KAPSARC
مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

Global Challenges and Sustainable Prospects of the Maritime Industry

March 2024

Doi: 10.30573/KS--2024-WB04

About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and applied research.

This publication is also available in Arabic.

Legal Notice

Key Points

As shipping has the advantage of being the most cost-effective mode of transportation, it will continue to grow with increasing international trade flows. Therefore, this advantage must be leveraged to achieve the long-term goals of the maritime industry. In the opening remarks, the following three areas of energy transition were highlighted:

- ***Volume of fuel consumption:*** A reduction in fuel consumption can curb energy-related emissions. The question is how many more companies have started to look at optimizing route planning between ports.

- ***Ship design:*** Many vessels are actively enhancing the energy efficiency of their engines, either by attaching solar panels or by employing wind energy to reduce fuel consumption. Some vessels are experimenting with attaching a modern kite or rotors to capture crosswinds.

- ***New fuel options:*** These options include biofuels, green ammonia, methanol and hydrogen. This topic is now being heavily discussed at the global level.

1. Introduction

An in-person workshop entitled “Global Challenges and Sustainable Prospects of the Maritime Industry” was organized by the King Abdullah Petroleum Studies and Research Center (KAPSARC) on May 30, 2023, in partnership with the University of Antwerp, Belgium. Representatives from the government, industry, academia, operators and regulatory authorities were invited to jointly determine the global challenges currently facing the maritime sector and to discuss and identify potential sustainable prospects and research that can help address these challenges.

The workshop looked at current challenges, such as persistent supply and demand imbalances and environmental constraints in the maritime industry, which participants discussed in a holistic way to understand the true nature of these issues, as well as the interlinkages among relevant stakeholders. Finally, the discussion participants sought to understand the future shape of the maritime industry through the exploration of a broad range of drivers of change, ascertaining which areas would have the greatest impact. In this discussion of what the future holds, workshop attendees attempted to determine to which issues the industry needs to respond and identify potential pathways to address these issues in a sustainable manner.

The discussions were organized into three sessions based on three wide-ranging topics related to maritime sectors and their stakeholders. Sessions 1, 2 and 3 focused on challenges, the environment, and the future of Kingdom of Saudi Arabia’s (KSA’s) maritime industry, respectively. Several key points were highlighted during the workshop.

2. Background of the Workshop

Sea transportation is an important industry that serves as the driving force of world trade and substantially contributes to the global economy. Despite being one of the most eco-friendly modes of transportation, the Fourth International Maritime Organization Greenhouse Gas Study 2020 reported that "the share of shipping emissions in global anthropogenic emissions has increased from 2.76% in 2012 to 2.89% in 2018" (IMO 2020), leaving potential room for improvement and decarbonizing the sector.

According to the *International Transport Forum Transport Outlook 2019*, global freight demand is projected to triple between 2015 and 2050 (Tiam, Sheng and Bin 2021). Therefore, transporting these goods will bring about a high demand for fuel in this industry. Without taking any action toward maritime decarbonization, this increase in freight activity is likely to continue to drive the increase in emissions and could damage the global efforts to achieve emission reductions.

The IMO's Initial GHG Strategy was adopted in 2018 to align international shipping with the goals of the Paris Climate Agreement. The strategy aims to halve GHG emissions from international shipping by 2050 and to reduce carbon intensity by 40% by 2030, compared to 2008 levels (IMO 2018). Measures and guidelines have also been proposed to facilitate climate mitigation efforts led by the IMO. However, shipping faces a unique set of climate mitigation challenges, and the current measures are unlikely to reduce emissions enough to align with the Paris Agreement climate goals.

On July 7, 2023, member states of the IMO met in London, the UK, at the 80th session of the Marine Environment Protection Committee (MEPC 80), where they adopted a revised strategy to reduce GHG emissions from international shipping (IMO 2023c). In the revised strategy, new checkpoints were established to achieve a 20% reduction in emissions by 2030, a 70% reduction by 2040 (compared to 2008 levels) and, as the ultimate goal, net-zero emissions by 2050 (IMO 2023b). However, a discussion on the revised ambitions was not included in this workshop, as the workshop occurred before the MEPC 80 meeting.

In line with these efforts, in 2013, the IMO mandated the Ship Energy Efficiency Management Plan (SEEMP), which indicated a reasonable approach to monitoring ship and fleet energy efficiency performance over time and focused on options to be considered when seeking to optimize ship performance. For instance, ships of 400 gross tonnage and above are required to keep a ship-specific SEEMP on board (IMO 2022). The Energy Efficiency Design Index (EEDI) and SEEMP came into force on January 1, 2013, aimed at curbing emissions. The EEDI was introduced to encourage the adoption of energy-saving equipment and engines for new ships.

The use of alternative fuels is becoming imperative for achieving IMO targets. This idea has been included in the mid- and long-term measures in the IMO Initial GHG Strategy but remains largely aspirational. There is uncertainty surrounding whether or how these measures will be implemented in countries across the world through the IMO framework. In addition to the uncertainty of the possibility of utilizing measures such as alternative fuels, new ship design introduces additional challenges and requires a greater amount of investment. Freight demand is dependent on various socioeconomic factors, such as GDP per capita, the behavioral pattern of consumption and market forces across the globe.

Changes in the geographical sources of supply and demand can influence transport routes, vessel

utilization and operational efficiency. Thus, maritime and port development also brings about numerous sustainability challenges, including growing productivity pressure, port congestion, rising GHG and other emission levels, and other negative externalities of port operations. Addressing these challenges requires a dedicated national strategy based on stakeholders' elements of consultation, coordination and partnership. The workshop focused on the economic, social and environmental aspects of sustainable maritime options with regard to these elements. This study considers both the global and KSA perspectives and aims to facilitate the exchange of views and suggestions on the challenges faced by the maritime sector and formulate reasonable recommendations.

3. Discussion

3.1 Challenges

Several challenges were put forward by participants, including security, safety and climate challenges. For instance, approximately 900 ships totaling 6.8 million twenty-foot equivalent units are due to be built and enter service in 2023-2024, and capacity is expected to increase by 30% compared to the levels prior to the COVID-19 pandemic. Maritime decarbonization may face enormous investment struggles; for example, *Reuters* estimates that USD 2.7 trillion will be needed to achieve net-zero emissions by 2050 (Chestney 2023). Another challenge is that digitalization in maritime technology has become popular, which results in potential cybersecurity vulnerability. Geopolitical tension was also highlighted in the session. For instance, the war between Russia and Ukraine is still ongoing, and the South China Sea is an issue in this regard, presenting challenges such as reduced shipping demand and increased costs. The connection between the challenges and implications was also illustrated in the discussion. For instance, geopolitical tensions can have implications for cost management, sustainability risk management, technology-enabled data analytics systems and diversified shipping pattern development. Similarly, capacity imbalance may impact cost management and structural transformation.

