MARPOL Compliant Marine Fuels Readiness from 2020

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Agenda

1. Background
2. Global Scenario
3. Production Process and Challenges for Domestic Refineries
4. Quality Aspects
5. MARPOL Bunker Readiness in India

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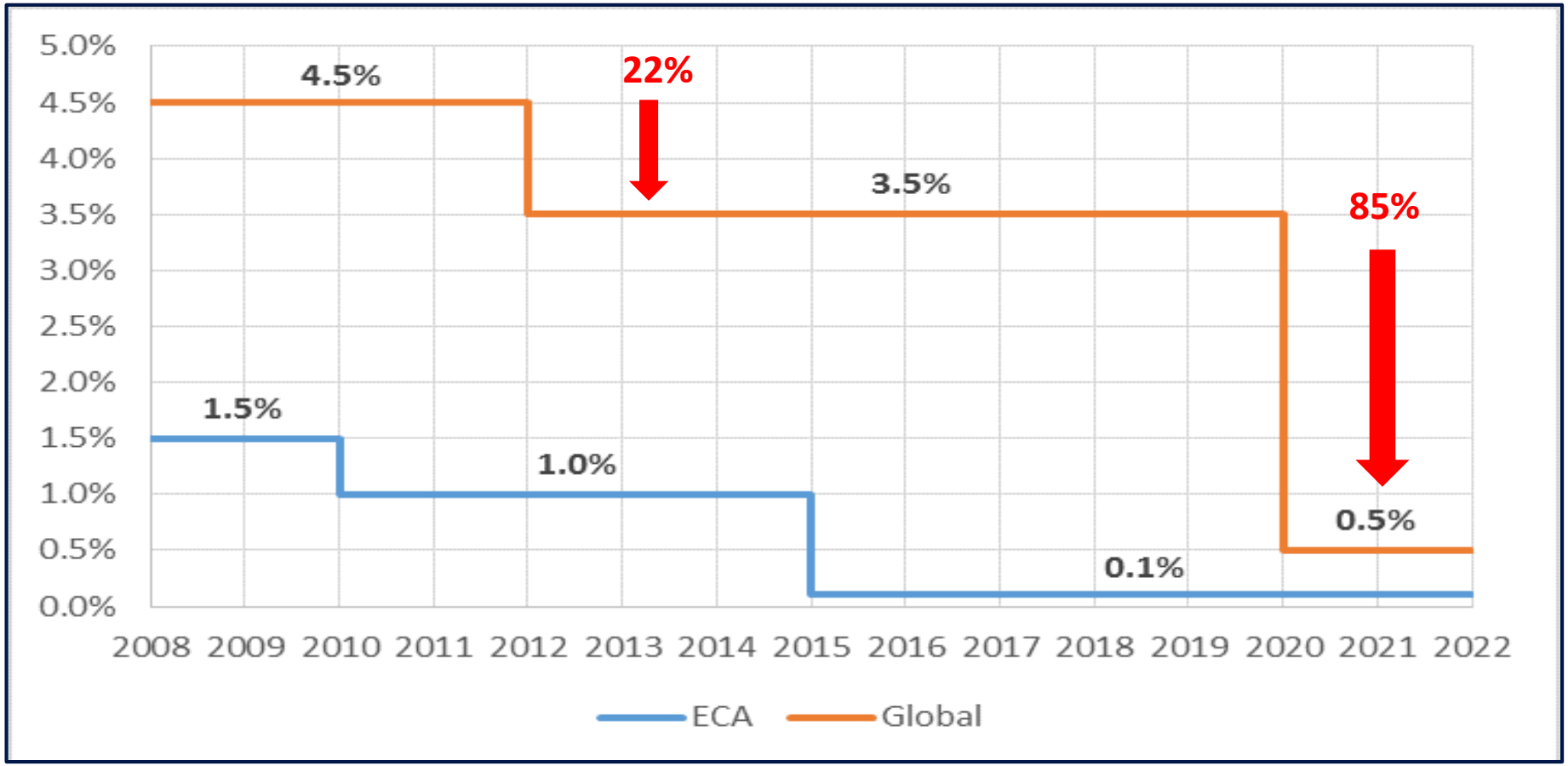
Background

- 2015 CE Delft study – Adoption of low sulfur bunker fuels feasible
- In Oct'16, IMO adopted max emissions at 0.5% sulfur equivalent effective Jan'20
- In Jul'17, MEPC reaffirmed the 2020 deadline.
- In Oct'18, MEPC formally adopted 'carriage ban' for high sulfur fuel oil effective Mar'20.
- In Sep'19, ISO published IMO 2020 Publicly Available Specification for Marine fuel.

