

concaawe



# Low sulphur marine fuel options: Technical, environmental & economic aspects

The European Fuels Conference

Michael Lane

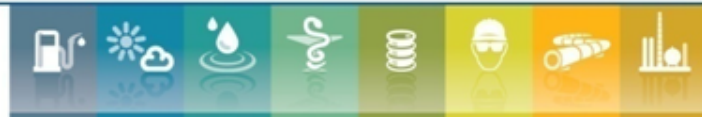
Secretary General, CONCAWE

13<sup>th</sup> March 2012

**CON**servation of  
**C**lean  
**A**ir and  
**W**ater in  
**E**urope

**The Oil Companies' European association for health,  
safety and environment in refining and distribution  
(founded in 1963)**

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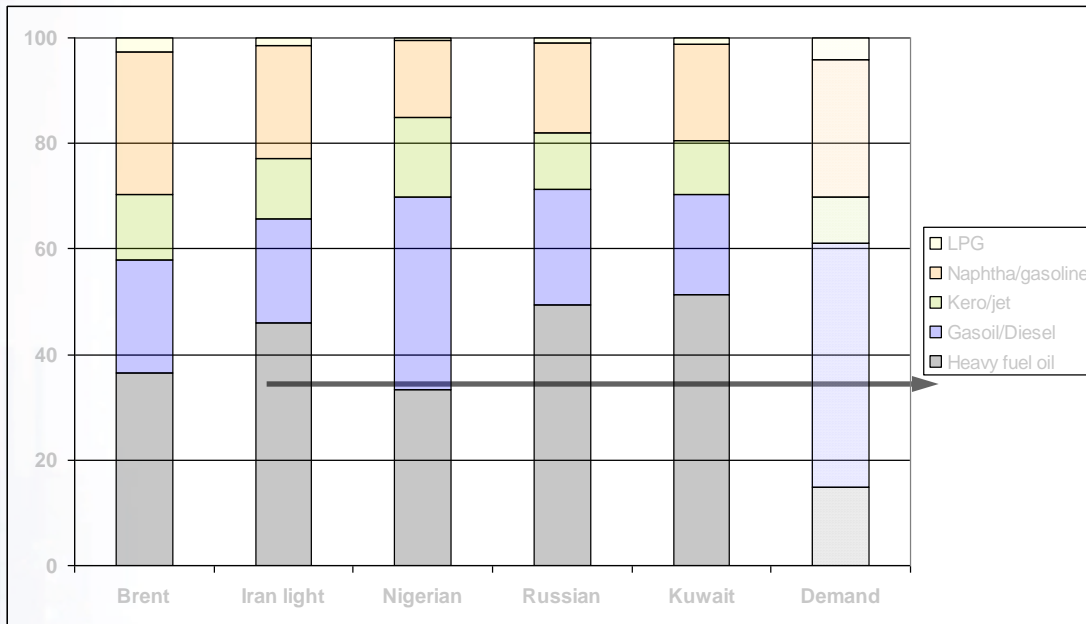
- ▶ **Open to companies owning refining capacity in the EU**
- ▶ **Currently 41 Member Companies:**

<b>ALMA</b>	<b>IPLOM</b>	<b>PKN Orlen</b>
<b>API</b>	<b>Koch</b>	<b>Preem</b>
<b>BP</b>	<b>KPI</b>	<b>Repsol</b>
<b>CEPSA</b>	<b>Lotos</b>	<b>RHG</b>
<b>ConocoPhillips</b>	<b>Lukoil</b>	<b>Rompetrol</b>
<b>ENI</b>	<b>LyondellBasell</b>	<b>Sara</b>
<b>ERG</b>	<b>Murco</b>	<b>SARAS</b>
<b>Essar Oil UK</b>	<b>MOL</b>	<b>Shell</b>
<b>ExxonMobil</b>	<b>Motor Hellas</b>	<b>SRD</b>
<b>Hansen &amp; Rosenthal</b>	<b>Neste Oil</b>	<b>ST-1</b>
<b>Hellenic Petroleum</b>	<b>Nynas</b>	<b>Statoil</b>
<b>INA</b>	<b>OMV</b>	<b>Tamoil</b>
<b>Ineos</b>	<b>Petrogal</b>	<b>Total</b>
	<b>Petroplus</b>	<b>Valero</b>

- ▶ **Represents nearly 100% of European refining capacity**
- ▶ **Not for profit association, funded by Member Companies**

