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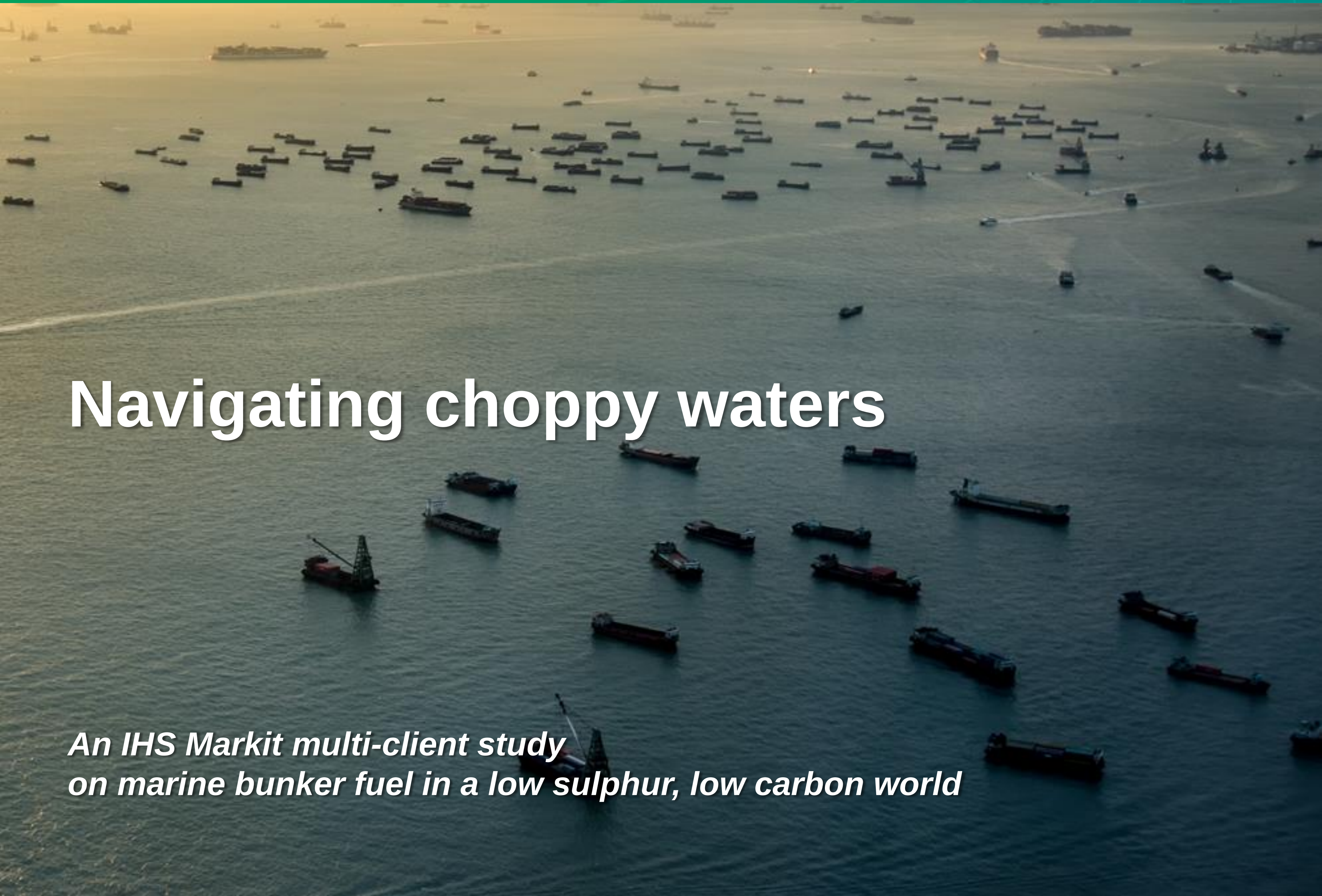


Navigating choppy waters

An IHS Markit multi-client study on marine bunker fuel in a low sulphur, low carbon world

IMO 2020 bunker specification change – the most disruptive impact on oil markets from a planned event?