Maritime decarbonization challenges were also discussed at the port level. Ports are critical infrastructure assets that serve as catalysts for economic growth and development. At the same time, they are also at risk of being impacted by climate variability and changes, particularly in view of their location in coastal zones, low-lying areas and deltas. The discussion participants identified a few strategic economic factors, such as populations, assets and services associated with ports; the size and value of the built infrastructure; port connectivity and supply chains; and land-based access points. Despite the key role of maritime transport in international transport and trade, GHG emissions from international shipping presently constitute only a small part of the total GHG emissions. International shipping contributes only 2.2% of global CO_2 emissions from fuel combustion, making it the most energy-efficient mode of transportation. Nevertheless, emissions are increasing and are projected to increase up to fivefold by 2050 (IMO 2015). In addition, seaports form complex systems and multimodal transport nodes. Larger ports are mostly integrated within large coastal urban agglomerates; consequently, ports are associated with a range of environmental effects.

The understanding of the current macro trends and perspectives in the maritime sector was explained to achieve successful decarbonization. The port industry has evolved over time, and its role today is not limited to providing services to the maritime industry. Ports play a fundamental role in the supply of goods at the service of society. Furthermore, ports are responsible for strengthening each country's economic stability, energy security and strategies aimed at transitioning toward cleaner energy.

The discussion identified demographic, technological and environmental factors as drivers of the transformation of the port industry as follows:

1. **Demographic**. There is a global trend toward increasing populations, especially in Africa and the Americas, although populations are decreasing in China and some European countries. Urban centers are expected to grow despite the scarcity of space as well as other difficulties.

2. **Technology**. The increase in the number of technologies at the service of ports and the reduction in their costs allow for the optimization

of resources and processes, which directly impacts the value chain given the technological improvements not only in ports, seasides and landsides but also in the interface and communication between them.

1. **Environment**. From an environmental point of view, considering the increase in global temperature, it is necessary to implement strategies that guarantee a sustainable future for new generations. This transformation is supported by the establishment of regulations and voluntary actions to improve the environmental performance of the maritime and port industry.

2. **Governance**. The governance of ports is changing and expanding in scope through digital data platforms for governance and environmental management. Today's ports are ecosystems in which several key players cooperate to satisfy social, economic and environmental requirements.

Port externalities also need to be addressed to achieve sustainable options in the maritime sector. Carbon footprinting is used to determine emission sources, track emission trends and provide the information needed to determine where ports can focus efforts to reduce their GHG emission levels. A carbon footprint is the amount of GHG emissions that an individual, organization or event directly or indirectly releases over a measured period. Whether ports choose to monitor emissions associated with their landside operations or to extend their view to monitor the emissions of ships and other equipment outside of their immediate boundaries, carbon footprinting serves as a valuable tool for identifying GHG emission levels. From there, a carbon management strategy can be developed and implemented to reduce port GHG emission levels.

3.2 Environment

During the discussion, it was noted that decarbonizing maritime transport (DMT) is integral and requires strong global and domestic regulations. It was suggested that while there is no consensus on the definition of DMT, policy can establish clear regulatory frameworks to encourage the decarbonization of the maritime sector. Discussion participants emphasized that strong partnerships should be a key element of maritime decarbonization and that organizations should engage with and clearly define roles for all stakeholders early in the process. Given the growth of DMT efforts, it is suggested that now would be a good time to establish formal mechanisms for information sharing and learning and that the IMO can take on this role at the international level.

The majority of the discussion focused on the importance of transparency and collaboration for successful and effective maritime decarbonization, although the core tension between data transparency and market competition ultimately needs to be resolved through policy intervention. A lack of a global consensus on the definition of DMT and guidelines pertaining to emissions, transparency and market competition may result in misleading information about the effectiveness of maritime decarbonization. Digitalization and data transparency should be important ways to share information, but market competition can present a challenge.

DMTs do not look the same in different geographic locations, which is why common measurements for determining progress and data transparency are critical. Discussion participants added that standardized measures of carbon intensity can provide level-setting requirements to build transparency, enable cargo owners to meet their decarbonization goals, and support investors

seeking to allocate funding to the most cost-effective tactics. Data should drive decisions around the implementation of DMT, and consideration should be given to regional areas with bunkering and alternative fuel production capabilities.

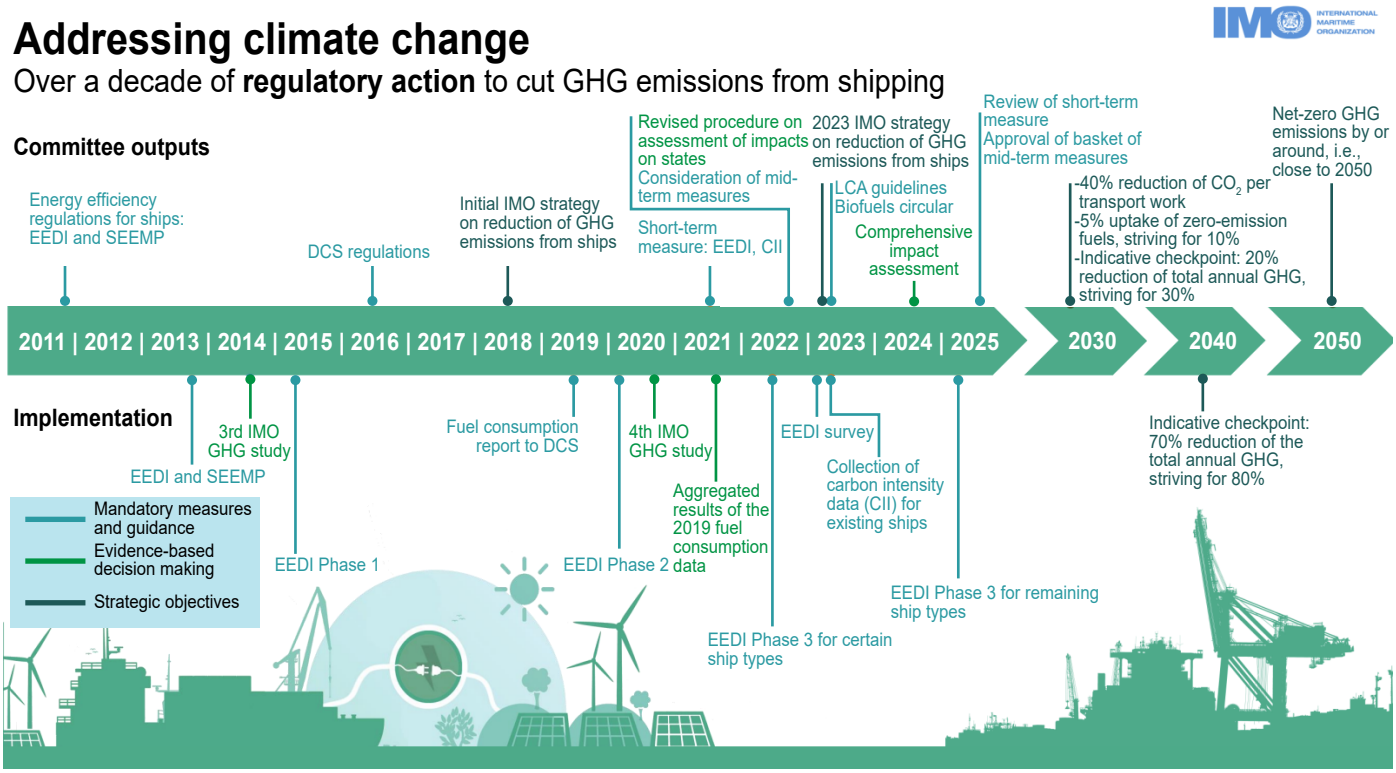
When discussing opportunities for the future, DMT efforts have been considered critical laboratories and incubators of innovation where the sector can build experience and learn what works as the world starts to navigate a major energy transition. These initiatives can provide opportunities to try out new technologies and demonstrate viability at a manageable scale.