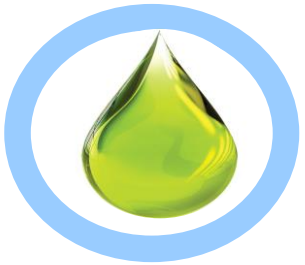
IMO Regulation poses significant impact on both Shipping and Refining industries

Global Sulfur cap

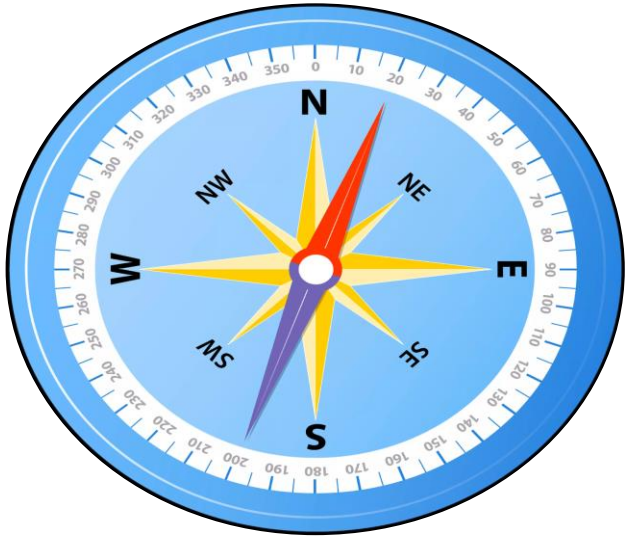


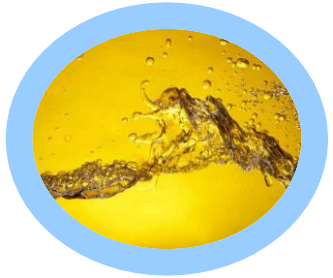
Time window is very short to meet this challenging target

Options for Compliance



Very Low Sulfur Fuel Oil





Marine GasOil