The International Maritime Organisation (IMO) agreed in October 2016 to reduce sulphur in marine bunker fuel from 3.5% to 0.5% as of January 2020

The impact is likely to be hugely disruptive, because of:

1. **The global nature of the change**
2. **The need to produce suitable, 0.5%S-compliant fuel, and in sufficient quantities**
3. **Demand destruction for high-sulphur fuel oil (HSFO) and the need to find alternative outlets**
4. **The higher cost of compliance, regardless of the route to compliance**

The IMO bunker specification change timeline: how IHS Markit has been keeping ahead of events

2009 & 2014

- IHS Markit first asserted that a bunker fuel specification change would result in huge disruption to global oil markets in multi-client studies

2016

- International Maritime Organisation (IMO) decided to reduce global bunker fuel specification from 3.5% to 0.5% sulphur, effective from 1st January 2020
- IHS Markit predicted:
  - Insufficient time for the shipping industry and/or refining industry to prepare for the change
  - Significant disruption to oil markets was likely, with a tightness in gasoil markets and excess high sulfur fuel oil

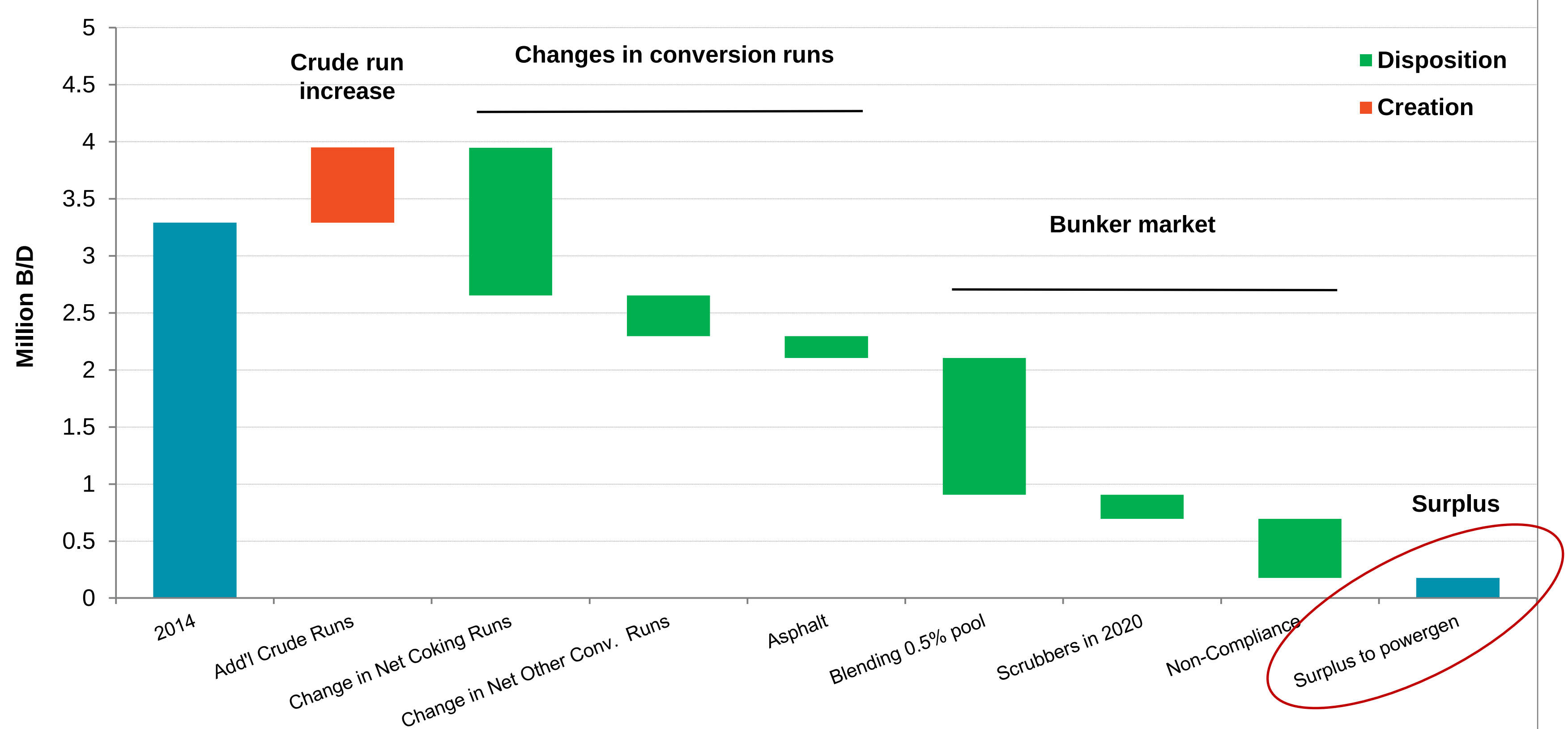
Today (18 months left)

