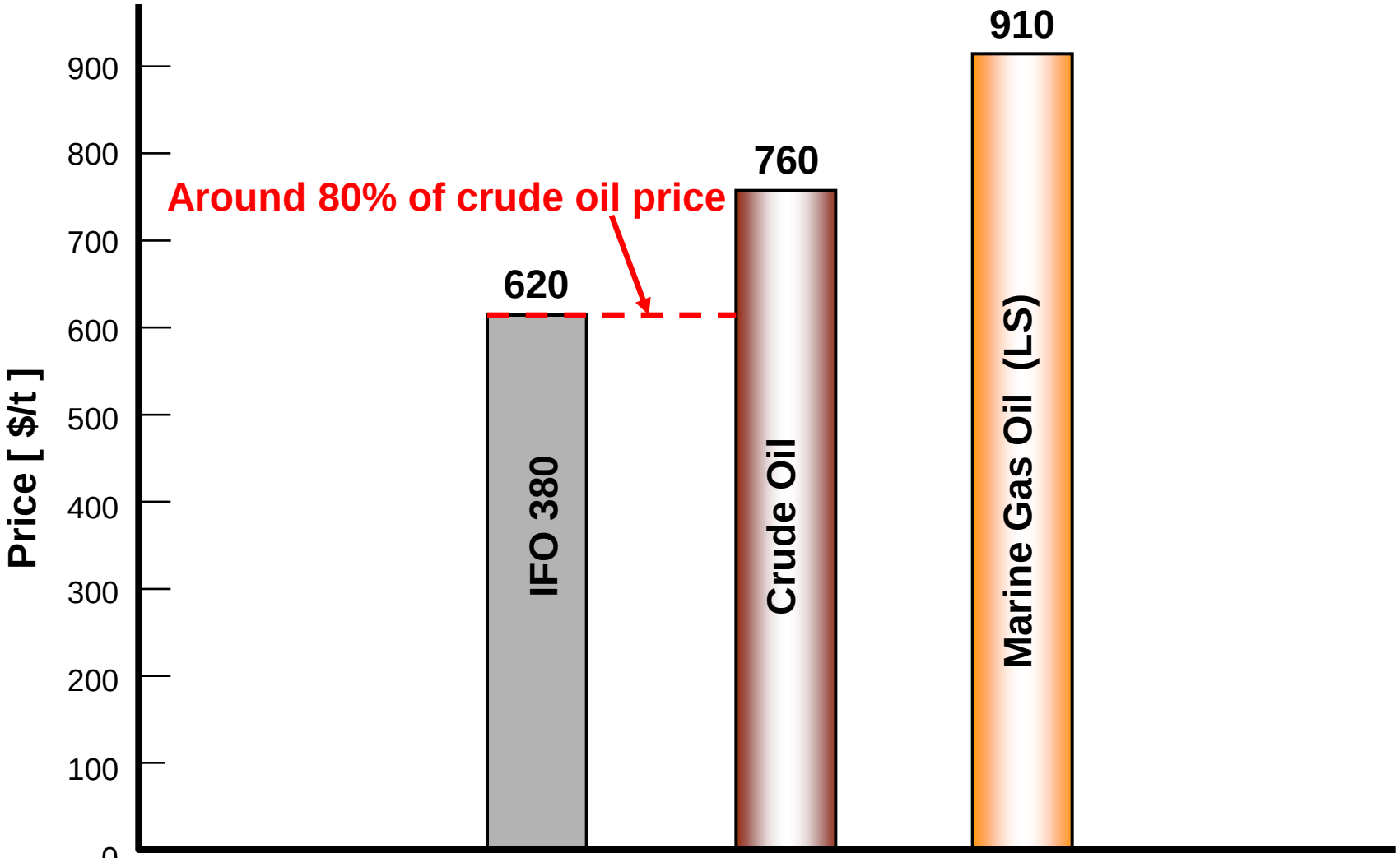
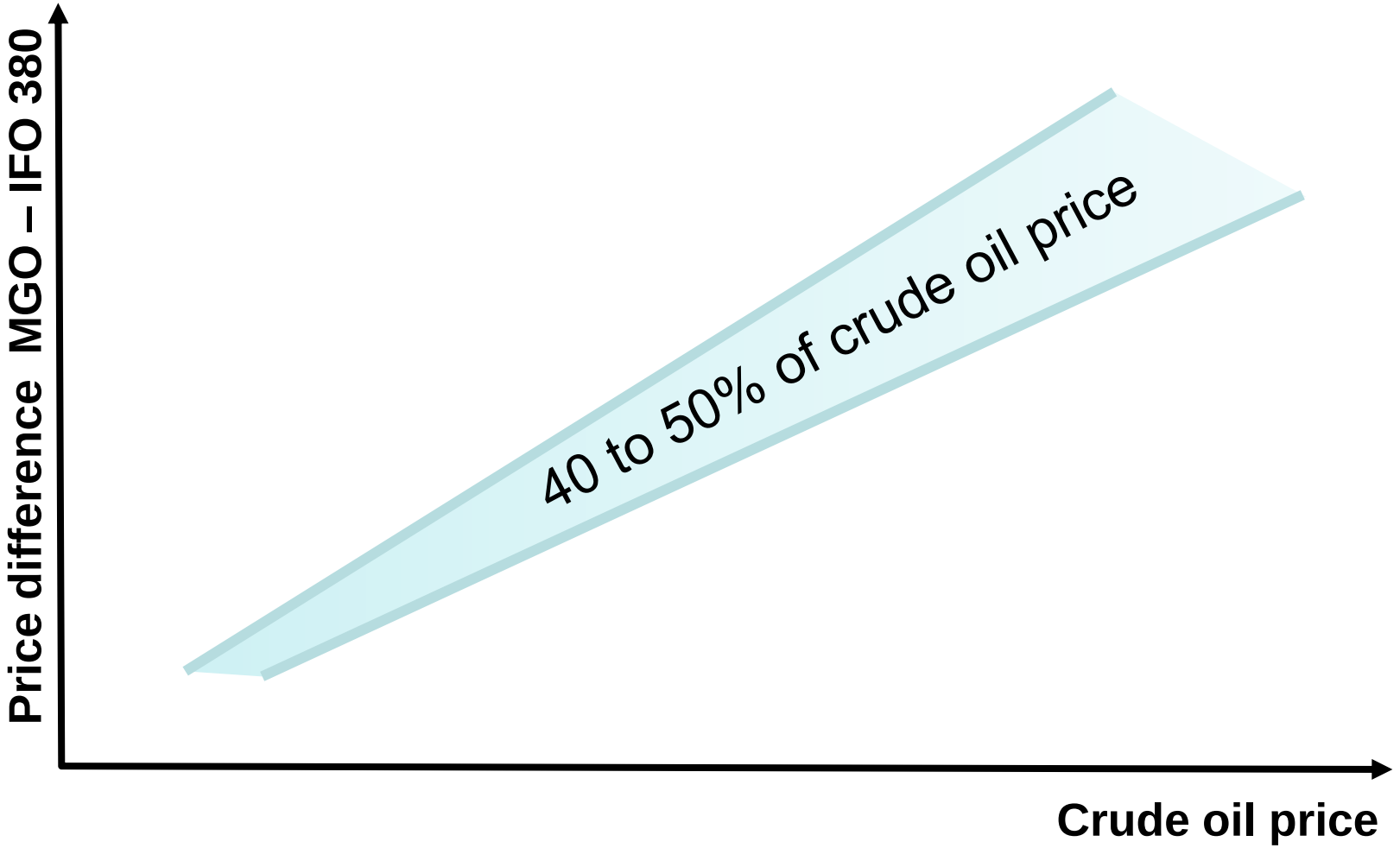
Bunker Prices in Rotterdam (September 2011)



Additional Costs for LS MGO Operation



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Every kilowatt power consumes

Heavy Fuel Oil for nearly 3 $ per day.

