

‘Reinventing the Aircraft and the Ship’ Prospectus

A Mobility and Energy Multi-Client Study



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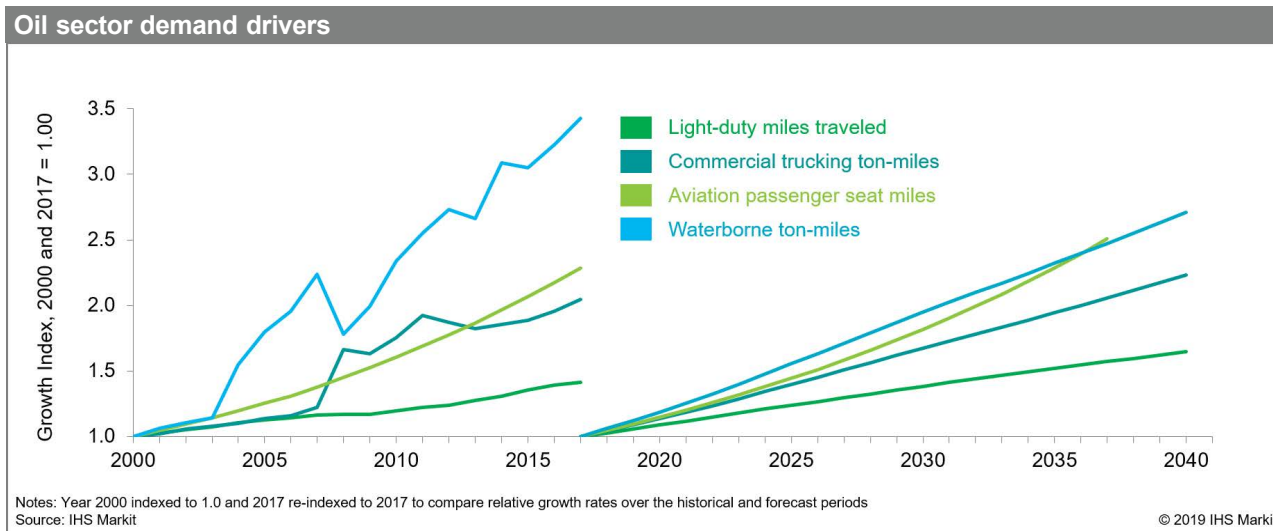
Introduction

The challenge of simultaneously meeting **growing global energy demand** and **reducing greenhouse gas emissions** has created the **platform for a radical energy transition**. The transportation sector, where oil demand has become increasingly concentrated, is at the heart of this transition. In recent years, IHS Markit has analyzed the future of road transportation, mapping radically different futures for light-duty vehicles ('Reinventing the Wheel', 2017) and medium and heavy-duty commercial vehicles ('Reinventing the Truck', 2018). IHS Markit is now turning its attention to the future of **two additional high-growth sectors** that are currently **heavily dependent on oil** and are increasingly **attracting the gaze of policymakers** – aviation and shipping.

Passenger traffic and air cargo growth rates are projected to continue to trend upwards for the foreseeable future while shipping freight traffic is expected to more than double by 2040¹. Yet both the shipping and aviation industries have had tough, long-term greenhouse gas reduction targets imposed upon them by the international bodies that govern their operations, the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO)². Faced with this sustainable growth challenge, an array of actors across the aviation and shipping industries have initiated significant research and development efforts aimed at increasing operational efficiency and reducing carbon emissions.

Environmental policy and technological change have the potential to **transform the aviation and shipping industries**, the markets they serve and the fuel they consume. In 'Reinventing the Aircraft and the Ship' IHS Markit will **examine the options available to both industries and the role that the energy industry will play in supplying the fuel for the planes and ships of the future**.

This document summarizes the objectives of the study and proposes a scope of work.



¹ In 2016, the International Civil Aviation Organization (ICAO) forecasted long-term compound average growth rates of 4.6% for passenger traffic and 4.2% for cargo. In its Rivalry case, IHS Markit expects shipping ton-km in key markets to more than double in the period between 2018 and 2040.