- IHS Markit continues to project that oil market disruption is very likely due to insufficient scrubber installation on ships and lack of refinery projects
- View is broadly accepted with all futures markets anticipating disruption in 2020

From 2020, ship owners and charterers will have various options to comply with the new sulphur regulation

Insufficient investment by refiners and shipping industry means that a residue surplus is likely in 2020

Global Residue in Bunker Sector - 2014 versus 2020 (Prelim ASW 2018)

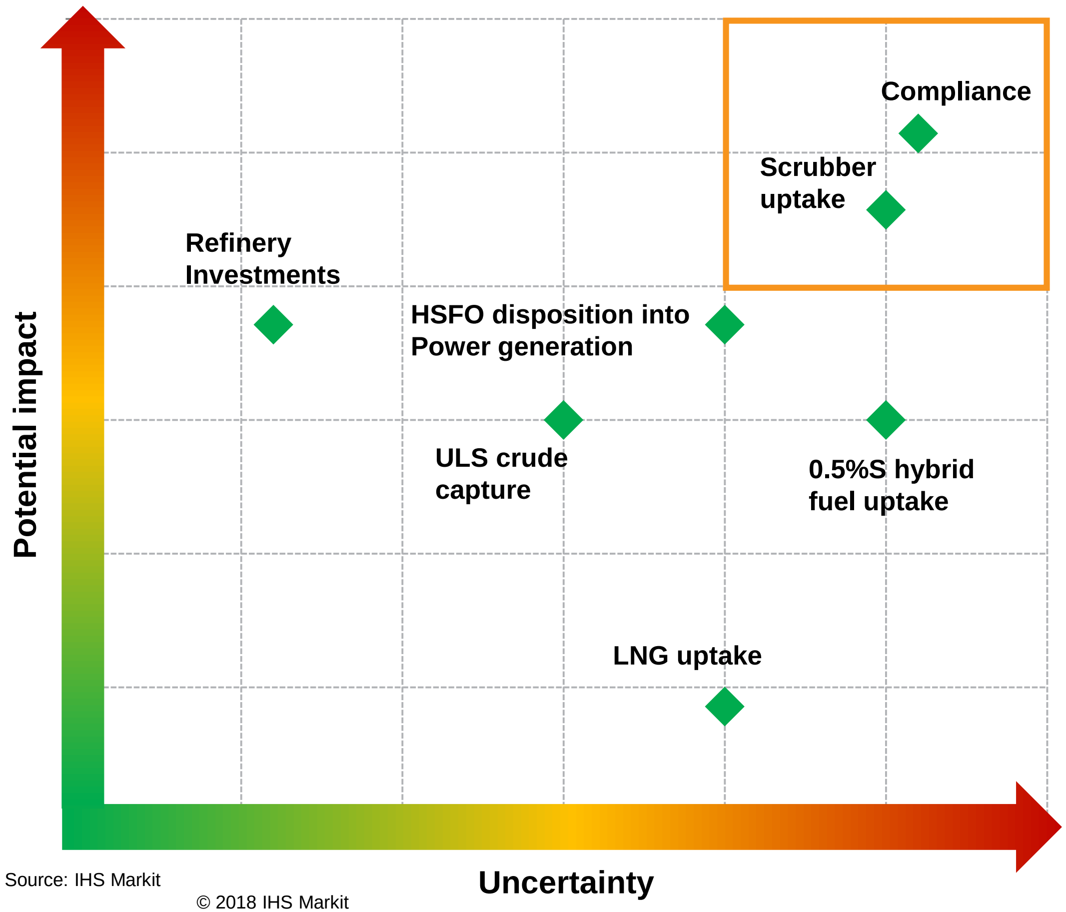


Notes: Net Other Conv. Runs include all residue conversion units excluding coking units

Source: IHS Markit

There is still high uncertainty regarding implementation and industry reactions of the bunker spec. change