(MGO: 4,5 $ / kW d)

September 2011

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Consequences after 2015 in ECAs

1. Majority of marine engines will burn low-sulfur marine gas oil.

2. On many ships heavy fuel oil can be burned, as exhaust gas cleaning systems reduce SO_x emissions by more than 90%.

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Consequences after 2015 in ECAs

1. Majority of marine engines will burn low-sulfur marine gas oil.

2. On many ships heavy fuel oil can be burnt, as exhaust gas cleaning systems reduce SO_x emissions by more than 90%.

3. LNG is an eco-friendly and attractive option for ships with dual-fuel engines.

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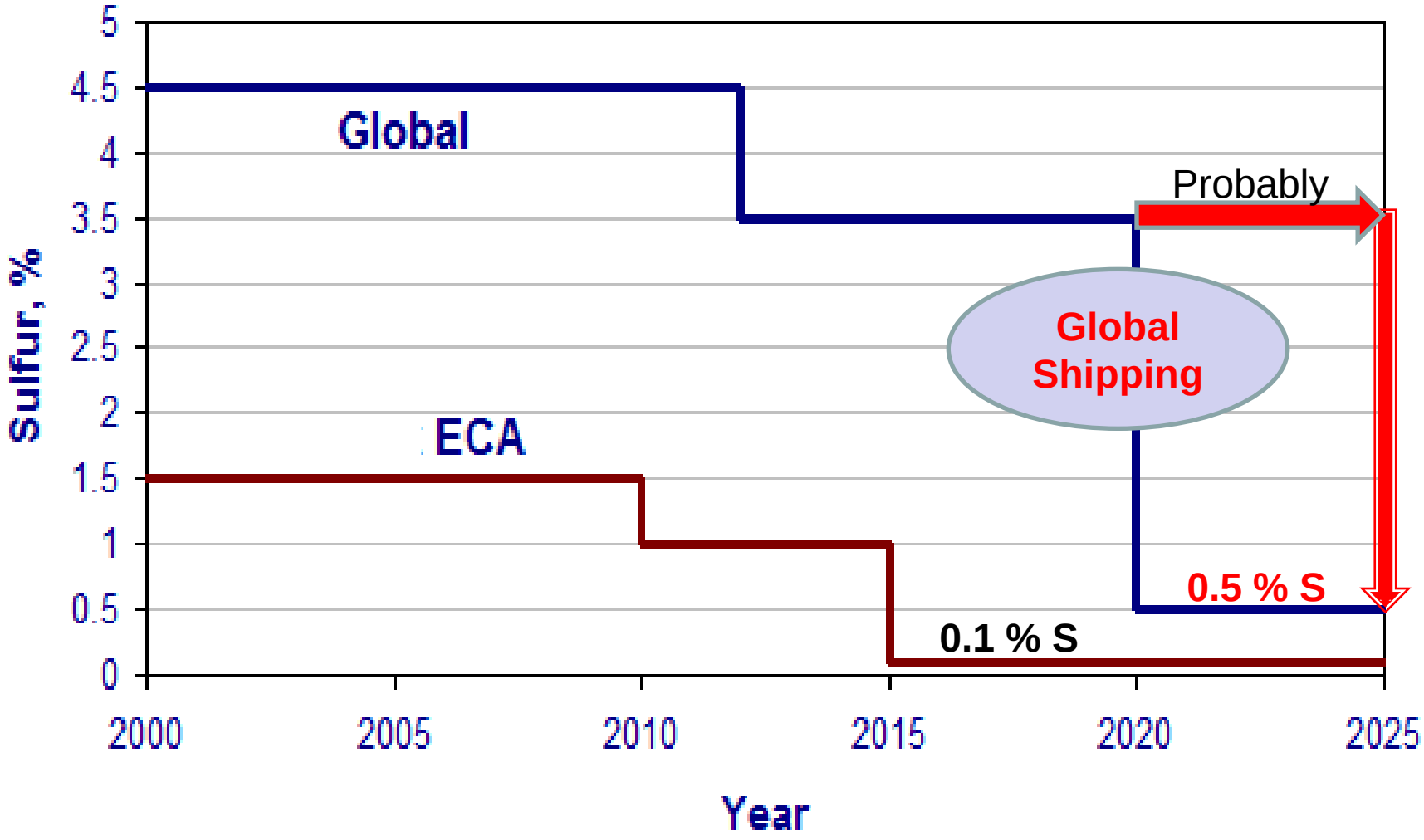
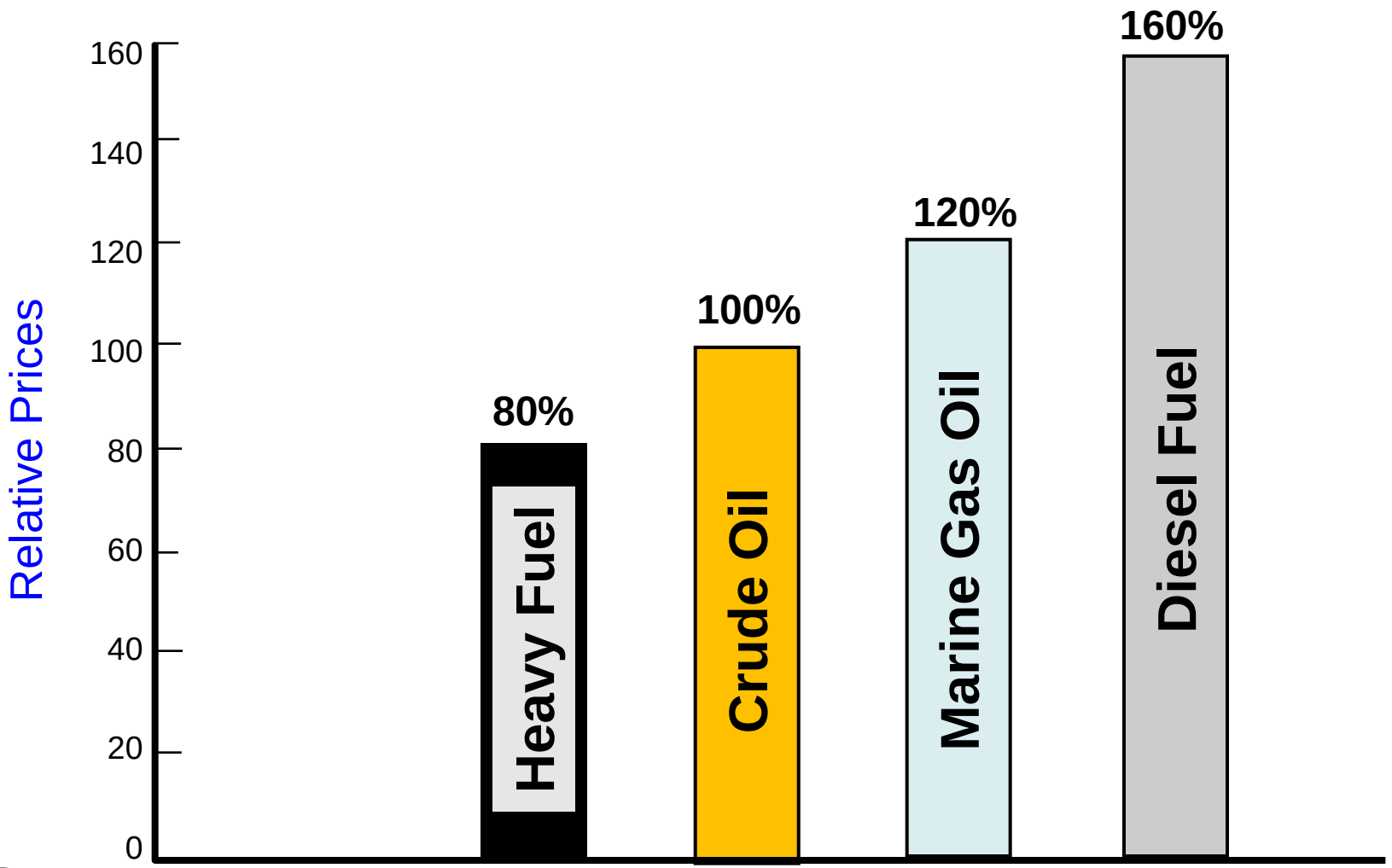
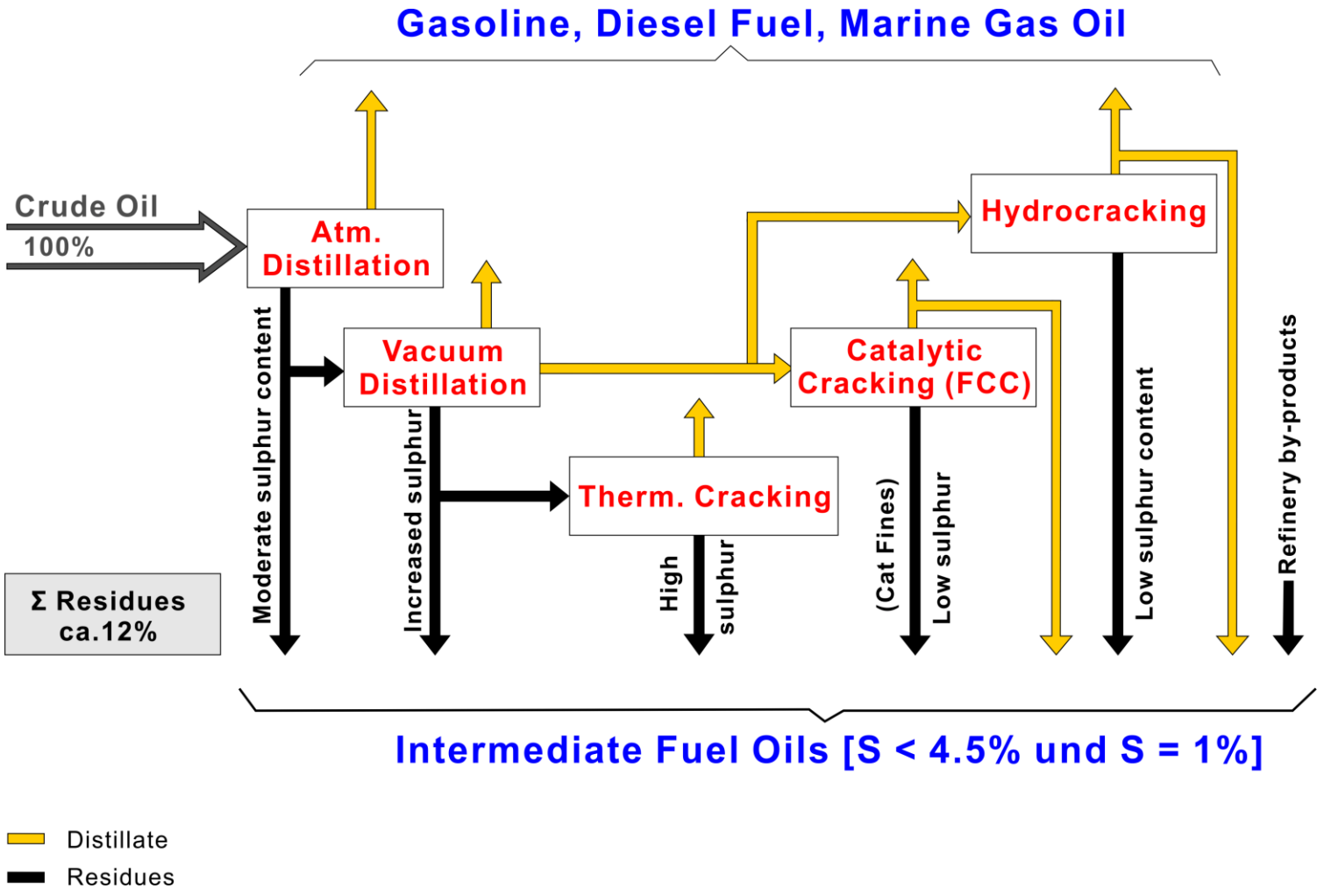
IMO Sulfur Limits