² The ICAO's Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA, aims for carbon neutral growth in aviation from 2020. The IMO is targeting a 50% reduction in CO2 emissions on 2008 levels from the shipping industry by 2050.

Key Questions and Outcomes

The overall objective of the study is to **examine the regulatory, technological and societal factors impacting the long-term outlook for the aviation and shipping industries** and develop long-term forecasts for the energy demand and mix for these segments within various scenarios. Key questions include:



To what extent will **societal change, technology and increased operational efficiency** offset growth in demand for aviation and shipping?



Will **regulation** become technology-forcing?



Which **propulsion technologies** will emerge as winners?



Which **fuels** will be the most cost and carbon competitive?



Who will **invest in infrastructure** to supply fuels?

Key outcomes will be:



The demand for aviation and shipping



The fleets of the future



The energy demand mix

Study Scope

IHS Markit proposes the following scope of works, which addresses issues common to both the aviation and shipping industries and issues which are industry-specific. The main workstreams and tasks are outlined below:

Workstream 1: The demand for aviation and shipping

- Task 1A: Define macroeconomic, demographic and energy price scenarios
- Task 1B: Forecast freight traffic
- Task 1C: Forecast passenger traffic

Workstream 2: Regulation

- Task 2A: Identify relevant regulation for i) aviation, ii) shipping and iii) energy that could disrupt the status quo and shape the future
- Task 2B: Develop coherent regulatory scenarios

Workstream 3: Efficiency gains

- Task 3A: Identify the scope for reducing fuel consumption by improving operational efficiency
- Task 3B: Identify the scope for improvements in fuel efficiency (excluding propulsion efficiency gains)

Workstream 4: Propulsion technology

- Task 4A: Identify and explain the different propulsion options
- Task 4B: Identify timelines for development
- Task 4C: Cost different options
- Task 4D: Describe the obstacles to development and adoption

Workstream 5: Fuel developments and cost

- Task 5A: Identify the different fuel options
- Task 5B: Provide a breakdown of the cost along the supply chain
- Task 5C: Identify the carbon emissions along the supply chain

Workstream 6: Fleets of the future

- Task 6A: Forecast plane sales and fleet
- Task 6B: Forecast ship sales and fleet

Workstream 7: Energy demand and implications

- Task 7A: Forecast energy demand
- Task 7B: Describe the impact on supply/demand and trade of refined product
- Task 7C: Discuss the infrastructure requirements and cost

IHS Markit proposes setting the following parameters:

- **Scenarios:** IHS Markit will develop two scenarios for aviation and shipping based on its Rivalry and Autonomy global energy scenarios.
- **Time period:** Forward-looking to 2050.
- **Geography:** Global with a deeper focus on key aviation and bunkering hubs.
- **Segments:** The aviation component will cover civil aviation only (freight and passenger) and will exclude helicopters. The shipping component will cover international commercial shipping and international bunker fuel.

Proposed Approach

The overall approach to the study envisages **common workstreams containing sector-specific research and analysis** on the aviation and shipping sectors with an **overarching emphasis on how the energy industry will be impacted** by potential transformations in both sectors. IHS Markit will utilize its unrivalled ability to bring together experts from across an array of business lines, working to map out future scenarios with **distinct, quantified, and transparent long-term outlooks**.

A collaborative effort involving experts from across IHS Markit

- The study requires an integrated understanding of how the aviation and maritime ecosystems (building, fueling, and using aircraft and ships) could evolve over time and what impact the choices these sectors make will have on the energy industry.
- To fully understand the complexities of these interconnected uncertainties, IHS Markit has brought together experts from across the firm's business lines, including Aerospace & Defense, Maritime & Trade, and Energy.