Uncertainties surrounding the 2020 bunker spec change



Source: IHS Markit

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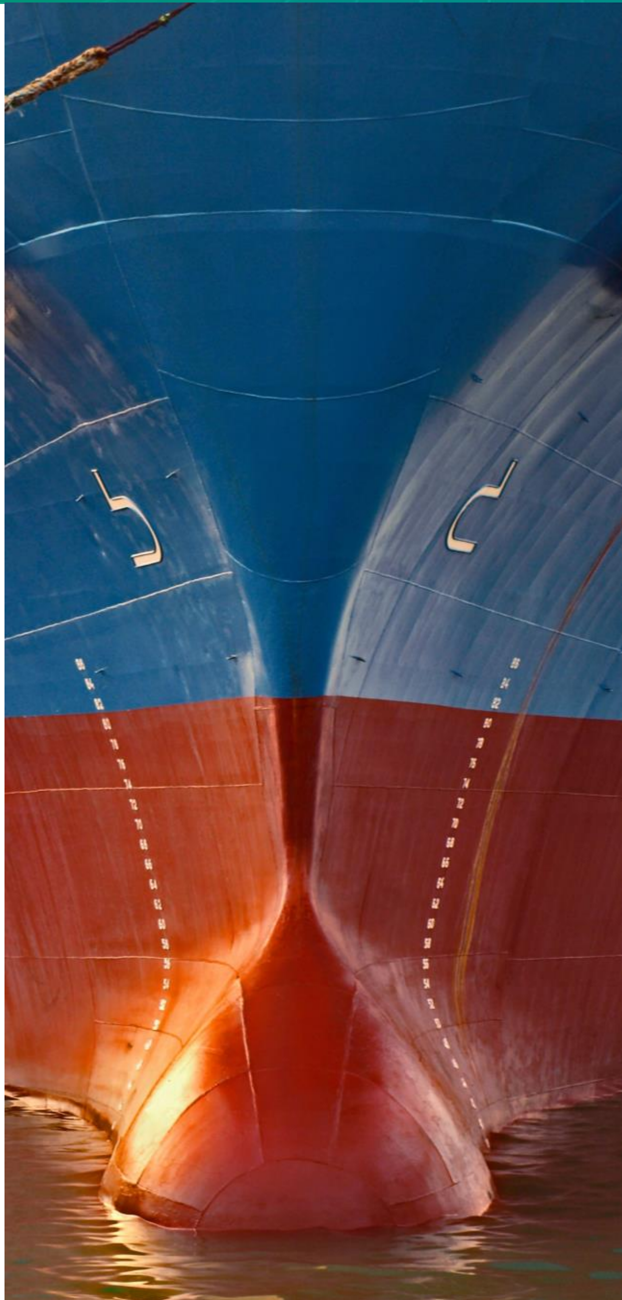
- We would assess compliance and the speed of scrubber retrofits as the two key uncertainties
- **Compliance** is harder to enforce in the open seas than in coastal areas:
  - > Some convenience flags are not expected to drive strong enforcement
  - > It is hard to imagine full compliance in some areas of the world
- **Scrubbers** are expected to be economic for the largest vessels:
  - > However, there is still technically- and operationally-inspired scepticism, and before January 2020 there is no incentive to pre-invest with retrofits

Why perform another IMO study?