Relative Prices of Fuels



Production of Marine Fuel Oils in Modern Refineries



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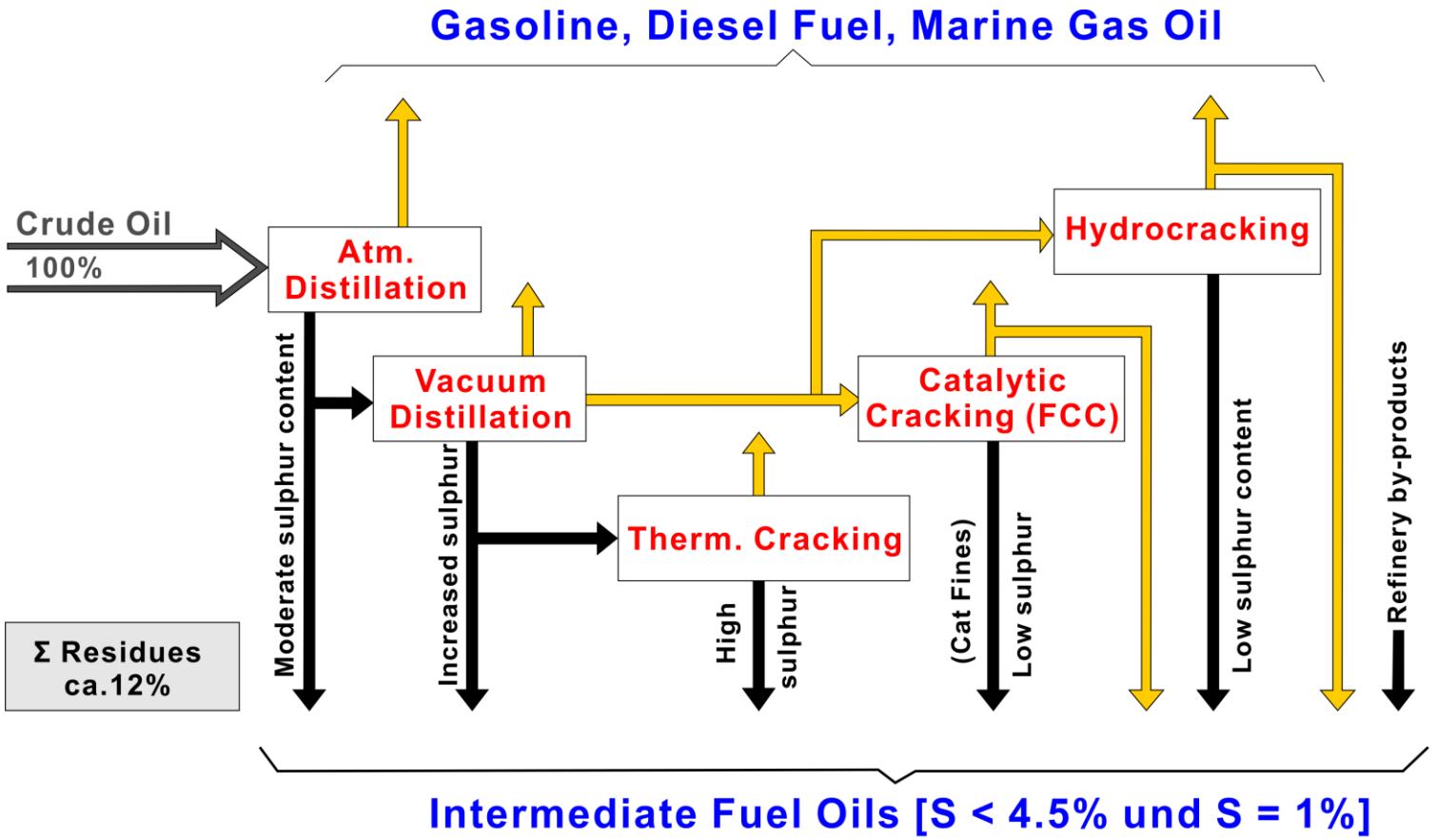
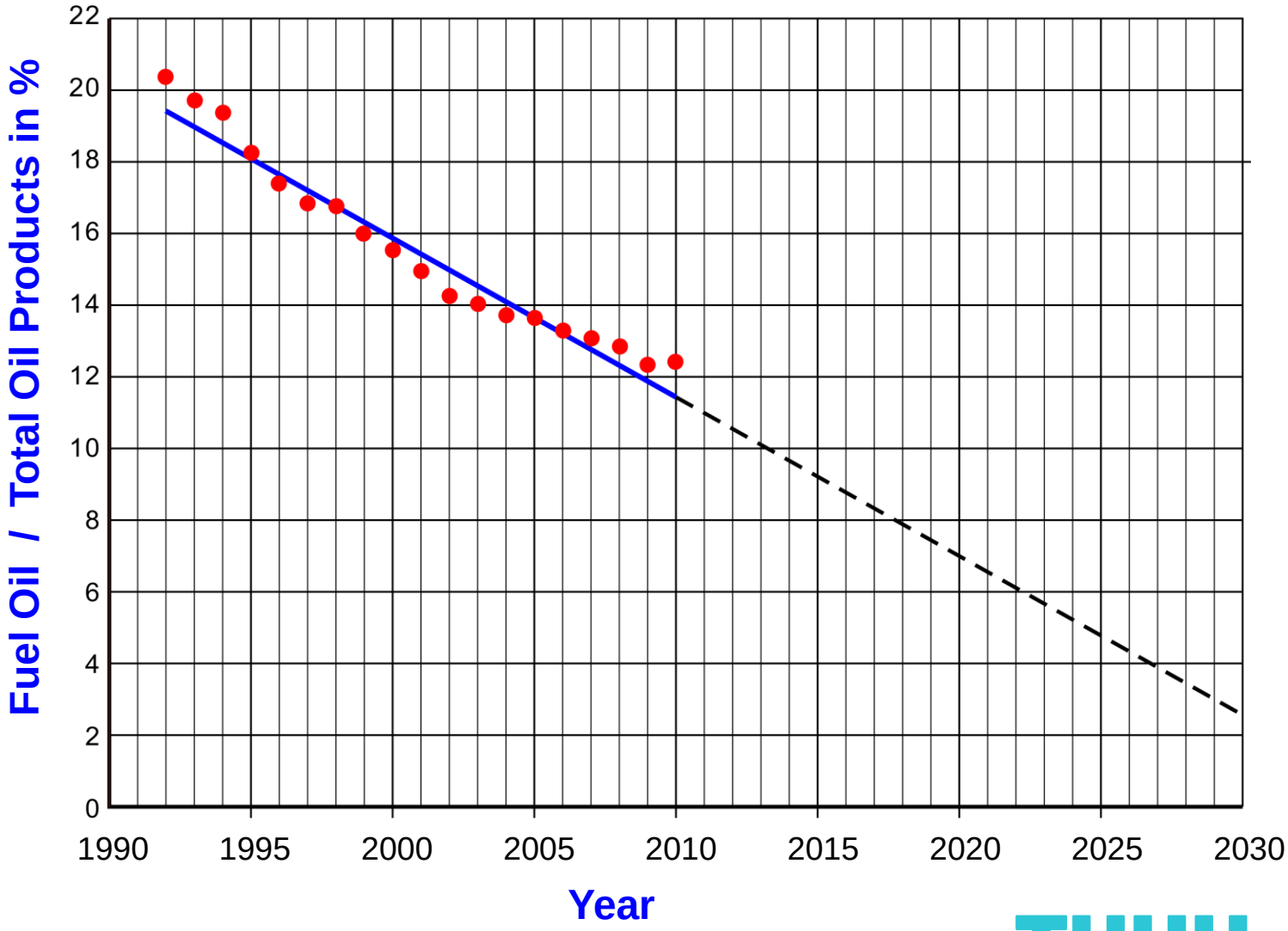