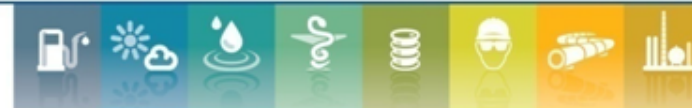


Crude oil: typically much "heavier" than product demand

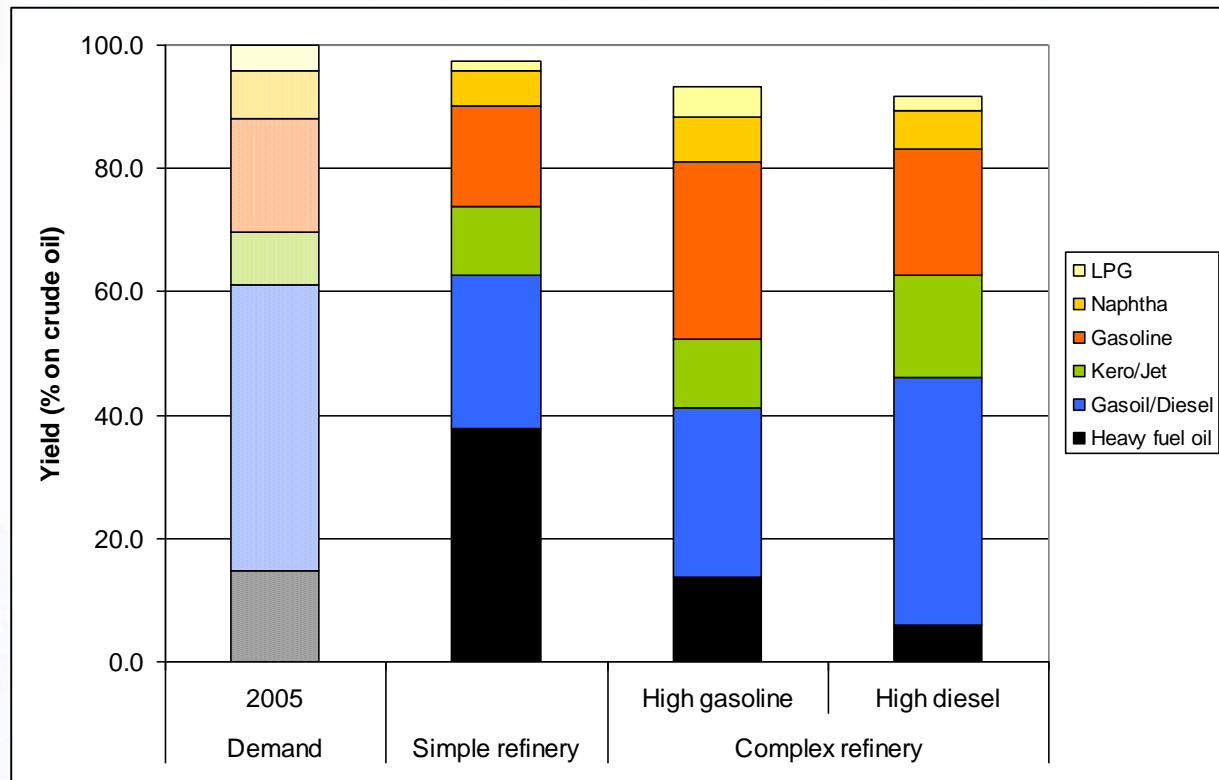


- Use available crudes:
  - Adapt to quality variations
  - Adapt to different crudes on a day-to-day basis
- Produce desired products:
  - All products must be "on-spec"
  - All must be produced at the same time
  - Nothing can be thrown away!
- **And ...minimise energy, CO<sub>2</sub>, environmental impacts, and costs**

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# concaweRefineries turn crude into multiple fit-for-purpose products



- ▶ Achieving this requires complex process technology and hydrogen
  - ▶ “Reforming” to obtain the desired molecules and distribution
  - ▶ Residue conversion to “crack” larger molecules into smaller ones
  - ▶ Hydrotreating to obtain the desired product quality (e.g. S removal)
- ▶ More refinery complexity means that more energy and more hydrogen are needed - and typically more CO<sub>2</sub> emissions