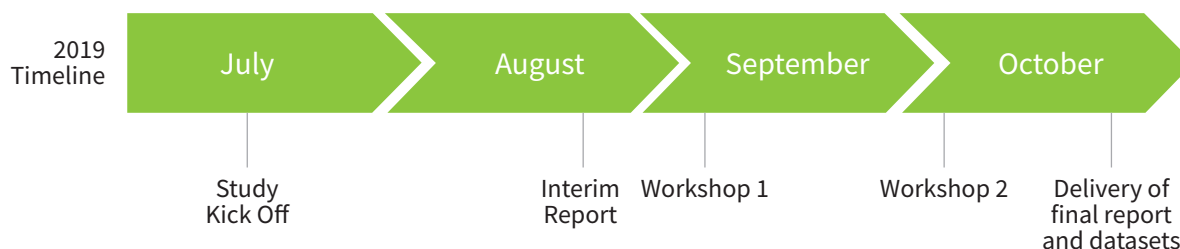
Leveraging IHS Markit's Global Scenarios

- IHS Markit will develop two scenarios for the future of aviation and shipping; these scenarios will be built upon two of our Global Energy Scenarios (Rivalry and Autonomy).
- The scenarios will inform our macroeconomic, demographic, energy price and global trade outlooks.
- The two scenarios will also encompass differing views on the extent of societal, cultural and technological shifts that may take place over the next thirty years while differing regulatory futures will also be developed.
- IHS Markit will then utilize the assumptions under the Rivalry and Autonomy scenarios to develop ton-km and Revenue Passenger Kilometers (RPK) forecasts for the aviation and shipping sectors, provide an overview of how the fleets of the future may develop, and forecast future energy demand and the future energy mix.

Study Deliverables and Timeline

Deliverables for this project will include:

- **Report:** An interim report and a final report in PowerPoint format
- **Datasets:** Forward-looking Excel datasets for each scenario documenting the following at global, regional and key country level:
 - GDP
 - Population
 - Energy prices
 - Ton-km
 - Revenue passenger km
 - Sales and fleet
 - Energy demand
 - Refined product demand and trade
- **Workshops:** In-person workshops
- **Webinars:** Kick-off and check-in webinars



Our Expertise

Energy industries and markets are complex and constantly changing. IHS Markit can help you navigate market uncertainties and make critical business decisions.

We have an unrivaled ability to bring together the complete 360-degree view of the economy, energy industry and related global businesses markets from several thousand experts around the world. Our 300 economists and integrated research and analysis in the upstream, oil markets, midstream, NGL, downstream, power, autos, maritime, chemicals, financial and other markets provide the foundation for our comprehensive views.

In the Oil, Mid-Downstream (OMD) space, we provide in-depth analysis across the oil value chain for crude oil, NGL, refining through marketing for both the short and long-term forecasts for all major global markets and all major products and sectors. Companies use this information to formulate their corporate long and short-term strategies, understand the signposts to watch related to commodity price forecasts and trade balances to manage their risks as it pertains to the crude, NGL and refining markets.

Connecting and creating the IHS Markit view within the OMD space is a team of over 80 professionals around the globe who provide thoughtful research papers, PowerPoints and data tables at the country-level up to the global-level. Delivered through our on-line portal Connect, deliverables for each subscription provide:

- Details and executive-level summaries on market statistics, policy, regulatory, infrastructure, company strategies, project investments and pricing. We have the most granular supply/demand/trade analysis and the most robust and comprehensive pricing and margin forecasting.
- Tactical (e.g. week-to-week & month-to-month) and other longer-term analysis for strategic planning
- Direct access to our global experts

[ihsmarkit.com](https://www.ihsmarkit.com)

About IHS Markit

IHS Markit (Nasdaq: INFO) is a world leader in critical information, analytics and solutions for the major industries and markets that drive economies worldwide. The company delivers next-generation information, analytics and solutions to customers in business, finance and government, improving their operational efficiency and providing deep insights that lead to well-informed, confident decisions. IHS Markit has more than 50,000 key business and government customers, including 85 percent of the Fortune Global 500 and the world's leading financial institutions. Headquartered in London, IHS Markit is committed to sustainable, profitable growth.

CONTACT INFORMATION

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