A market need to **determine the magnitude and duration of the disruption,** using scenario-based impact analysis of key variables including **compliance level** and **scrubber uptake.**

The new study will:

- Provide a probabilistic impact analysis on the market
- Examine the impact on regional trade and supply of low-sulfur & high-sulfur bunker fuels in the key bunkering hubs
- Assess other key unknowns relating to the transition
  - Blending of new 0.5% fuel
  - Impact on VGO and lubricant markets
  - Impact on shipping costs
  - Influence of CO_2 ship emission reduction targets
- Leverage insights and analysis conducted by world leading industry experts from both IHS Markit Energy and Maritime & Trade teams, **making IHS Markit uniquely placed to do this IMO study**.



Critical questions addressed by the study

Probabilistic analysis of the market impact, providing not just base case impact but sensitivity and scenario analysis to provide probabilistic impact analysis

Will refineries make the necessary investments to supply 0.5%S fuel? And, when? What might be the margin impact on different types of refinery in different regions?

What could be the impact of the new fuel quality on bunker fuel prices and freight rates around the world?

What will happen to crude oil prices for heavy sour crude oils, and would this affect production economics and supply?

Might LNG start to play a larger (and quicker) role as bunker fuel of choice? Will economics and infrastructure support this?

Are scrubbers a sustainable solution?

What would be the effect on bunkering patterns from the new low-sulfur fuel?

Who will absorb the HSFO surplus?

How will gasoil, fuel oil and feedstocks trade flows change after the switch?

What level of non-compliance to expect? Might the recent shipping GHG emission reduction targets impact IMO transition?

Might IMO transition affect the lubricants market, both from a demand and from a production economics perspective?

What is a multi-client study?

- A Multi-client Study is an interactive research project that gathers a diverse member community to explore in depth a critical and time-sensitive industry issue.
- Multi-client Studies respond to a key market need that is too complex and/or urgent to be covered in sufficient detail by our ongoing services.
- Multi-client Studies allow IHS Markit to deploy a large multi-disciplinary team.
- Multi-client Studies leverage IHS Markit expertise and datasets to create new and innovative research.
- Multi-client Studies bring together a community who help shape the research effort with feedback.
- IHS Markit does not expect members to share proprietary information.

Study Scope

The study will primarily focus on a deep-dive into 2 key aspects of the IMO 2020 transition:

1. **Regional residual supply and disposition modelling**: regional balances of LS and HS fuel supply, demand and trade in the IMO transition period.

   - IHS Markit will use our global refinery capacity database and our regional refinery models to forecast compliant fuel supply. We will use our maritime database, bunker fuel demand data and ship tracking data to model demand and from this to create a trade forecast.
   - We will also focus on the Top 10 global ports by bunker fuel consumption, which covers 75% of global bunker fuel consumption. We will analyse their likely ability to supply both 0.5%S and high-sulfur fuel. This analysis will be based on supply-chain analysis and port infrastructure analysis, nearby refining capacity, and expected trade flows.
   - We would assess the key bottlenecks in the supply chain and nearby potential storage capacity for bunker fuels using our oil infrastructure database EDIN.
   - The deep-drive will include regional modelling of supply/demand balances for other impacted oil products in 2020, including fuel oil, gasoil and feedstocks trade flows.

Study Scope

2. **Ship and Refining Industry Scenario Analysis:** Analysis of shipping industry response to new rules, including compliance levels, scrubber take-up, and regional outcomes. Review of refinery project delays, anticipated unannounced capacity and refinery operational changes and potential regulatory transitional measures intended to smooth the transition.