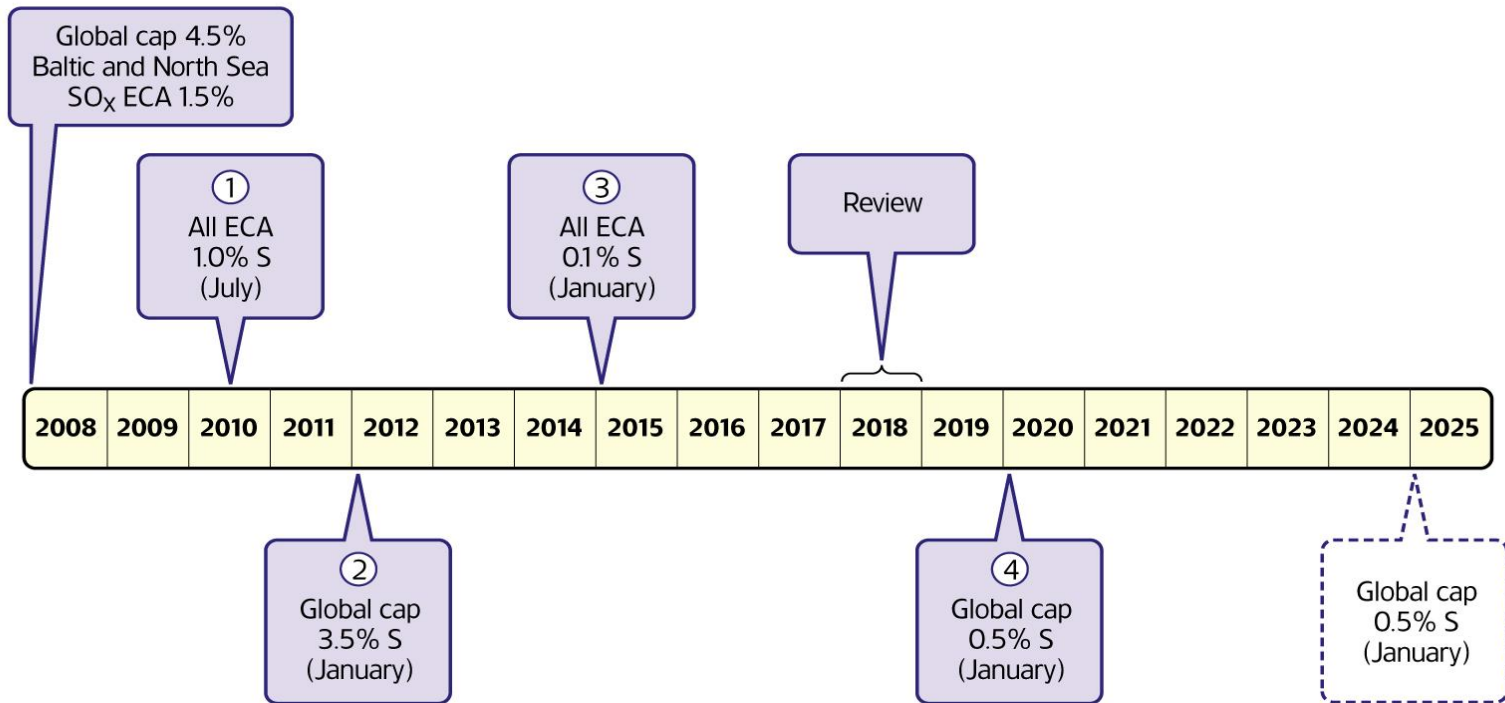
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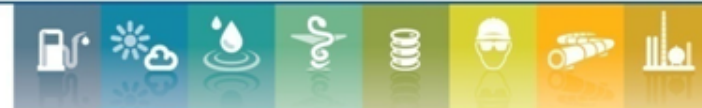


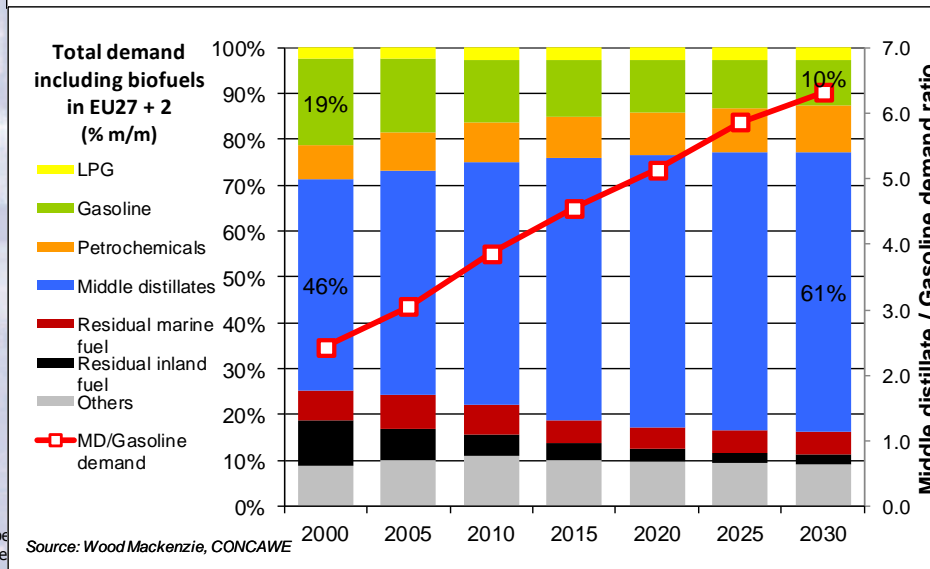
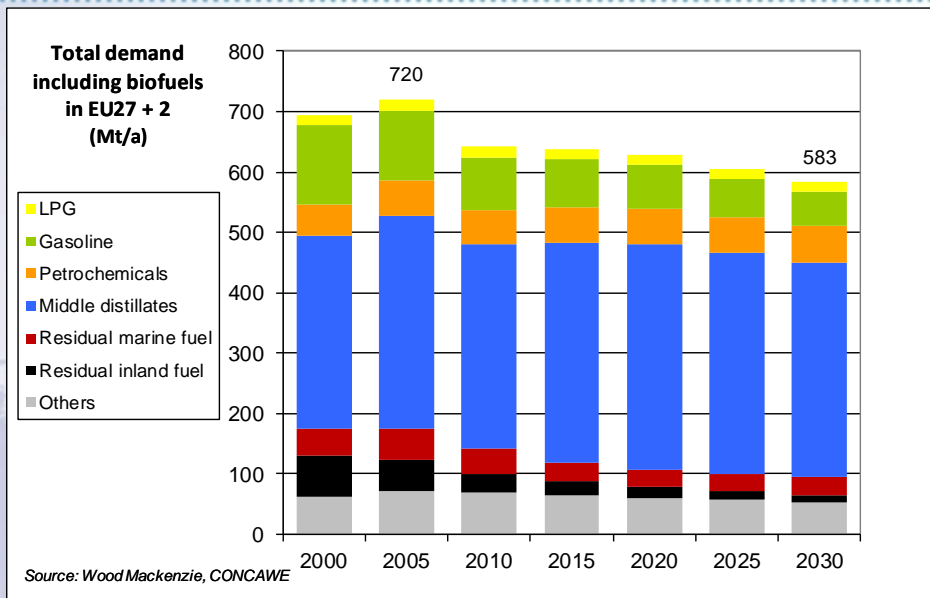
## Proposed implementation schedule has four steps

