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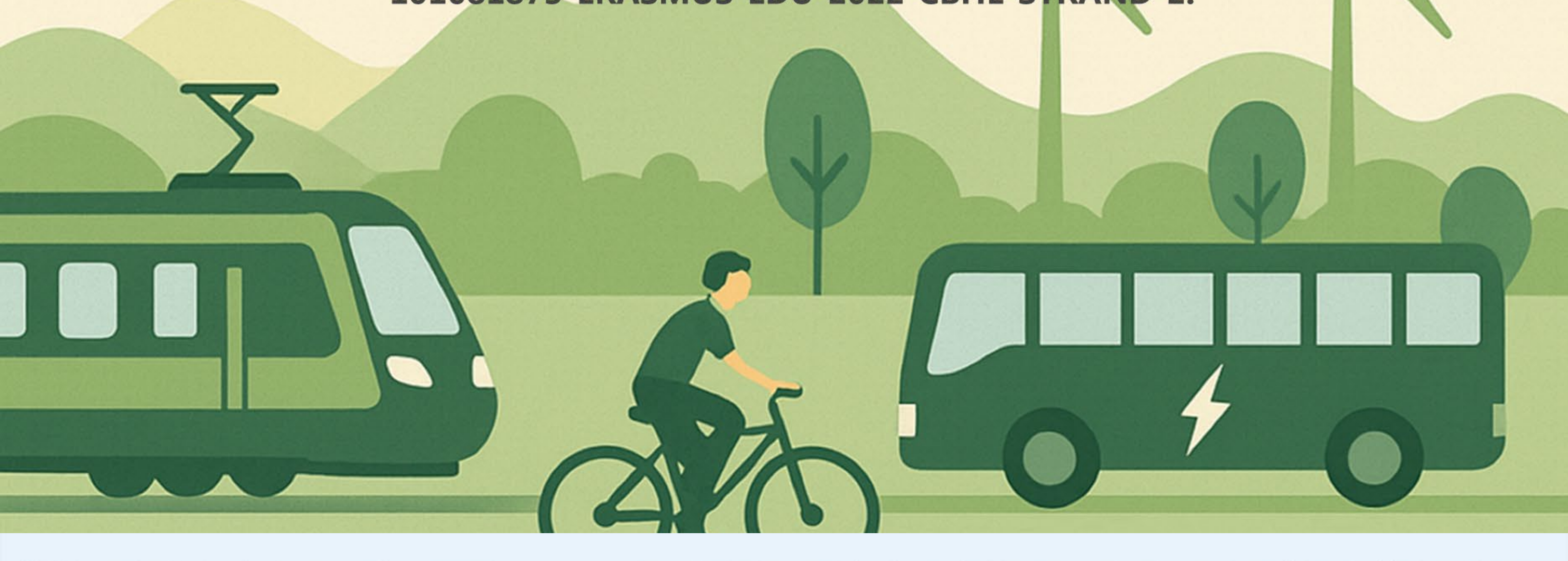

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EMISSION REDUCTION OF MARINE PROPULSION SYSTEMS IN SECA ZONES THROUGH THE INTEGRATION OF HYDROGEN TECHNOLOGIES

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Abstract

The maritime transport sector is subject to progressively stricter environmental regulations under the International Maritime Organization (IMO), particularly through MARPOL Annex VI and the establishment of Emission Control Areas (ECAs). Within Sulphur Emission Control Areas (SECAs), limits on Sulphur oxides (SO_x), nitrogen oxides (NO_x), particulate matter, and carbon dioxide (CO_2) significantly constrain the operation of conventionally fueled vessels. While compliance is currently achieved through low-Sulphur fuels, exhaust gas cleaning systems, or engine modifications, these measures present economic, operational, and environmental trade-offs. As a result, alternative energy carriers and propulsion technologies, including hydrogen-based fuel cells (FCs), are increasingly considered for short-sea and regional shipping.

This paper presents a qualitative and comparative analysis of conventional marine diesel propulsion systems and fuel cell–diesel hybrid propulsion concepts for ships operating in SECA zones. The analysis is based on regulatory requirements, emission performance indicators, energy efficiency metrics, and operational considerations relevant to maritime applications. International regulations, including IMO and MARPOL provisions, are reviewed alongside publicly available

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technical data from existing and demonstrative fuel cell-powered vessels. The role of hydrogen as a marine fuel, including storage, safety, and integration aspects, is assessed within the context of hybrid propulsion architectures.

