

1. Sustainable greener prospects in Inland Water Transport-Water Metro – Gliston-Water Metro

Inland Water Transport (IWT) presents a significant opportunity for sustainable and greener transportation, particularly in regions with extensive navigable waterways. By prioritizing environmental responsibility alongside economic efficiency, IWT can contribute to a more sustainable future. The "greening" of inland water transport is a critical focus in modern transportation, driven by the need to reduce environmental impact and promote sustainable goals. Technological advancements for green vessels basically Electric power and Hydrogen fuel cells play key role. Further encouraging modal shift of passengers and freight transport from roads to inland waterways that can drastically reduce congestion on roads and decrease the carbon footprint of transportation. Improving vessel design for greater fuel efficiency, implementing advanced navigation and traffic management systems to optimize fuel consumption, Infrastructure Development, investing in port facilities that support sustainable practices. Ensuring that waterway maintenance is conducted with minimal environmental impact. Policy and Regulation. The successful greening of inland waterways requires a coordinated effort involving governments, industry, and research institutions. Policy and regulation must be carefully designed to promote sustainable practices. The Green Voyage 2050 by International Maritime Organization is supporting shipping's transition towards a low carbon future. India has declared the goal to achieve Net Zero emissions by 2070. The Green Hydrogen mission aims at net zero emission. The Ministry of Ports, Shipping and Waterways has introduced several new initiatives to advance the goals of the Maritime India Vision 2030 (MIV 2030) and Maritime Amrit Kaal Vision 2047 (MAKV 2047). Major sectors like mobility and industrial production are significantly dependent on imported fossil fuels. This necessitates a shift towards technologies that enable enhanced share of renewable sources in the energy mix, and progressively reduce the reliance on fossil fuels. The Government envisions complete transition to Green Vessels by 2047 with the objectives Developing and operationalizing new age vessels with standardized designs/infrastructure that are green and safe, Creating an enabling ecosystem for the operation of such Green Vessels, Promoting safe, convenient and green inland waterway-based passenger transport, In essence, the future of inland waterways lies in its ability to integrate environmentally sound practices, leveraging technological innovation and strategic policy to create a sustainable, green and efficient transport network.

2. A Peer-to-Peer Certification System - A Solution to fraudulent Certification Through Blockchain Enabled Digital Certificates(COC) Capt Vinod Naveen - Bernard Schulte Maritime Training

A purely peer-to-peer version of digital records would allow online digital transactions to be sent directly from one party to another without going through a 3rd party institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to verify and prevent duplications. We propose a solution to the problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

Key Words -Blockchain, Transparency , Distributed Ledger, Certification, Consensus

3. **BIOCOMPOSITE FOR SUSTAINABLE INLAND WATERWAYS VESSELS –**
Renjith R,Aravind K.R, Rajesh P Nair, A, Mathiazhagan- Ship technology

Bio composites are used in marine engineering for boat hulls, and other marine structures because they have high strength to weight ratio, reduced carbon footprint and are eco-friendly. This paper discusses about the use of bio composite in boat building and its characterization with respects to mechanical properties. The application of bio composite for inland waterways also discussed in the paper. As a significant innovation, the use of bio composite materials in vessel construction offers benefits such as reduced weight, increased payload capacity, and greater durability, sustainability, contributing to enhanced operational performance. The structural stability of composites is a critical factor for their application in marine environments. This study includes an analysis of stiffened plates, which are commonly employed in ship structures and offshore platforms, to evaluate their mechanical performance and feasibility for such applications. By incorporating composite materials and advanced energy systems, both inland and offshore transport sectors are poised to contribute to a more sustainable future for global marine transportation.