Ratified at the October 2008 IMO MEPC meeting



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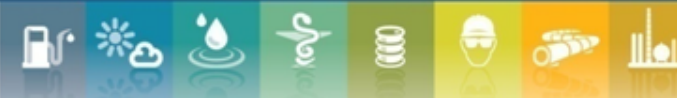


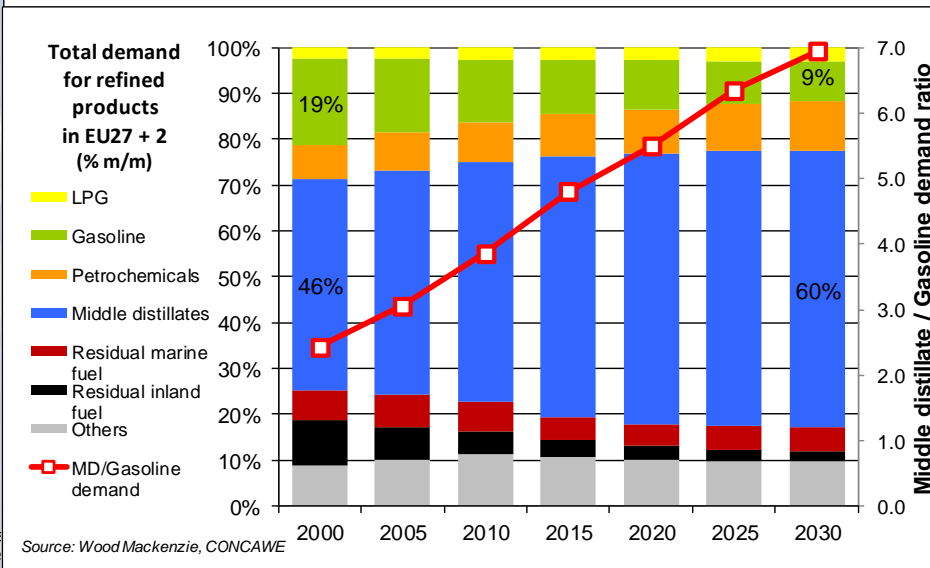
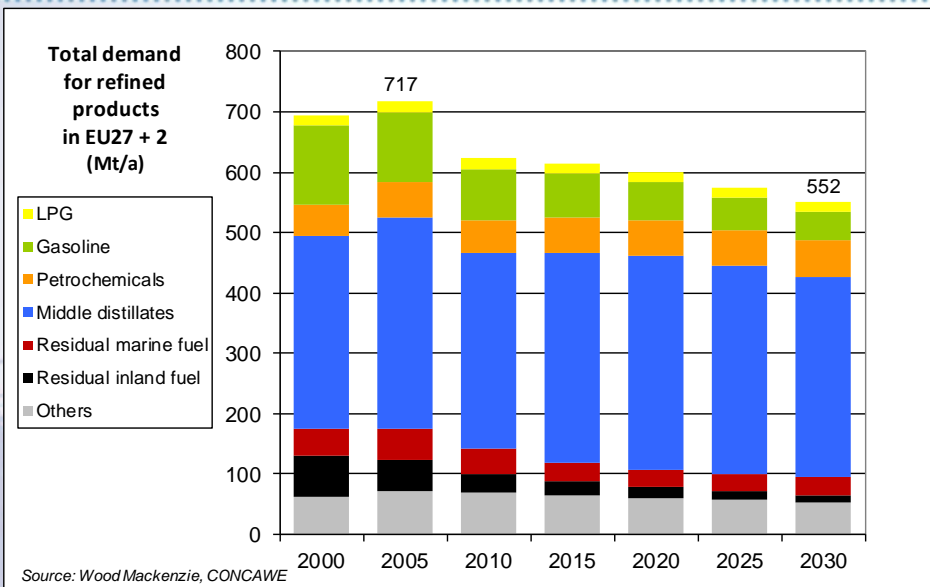