HSFO with Scrubbers

LNG, Methanol etc Alternative fuel

Economics, fuel availability and other Factors like vessel's ownership, service type, design, age and to determine compliance method

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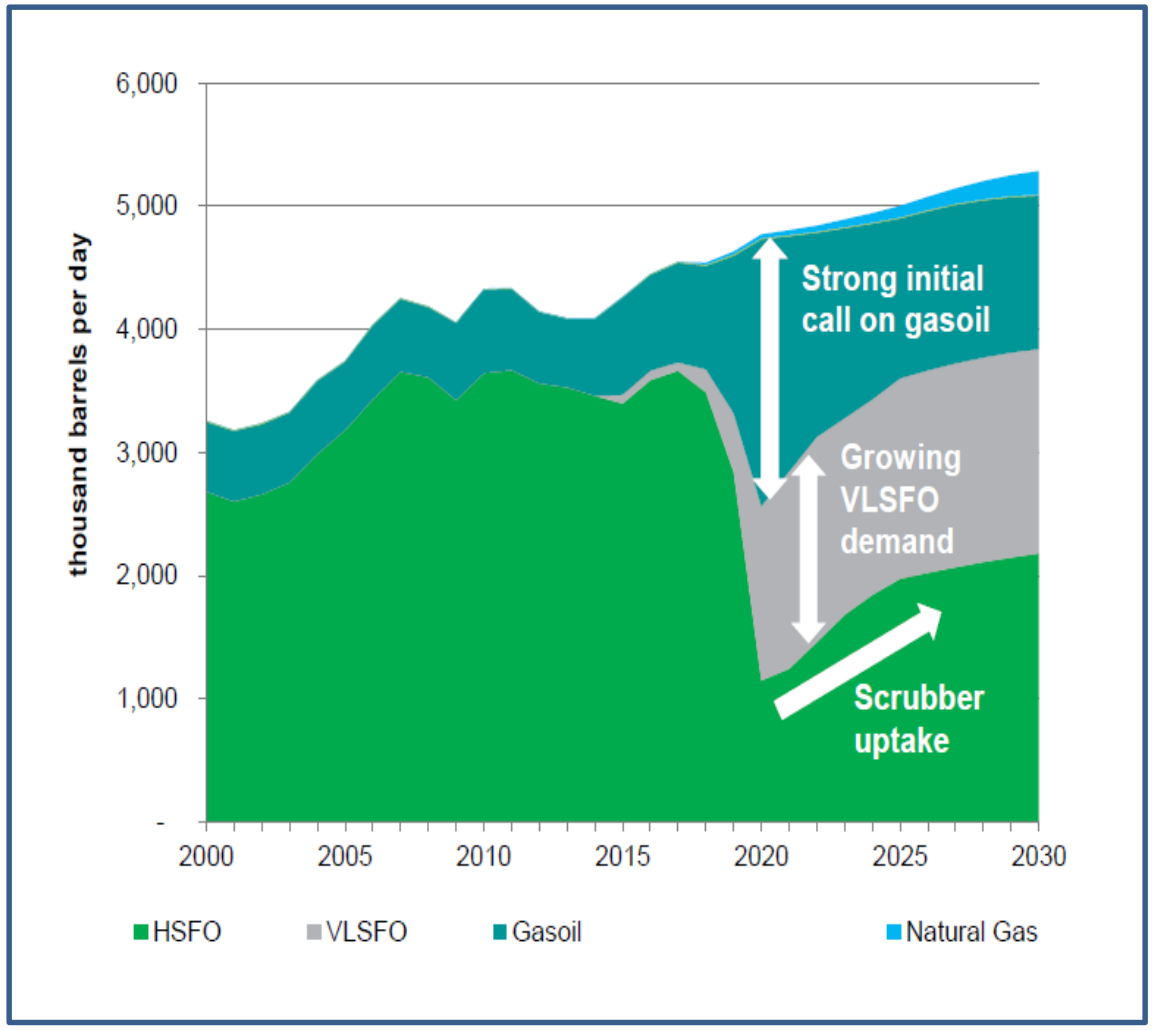
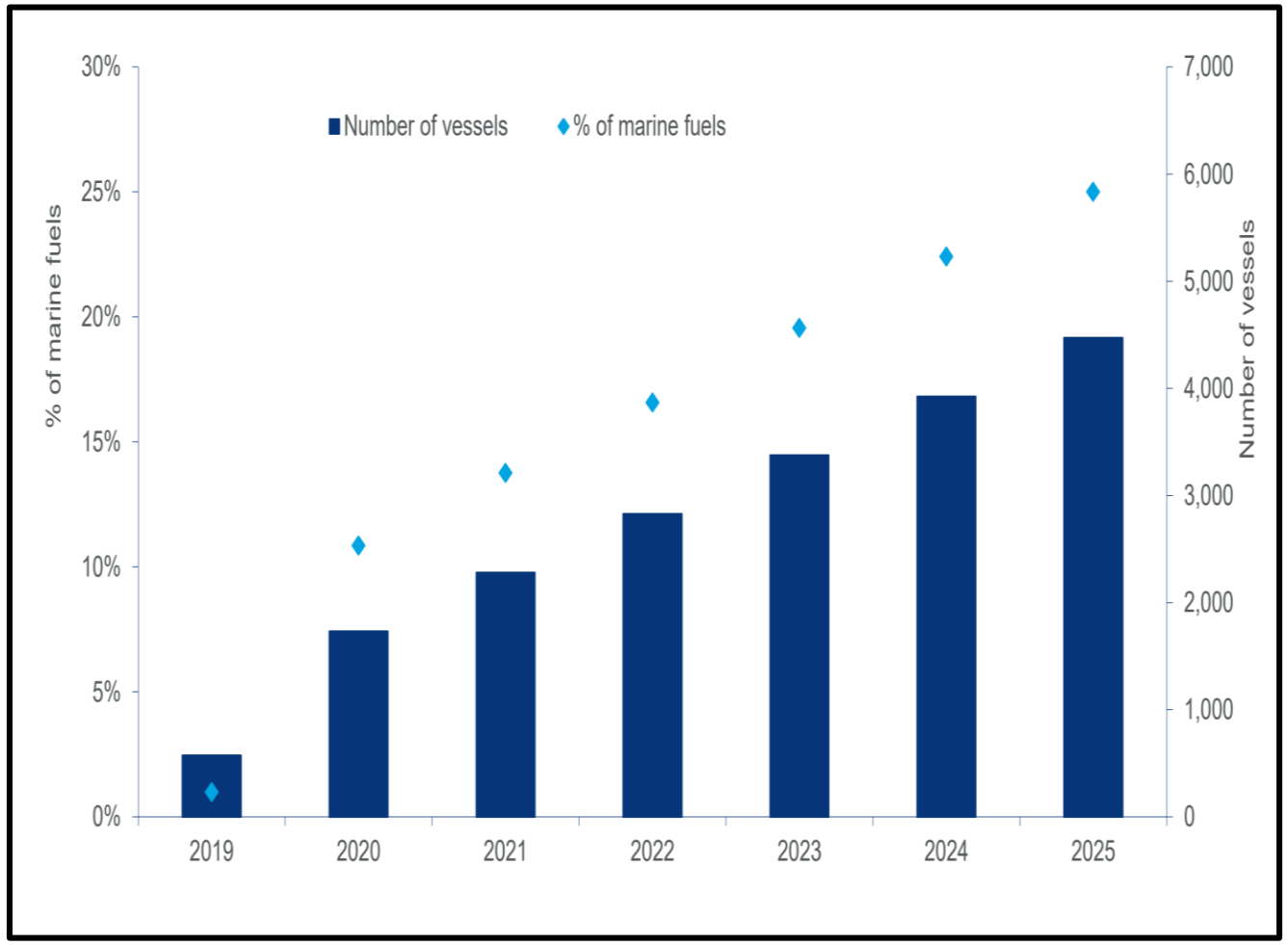
Global Demand shift