4. **Revolutionizing Indian Coastal Shipping: Pioneering Economic Growth, Seamless Passenger Connectivity, and Sustainable Green Maritime Corridors-** Darla Siva Rama Krishna, Aditya Krishnadas Nair, Gandrothu Pranav, Omkar Pradeep Mahadik-
Euro Tech Maritime Academy

India's inland waterways are huge with regard to augmenting sustainable and economical transport. This paper discusses the status, issues, and prospects in the development of inland waterways as a cost-effective logistics network. Emphasis is laid on the use of Green Corridors, where eco-friendly measures like low-carbon vessels, shore-side electricity, and integration of renewable energy are brought together. The report examines policy structures, technological innovations, and infrastructure facilities needed to maximize inland water transportation. Through the use of digital navigation tools, multimodal connectivity, and green propulsion technologies, India can lower its carbon footprint substantially while enhancing the efficiency of trade. The research underscored the potential of Green Corridors to make India's inland waterway network more sustainable and economically robust mode of transport. This report offers policy recommendations to policymakers and stakeholders on how to promote the uptake of green and climate-resilient inland water transport solutions.

Keywords— component, formatting, style, styling, insert (key words)

5. **Advancing Maritime Sustainability through Computational Mechanics –**
Kiran Mukund, Harikrishnan M, Anantha Krishnan G-KMSME

The maritime industry is undergoing a significant transformation towards sustainability due to growing environmental concerns, stringent regulatory frameworks, and the urgent need to reduce greenhouse gas emissions. Computational mechanics has emerged as a powerful tool in optimizing ship design, improving operational efficiency, and minimizing the environmental impact of maritime activities. This paper explores various computational approaches, including finite element analysis (FEA), computational fluid dynamics (CFD), and artificial intelligence (AI)-based optimizations, that contribute to sustainable maritime operations. By leveraging these advanced techniques, shipbuilders and operators can enhance structural integrity, reduce hydrodynamic drag, optimize

fuel consumption, and implement predictive maintenance strategies. Additionally, digital twins and real-time monitoring systems provide a data-driven approach to improve decision-making, further enhancing energy efficiency and reducing emissions. The study highlights the growing importance of computational mechanics in shaping the future of green shipping practices and underscores the role of technological innovations in achieving a more sustainable maritime industry.

6. **Advanced Hydrogen Storage Solutions for Maritime Transport: A Technical Review of LOHCs Versus Alternative Methods**

Vivek Yohan Anil, Sneha A S, Joppu Joseph, Nishant Bhasker-Marine Engineering Training Institute Cochin Shipyard Ltd.

The maritime sector's reliance on traditional fuels results in substantial greenhouse gas emissions, driving the urgent need for decarbonization through alternative fuels, notably hydrogen. While hydrogen presents a clean, high-energy density solution, its low volumetric density and associated storage/transportation challenges, including boil-off and safety considerations, necessitate advanced storage technologies. Solid-state hydrogen storage, utilizing metal hydrides and complex hydrides, offers high volumetric density but faces kinetic and thermodynamic limitations. Liquid Organic Hydrogen Carriers (LOHCs) emerge as a promising alternative, enabling safer and more efficient hydrogen storage via reversible catalytic hydrogenation and dehydrogenation reactions. Specifically, systems employing cycloalkanes/arenes such as toluene/methylcyclohexane or dibenzyltoluene/perhydro-dibenzyltoluene, coupled with heterogeneous catalysts like supported noble metals (Pt, Pd, Ru), demonstrate high storage capacities and efficient release kinetics. The thermodynamic parameters, including enthalpy and entropy of the dehydrogenation reaction, directly influence the operational temperatures and release rates. Optimizing catalyst design, including support materials and metal particle size, is crucial for enhancing reaction kinetics and minimizing side reactions. Furthermore, understanding the mass transfer limitations in LOHC systems, particularly during dehydrogenation, is critical for scalable reactor design. Advancements in these storage and delivery technologies, coupled with integrated fuel cell systems, are essential for the maritime industry's transition to green hydrogen, fostering a sustainable energy future.