- ▶ Basis: JEC Fleet & Fuels model for road diesel and gasoline. Wood Mackenzie 2011 for all other products
- ▶ Average new passenger car fuel economy:
  - ▶ 95 g CO<sub>2</sub> /km by 2020
  - ▶ 75 g CO<sub>2</sub> /km by 2030
- ▶ Total diesel+gasoline road demand shrinks by 50 Mt from 2005 to 2030
- ▶ Steady decline in total demand **but increasing** share of middle distillates and *decreasing* shares of gasoline and residual fuels
- ▶ Step increase in middle distillates in 2015 with switch of 15 Mt SECA bunker from 1.0%S to 0.1%S distillate
- ▶ Steep decline in residual inland fuel oil demand: 2030 demand is only 17% of demand in 2000

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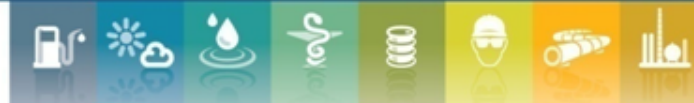
Source: Wood Mackenzie, CONCAWE



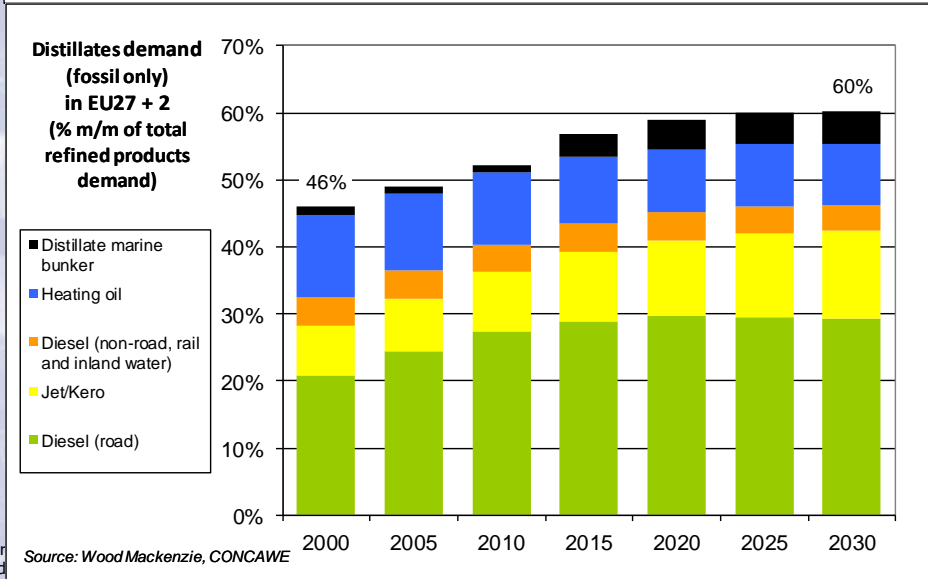
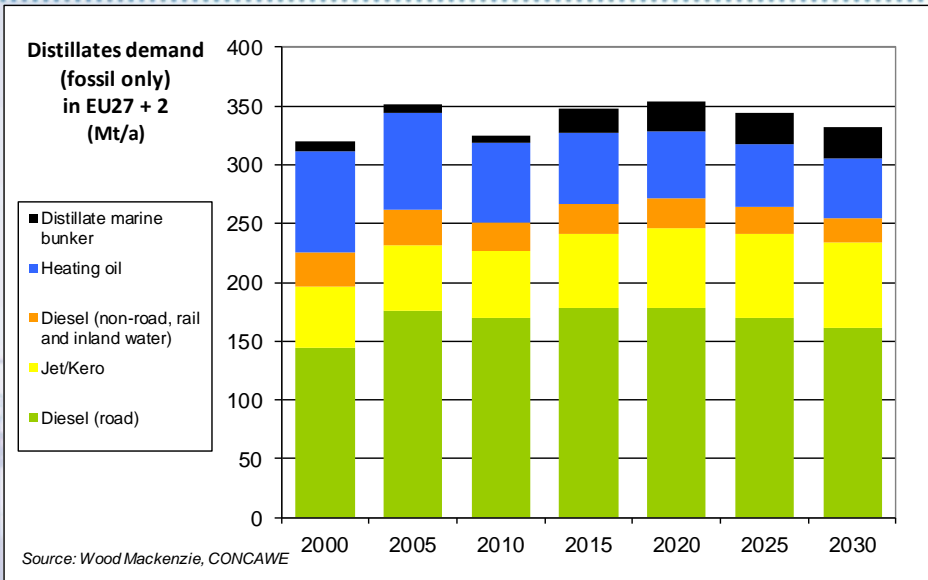