The comparison indicates that fuel cell–diesel hybrid systems offer substantial reductions in SO_x, NO_x, particulate matter, and CO_2 emissions when operating in SECA zones, particularly during low- and medium-load conditions. Fuel cell operation enables near-zero local emissions, while the hybrid configuration maintains redundancy and operational flexibility. Case studies of existing fuel cell installations in maritime applications demonstrate technical feasibility, improved emission profiles, and compliance with current ECA requirements, albeit with limitations related to power density and fuel storage.

Fuel cell–diesel hybrid propulsion systems represent a viable transitional solution for emission-sensitive maritime operations in SECA zones. While challenges remain regarding hydrogen infrastructure, system costs, and large-scale implementation, ongoing technological development and regulatory support are expected to enhance feasibility. The adoption of fuel cell technology can contribute significantly to IMO emission reduction goals and support the broader transition toward sustainable maritime transport.

Keywords: ECA zones, maritime emissions reduction, fuel-cell propulsion, green hydrogen

I. INTRODUCTION

International maritime transport carries more than 80% of global trade by volume and remains a critical component of the global economy. The maritime sector enables large-scale movement of raw materials, energy resources, and manufactured goods, supporting global supply chains and international economic stability. Despite its relatively high energy efficiency relative to the mass of cargo and distance transported, shipping remains a significant source of atmospheric pollution due to the scale of global operations and the continued reliance on fossil-based propulsion systems. Sulphur oxides (SO_x) and nitrogen oxides (NO_x) emissions from ships have attracted increasing regulatory and scientific attention. Historically, the widespread use of high sulphur residual fuels in large marine compression-ignition engines has resulted in substantial emissions of SO_x and NO_x, particularly in coastal and port regions with high shipping traffic. SOx are formed through the oxidation of sulphur compounds contained in marine fuels during combustion, while NOx arise primarily from high-temperature combustion processes that promote the fixation of atmospheric nitrogen. In response to these challenges, the International Maritime Organization (IMO) introduced Annex VI to the MARPOL Convention, establishing global limits on air pollutant

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emissions from ships and defining Emission Control Areas (ECA) where more stringent requirements apply. Within Sulphur Emission Control Areas (SECA), the maximum permitted sulphur content of marine fuels is limited to 0.10% m/m, compared with the global limit of 0.50% m/m. In parallel, Nitrogen Emission Control Areas (NECA) impose Tier III NO_x emission limits on marine diesel engines installed on ships constructed after the relevant enforcement dates. These limits require reductions of approximately 75-80% relative to Tier I standards, typically necessitating advanced exhaust after-treatment systems such as selective catalytic reduction (SCR). Conventional compliance strategies for SECA and NECA requirements therefore include the use of low-sulphur fuels, exhaust-gas cleaning systems, and NO_x after-treatment technologies. Although these approaches enable regulatory compliance, they do not address pollutant formation at the source and may introduce additional economic and operational burdens. This has led to growing interest in alternative propulsion concepts capable of fundamentally reducing emissions rather than mitigating them downstream. Hydrogen fuel-cell systems represent a fundamentally different approach to marine propulsion and onboard power generation. Fuel cells convert chemical energy directly into electrical energy through electrochemical reactions, without combustion. As hydrogen contains no sulphur, fuel-cell operation inherently eliminates SO_x emissions at the point of use. Furthermore, the absence of high-temperature combustion effectively prevents NO_x formation. These characteristics position hydrogen fuel-cell systems as intrinsically compliant solutions for operation within SECA and NECA zones. Fuel-cell propulsion technology has advanced significantly over the past two decades, with an increasing number of maritime demonstrations and early commercial projects confirming its technical feasibility. Proton exchange membrane fuel cells (PEMFC) are generally favored for small to medium-sized vessels and hybrid propulsion architectures due to their high-power density, modularity, and rapid load response. This flexibility is particularly relevant for larger vessels and offshore applications where hydrogen storage and bunkering infrastructure may be constrained. This paper provides a techno-regulatory assessment of hydrogen fuel-cell propulsion systems for maritime operation within SECA zones. By integrating regulatory requirements, emission mechanisms, and empirical evidence from operational projects, the study evaluates the extent to which hydrogen-based propulsion can support compliance with existing emission limits. Furthermore, the emergence of multi-source hybrid architecture, integrating fuel cells with battery energy storage and conventional internal combustion, presents a transitional pathway for achieving localized zero-emission operations while maintaining traditional maritime range requirements. The results contribute to the broader assessment of hydrogen technologies as a viable solution for emission reduction and long-term sustainability in the maritime sector.