Keywords:

Hydrogen Storage, LOHCs, Decarbonization, Catalytic, Hydrogenation/Dehydrogenation, Reaction Kinetics, Thermodynamic Parameters, Fuel Cell Systems, Green Hydrogen

7. **Sustainable Ship Building Materials for marine application -**

Vysakh K.B, Mathiazhagan A- Ship technology

The maritime industry plays an important role in global trade, but it also leaves a substantial carbon footprint. The imperative for sustainability has led to the development and adoption of green technologies that aim to reduce emissions, conserve resources, and minimize the impact on marine ecosystems. This paper discusses the latest developments in stainless steel for shipbuilding industry particularly on super duplex stainless steel in the perspective of sustainable ship construction using FB-TIG welding process, which has shown increased weld quality, mechanical and corrosion performance. Overall, the proposed welding technique enhances productivity while promoting sustainable manufacturing practices, making it ideal for marine application.

Key words: FB-TIG Welding, Super duplex stainless steel, Mechanical Properties, Corrosion Rate

8. **Towards a Green Maritime Future : Sustainable Shipping and Waste Management India-**
Adhiga Subah, Maria Shery, Priyal P-School of Legal Studies

India, with its extensive coastline and major ports, faces significant environmental challenges in maritime trade, including emissions and inefficient waste management. The global push for Green Shipping Corridors (GSCs) presents an opportunity for India to adopt sustainable practices in its port operations. This study examines national and international frameworks like India's Maritime Vision 2030 and IMO's MARPOL Annex VI, assessing gaps in regulatory enforcement and infrastructure. Key concerns include ship-generated waste, ballast water treatment, and marine pollution. The role of GSCs in decarbonization is explored, with case studies like the Los Angeles–Shanghai Green Corridor offering insights into fuel innovation and waste management. A policy-driven approach is crucial for India's transition to sustainable shipping. Measures such as stricter regulations, public-private partnerships, and investment in clean energy infrastructure are recommended. Kochi, as a key maritime hub, can serve as a model for green port development, demonstrating how Indian ports can lead in eco-friendly maritime trade. For India to make the transition to sustainable shipping, a policy-driven strategy is essential. It is advised to implement policies including more stringent laws, public-private collaborations, and infrastructure investments to achieving a greener maritime future.

Keywords— Keywords—Sustainable Shipping, Green Ports, Green Shipping Corridors (GSCs), Maritime Decarbonization

9. GHG EMISSIONS IN MARITIME TRANSPORT: EXAMINING THE EFFECTS OF CARBON LEVY ON INDIA'S SHIPPING INTERESTS –

Mitha Ramesh -School of Legal Studies

The years following COP28 saw the beginning of extensive deliberations in international forums about charging carbon levy on shipping emissions. In addition to the growing opposition to fossil fuel subsidising (\$7 trillion globally), more than 50 states, or 66% of the world's fleet, are in support of the proposal for shipping levy of \$150 per tonne CO₂ on shipping emissions by IMO to incentivize decarbonization. India is one among the top five countries in the world providing fossil fuel subsidies; in 2022, the total quantity of fuels subsidized was \$346 billion, demonstrating the carbon-intensive nature of Indian industry. India, having an aged shipping fleet, has taken a defensive stance towards the proposed carbon levy. Apart from the EU, the Petro-States and the BRICS (including India) nations are opposed to this plan. With the IMO's "comprehensive impact assessment" showing results in favour of carbon pricing, backing for this strategy is on the rise. But carbon levy is not without challenges, especially when it comes to developing countries. There is a possibility of it substantially reducing the country's purchasing power and quantum of maritime transport which in turn could affect the GDP. The pricing could burden the local vessels, as they lack practical alternatives due to inadequate infrastructure, investment, and research on renewable alternatives. Taking into account the ongoing deliberations, the paper would be exploring India's stand on this matter and the implications of carbon pricing on the country's shipping industry and economy.

Keywords—Carbon levy, Shipping pollution, International Maritime Organisation, India, fuel subsidies.