Source: IHS

- **Long held status of 3.5% fuel oil (HSFO) as dominant fuel diminished.**
- **Jump in demand for VLSFO.**
- **Strong call for GasOil initially with IMO implementation in Jan'20.**
- **Owing to Gasoil price spikes, heavy reliance on Very Low Sulfur Fuel Oil (VLSFO) to reduce costs.**
- **LNG fuel of the future but will take time.**

Growth in Scrubber



Source: Mckinsey

- **Payback economics depends upon HSFO – VLSFO price differential.**
- **Approx 2,000 ships are expected to be fitted with a scrubber before January 2020.**
- **Many large companies have embarked on multi-year programs.**
- **Scrubber installation constrained by available shipyards, dry docks, space in vessels etc.**
- **Ban of open loop scrubber in Fujairah and Singapore**

VLSFO production

- Globally many refiners have announced their plans to deliver VLSFO.
- Refiners have undertaken debottlenecking efforts, operational changes to produce VLSFO.
- Few refiners have invested in VLSFO producing topping refineries.
- Trials with VLSFO has already been started by shipping operators to prepare for the new sulfur cap.

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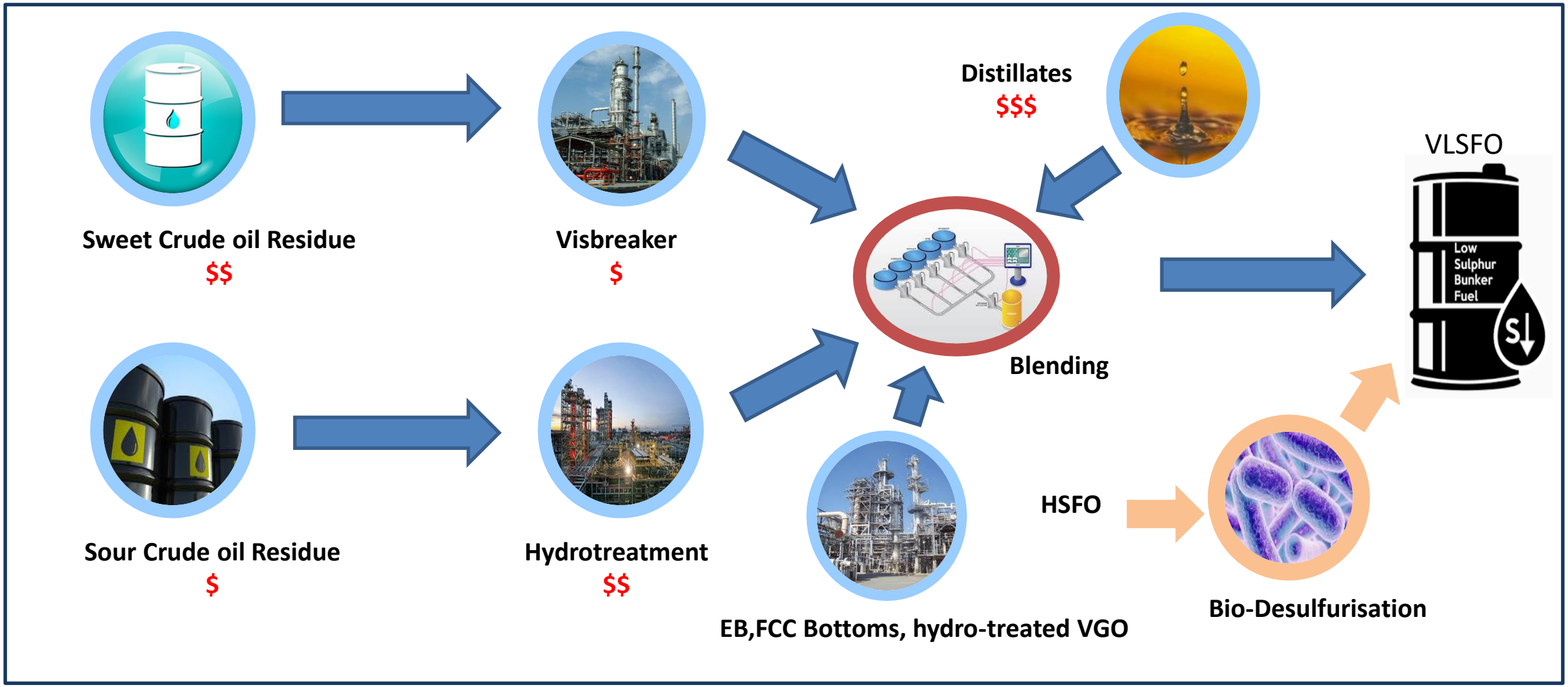
VLSFO Production Process



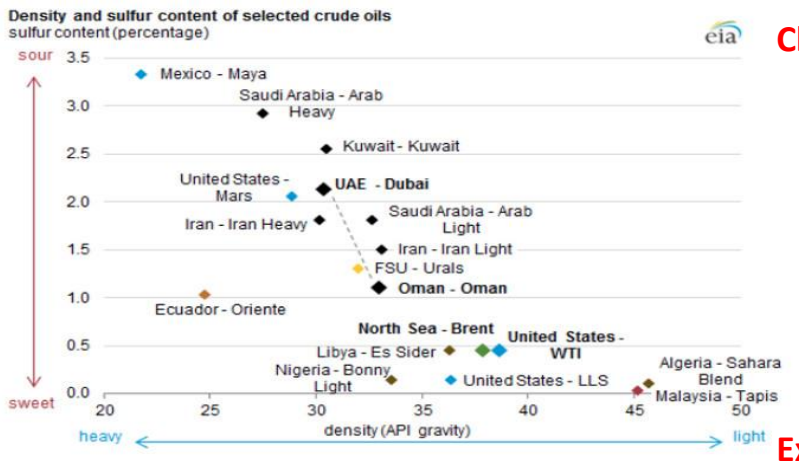
Production of VLSFO

Option with refiners to control sulfur content:

- ✓ **Crude oil Sourcing :**
  - Optimal selection of low sulfur crudes
  - No Capital Investment

- ✓ **New refinery units /Repurposing existing:**
  - Residue Desulphurization
  - High Capital investment

- ✓ **Blending of low sulfur distillates to dilute sulfur content of high sulfur residues.**