The discussion explored how international policies and strategies can help support DMT, focusing on existing programs, collaboration and opportunities for private–public partnerships. The importance of opportunities to support maritime decarbonization at both the national and international levels was highlighted, and it was suggested that the IMO and relevant stakeholders coordinate with each other regarding their funding opportunities and mechanisms for maritime decarbonization to ensure maximum effectiveness. In addition, stakeholders need to be empowered by learning as much as possible about new technologies through maritime decarbonization options.

Session participants also discussed the IMO's mandates for energy efficiency requirements over the past decade. Figure 1 provides an overview of the work carried out by the IMO to address GHG emissions from ships.

In 2011, a significant milestone was achieved when the IMO established international mandatory

Figure 1. IMO's GHG emission reduction regulatory actions. "IMO's Work to Cut GHG Emissions from Ships." https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx



Source: IMO, 2023a.

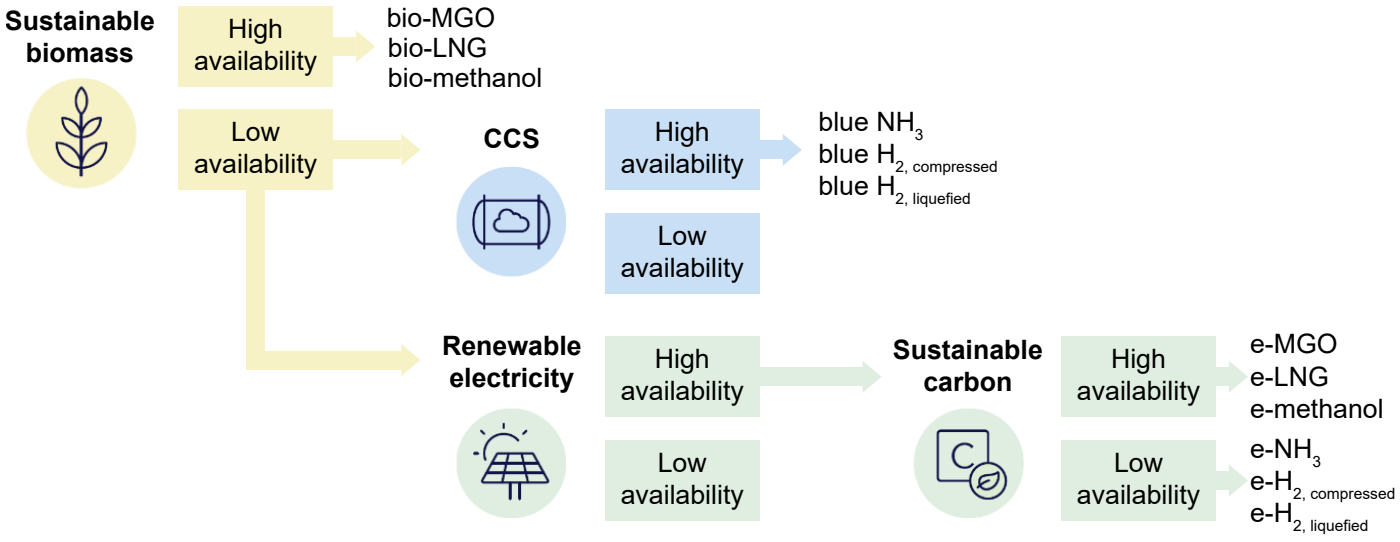
measures related to enhancing the energy efficiency of ships, as shown in Figure 1. The adoption of the initial IMO GHG reduction strategy in 2018 was another major step toward tackling GHG emissions within the maritime industry. However, the initial IMO GHG reduction strategy was revised in 2023, indicating net-zero GHG emissions by or around (i.e., close to) 2050. To limit the temperature increase in 2100 to 1.5°C, the Intergovernmental Panel on Climate Change emphasizes that zero GHG emissions must be achieved for all sectors before or by 2050.

DMT is not easy, but it is expected to be possible. The shipping industry is already in transition mode and achieving enormous emission savings with existing engines, but its transition must be accelerated. Maritime shipping is a solution, not an obstacle, to achieving an environmentally friendly economy, and a substantial reduction in CO_2 emissions is possible.

In the maritime sector, accelerating collaborative action is imperative and can be successful only if everyone pools their resources together across the industry to find a common solution. Maritime shipping is expected to decarbonize through a variety of solutions (Figure 2). Retrofitting or adopting new technologies such as engine conversions, more efficient propellers, low-drag rudders, hull protection, air lubrication systems and multifuel engine platforms will be required in the future. A pathway for alternative fuels appears, with liquefied natural gas (LNG) likely to play an important role as a transition fuel, while (green) hydrogen has potential in fuel cells, although challenges remain for its use in cargo ship propulsion. Furthermore, green methanol/ammonia has proven to be a promising alternative.

To decarbonize shipping, the level of availability of all carbon-neutral fuels must increase. By 2030, 5% of fuel for the world fleet would have to be carbon neutral to achieve a 40% reduction in carbon intensity from (DNV 2022). If sufficient sustainable biomass becomes available, then biofuels will be preferred, as biomass is easily converted to relatively energy-dense hydrocarbon fuels, such as bio-marine gasoil (MGO), bio-LNG or bio-methanol.