- ▶ Total refined diesel+gasoline road demand shrinks by 81 Mt between 2005 and 2030
- ▶ Refined products demand falls by 166 Mt from 2005 to 2030
- ▶ Share of light products in the demand basket increases from 75% in 2005 to 83% in 2030
- ▶ Ratio of middle distillates to gasoline in refined product demand increases from 3.1 in 2005 to 6.9 in 2030
  - ▶ Increasingly difficult for gasoline-oriented refineries to meet changing demand ratio

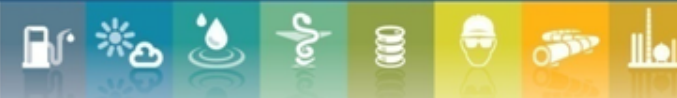
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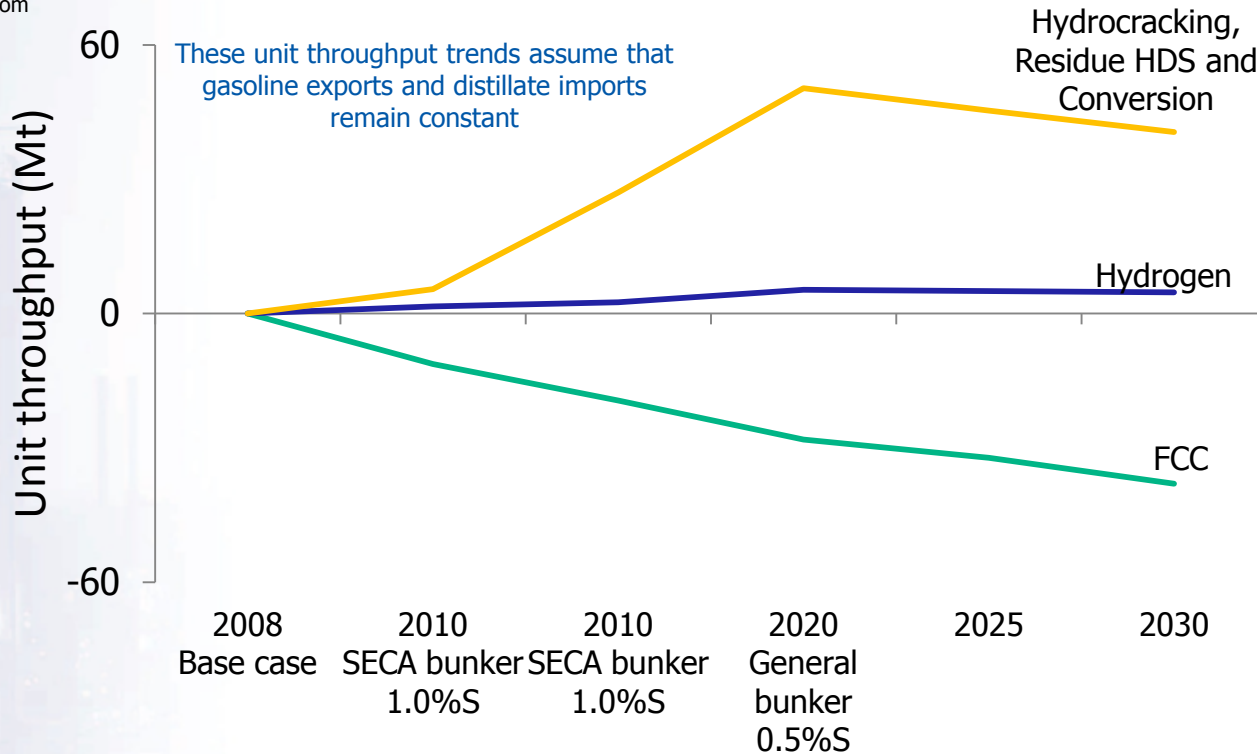




- ▶ *Total* fossil fuel distillates demand does not grow in absolute tonnage.
- ▶ *Share* of distillates in total fossil fuel product market continues to increase.
- ▶ Contrasting and partially compensating market tonnage trends:
  - ▶ Growing demand for jet fuel
  - ▶ Distillate marine bunker (36 Mt increase from 2005 to 2030)
    - ▶ Switch of ECAs from residual marine bunker to distillate fuel in 2015
  - ▶ Declining demand for heating oil and road diesel (54 Mt decrease from 2005 to 2030)