Cheap

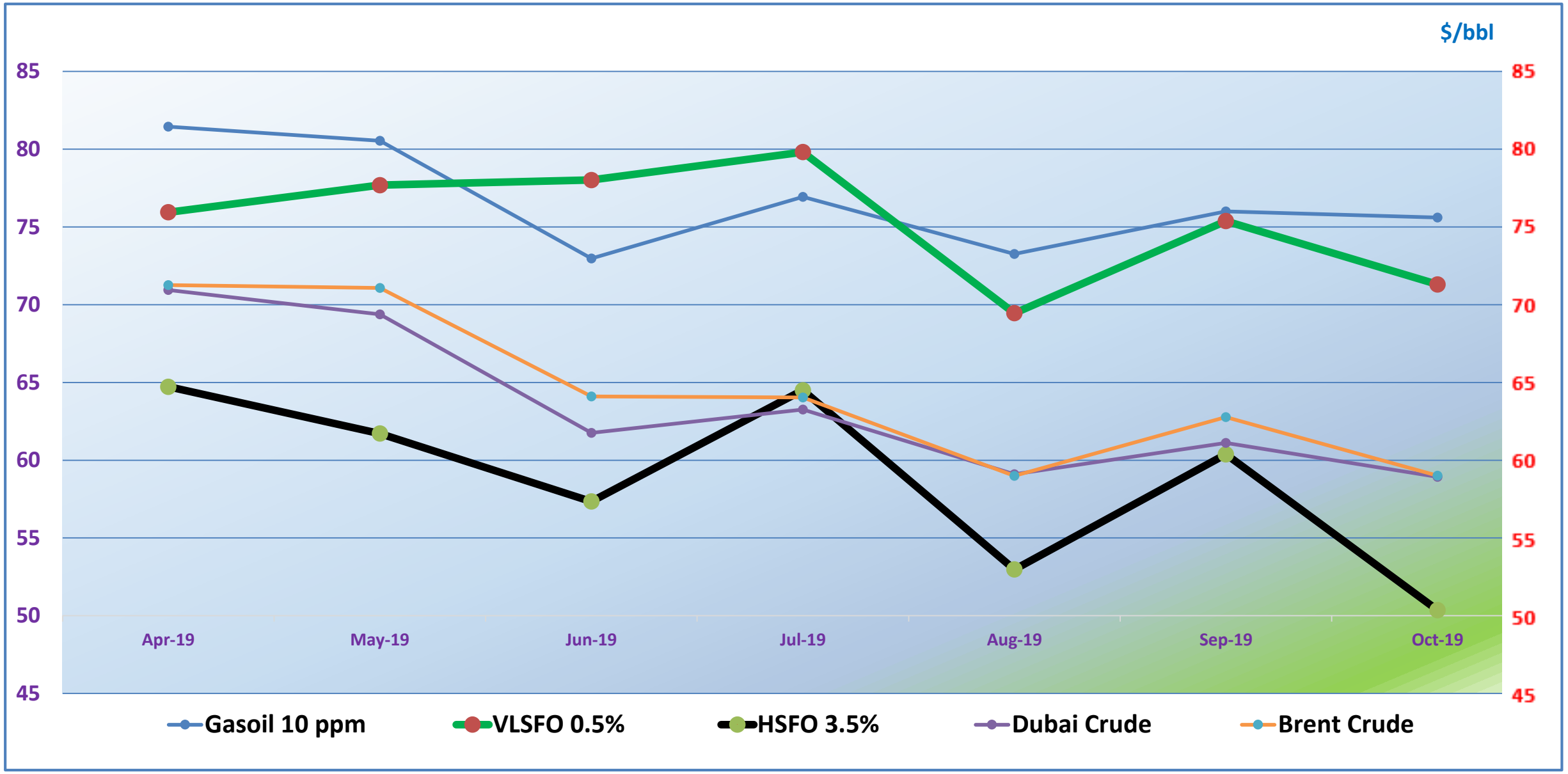
Expensive

Many alternative ways of producing VLSFO

Production Challenges

- ✓ Each refinery is different in terms of refinery configuration, crude diet, product slate etc.
- ✓ Every refinery has its unique constraints and solutions
- ✓ No “One solution” fits all refineries.
- ✓ Refineries have to adopt their best fit solution to produce MARPOL in an optimal way.