Distillate
Residues

80%	+	20%	→	IFO 180
92%	+	8%	→	IFO 380
95%	+	5%	→	IFO 480

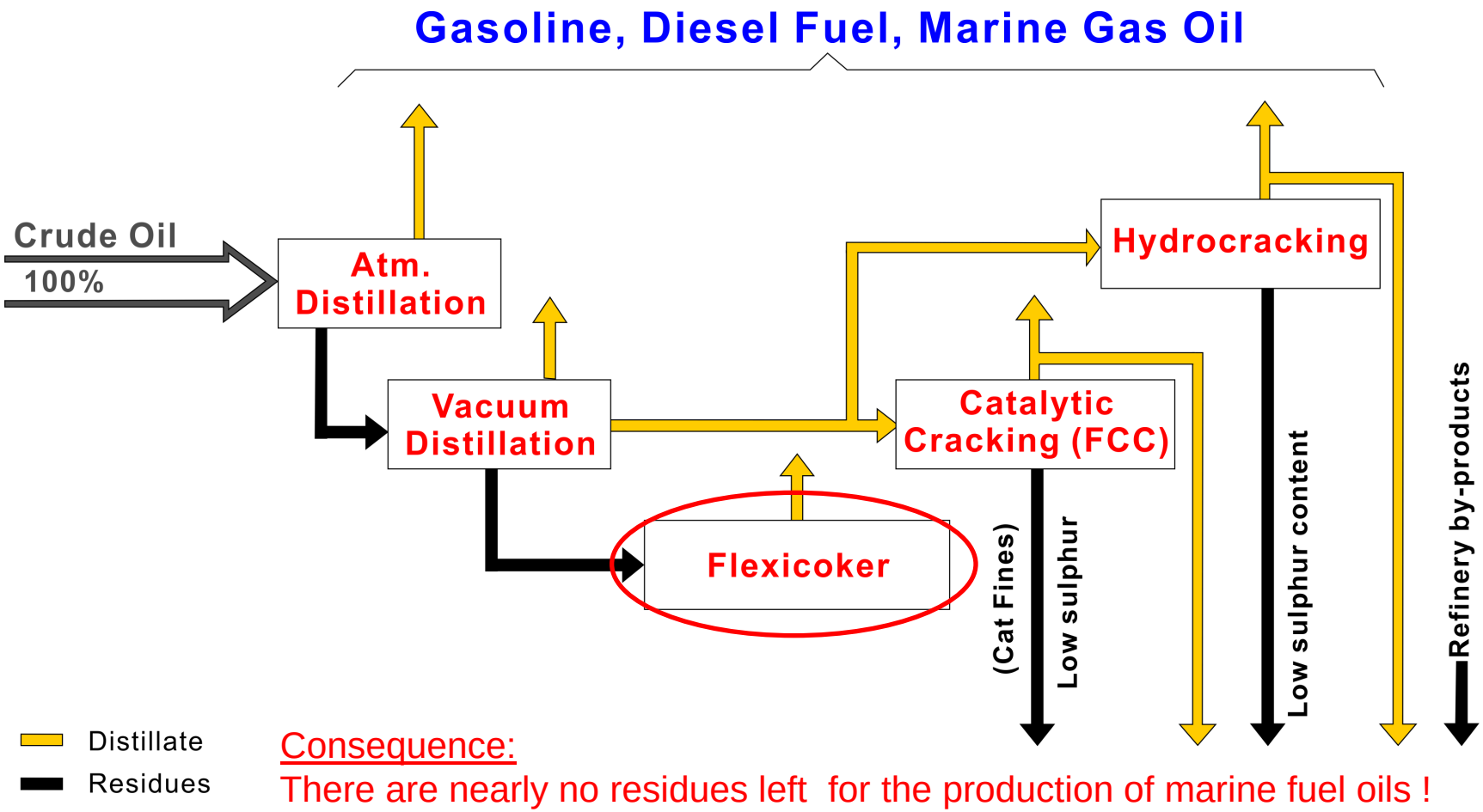
Residual Fuel Oil as a Percentage of all Oil Products (BP Statistical Review 2010)



Residual Fuel Oils in Refineries

1. The production of residues in refineries continues to decline (Flexicoker !).

Refinery with FLEXICOKER



Consequence:

There are nearly no residues left for the production of marine fuel oils !

Residual Fuel Oils in Refineries

1. The production of residues in refineries continues to decline (Flexicoker !)

2. The international marine market consumes roughly one third of all residues.
   Competitors: Power Plants

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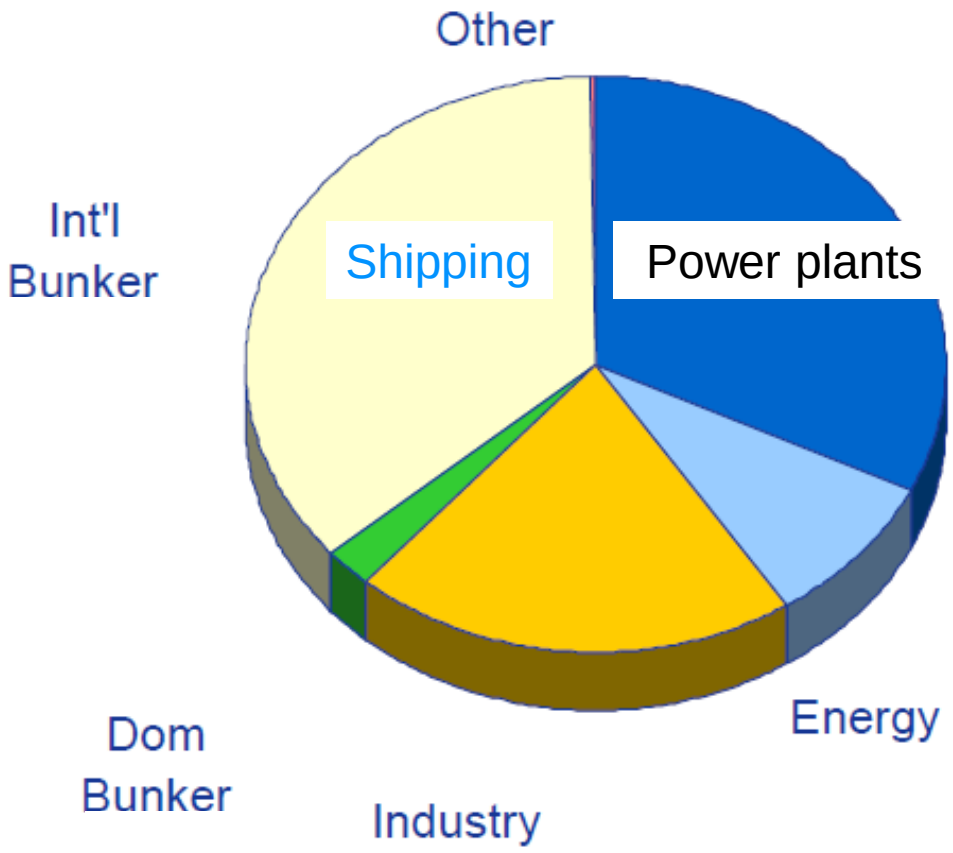
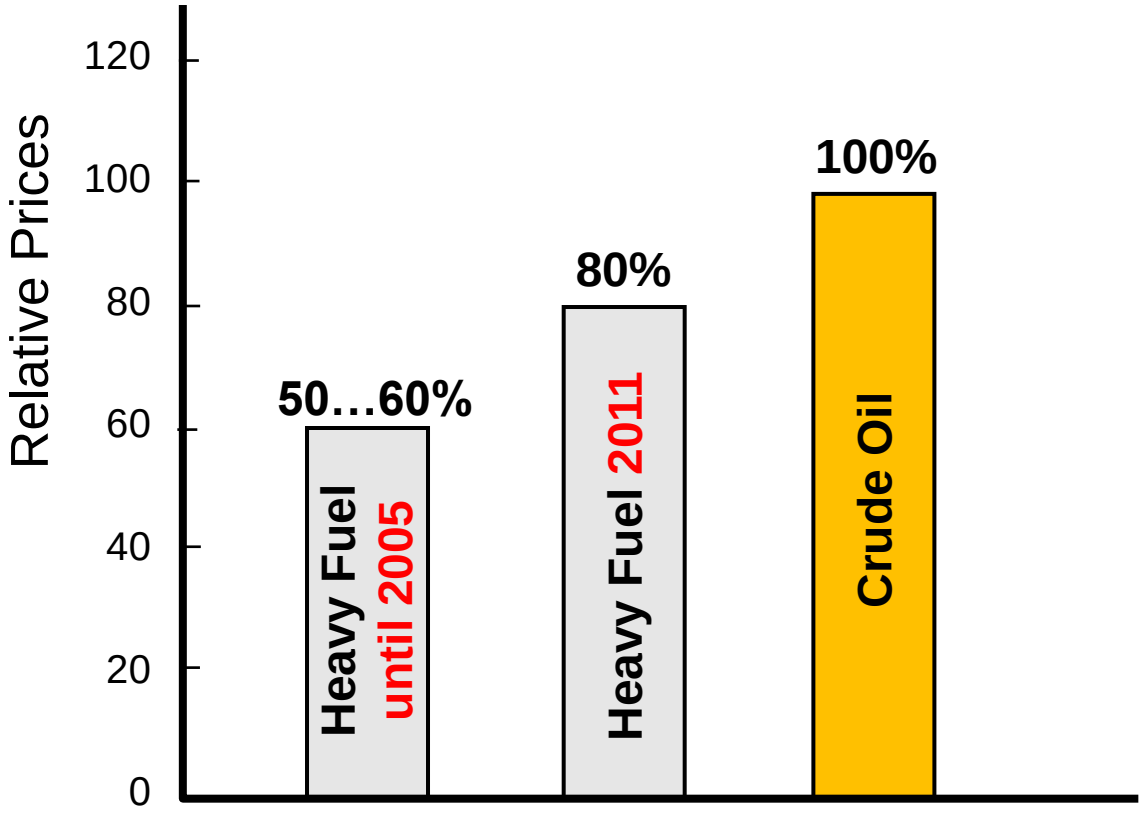
Worldwide Consumption of Heavy Fuel Oils