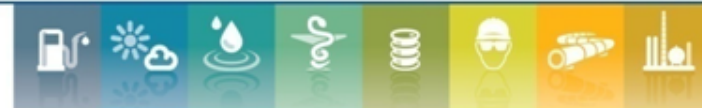


Note: Draft graphs and figures from CONCAWE work in progress

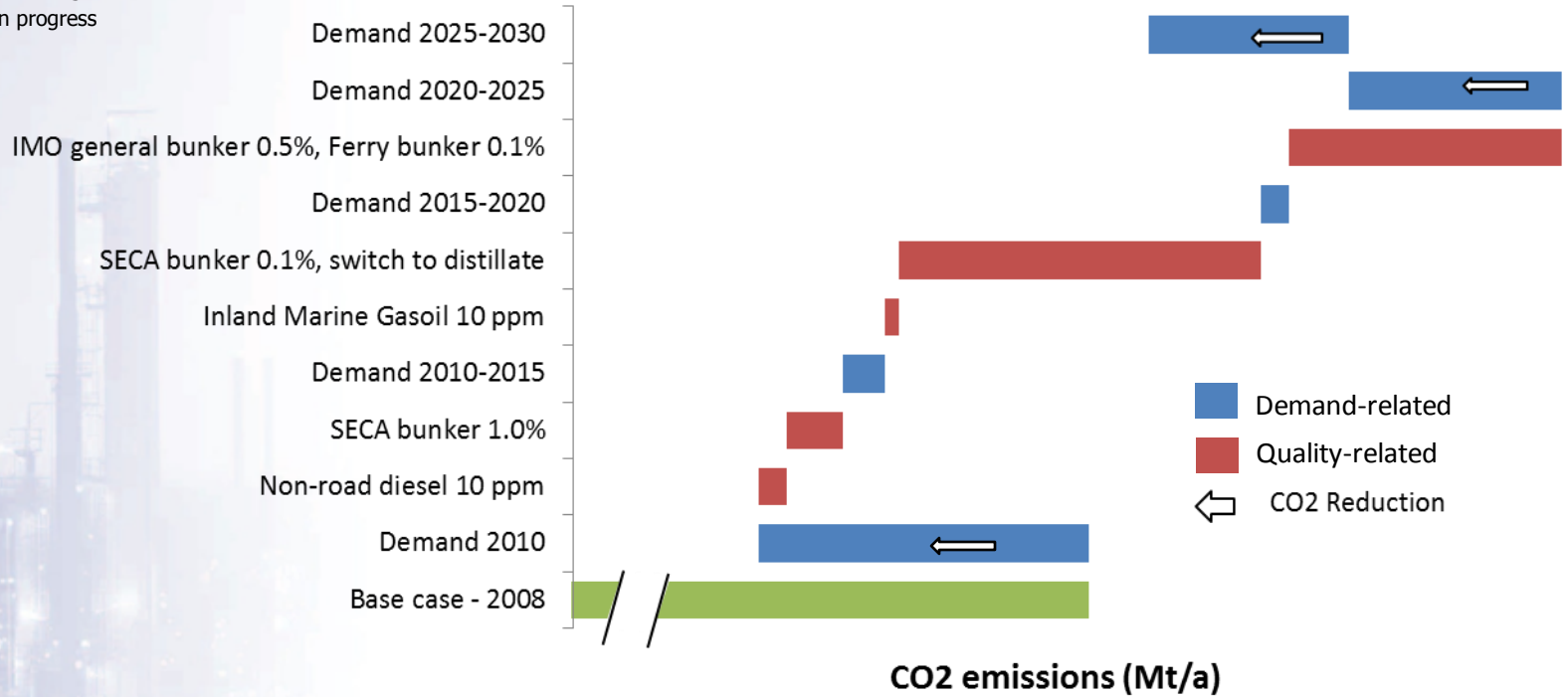


- ▶ Throughput of gasoline-producing FCC units drops dramatically, due to declining gasoline demand
- ▶ Significant capacity additions required of diesel-producing units (Hydrocracking), Residue hydrodesulphurisation (HDS), Residue conversion (Coking) and Hydrogen production units
  - ▶ Driven by IMO bunker sulphur reduction and growing demand share of distillates
  - ▶ Requires massive investment in new unit capacity

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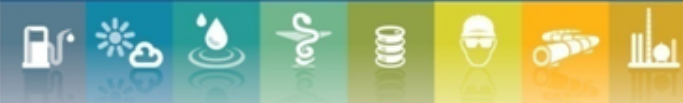