   For each scenario, the study will provide:

   - a regional price outlook for key refined products and crude oils, and will compare this with our base case price and margin forecast
   - refinery margin impact analysis using at least four different refinery configurations in each of the key regions of USGC, NWE, Med and Asia, intended to provide a view on the stronger and weaker refining assets in each region during the IMO period

   Using the scenario analysis output on market prices IHS Markit will also provide probabilistic based analysis of the range of outcomes on:

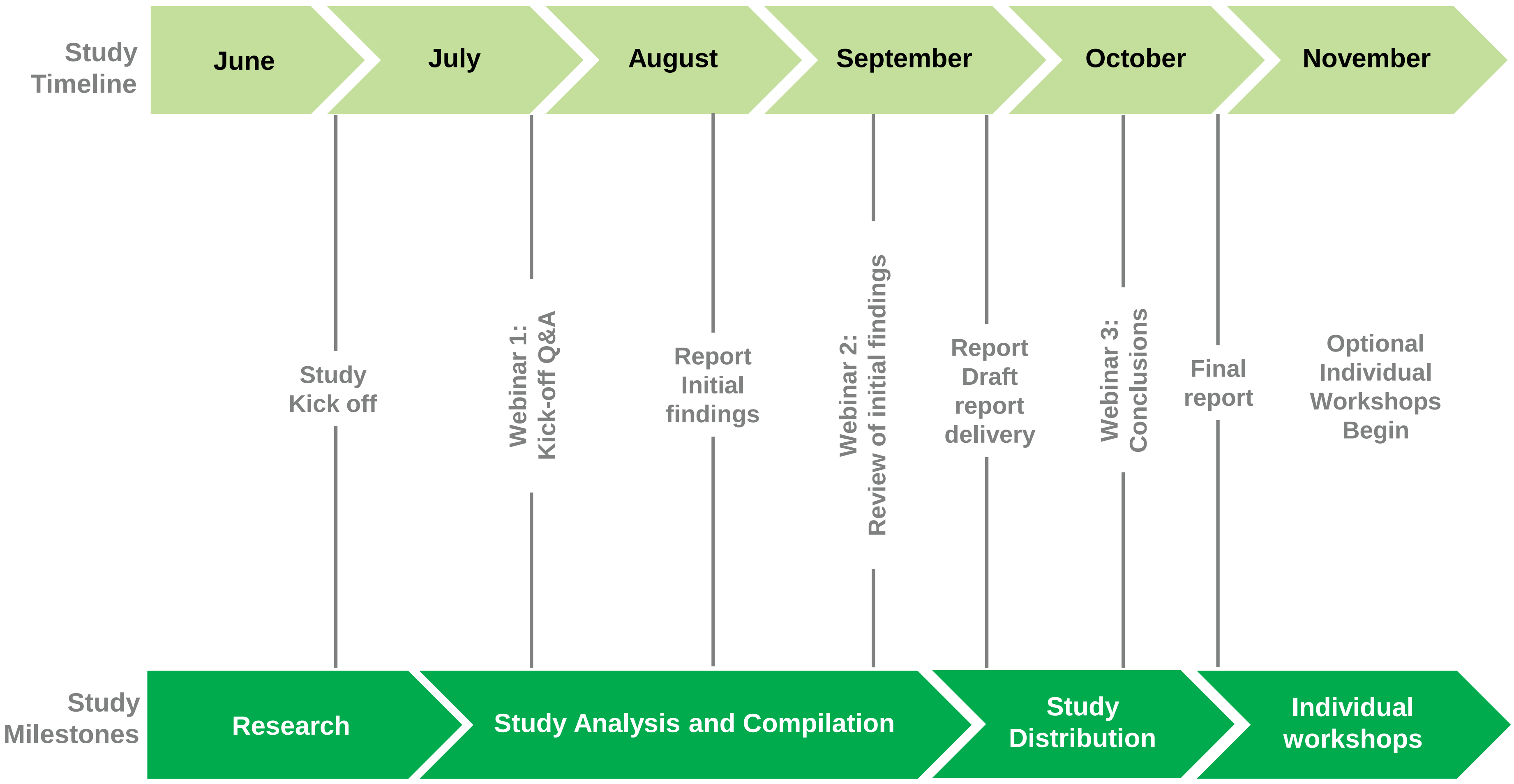
Inputs	Outputs
• Refinery margin & throughput	• Refinery profitability
• Bunker fuel price, required annual quantity and scrubber installation cost	• Annual bunker fuel purchase cost • Scrubber installation payback