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II. METHODS

A structured methodology was applied to evaluate the suitability of hydrogen fuel-cell propulsion systems for compliance with emission requirements in SECA and NECA zones. The analysis is based exclusively on secondary data, including international regulatory documents, peer-reviewed scientific literature, and publicly available technical information from operational and demonstration projects. No primary experimental measurements were conducted. The methodological framework combines regulatory analysis, emission performance assessment, energy efficiency evaluation, and qualitative case study review. This integrated approach enables a consistent comparison between conventional diesel propulsion systems and hydrogen fuel-cell-based solutions under realistic operational and regulatory conditions.

1. Regulatory analysis

The regulatory analysis focused on the international framework governing ship air emissions, with particular emphasis on MARPOL Annex VI. Regulation 14, addressing SOx emissions through fuel sulphur content limits, and Regulation 13, governing NOx emissions from marine engines. The maximum global fuel sulphur content was historically limited to 3.50% m/m prior to 2020. It was reduced to 0.50% m/m globally from 1 January 2020 and is further restricted to 0.10% m/m within designated Tier I, Tier II, and Tier III NO_x standards were reviewed, with particular attention given to Tier III limits applicable within NECA. Regulatory limits were converted into units of specific emissions (g/kWh) to facilitate direct comparison. Fuel sulphur content limits were translated into equivalent SOx emissions, assuming complete oxidation during combustion, consistent with standard maritime emission inventory practices. Figure 1 illustrates the geographical areas designated as ECA zones under MARPOL Annex VI. Since 1 January 2020, a global fuel sulphur limit of 0,50% m/m applies to all ships. However, stricter limits remain in force within designated ECA zones, where a maximum sulphur content of 0.10% m/m is required in the North Sea, Baltic Sea, North American, US Caribbean regions and the Mediterranean Sea. Additional sulphur control zones established by individual states are also indicated.

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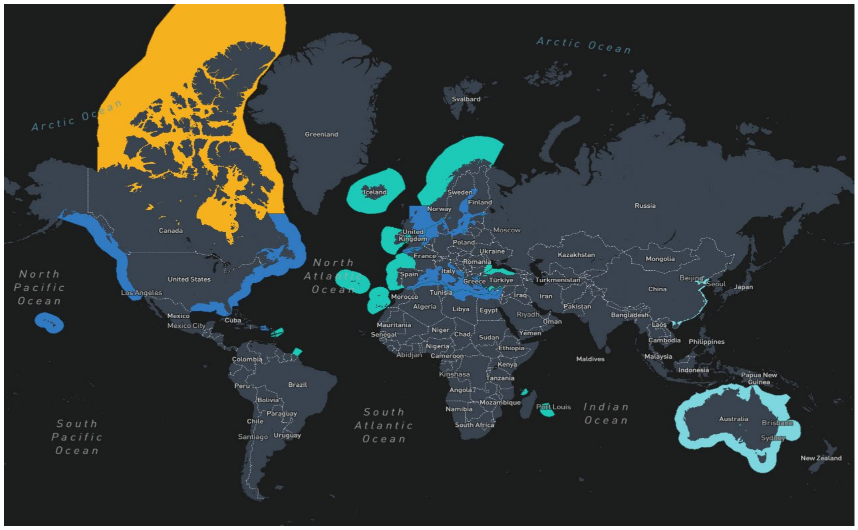

Figure 1. Global map of SECA zones under MARPOL Annex VI Regulation 14, alongside additional regional sulphur control zones implemented by individual states.

2. Emission performance assessment

A comparative emission performance assessment was conducted for conventional marine diesel engines and hydrogen fuel-cell systems. Diesel engine emissions were represented using standardized emission factors corresponding to steady-state operation near rated load, reflecting typical cruising and auxiliary power conditions. Hydrogen fuel-cell systems were assumed to produce zero SOx emissions and negligible NOx emissions at the point of use due to the absence of fuel-bound sulphur and combustion processes. Hybrid diesel–hydrogen configurations were included to reflect transitional operational strategies. In these configurations, fuel cells supply auxiliary loads, hotel loads, or low-speed propulsion power, particularly during port operations and maneuvering. This operating strategy reduces exposure to regulated emissions in sensitive coastal and port areas while maintaining operational flexibility.

3. Energy efficiency and fuel consumption

Energy efficiency and fuel consumption were evaluated using a comparative framework that contrasts the thermodynamic performance of electrochemical conversion against internal combustion. For the diesel baseline, a specific fuel consumption (SFC) of 162.3 g/kWh was utilized, a value representative of modern high-efficiency marine engines like the CMD-WinGD units. Hydrogen consumption rates were derived from the performance data of the MV Sea Change and H2-Barge 1, accounting for a stack efficiency range of 45% to 55%. The analysis also factored in the

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lower heating value (LHV) of hydrogen (33.3 kWh/kg) to determine the mass flow requirements. Furthermore, the role of battery energy storage systems (BESS) was assessed not merely as a power source, but as a dynamic buffer for peak shaving and transient load handling.