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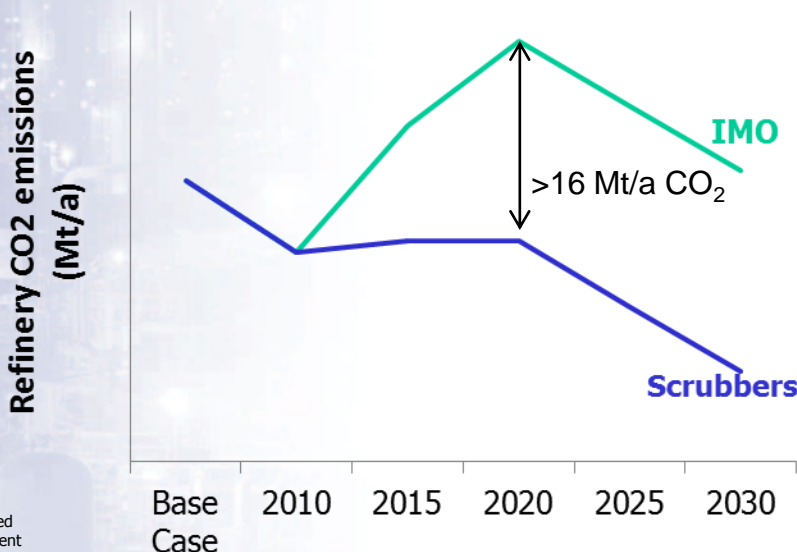
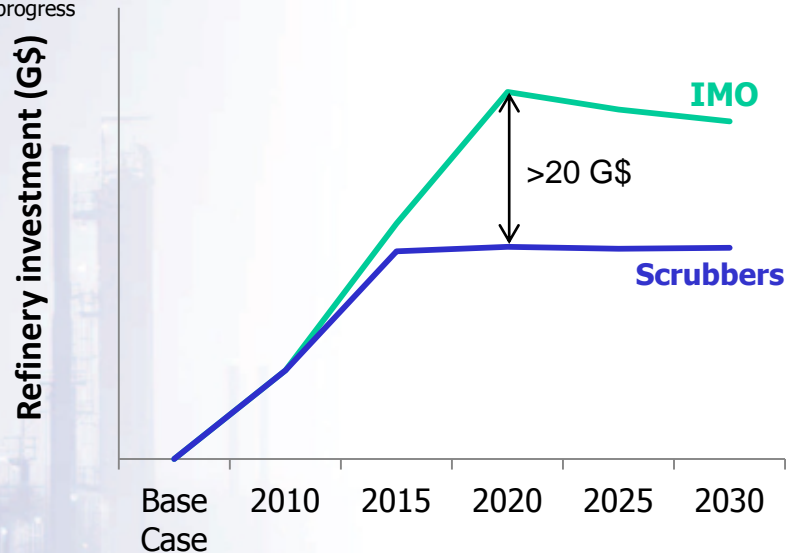


- ▶ Biggest increases in refinery CO<sub>2</sub> emissions are caused by:
  - ▶ 2015 switch to 0.1%S distillate bunkers in SECAs
  - ▶ 2020 switch to 0.1%S distillate bunker for EU ferries and 0.5%S IMO general bunker
- ▶ Declining demand post-2020 reduces CO<sub>2</sub> emissions from the 2020 peak

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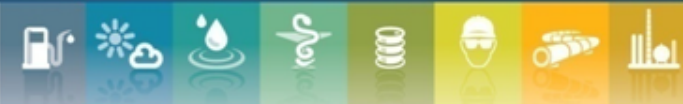
Note: Draft graphs and figures from CONCAWE work in progress



- ▶ Investments and refinery CO<sub>2</sub> emissions are estimated in two scenarios:
  - ▶ **IMO:** All bunker fuel ex-refinery must meet IMO specs. **No on-board scrubbers.**
  - ▶ **Scrubbers:** All ships are equipped with on-board scrubbers from 2015 onwards.
- ▶ The refinery investment savings for the 100% scrubbers case would be in excess of 20 G\$ in 2020
- ▶ The saving in refinery CO<sub>2</sub> emissions with 100% scrubbers would be in excess of 16 Mt/yr CO<sub>2</sub>

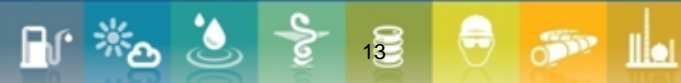
Note: CONCAWE's investment projections are based on its refinery model and publicly available information

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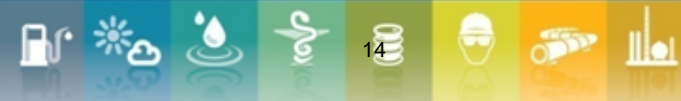


- ▶ **Mainly distillate fuel or distillate / residual fuel mix**
- ▶ **Major conversion capacity additions required:**
  - ▶ **Cokers, hydrocrackers, hydrodesulfurisation**
- ▶ **Unprecedented volume transition on a global scale**
- ▶ **Many unknowns:**
  - ▶ **Development of emission abatement technology, demand evolution for other fuels, ETS, ...**
  - ▶ **Supply & investment decisions by individual refiners & ship owners**

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- **2010 and 2012 changes to S content of marine fuels:**
  - some limited crude slate optimisation
  - blending / segregation
- **Longer term (2015 - 2025):**
  - unprecedented step changes & major investments needed
  - refiners unlikely to be able to supply market in the same way
- **Not currently possible to predict how the market will react**
- **Much depends on factors such as:**
  - the rate of ECA growth
  - the application of abatement technology, etc.
- **Switching marine fuels to distillate will increase the total supply chain CO<sub>2</sub> emissions**
- **GHG / warming impact of marine fuel S reduction is significant**



**Our technical reports are available at no cost to all interested parties**

**CONCAWE Website:**

**[www.concaawe.org](http://www.concaawe.org)**

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