Increasing Value of Heavy Fuel Oil



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Residual Fuel Oils in Refineries

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3. Heavy fuel oil is no more a cheap waste product.

1. Intensified conversion of residues into distillates

2. Hydrodesulfurization of the residues

3. Processing of low-sulfur crude oils

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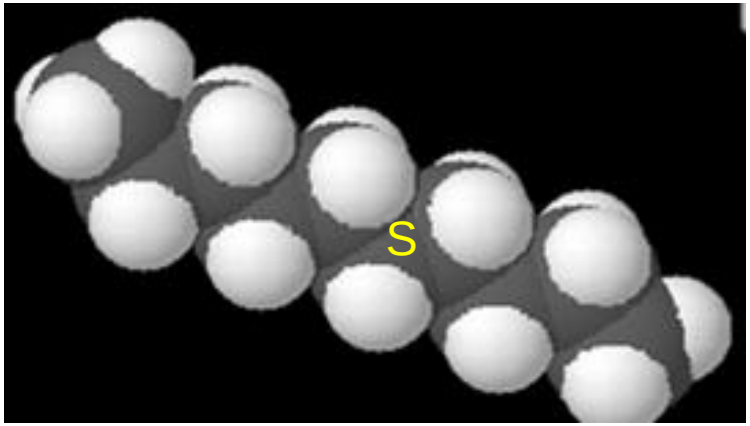
Hydrodesulfurization of Residual Fuels (HDS)



Requirements:
- High pressures and temperatures
- High energy consumption
- Large quantities of hydrogen
- Very high capital investment (≥ 80 Mrd. USD)