4. Case study analysis

The case study methodology focused on the practical integration of hydrogen systems into operational vessels, specifically those navigating SECA and NECA zones. The analysis prioritized vessels with documented operational hours, such as the MF Hydra, H2-Barge 1, and the MV HANARIA, to evaluate different storage and power-train architectures. The qualitative review focused on the "Triple Hybrid" configuration (Diesel-Fuel Cell-Battery), examining how these vessels manage the transition between zero-emission modes in port and conventional or hybrid modes during transit. By focusing on vessels that handle multi-megawatt auxiliary loads or significant hotel loads, the study provides a realistic assessment of how hydrogen technology can be scaled beyond small-scale demonstration projects to larger commercial applications.

III. RESULTS

1. SO_x emission mechanisms and regulatory limits

SO_x emissions are fundamentally a byproduct of fuel quality, with conventional compliance in SECA zones relying on low-sulphur fuels (0.10% m/m) or exhaust gas cleaning systems. Technical data from the H2-Barge 1 and the MF Hydra confirm that hydrogen fuel-cell systems eliminate these pollutants entirely at the source, as hydrogen is an inherently sulphur free fuel. While a vessel using 0.10% sulphur fuel still emits approximately 1.5 g/kWh of SO_2, hydrogen-powered vessels achieve a 100% reduction, effectively removing the need for the chemical monitoring and waste-stream management associated with scrubbers. This is particularly significant for short-sea shipping and inland navigation in the North Sea and Baltic Sea SECA, where vessels like the H2-Barge 1 operate. By carrying roughly 1,000 kg of gaseous hydrogen at 300 bar, such vessels provide a regulatory cushion that exceeds current MARPOL Annex VI requirements, ensuring long-term compliance with potentially even stricter future local air quality standards in European ports. Comparative test-bed data confirms that at lower operational loads (100 kW), fuel-cell systems emit only 9% of CO_2 produced by equivalent commercial diesel engines.

2. NO_x formation and Tier III compliance

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NO_x formation is a temperature-dependent process occurring during the combustion of fossil fuels, necessitating SCR or exhaust gas recirculation (EGR) to meet Tier III NECA standards. Hydrogen fuel cells, operating at much lower temperatures and through electrochemical rather than thermal processes, avoid NOx formation entirely. Operational evidence from the MV HANARIA illustrates the efficacy of the hybrid approach; by utilizing a 480 kW PEMFC system for harbor entry and hotel loads, the vessel eliminates localized NOx emissions during the most sensitive phases of operation. This "Zero-Emission Mode" allows hybrid vessels to bypass the complexities of SCR temperature management, which often fails to maintain catalyst efficiency during low-load maneuvering when exhaust temperatures drop. For larger-scale applications, the displacement of auxiliary diesel generators with fuel cells, as explored in the ShipFC project with its 2 MW ammonia-to-hydrogen system, demonstrates a path toward eliminating the NO_x produced by ships while they are docked and providing power to refrigerated containers or onboard utilities.

3. Energy Efficiency and Hydrogen Consumption

The energy efficiency of the analyzed hydrogen systems remains superior to conventional internal combustion, particularly under partial load conditions. The MV Sea Change provides a concrete benchmark, consuming approximately 100 kg of gaseous hydrogen daily for its 360 kW power plant. To generate equivalent energy, a diesel generator would consume nearly double the mass in marine gas oil, highlighting hydrogen's high gravimetric energy density. However, the volumetric challenge is evidenced by the H2-Barge 1, which requires two 40-foot containers for its 300 bar gaseous storage to support its 825 kW stack. This illustrates that while fuel cells are highly efficient, the primary constraint for scaling remains the space required for gaseous storage. Hybridization with a battery, as seen in the Elektra tugboat, partially mitigates this by allowing the battery to handle peak propulsion power while the gaseous hydrogen system provides a steady, high efficiency energy supply for the hotel loads, effectively extending the vessel's operational range from 8 to 16 hours.

4. Operational case studies

The integration of hydrogen into the maritime sector is currently defined by the success of hybrid architectures that combine different energy sources to balance range, power availability, and emissions compliance. Operational vessels employing fuel-cell and battery systems alongside conventional diesel engines demonstrate how localized zero-emission operation can be achieved without compromising safety, redundancy, or overall operational flexibility. Table 1 summarizes the installed fuel-cell and diesel engine power for each vessel.