10. Emerging Challenges in Underwater Plume Dynamics for Naval and Subsea Operations- Kiran Mukund, Anantha Krishnan G, Reghunandan –KMSME

Underwater plumes, arising from naval activities, industrial discharges, and natural phenomena, pose significant challenges in detection, monitoring, and mitigation. Despite

advancements in computational modeling and sensing technologies, emerging challenges related to environmental impact, stealth technology, and real-time monitoring persist. This paper discusses key obstacles in understanding underwater plume behavior and proposes potential solutions for future research and technological development.

11. THE ECONOMIC RATIONALE OF WATER-CENTRIC MULTIMODAL LOGISTICS TOWARDS SUSTAINABLE SHIPPING –

Abhirami S, Devika S Krishna –KMSME

The global economic crisis triggered from Covid19 pandemic has underscored the deep rooted fault lines in the massive offshore dependent global value chains. The Chinese centric supply shock and the severe demand shock from the rest of the economies emanated from the economic shutdowns have dented the sourcing (inward logistics), manufacturing / production and distribution (marketing logistics), the three pillars of global Supply Chain Management – SCM. Back to the beginning of new millennium, supply chain resilience in a globalised interdependent economy has become a contentious issue among all stakeholders. Today logistics is enjoying an elevated priority in many economies as it facilitates trade and transport. The logistics cost in India is currently ruling at 13-14% of GDP which is quite higher than the global average (7-8%). Further, the large chunk of the above cost (about 70%) accounts on transportation, one of the classical barriers of trade, due to heavily lopsided modal mix. This paper is delved to spell out the logic of a water-centric multimodal transport grid for a sustainable shipping. The salient features are: high throughput intermodal corridors will be in a better position to offer a competitive price, lead time and distance than the conventional surface transport and can generate more rural employment opportunities. Inland and coastal container barging fosters a major role in the realm of an integrated logistics platform. IWT can be perceived as land mode shipping maritime hinterland operating in shallow waters rather than a mini maritime division and can be led a leading position in technological and operational innovations. In short, the above water centric network can serve the economy and the society by delivering freight through cost-efficient and safe transport services with minimal environmental impact. After all, the key driver of freight transport demand is the socio-economic development.

Key words: Multimodal transport, Container barging, Logistic Performance Index – LPI.

12. Hydrogen Production Technologies–Pathways to a Sustainable Maritime Future-

Abhishek Krishna , Aswin S , Siva Jayakumar -KMSME

Hydrogen is emerging as a cornerstone of clean energy strategies due to its potential to reduce carbon emissions and provide an efficient energy carrier for various applications. This paper explores the primary hydrogen production technologies, categorized into biological, electrical, and chemical methods, highlighting their processes, efficiencies, and challenges. Biological hydrogen production employs microorganisms through pathways such as biophotolysis, dark fermentation, and photofermentation. Algae and cyanobacteria split water using sunlight in biophotolysis, while anaerobic bacteria convert organic matter into hydrogen during fermentation. Despite its eco-friendliness, biological production faces limitations in efficiency and scalability. Electrical hydrogen production, primarily through electrolysis, uses electric current to split water into hydrogen and oxygen. Alkaline

electrolysis (AEL) and Proton Exchange Membrane (PEM) electrolysis are the dominant methods.

While AEL offers

large-scale production at lower costs, PEM is more efficient but expensive due to the use of precious metal catalysts. Chemical production methods, such as steam methane reforming (SMR) and thermochemical water splitting, dominate current hydrogen generation. SMR, although cost effective, emits CO₂, limiting its sustainability. In contrast, thermochemical cycles, powered by renewable energy, promise a greener alternative but are still in developmental phases. The seminar will provide an in-depth analysis of the efficiencies, production rates, and environmental impacts of each technology. It will also explore advancements in green hydrogen production, which uses renewable energy sources to power electrolysis, making the process entirely carbon-neutral. As the demand for clean energy surges, understanding the strengths and limitations of various hydrogen production technologies is vital. This paper aims to offer insights into current challenges, innovative solutions, and the future outlook of hydrogen as a key player in the transition to sustainable energy systems.