Aim:
- Desulfurization down to 0.5 …1% sulfur

Experience:
- Few plants mainly in Asia

Japanese Refinery with Hydrodesulfurization of Residues

Quelle: Shell

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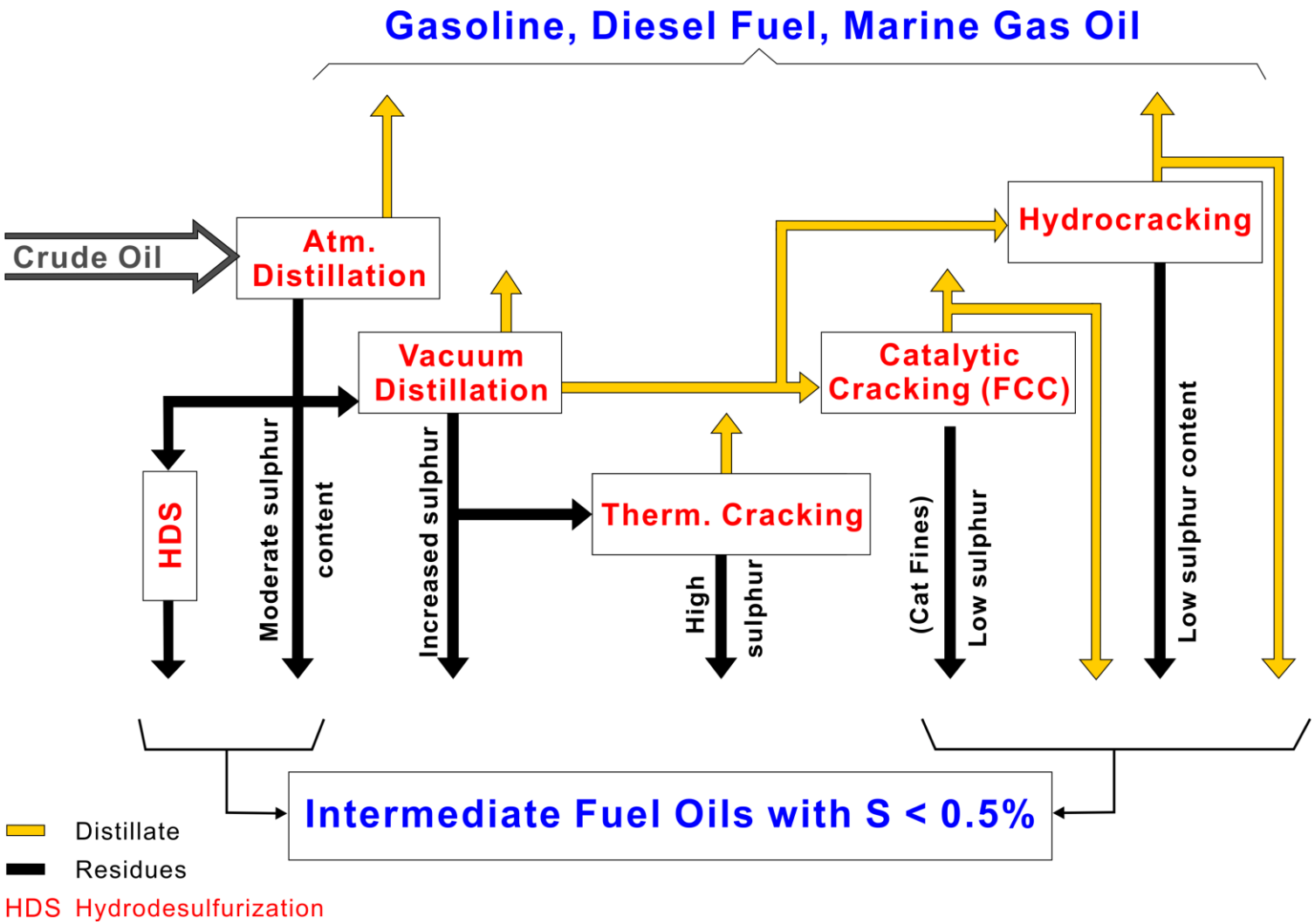
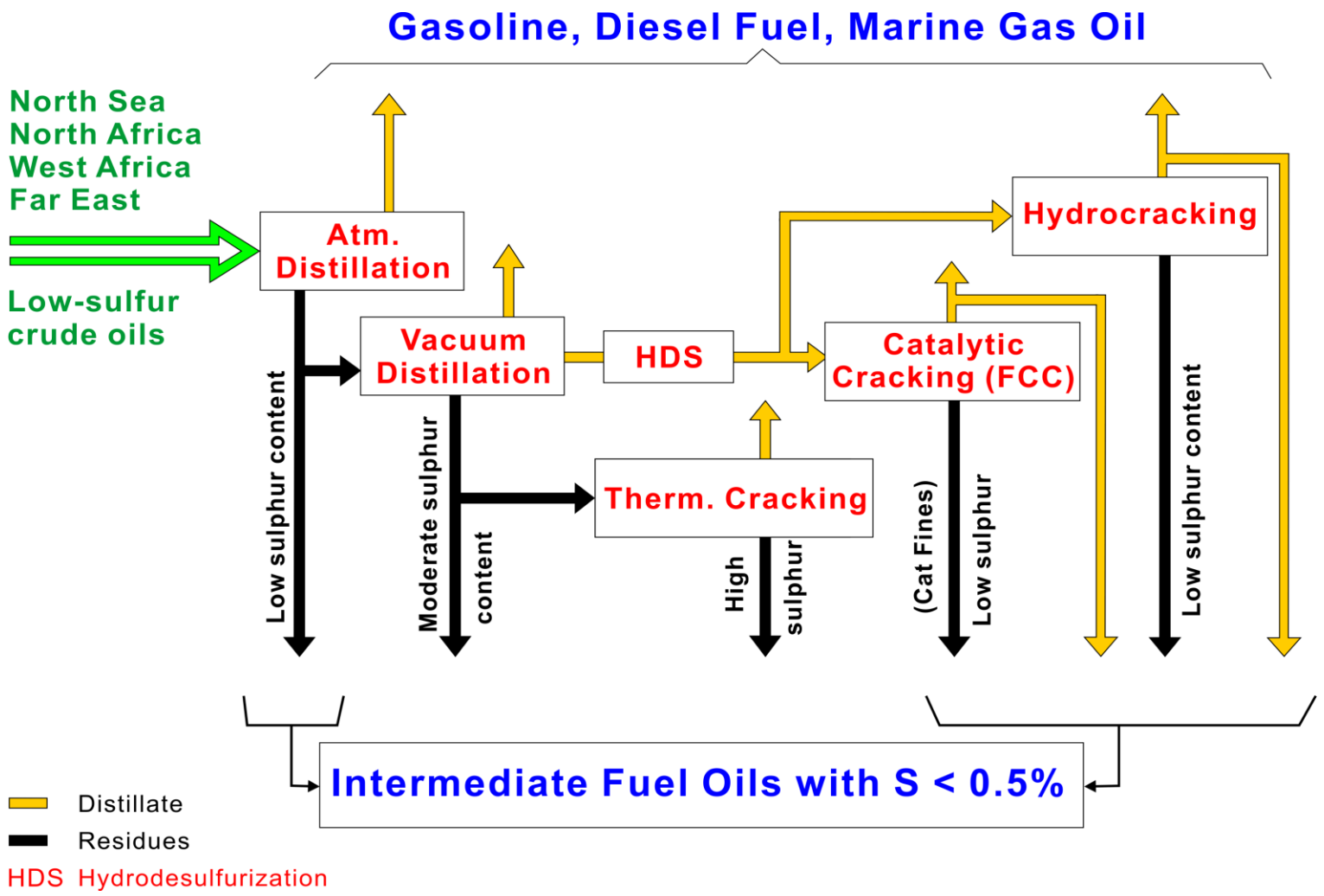
Future Production of Intermediate Fuel Oils with Sulfur Contents of 0.5 %



Processing of Low-Sulfur Crude Oils for the Production of Intermediate Fuel Oils with 0.5 % Sulfur



Options of Oil Industry after 2020/25 for Production of HFO with 0.5% Sulfur

	Consequences for Oil industry	Shipping
1. Intensive hydrodesulfurization of residues	> 80 Mrd.$	HFO prices increase by around 80 ..150 $/t
2. Low-sulfur crudes (and moderate hydrodesulfurization)	< 80 Mrd. $	
3. Conversion of residues into distillates	> 100 Mrd. $	MGO price

Option No. 3 is probably the most attractive alternative for the oil industry !

Summary

- Also during the next 30 years mineral oil products will remain the major energy source onboard ships.

- In ECAs the use of LNG and the application of exhaust gas cleaning systems may be attractive options.