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Table 1. Installed fuel-cell and diesel engine power for each vessel.

Vessel	Vessel type	Fuel cell power (kW)	Diesel engine power (kW)
MV Sea Change	Passenger ferry	360	-
H2-Barge 1	Inland cargo barge	825	-
MF Hydra	Ro-Pax ferry	400	2 × 750
MV HANARIA	Research / coastal vessel	300	2 × 1000
Elektra tugboat	Harbour tugboat	300	2 × 1800

The MF Hydra represents a significant milestone in SECA compliance, utilizing 400 kW of proton exchange membrane fuel-cell power, 1.5 MW of installed diesel generator capacity, and a 1.36 MWh lithium-ion battery system. The impact of this configuration on SO_x emissions is illustrated in Figure 2, which compares SO_x emissions for pure diesel operation using pre-2000 high-sulphur fuel (3.50% m/m), the current global sulphur cap (0.50% m/m), SECA-compliant low-sulphur fuel (0.10% m/m), and the vessel's current hybrid operating profile. The results show that while compliance with SECA regulations through low-sulphur fuel significantly reduces SO_x emissions, the integration of hydrogen fuel cells further reduces emissions by minimizing diesel operation during regulated operating phases.

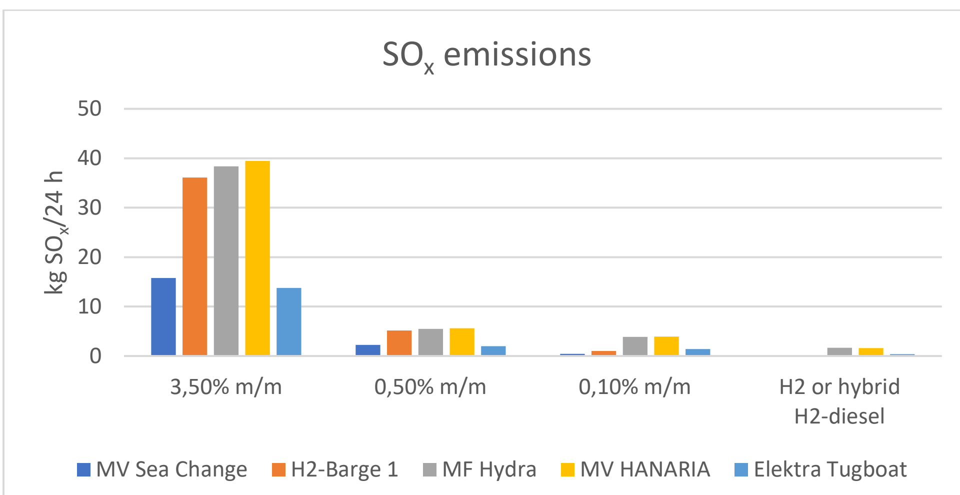

Figure 2. Comparison of SO_x emissions for vessels under pure diesel operation (3.50%, 0.5% and 0.10% sulphur content) and current hydrogen or hybrid propulsion configurations (24 h normalized).

A similar operational strategy is observed in the inland container vessel H2-Barge 1, which operates exclusively on an 825 kW hydrogen fuel-cell system supported by battery buffering. As shown in

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Figure 2, the vessel achieves complete elimination of SO_x emissions at the point of use, independent of fuel sulphur limits, demonstrating inherent compliance with SECA requirements. The same figure highlights the contrast between hydrogen-based operation and equivalent diesel propulsion using both high- and low-sulphur fuels over a normalized 24-hour operating period. NO_x exhibit an even clearer distinction between combustion-based and fuel-cell-based propulsion. NO_x emissions for conventional diesel propulsion remain significant despite Tier III compliance requirements. Figure 3 presents a comparison of NO_x emissions for pure diesel propulsion and the current hydrogen or hybrid operating modes of the analyzed vessels. Fully hydrogen-powered vessels such as MV Sea Change and H2-Barge 1 demonstrate zero NO_x emissions, reflecting the absence of high-temperature combustion processes. Hybrid vessels, including MF Hydra, MV HANARIA, and the Elektra tugboat, show substantially reduced NO_x emissions compared with pure diesel operation due to the displacement of diesel-generated power during port operations and low-load conditions.