Figure 2. Sustainable options toward carbon-neutral fuels. Maritime Forecast to 2050: Energy Transition Outlook 2022. https://llsra.lt/wp-content/uploads/2023/04/DNV_Maritime_Forecast_2050_2022-final.pdf



Source: DNV, 2022.

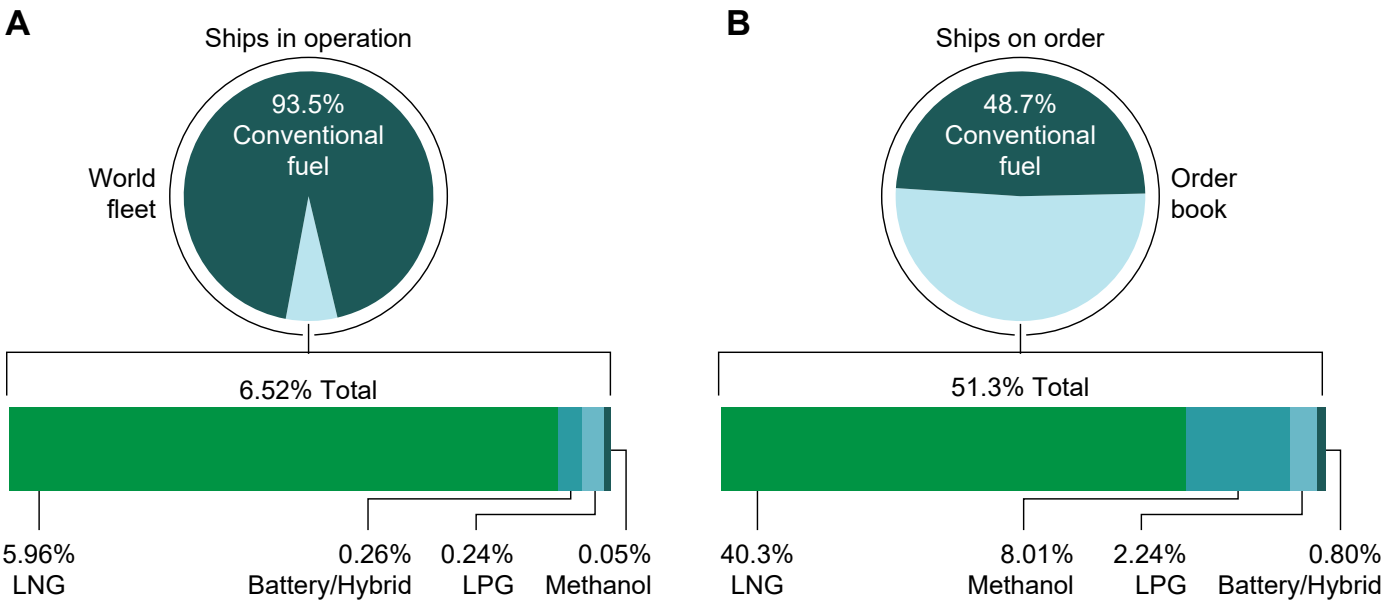
A large-scale build-out of carbon capture infrastructure and storage capacity is necessary to provide large amounts of blue fuels for shipping or the large-scale use of onboard carbon capture and storage. The cost of sustainably sourced CO_2 needs to be low, and it is expected to be low in the beginning—for example, from biogas—but will increase once the lowest-cost sources are used. Direct air capture of CO_2 may potentially need to be used to produce electro fuels containing carbon, but the current cost of such CO_2 is prohibitively high.

As Figure 3 shows, the fuel transition in shipping has started and is accelerating. The share of ships in the order book that can operate on alternative fuels has increased significantly. The trend of larger ships being ordered with alternative fuel propulsion is continuing. Fossil LNG is the dominant fuel, with 51% of the ships in the order book being able to use LNG as fuel (DNV 2023).

The development of sustainable fuel supply chains must be accelerated to achieve the transition; at least 5% acceleration is needed by 2030. Clear criteria and increased production, sustainable biomass, renewable electricity, and sustainable carbon and carbon storage are required. The transition will require large annual onboard investments of 8–28 billion dollars but even greater onshore investments of 30–90 billion dollars. Fuel flexibility and fuel-ready solutions, combined with improved energy efficiency, provide robustness and reduce carbon risk, which requires collaboration across industries and authorities.

The importance of digitalization was also discussed in the workshop. The necessity of automating supply chains using AI and robotics should be emphasized. AI-based models can forecast market demand more accurately; robots can facilitate warehouse automation, which may improve productivity, accuracy and worker safety. It was also

Figure 3. Fuel transition in shipping. Energy Transition Outlook 2023: Maritime Forecast to 2050. https://www.dnv.com/maritime/publications/maritime-forecast-2023/download-the-report.html