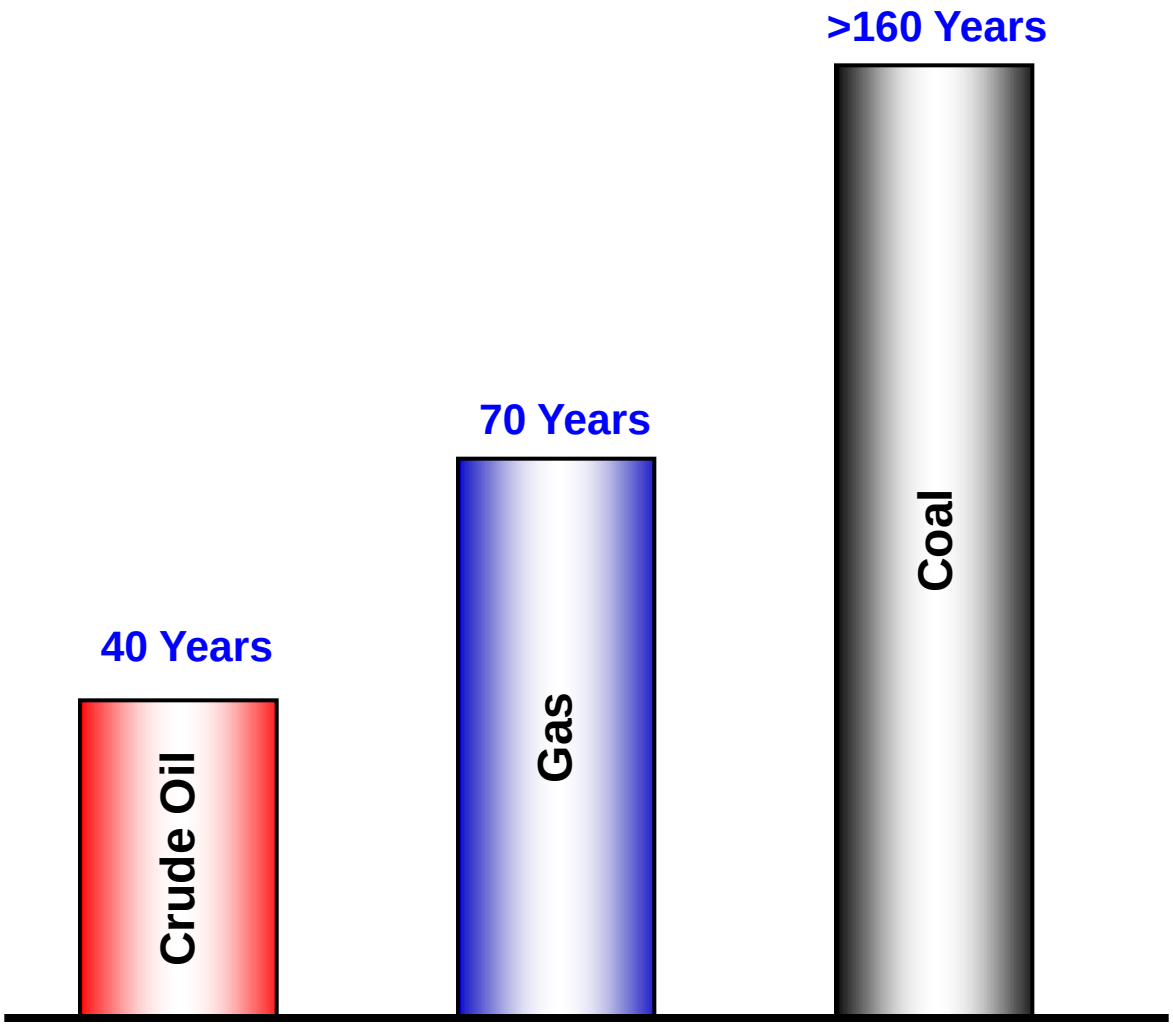
- Local and temporary shortages of low-sulfur distillates are likely.

- The introduction of heavy fuel oil with 0.5% sulfur probably after 2025 will lead to technical, logistic and financial challenges for the oil industry. The bunker market will then become even less attractive than today. Several oil companies will probably withdraw from the marine market.

- Market conditions will result in much higher fuel prices and HFO will lose its status as a cheap energy source.

Thank you for your attention !

Reserves-to-production Ratios



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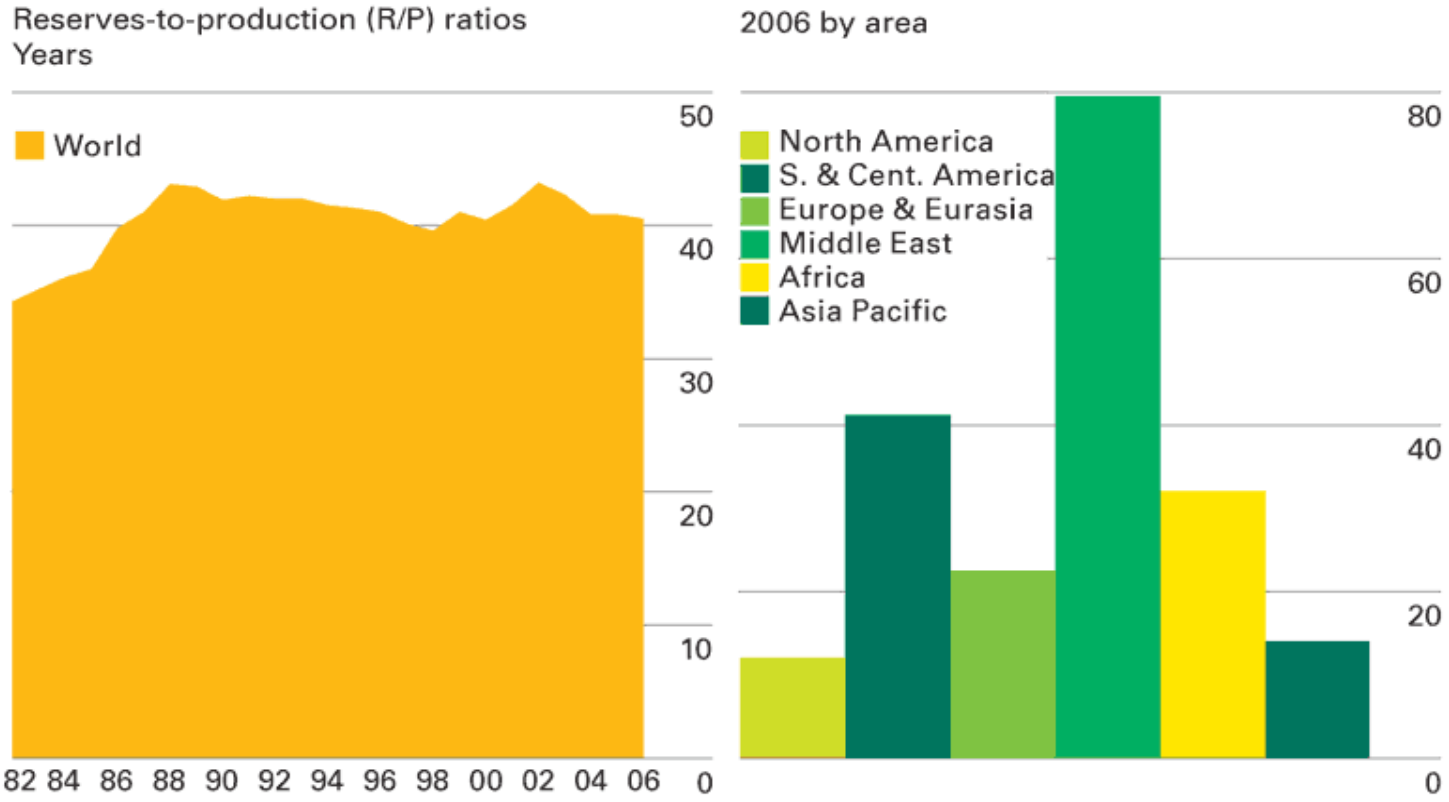

The world's oil R/P ratio edged lower in 2006, reaching 40.5 years, compared with 41 years in 1996 and 39.8 years in 1986. The level of reserves fell by 1 billion barrels, or 0.1%. Declines in Norway and Mexico were partially offset by increases in Russia and Brazil.

- Sulphur emission is eliminated
- Particulate matters is close to zero
- CO2 is reduced by 26%
  Due to unburned methane the net reduction of greenhouse gases is somewhat lower
- NOx is reduced by 80-90%

Efficiency of Propulsion Systems