Study Scope

Additionally, the study will provide insight on:

- Latest data on ship scrubber technology, availability, cost and timing of installation and scrubbing economics and installation payback using the scenario analysis.
- Open and closed scrubber technology, current global legislation and potential future legislation.
- Initial assessment of refinery blending options for 0.50%S bunker fuel, potential compatibility, handling and other fit-for-use issues emerging from new bunker formulations and the use of unusual components.
- Potential impact on global lubricant market as a result of VGO market tightening as some VGO is used to supply the bunker fuel market.
- Potential impact on shipping operating costs, global freight rates, shipping economics, scrubber appetite and accelerated scrappage using the scenario analysis output.
- High-level review of the recent CO_2 emission reduction targets, set by the IMO for 2030 and 2050, and how this might influence and impact the 2020 transition, and make some of the compliance pathways less attractive.

Study deliverables and timeline



Who can benefit from this study?

Refining Companies
Light/heavy price differentials
0.50%S bunker supply economics
Low and high sulfur fuel oil trade

Storage Providers &Trading Firms
Trade flows and supply availability
Success factors for bunker business

Shipping Companies
Increase in voyage costs
Fuel quality issues
Optimal compliance strategies

Governments & Port Authorities
Port competitiveness
Shifting trade – infrastructure needs
Availability of new fuels

Financial Institutions
Investment opportunities
Portfolio risk

Utility & LNG companies
Potential opportunity and impact on LNG as bunker fuel

Crude Producers
Pricing relationships

Equipment & Chemicals Suppliers
Demand for scrubbers, gas-fuelled engines, fuel additives

Covering the full set of required capabilities

Deep refining markets expertise

Purvin & Gertz,
CERA and PFC legacy

LNG market expertise

Waterborne LNG

Comprehensive baseline energy models

Energy Demand Model
IHSM Pricing Model
Refinery Cost & Margin Analytics Model
EDIN oil infrastructure data

IHS Markit

IMO Multi Client Study

Shipping marketing and technology experience

IHS Maritime and Trade
Fairplay expertise
Market Intelligence Network
IHS Sea-web

Proprietary research/models covering bunker market fundamentals

Annual Strategic Workbook
2009 & 2014 Bunker MCS

Project Team

Spencer Welch – Project Manager

Spencer worked for BP and Petroplus for 17 years before joining IHS Markit. Since then he has been involved in consulting and research, most recently leading the Global refining & marketing short-term price forecasting team and currently an Executive Director leading the Oil Midstream & Downstream consulting team for Europe/CIS/Africa.

Kurt Barrow – Project Advisor

Kurt is currently Vice President, leading the Global Oil Midstream and Downstream (OMD) research team. He began his career at the Exxon Baytown Refinery in various engineering and planning roles before spending six years working for Purvin & Gertz in Singapore. He has a long history with the IMO bunker fuel change having been heavily involved in both the 2009 and 2014 studies.

Sandeep Sayal – Project Advisor

Sandeep is based in Houston and also has a long history with the IMO transition. He is Vice President leading the OMD Annual Strategic Work team which provides the long-term supply, demand and trade analysis for crude oil and refined products. Prior to IHS Markit he had various positions with major downstream oil and gas companies.

Avital Johanan – Project Advisor

Avital is Executive Director of IHS Maritime and Trade, currently leading the Analysis and Forecasting team which provides long and short term forecasts of the shipping market, supply and demand analysis and deep industry expertise. Avital has been with IHS Markit for 13 years in various analyst, commercial and leadership roles.

Daniel Evans – Project Advisor

Daniel is currently Vice President with the OMD team, leading the Refining & Marketing team. He began his career with PFC Energy. Prior to joining IHS Markit he worked for Statoil in corporate strategy, framing the strategic investment context for senior management.

Victor Shum – Project Advisor

Mr. Shum is a Vice President leading the IHS Markit Oil Midstream and Downstream consulting practice in Asia Pacific. Based in Singapore since 1999, he has extensive experience working with senior management teams on strategy, acquisitions and operational solutions. He began his career with Amoco Oil in the U.S.