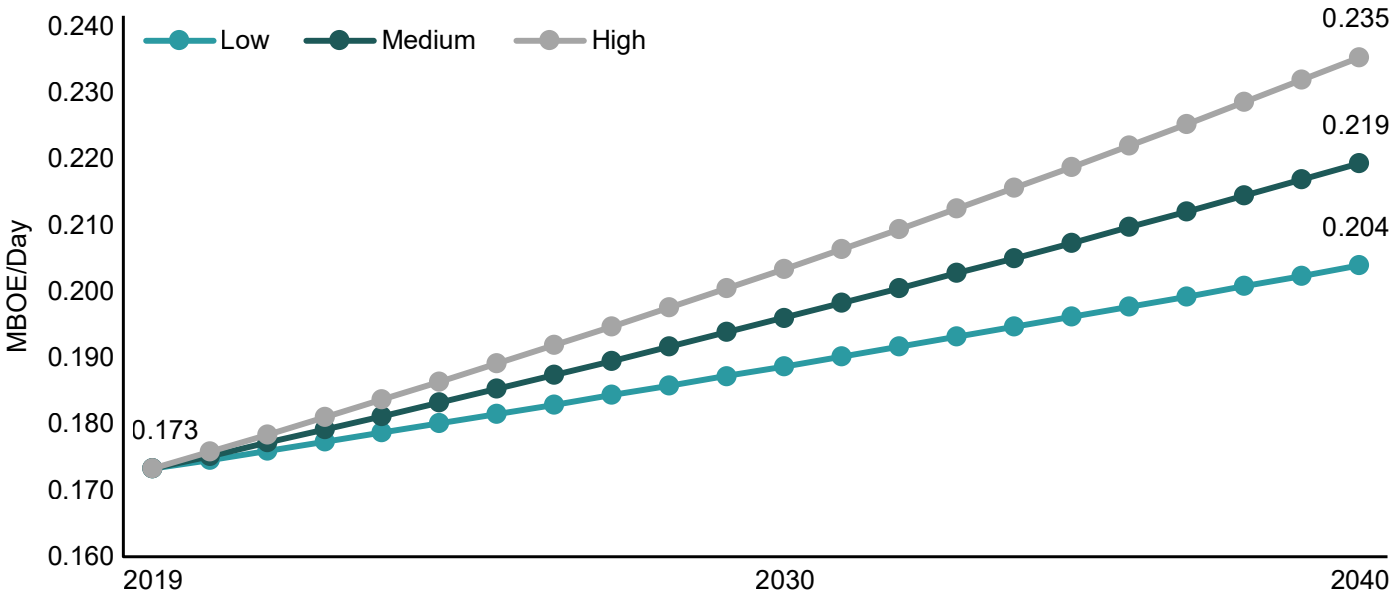
Source: DNV, 2023

mentioned that robotic and drone delivery is gaining popularity in last-mile operations. The Internet of Things can enable asset tracking and remote equipment monitoring, while cybersecurity solutions can protect digital assets in supply chains from malicious attacks. Furthermore, with the increase in globalization, businesses need to maintain flexible supply chains to mitigate supply chain disruptions due to market changes. Businesses are also adopting sustainable supply chains with circular and reverse logistics solutions.

3.3 KSA and Future Maritime Sector

Sea transportation is the most important industry that largely serves world trade and marks a significant amount of oil demand to perform such trade. The growing world population and expected living standards result in the shrinking of the amount of local resources and thus increase the world economy's dependency on international trade. This situation, in turn, results in an increase in world seaborne trade. Recently, Saudi Arabia has established several strategic tactics to map the future of the country, such as Saudi Vision 2030. One of the key elements in this vision is to transform Saudi Arabia into a global transport and logistics hub, with its strategic location at the epicenter of three continents: Asia, Europe and Africa. The utilization of this locational advantage is expected to cause a large increase in trade in the future, allowing Saudi Arabia to become a leading regional logistics hub and resulting in increased energy demand levels in this sector. To improve the country's economy, it is necessary to predict

Figure 4. Energy demand in the Saudi maritime sector by 2040.



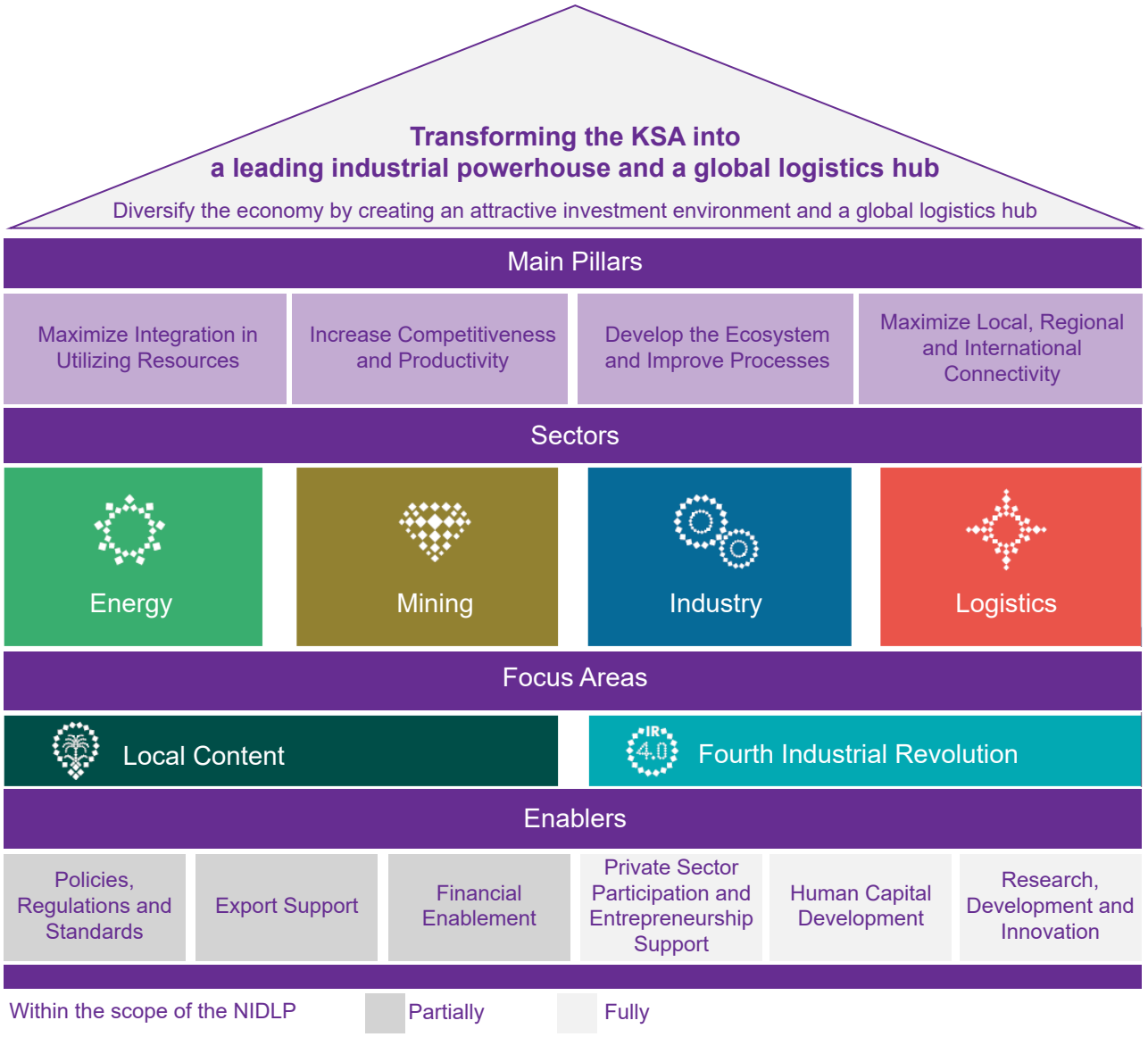
Low means 0.78%, Medium means 1.13%, and High means 1.47%.

Source: Anwar et al, 2023.

the future total seaborne export volume and the potential energy consumption of the Saudi shipping sector. Furthermore, Saudi Arabia launched the country's National Transport and Logistics Strategy (NTLS) program, which includes a target of reaching a capacity of more than 40 million TEU annually (SPA 2021).