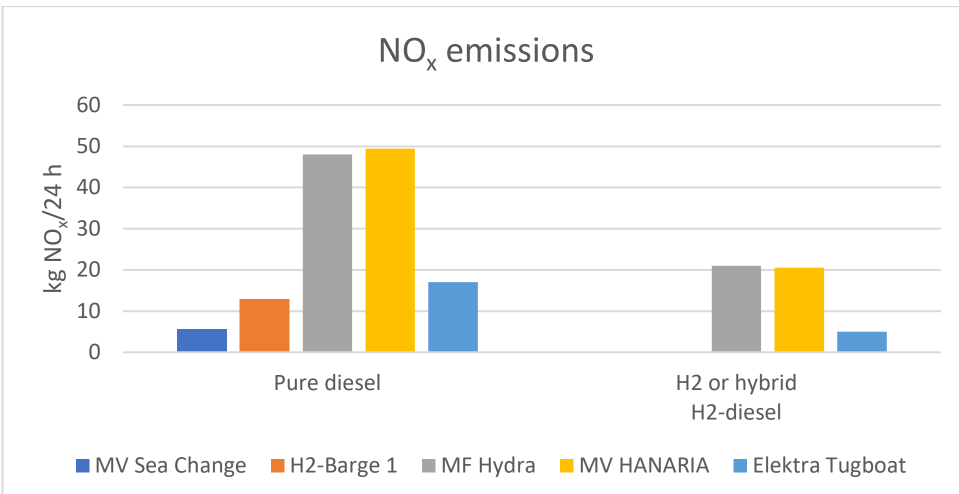

Figure 3. NO_x emissions for pure diesel propulsion compared with current hydrogen and hybrid propulsion configurations (24 h normalized).

Carbon dioxide emissions provide insight into the broader climate impact of hydrogen integration. Figure 4 compares CO_2 emissions for pure diesel propulsion and current vessel configurations. Fully hydrogen-powered vessels, such as MV Sea Change and H2-Barge 1, achieve zero operational CO_2 emissions. Hybrid configurations demonstrate substantial reductions relative to diesel-only operation, as fuel cells and batteries displace diesel generator usage during high-frequency port calls and auxiliary load operation. These reductions are particularly evident for vessels with significant hotel loads and frequent maneuvering cycles.

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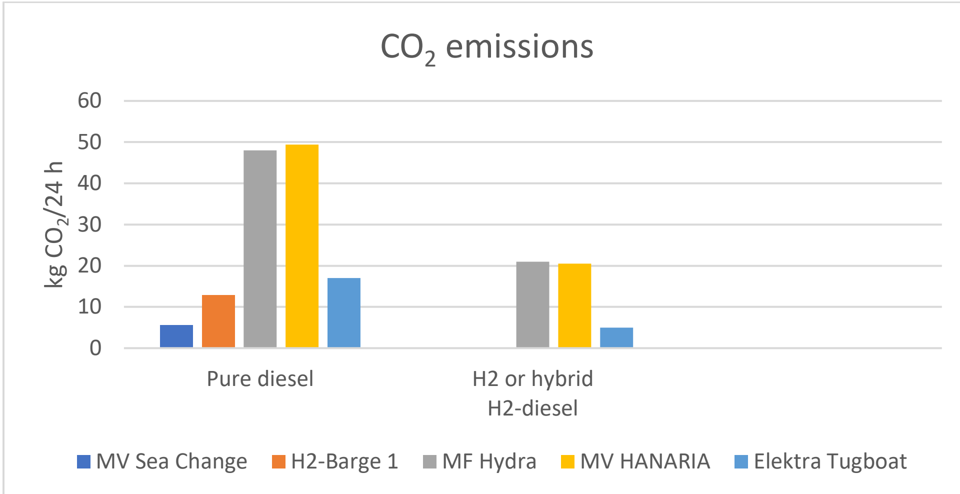

Figure 4. CO_2 emissions for pure diesel propulsion and current vessel operating configurations, illustrating the impact of hydrogen and hybrid power systems (24 h normalized).

Collectively, the emission comparisons presented in Figures 2–4 confirm that hydrogen fuel-cell systems, whether deployed as full propulsion solutions or as part of hybrid architectures, provide immediate and measurable reductions in SO_x, NO_x, and CO_2 emissions. These operational case studies demonstrate that gaseous hydrogen systems, when integrated with intelligent energy management and battery storage, can support MW-scale inland and coastal vessels while achieving compliance with SECA and NECA requirements.