13. From Anchors to Algorithms: AI-Driven Fuel Optimization in Maritime Transport-

Aan Bhagath Goutham K , Fidel S Kundukulam – KMSME

Maritime transport, which accounts for nearly 90% of global trade, faces increasing pressure to reduce costs and environmental impact. Traditional navigation and fuel consumption methods are being transformed by Artificial Intelligence (AI), which optimizes routes, lowers fuel consumption, and reduces pollutant emissions. This paper explores how AI-driven solutions enhance maritime efficiency, increasing fuel savings, pollutant reductions, and cost analysis.

Keywords : AI, Fuel, Emission, Optimize

14. Enhancing Dredging Operations For Cochin Port: Lessons From Global Practices

Abhishek Krishna , Aswin S , Siva Jayakumar – KMSME

Cochin Port, a vital maritime hub in Kerala, India, faces persistent siltation challenges, requiring substantial annual dredging with trailing suction hopper dredgers. This study explores potential strategies to enhance **dredging efficiency**, reduce operational timelines, and **lower costs** while promoting sustainability. By **analyzing existing ports** that employ advanced dredging techniques under similar conditions, along with data from online sources and a planned field study at Cochin Port, we examine the feasibility of various approaches.

Key areas of exploration include the use of advanced dredging equipment such as cutter suction dredgers, water injection dredging, and sand by-passing systems, which have been effective in managing sedimentation in comparable environments. Additionally, smart technologies like **AI-based sediment prediction**, real-time monitoring, and automated dredging systems are investigated for their potential to optimize operations. Effective sediment management strategies, including mangrove restoration and tidal flow adjustments, are also assessed for their role in **natural sediment control**. Furthermore, we explore the viability of beneficial **sediment reuse**, where dredged materials can be repurposed for **land reclamation**, coastal protection, or construction applications.

By evaluating these techniques in the context of Cochin Port's unique challenges—such as high siltation rates, tidal dynamics, and marine clay composition—this study aims to provide insights into improving dredging practices while minimizing environmental impact.

15. Sailing Into the Future: Molten Salt Reactors as the Key to Zero-Carbon Maritime Propulsion

Aman Soopy Benzeera, Adarsh J. S - KMSME

The global shipping industry is striving for zero-carbon emissions, driven by stringent environmental regulations and the urgent need to combat climate change. While alternative fuels such as LNG, methanol, hydrogen, and ammonia have been proposed, they face challenges related to energy density, storage, and infrastructure. In contrast, nuclear propulsion, particularly through Small Modular Reactors (SMRs), offers a high-energy, zero-emission alternative. This paper focuses on the Molten Salt Reactor (MSR) as a next-generation solution for maritime applications, emphasizing its inherent safety mechanisms, high thermal efficiency, and long operational lifespan compared to conventional nuclear reactors.

A comparative analysis is conducted between MSRs and other sustainable marine fuels, evaluating factors such as cost, energy output, refueling requirements, and scalability. The study presents a detailed cost breakdown over a 25-year operational period, demonstrating that while MSRs require higher initial investment, their low fuel costs, minimal refueling needs, and long term economic benefits make them a financially viable solution for the shipping industry.

Additionally, the paper addresses one of the key concerns surrounding nuclear propulsion which is waste management. Modern reprocessing techniques and molten salt waste handling strategies are explored, showcasing how MSRs can significantly reduce both waste volume and radiotoxicity compared to conventional nuclear systems.

By examining both the technical feasibility and economic sustainability of MSRs in maritime applications, this paper argues that advanced nuclear technology could revolutionize the shipping industry. With the International Maritime Organization (IMO) targeting net-zero emissions by 2050, MSRs offer a scalable, efficient, and sustainable propulsion system that could reshape the future of maritime transportation and drive the industry toward a cleaner, more sustainable future.

Keywords: Decarbonization, Small Modular Reactor, Molten Salt Reactor, Safety, Nuclear waste.