According to Figure 4, the estimated energy consumption in the Saudi shipping sector was approximately 0.173 MBOE/day in 2019. Considering it as a baseline demand, energy demand is expected to increase by 0.046 MBOE/day by 2040 under the business-as-usual medium-growth scenario (Figure 5). Anwar et al. (2023) conducted

Figure 5. NIDLP strategy house. NIDLP. 2019. National Industrial Development and Logistics Program Delivery Plan 2021-2025. Accessed October 17, 2023. https://www.vision2030.gov.sa/media/5hlpbuuq/2021-2025-national-industrial-development-and-logistics-program-delivery-plan-en.pdf



Source: NIDLP, 2019.

research and revealed that Saudi Arabia could reach the NTLS target depending on various levels of GDP growth. Thus, this insight provides evidence-based information about the nation relating to seaborne exports and corresponding energy demand, which is a valuable resource for policymakers. With access to these results, policymakers can make well-informed decisions that support growth and development in the nation.

A Saudi program, called the National Industrial Development and Logistics Program (NIDLP), aims to transform the KSA into a leading global industrial powerhouse and logistics center. The program largely contributes to driving the KSA's economic diversification toward sustainable growth by unlocking the full potential of local content such as logistics. As mentioned in the discussion, Saudi Arabia, the world's 18th largest economy, is strategically located within five hours of air transport from half of the world's population. Geographically, it is located at the crossroads of the East and the West, along one of the main seaborne trade routes in the Red Sea, near the Middle East, North Africa and West Africa regions. The KSA is expanding its existing infrastructure and internal distribution network to become an effective platform for exporting and re-exporting to substantially increase its exports by 2030. The NIDLP has four strategic pillars (energy, mining, industry and logistics) to diversify the economy by creating an attractive investment environment and global logistics hub (Figure 5). The strategy capitalizes on a development model that starts by enriching current capabilities and strengths and creating new competitive advantages. The strategy enablers focus on increasing the short- and long-term competitiveness of the sectors.

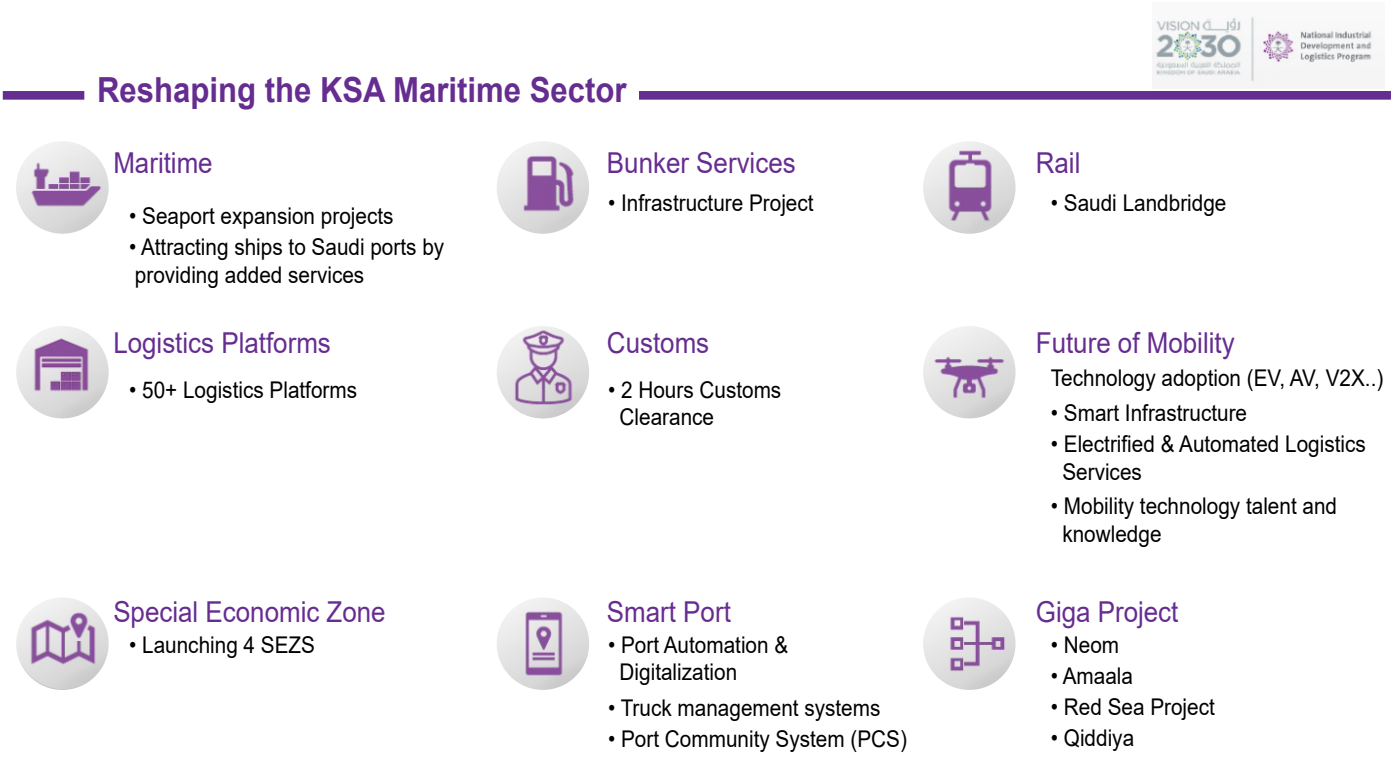
As per the discussion in line with Vision 2030, the strategy of Saudi Arabia can be threefold: creating a vibrant society, a thriving economy and an ambitious nation. Moreover, the objectives are to strengthen Islamic and national identity, provide a healthy lifestyle, grow and diversify the economy, increase employment, enhance government effectiveness and enable social responsibility. From the conversations, the following points are noted: i) a growing contribution of the private sector to the economy, ii) the maximization of the value captured from the energy sector, iii) the unlocking potential of nonoil sectors and iv) the positioning of Saudi Arabia as a global logistics hub.

The strategy of the KSA is to diversify the economy by creating an attractive investment environment and a global logistics hub, capitalizing on a development model that starts by enriching current capabilities and strengths and then moves to creating new competitive advantages.

Figure 6 depicts the potential reshaping of the KSA maritime sector, as highlighted in the discussion. As discussed, the maritime sector is reshaped in the following ways:

- Seaport expansion projects
- Attracting ships to the KSA by providing added services
- 50+ logistics platforms
- Launching 4 special economic zones
- Bunker services infrastructure project
- 2-hour customs clearance
- Port automation and digitalization
- Truck management systems
- Port community system
- Saudi landbridge
- Stimulating future mobility
- Promoting giga projects: NEOM, Amaala, Red Sea Development Company, and Qiddiya

Figure 6. Reshaping KSA maritime sector.