IV. DISCUSSION AND CONCLUSION

Hydrogen fuel-cell propulsion provides inherent compliance with SO_x and NO_x emission regulations by eliminating fuel-bound sulphur and combustion-related nitrogen oxide formation. The elimination of SO_x emissions directly satisfies the stringent requirements imposed within SECA zones, while NO_x emissions from fuel-cell systems remain orders of magnitude below Tier III limits applicable within NECA zones. Hybrid diesel–hydrogen configurations provide a pragmatic transitional pathway for the maritime sector by balancing zero-emission requirements with operational redundancy. By supplying auxiliary power, hotel loads, and low-load propulsion through fuel cells, conventional engines can be operated closer to optimal efficiency or shut down entirely in sensitive operating modes. Integration of battery energy storage systems, as evidenced by the 1.36 MWh installation on the MF Hydra, further enhances operational flexibility by enabling peak shaving and improved dynamic response. These real-world applications prove that gaseous hydrogen storage at pressures of 250 to 350 bar can effectively support MW-scale operations, bridging the gap between small demonstration boats and commercial inland shipping. From a

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greenhouse gas perspective, hydrogen fuel-cell systems offer substantial reductions in CO_2 emissions compared with conventional diesel propulsion. While hybrid configurations typically achieve reductions in the range of 20 to 50%, specialized projects like the H2-Barge 1 demonstrate that a shift to pure fuel-cell-battery architectures can eliminate up to 2,000 tonnes of CO_2 equivalent per year on high traffic corridors. These reductions align with international maritime decarbonization objectives and support compliance with long-term greenhouse gas reduction targets. When coupled with low-carbon hydrogen or alternative fuels for SOFCs, such as the ammonia-to-hydrogen conversion explored in the ShipFC project, fuel-cell propulsion offers a definitive pathway toward near-zero lifecycle emissions. Several technical challenges remain for widespread adoption. Fuel-cell durability is influenced by electrochemical degradation mechanisms, load cycling, and exposure to the maritime environment, necessitating robust system design and optimized control strategies. Hybridization with batteries reduces fuel-cell stress and improves longevity, while SOFCs provide additional fuel flexibility that can alleviate constraints related to hydrogen storage and availability. PEMFCs, characterized by high power density and modularity, are particularly well suited to small and medium-sized vessels operating within emission control areas. Economic feasibility is closely linked to regulatory conditions. While hydrogen fuel-cell systems currently have higher capital cost than conventional diesel engines, operational savings associated with the elimination of sulphur compliance measures, reduced NOx control requirements, and potential carbon pricing mechanisms can partially or fully offset the initial investment. For vessels operating predominantly within SECA zones, the avoidance of sulphur related compliance costs strengthens the economic case for hydrogen propulsion, particularly in hybrid configurations that balance fuel cost and emission reduction. In conclusion, hydrogen fuel-cell propulsion represents a technically viable and regulation resilient solution for maritime operation within emission control areas. Demonstration projects confirm scalability across vessel classes and power levels, while hybrid architectures enable deployment under existing infrastructure constraints. Continued development of hydrogen supply chains, cost reductions in low-carbon fuel production, and regulatory clarity will be critical to accelerating adoption. The combined benefits of eliminating SO_x and NO_x emissions, reducing CO_2 output, and improving air quality position hydrogen fuel-cell systems as a technology in the transition toward sustainable and low-emission maritime transport.

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REFERENCES

Ballard Power Systems. (2023). *Norled MF Hydra operational milestones*. https://blog.ballard.com/marine/norled-hydra-operational-milestones-ballard-fcwave

Elkafas, A. G., Rivarolo, M., Gadducci, E., Magistri, L., & Massardo, A. F. (2023). Fuel cell systems for maritime: A review of research development, commercial products, applications, and perspectives. *Processes, 11*(1), 97. https://doi.org/10.3390/pr11010097

EnkiAI. (2023). *Fuel cell installations in maritime: Top 10 projects and companies*. https://enkiai.com/fuel-cell-installations-in-maritime-top-10-projects-companies

European Maritime Safety Agency. (2022). *Air pollutant emission factors for maritime transport*. https://www.emsa.europa.eu/publications/emsa-reports.html

European Maritime Safety Agency. (2022). *European maritime transport environmental report*. https://www.emsa.europa.eu/environment/emissions.html

Future Proof Shipping. (2023). *Future Proof Shipping launches first hydrogen-powered inland container ship.* https://futureproofshipping.com/news/2023/future-proof-shipping-launches-first-hydrogen-powered-inland-container-ship/

Guan, W., Chen, L., Wang, Z., Chen, J., Ye, Q., & Fan, H. (2024). A 500 kW hydrogen fuel cell-powered vessel: From concept to sailing. *International Journal of Hydrogen Energy, 89*, 1466–1481. https://doi.org/10.1016/j.ijhydene.2024.09.418

International Energy Agency. (2023). *Global hydrogen review 2023*. https://www.iea.org/reports/global-hydrogen-review-2023