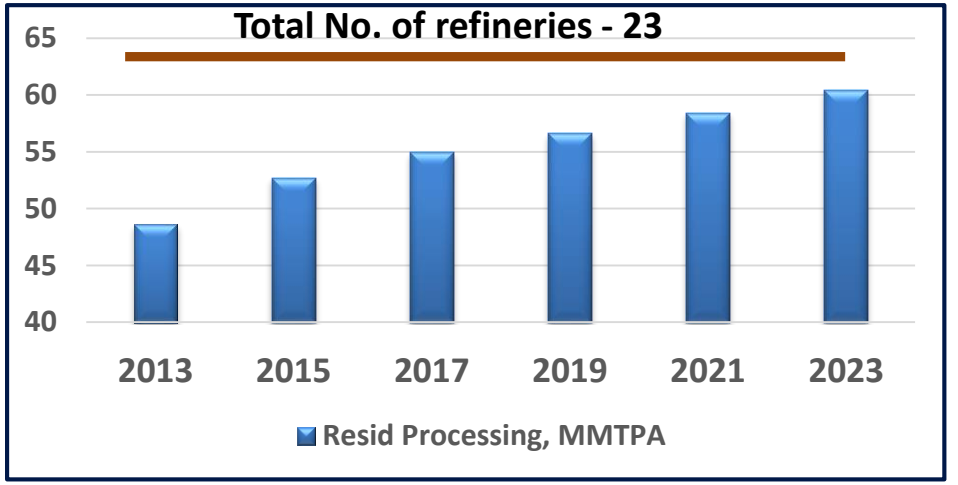
VLSFO 0.5%S vs HSFO 3.5%S - Price Trend



Challenges for Indian refiners

Resid processing – 23% on crude

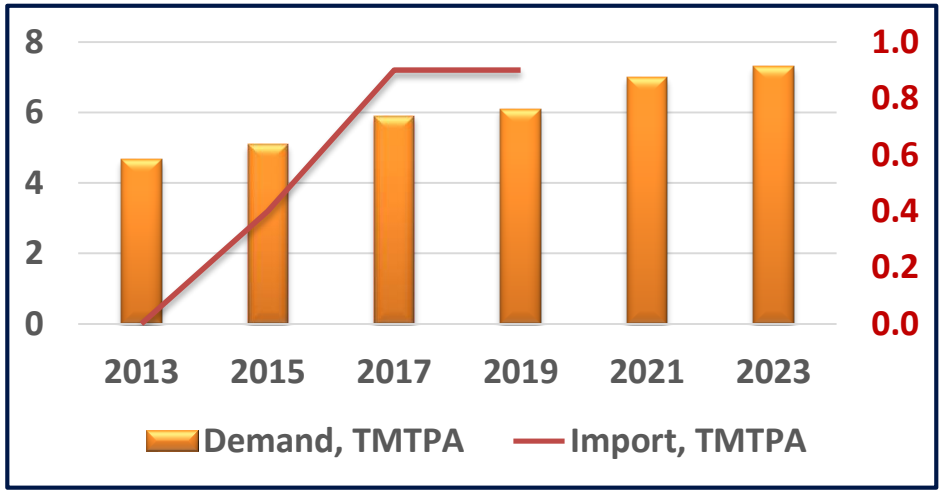
- Most Refineries have complex configuration
- Invested in Resid units for meeting diesel demand



Refineries with resid-upgradation

Road construction @ 27 km/day

- Growing demand for Bitumen
- 0.9 MMTPA Import



Source: www.ppac.gov.in

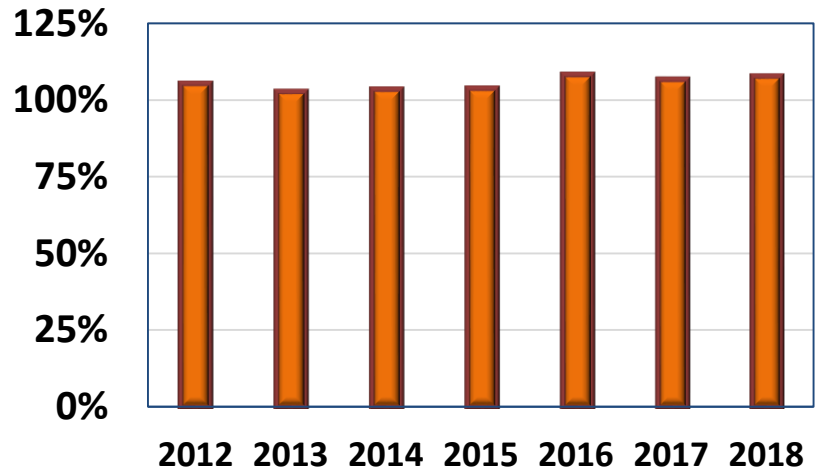
Indian refiners built complex refinery configuration - suitable for distillate production

Challenges for Indian Refiners

Asset Utilisation:

- ✓ Refinery Capacity utilization > 100%.
- ✓ Low sulfur crude mix – Idling Resid processing capacities.
- ✓ Hydro-treated blend stocks

Refinery Capacity Utilisation



Source: www.ppac.gov.in

Quality Challenges:

- ✓ Pour point
- ✓ Trace metals
- ✓ Compatibility

Economic Consideration:

- ✓ Light Sweet Vs heavy sour crude differential
- ✓ Diesel Vs VLSFO price differential

Economics to drive production of VLSFO vis-à-vis Distillate production

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MARPOL FO Specification (ISO:8217 2017)

Sl No.	Characteristics	Specification	
		RMG 180	RMG 380
1	Density at 15°C, g/ml, Max	0.991	0.991
2	Kinematic viscosity, cSt at 50 deg C Max	180	380
3	Flash point, °C Min	60	60
4	Pour point , °C Max	30	30
5	Carbon Residue Micro, Percent by mass, Max	18	18
6	Ash, percent by mass , Max	0.1	0.1
7	Water Content , Percent by volume , Max	0.5	0.5
8	Sulphur , total percent by mass, Max	0.5	0.5
9	CCAI, Max	870	870
10	Sodium , ppmw , Max	100	100
11	Vanadium , ppmw , Max	350	350
12	Aluminium + Silicon , ppmw , Max	60	60
13	Acid number ,mg KOH/gm, Max	2.5	2.5
14	Accelerated dry sludge content, percentage by mass, Max	0.1	0.1
15	Used Lubricating oils: Calcium, Zinc, Phosphorus ppmw max	Ca>30, Zn>15 or Ca>30, Ph>15	Ca>30, Zn>15 or Ca>30, Ph>15

Quality differences expected between VLSFO grades supplied around the world

Quality Aspects

Blending of low sulfur distillates to reduce sulfur content:

- Usage of high value blendstocks comes at a cost.
- Selection of proper blendstock is very important.
- Distillate based fuels if more paraffinic than present bunker fuel, wax build-up is likely to becomes important aspect.
- Compatibility issues need to be addressed during blend formulation.