Source: Adopted from NIDLP 2019.

The Clean Energy Marine Hub (CEM-Hub) initiative, aimed at establishing a public–private platform among the energy, maritime, shipping and finance communities to de-risk investments and transform the energy-maritime supply chain, was discussed in the session. The purpose of such hubs is to bring the private sector and governments together across the energy-maritime value chain to transform maritime transportation and production hubs for future low-carbon fuels. The CEM-Hub initiative was initially backed by Canada, Norway, Panama, Uruguay and the United Arab Emirates in partnership with the International Chamber of Shipping and the International Association of Ports & Harbors. To accommodate demand, according to the International Renewable Energy Agency, the shipping industry is expected to transport at least 50% of all traded low-carbon fuels by 2050. However, the production centers, vessels and port infrastructure required to accommodate the expected demand for low-carbon fuel do not currently exist at the commercial scale. For instance, the scales of hydrogen, ammonia and other low-carbon fuels are far from what heavy industries, transport and other sectors require. To support the global transition to net-zero targets, shipping is expected to transport two to five times the amount of low-carbon fuels expected to be consumed by 2050. The mix of fuels that shipping moves also need to be changed to align with the Paris Agreement.

4. Conclusions and Recommendations

As per the discussion, alternative fuels can be one of the most direct paths to maritime decarbonization. However, these fuels cannot currently meet the same operational needs as can incumbent fuels, and there is currently no regulatory structure for approving the technologies that use these fuels globally. Even using IMO regulations as a reference may not work as expected because the maritime industry differs across countries, and IMO regulations do not translate appropriately to address the abilities or targets of most countries. However, the IMO's strategy is appreciated because the organization's efforts are considered a first step toward alignment with the Paris Agreement.

Participants in the discussion noted that the lack of regulations around zero-emission technology brings about risk and can hamper the business case for innovation. For example, it is difficult for businesses to justify investing in new smart engines when regulations still allow for the use of existing engines, and there is a lack of clarity about new technologies. Without additional funding, businesses will likely lack the resources and capacity needed to build and manage these new technologies. Furthermore, significant financial and time resources are required to develop and build a ship based on a new design. To be successful, a shared vision and frequent research collaboration and communication with all parties involved is key, particularly sharing risk and responsibility with shipyards constructing these new vessels. Discussion participants shared unexpected challenges in the design of a zero-emission vessel, including making space for additional technology required and retraining mariners on how to navigate the vessel with the new propulsion system. To make the process more sustainable, they recommended that policymakers create and sustain longer-term incentives that support investment in the development and launch of zero-emission vessels and infrastructure.

Working together is critical, as all stakeholders work on new pathways for zero-emission vessels in their own ways. The need for collaboration among ship owners, shipbuilders and the government on maritime challenges and solutions is crucial. A public–private partnership was suggested to achieve the maritime targets by 2050. The CEM-Hub initiative is a good example of a coordinated decarbonization effort in this sector. While discussing the regulatory issue, participants highlighted the challenges in creating a comprehensive and standardized regulatory strategy with technology changing rapidly and in diverse ways. However, the discussion revealed that standardization may also present a challenge.

Finally, uncertainty about the shipping sector's ability to reach zero CO_2 emissions by 2050 can be reduced. Currently, energy efficiency needs to be promoted and effectively embraced, which not only would result in an immediate reduction in carbon emissions but also could potentially result in important fuel savings and thus an increase monetary revenue for ship owners and operators. From a technological perspective, renewable energies are competitive. Indeed, renewable energy costs have been decreasing at an accelerated rate. For renewable-energy-derived fuels to become the prime choice for propulsion, further cost declines are needed, particularly for renewable-energy-supportive technologies (e.g., electrolyzers and hydrogen storage). In this context, sectoral decarbonization can be accelerated, and ambitions can be raised beyond those related to climate goals by fostering investment in the production of renewable fuels. For this purpose, relevant and timely coordinated international policy measures must be adopted. In addition, stakeholders must develop broader business models and establish strategic partnerships involving energy-intensive industries, power suppliers and the petrochemical sector.

References

Anwar, Ahm Mehbub, Dua, Rubal, Alwosheel, Abdulrahman, and Nezamudding, Nora. 2023. *Future Fuel Demand from the Saudi Shipping Sector: A Business-as-Usual Estimation*. Riyad: KAPSARC. https://www.kapsarc.org/research/publications/future-fuel-demand-from-the-saudi-shipping-sector-a-business-as-usual-estimation/

Chestney, Nina. 2023. "World Needs $2.7 Trillion Annually for Net Zero Emissions by 2050, Wood Mackenzie Report Says." *Reuters*, September 14, 2023. https://www.reuters.com/sustainability/climate-energy/world-needs-27-trillion-annually-net-zero-emissions-by-2050-wood-mackenzie-2023-09-14/

DNV. 2022. *Maritime Forecast to 2050: Energy Transition Outlook 2022*. Accessed November 23, 2023. https://llsra.lt/wp-content/uploads/2023/04/DNV_Maritime_Forecast_2050_2022-final.pdf

———. 2023. *Energy Transition Outlook 2023: Maritime Forecast to 2050*. Accessed November 23, 2023. https://www.dnv.com/maritime/publications/maritime-forecast-2023/download-the-report.html

IMO (International Maritime Organization). 2015. *Third IMO Greenhouse Gas Study 2014*. Accessed August 27, 2023. https://www.imo.org/en/ourwork/environment/pages/greenhouse-gas-studies-2014.aspx.

———. 2018. *Initial IMO GHG Strategy*. Accessed July 16, 2023. https://www.imo.org/en/MediaCentre/HotTopics/pages/reducing-greenhouse-gas-emissions-from-ships.aspx#:~:text=In%202018%2C%20IMO%20adopted%20an,out%20as%20soon%20as%20possible

———. 2020. *Fourth Greenhouse Gas Study 2020*. Accessed August 27, 2023. https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx

———. 2022. *2022 Guidelines for the Development of a Ship Energy Efficiency Management Plan (SEEMP): Annex 8*. Accessed August 27, 2023. https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.346%2878%29.pdf

———. 2023a. "IMO's Work to Cut GHG Emissions from Ships." Accessed November 21, 2023. https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx

———. 2023b. *Resolution MEPC.377(80): 2023 IMO Strategy on Reduction of GHG Emissions from Ships*. Accessed July 16, 2023. https://www.imo.org/en/MediaCentre/PressBriefings/pages/Revised-GHG-reduction-strategy-for-global-shipping-adopted-.aspx