Premasish Das – Project Advisor

Premasish Das, Executive Director, IHS Markit, leading the Downstream research team for Asia. He has over 18 years of industry experience in both refining and petrochemicals. Prior to joining he worked for ExxonMobil at Singapore refinery and also National Organic Chemical Industries Limited in India.

Project Team

	**Stephen Jew** Stephen begin his career with UOP prior to joining IHS Markit. He was responsible for the global oil long-term price forecasting models, before becoming the Global refinery & marketing short-term forecasting lead.		**Hédi Grati** Hédi began his career with Exxon-Mobil before joining IHS Markit. Both with Exxon-Mobil and since joining IHS Markit Hédi has been heavily involved in bunker fuel market analysis. He is currently responsible for our Global long-term price forecasting models.
	**Dalibor Gogic** Dalibor joined IHS Markit in 2013, Dalibor is the lead analyst on the fleet capacity forecast. Before joining IHS Markit Dalibor was a shipping analyst at Worldscale Association in London.		**Krispen Atkinson** Krispen joined IHS Maritime in 2005 and is recognized as a shipping industry expert. He has led the Ports & Terminal team, New Construction and Ships in Service departments and contributed as a subject matter expert in Maritime research & analysis projects.
	**Ronan Graham** Ronan Graham is a Senior Analyst within the IHS Markit Oil Midstream and Downstream and is based in Paris. He is leads the IHS Markit quarterly IMO publication. Prior to joining IHS Markit, Ronan was a policy analyst at the European Gas Network in Brussels, Belgium.		**Ben Nevarez** Ben Nevarez is a consultant in the Midstream Oil and NGLs team at IHS Energy. He joined IHS Markit in 2014. Prior to joining IHS Markit, Ben worked in investment operations for Invesco, where he was primarily responsible for valuing and pricing the company's commodity-based swaps
	**Matthew Chew** Matthew Chew focuses on the crude oil and refined product market for Asia and the Middle East and has 10 years of experience in the oil and energy industry. Before joining IHS Markit, he worked for Platts, Singapore Petroleum and ExxonMobil.		**Anurag Trivedi** Anurag is a Director with the OMD Middle East Consulting team. He brings in more than 21 years of Oil Industry experience, primarily focused on the Middle East. Prior to joining IHS in 2017, he has held multiple industry and consulting roles with many downstream players across the regions.

About IHS Markit

We bring together the deepest intelligence across the widest set of capital-intensive industries and markets. By connecting data across variables, our analysts and industry specialists present our customers with a richer, highly integrated view of their world.

That is the benefit of The New Intelligence. We’re able to isolate cause and effect, risk and opportunity in new ways that empower our customers to make well-informed decisions with greater confidence.

IHS Markit is a dynamic team that includes more than 5,000 analysts, data scientists, financial experts and industry specialists. Our global information expertise spans numerous industries, including leading positions in finance, energy and transportation.

An interconnected view for interconnected industries

Resources

Financial Markets

Transportation

Consolidated Markets & Solutions

IHS Markit

ENERGY

Today's global energy landscape is interconnected and dynamic.

Our Energy solutions comprise some of the most extensive information, analytics, insight and advisory services in the world.

IHS Markit delivers oil and gas databases and software, integrated energy supply and demand forecasts, and comprehensive data on transactions at the global and regional market levels.

Our renowned energy experts empower leaders worldwide to make their best decisions.

MARITIME & TRADE

Today's complex maritime and trade markets require expert insights.

IHS Markit maritime and trade solutions utilize the world's largest maritime database, built on more than 250 years of industry experience. Governments, traders, cargo owners and the global shipping industry all rely on our solutions.

We manage ever-changing technology and regulations along with market risk and geopolitical threats. This proprietary knowledge and experience enables world leaders to understand complex global supply chains. We help our customers identify new competitive advantages and safeguard our oceans and borders from potential security risks.

More information

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