Quality Aspects

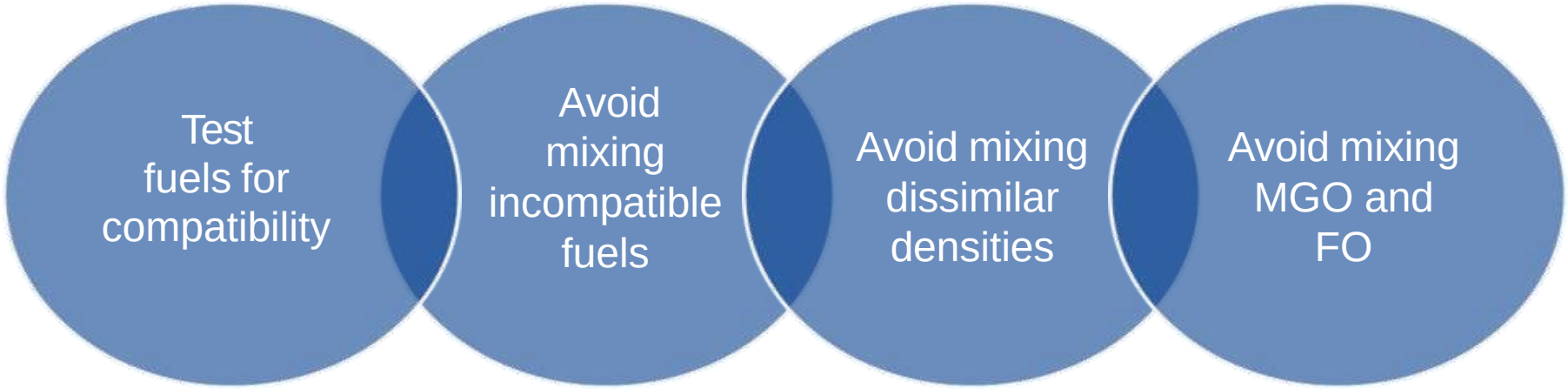
Pour Point:

- Heavy Residue of Low sulfur crudes have high pour point leading to high pour point in VLSFO.
- Increased distillate blending reduces kinematic viscosity leading to quality giveaway.
- Paraffinic fuels must be stored at a relatively high temperature to avoid wax deposition and filter clogging.
- Selection of pour point depressant is crucial for optimizing distillate blending.

Quality Aspects

Compatibility:

- The ability of fuel to stay homogenous when mixed with different fuels without occurrence of adverse effects such a asphaltene precipitation.
- Selection of right fuel mix is crucial to achieve a stable blend
- Compatibility challenges are likely to increase with usage of more paraffinic streams for blending.
- Compatibility testing of FO samples in QC - LAB to establish maximum blending proportions.