———. 2023c. "Revised GHG Reduction Strategy for Global Shipping Adopted." July 7, 2023. https://www.imo.org/en/MediaCentre/PressBriefings/pages/Revised-GHG-reduction-strategy-for-global-shipping-adopted-.aspx

NIDLP (National Industrial Development and Logistics Program). 2019. *National Industrial Development and Logistics Program Delivery Plan 2021-2025*. Accessed October 17, 2023. https://www.vision2030.gov.sa/media/5hlpbuuq/2021-2025-national-industrial-development-and-logistics-program-delivery-plan-en.pdf

SPA (Saudi Press Agency). 2021. "His Royal Highness the Crown Prince Launches the National Transport and Logistics Strategy, One of the Vision 2030 Pillars." *Saudi Press Agency*, June 30, 2021. https://www.my.gov.sa/wps/portal/snp/content/news/newsDetails/CONT-news-300620212/!ut/p/z0/04_Sj9CPykssy0xPLMnMz0vMAfljo8zivQIsTAwdDQz9LQwCXQ0CnV0MfYyNQgwM_M30g1Pz9L30o_ArAppiVOTr7JuuH1WQWJKhm5mXlq8f4ezvF6Kbl1perGtsYGBmZGBkaKRfkO0eDgDAKm_T/

Tiam, Goh, Sheng, Zhong, and Bin, Su. 2021. "Decarbonization of International Shipping: Challenges and Prospects." *Energy Studies Institute Policy Brief* 40 (March). https://esi.nus.edu.sg/docs/default-source/doc/decarbonisation-of-international-shipping--challenges-and-prospects.pdf

About the Workshop

This workshop was implemented jointly by the KAPSARC and the University of Antwerp. It took place in the APEX building of the KAPSARC in Riyadh, Saudi Arabia, on May 30, 2023. It brought over 20 regional and international experts together to openly discuss the key issues related to maritime challenges and their potential solutions.

List of Participants

Mr. AHM Mehbub Anwar – Research Lead, Transportation and Infrastructure, KAPSARC

Benny Willen – CEO, Cloudalize

Christa Sys – Professor, BNP Paribas Fortis Chair on Transport, Logistics and Ports - Department of Transport and Regional Economics, University of Antwerp

Ebtisam Ahmed – Acting Head of Post, Government of Flanders, Flanders Investment & Trade, Embassy of Belgium

Ekaterina Derbilova – PhD Student, Primakov Institute of World Economy and International Relations, Russian Academy of Sciences

Essam Al Ammari – Former KSA Permanent Representative in IMO and Senior Experts at Transport General Authority

Fabio Ballani, PhD – Associate Professor, Maritime Energy Management, World Maritime University

Gabriel Castellanos – Technical Officer, International Maritime Organization (IMO)

Hannes (Johnson) von Knorring – Principal Consultant, Maritime Decarbonization DNV

Kevin Smith – Business Development Manager, Cloudalize

Luc Geerts – Strategic Account Manager & International Relations - Owner Representative KSA, Manuport Logistics

Mohammad ALTelmesani – GDP Intern, Transportation and Infrastructure, KAPSARC

Mohammed Alshammari – Director, National Industrial Development & Logistics Program (NIDLP)

Mutab Zaydan Alenzy – Lecturer, Taibah University

Muteb BinDhamnah – Transportation Manager, Oil Sustainability Program

Nelson Mojarro – Head of Innovation and Partnership, International Chamber of Shipping

Raed Al Mestneer – Research Lead, Oil and Gas, KAPSARC

Ranjith Powell – Head of Ports and Transport Infrastructure, Public Investment Fund (PIF)

Rubal Dua – Research Fellow II, Transportation and Infrastructure, KAPSARC

Saleh Ahmed – Assistant Professor, Public Policy (Environment), Boise State University

Vinh V. Thai – Professor, Royal Melbourne Institute of Technology (RMIT) University

Xun Xu – Research Lead, Transportation and Infrastructure, KAPSARC

Yanjia Wang - Professor, Tsinghua University

Notes

Notes

Notes

About the Team

AHM Mehbub Anwar

Dr. AHM Mehbub Anwar is a Research Lead at KAPSARC. He currently leads the Energy Decision Model for Maritime, which results in research outcomes as well as advisory inputs for the energy ecosystem across the Kingdom. This project investigates future port activity including seaborne trade and fuel consumption in the shipping sector both locally and globally. He also works on the KAPSARC Spatial Urban Energy System (KSUES) project. Prior to joining KAPSARC, he worked in Transport for New South Wales (TfNSW), a state government organisation, as a transport planner, and at the University of Wollongong (UOW) in Australia as a researcher. He led the update on the state of transport in the TfNSW regions as part of the strategic planning for its Future Transport 2056. He has also worked as a lecturer at Khulna University of Bangladesh, and was later promoted to a professor in urban transport planning. He holds a Ph.D. with an examiners' commendation for an outstanding thesis from the UOW. His thesis focused on modeling travellers' preference heterogeneity.

Anvita Arora

Anvita is an architect and transport planner whose current areas of research at KAPSARC include smart cities, electric vehicles, and freight mobility. Before joining the Center in February 2018, she was the managing director and CEO of Innovative Transport Solutions (iTrans), an incubator company of IIT Delhi, where she led over 40 applied research and planning projects for 10 years for clients ranging from city level and country level authorities to funding agencies including the UNEP, World Bank, Asian Development Bank, and DFID. Supporting cities to become sustainable, inclusive and climate resilient was the primary focus of the work. She was also the India Resident Representative for the Bicycle Partnership Program of the Interface for Cycling Expertise (I-CE), the Netherlands, for four years.

Anvita has been teaching transport planning in the Urban Design Department of the School of Planning and Architecture in Delhi for the past 12 years and was visiting faculty at the TERI University, Delhi. She was also associated with the Transportation Research and Injury Prevention Program (TRIPP) at IIT Delhi, a Volvo Research and Educational Foundations (VREF) Centre of Excellence, for nearly 12 years.

About the Project

The increasing global seaborne trade volume is the major driver of the marine fuel market. According to the International Chamber of Shipping, over 90% of the world's shipped goods travel by marine cargo vessels. Seaborne trade is continuously expanding, adding benefits for consumers through competitive freight costs. Trade expansion in the marine sector has significant implications for marine fuel demand. Additionally, a few interventions introduced by the IMO will have an impact on future oil demand and on fuel shifts across the global marine industry. Therefore, the maritime sector will continue to experience unique oil demand and consumption trends. This project is designed to draw insights from the characteristics and energy decisions of the maritime sector in different regions of the world.

www.kapsarc.org