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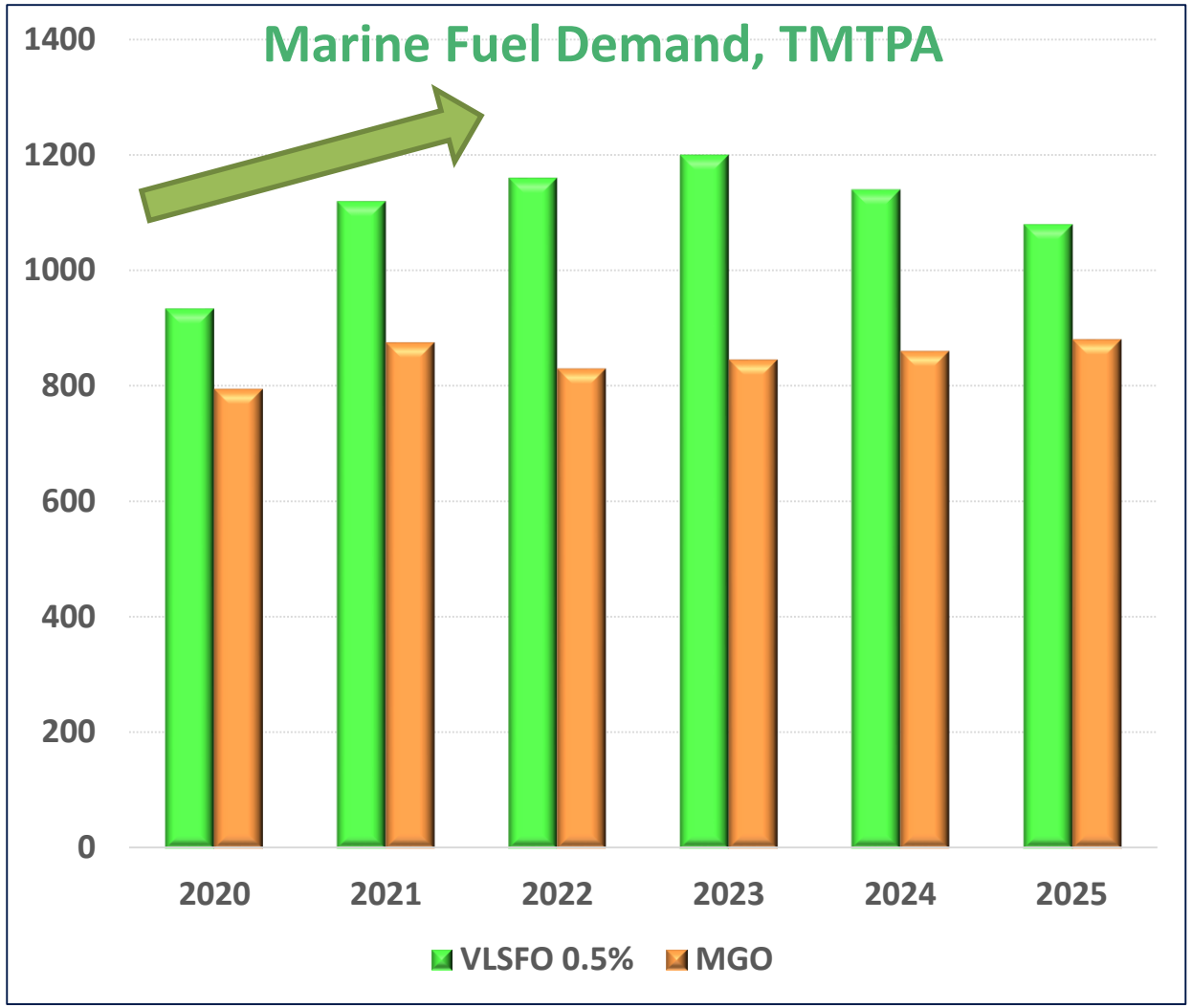
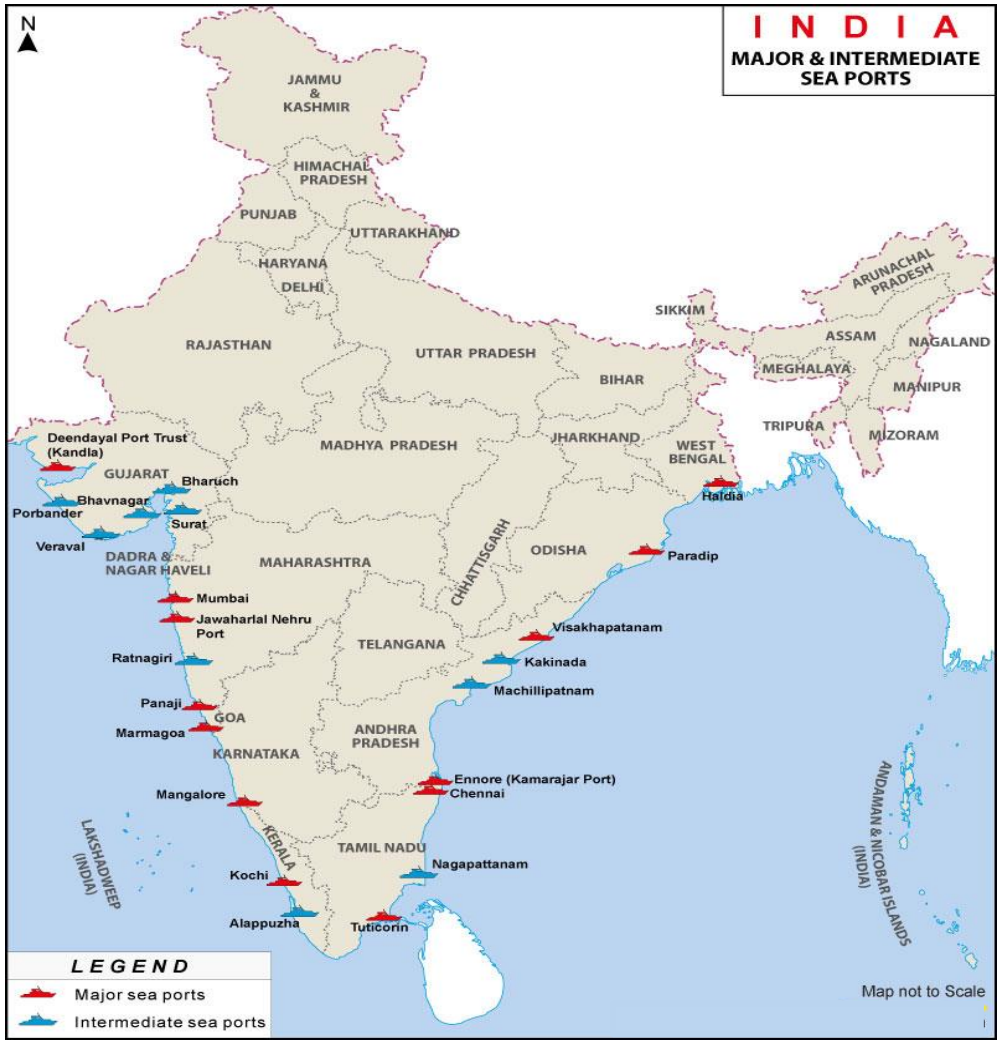
Indian – Marine Fuel Landscape



- ***Steady demand for VLSFO and MGO in India post 2020.***



- ***Bunker fuel demand scattered in many ports across coastline > 7500 kms.***

Indian Refiner's Response on Readiness

- **IndianOil – 1st company in India to announce supply of 1.0 MMTPA VLSFO.**
- **IndianOil has plans to supply 0.5 ~ 1.0 MMTPA Marine Gasoil from Jan'20.**

IndianOil's Approach:

- ✓ Spec – **ISO 8217 : 2017**
- ✓ Pilot study completed
- ✓ Product - No compatibility issues.
- ✓ Trial VLSFO production started in Sep'19.

Supply Chain:

VLSFO supply from following ports:

- ✓ Kandla, Mumbai, Mangalore and Kochi
- ✓ Tuticorin, Chennai, Vizag, Paradip and Haldia.

Supply Locations

- *VLSFO*
- *Marine Gasoil*

Towards a Cleaner World for Our Future Generation

Thank You