International Maritime Organization. (2022). *Fourth IMO greenhouse gas study*. https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study.aspx

International Maritime Organization. (2022). *International convention for the prevention of pollution from ships (MARPOL), Annex VI.* https://www.imo.org/en/about/conventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx

International Maritime Organization. (2022). *Nitrogen oxides (NO_x) – Regulation 13*. https://www.imo.org/en/ourwork/environment/pages/nitrogen-oxides-(nox)-%E2%80%93-regulation-13.aspx

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International Maritime Organization. (2022). *Sulphur oxides (SO_x) – Regulation 14*. https://www.imo.org/en/ourwork/environment/pages/sulphur-oxides-(sox)-%E2%80%93-regulation-14.aspx

Maritime Optima AS. (2026). *Maritime Optima – Emission control areas map* [Web application]. https://app.maritimeoptima.com/select

Melideo, D., & Desideri, U. (2024). The use of hydrogen as alternative fuel for ship propulsion: A case study of full and partial retrofitting of roll-on/roll-off vessels for short distance routes. *International Journal of Hydrogen Energy, 50*(Part B), 1045–1055. https://doi.org/10.1016/j.ijhydene.2023.10.142

MOL Service. (2024). *The birth of hydrogen passenger vessel "HANARIA*." https://www.mol-service.com/blog/hanaria

Nazemian, A., Boulougouris, E., & Melemadom, S. K. (2024). Hybrid and alternative fuel power management systems in ships - Multi-criteria decision-making assessment. *Proceedings of 15th International Marine Design Conference* (IMDC-2024), Amsterdam, Netherlands.

Pourrahmani, H., Gay, M., Yavarinasab, A., & Van Herle, J. (2022). Optimization and dynamic responses of an integrated fuel cell and battery system for an 800 kW ferry: A case study. *Energy Reports, 8*, 9757–9776. https://doi.org/10.1016/j.egyr.2022.07.144

Pratt, J. W., & Klebanoff, L. E. (2025). *Performance assessment of the MV Sea Change hydrogen fuel cell ferry*. Sandia National Laboratories. https://www.sandia.gov/app/uploads/sites/273/2025/02/Sea-Change-DOE-Report.pdf

Roh, G., Kim, H., Jeon, H., & Yoon, K. (2019). Fuel consumption and CO_2 emission reductions of ships powered by a fuel-cell-based hybrid power source. *Journal of Marine Science and Engineering, 7*(7), 230. https://doi.org/10.3390/jmse7070230

Saadeldin, M., Vasylyev, A., Rivarolo, M., & Sorce, A. (2026). Feasibility analysis of hydrogen fuel cell-powered passenger vessels: A multi-criteria and MILP-based analysis for sustainable inland navigation. *Ocean Engineering, 349,* 124186. https://doi.org/10.1016/j.oceaneng.2026.124186

Shim, H., Kim, Y. H., Hong, J.-P., Hwang, D., & Kang, H. J. (2023). Marine demonstration of alternative fuels on the basis of propulsion load sharing for sustainable ship design. *Journal of Marine Science and Engineering, 11*(3), 567. https://doi.org/10.3390/jmse11030567

United Nations Conference on Trade and Development. (2022). *Review of maritime transport 2022*. https://unctad.org/publication/review-maritime-transport-2022

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Ustolin, F., Campari, A., & Taccani, R. (2022). An extensive review of liquid hydrogen in transportation with focus on the maritime sector. *Journal of Marine Science and Engineering, 10*(9), 1222. https://doi.org/10.3390/jmse10091222

Wang, H., Liu, Y., Yang, Y., Yan, R., & Wang, S. (2023). Optimal shipping route under the designation of the Mediterranean sulfur emission control area: Mathematical models and applications. *Mathematics, 11*(24), 4897. https://doi.org/10.3390/math11244897

Wang, Z., Dong, B., Wang, Y., Li, M., Liu, H., & Han, F. (2024). Analysis and evaluation of fuel cell technologies for sustainable ship power: Energy efficiency and environmental impact. *Energy Conversion and Management: X, 21*, 100482. https://doi.org/10.1016/j.ecmx.2023.100482

Zhou, Z., & Tao, J. (2025). Hydrogen-powered vessels in green maritime decarbonization: Policy drivers, technological frontiers and challenges. *Frontiers in Marine Science, 12*. https://doi.org/10.3389/fmars.2025.1601617

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International conference on sustainable mobility

Agenda

Project title: International Engineering Competence Centres to push Sustainable Mobility Development in Albania and Montenegro
Acronym: INTEC

Work package	
WP11	**International conference**
TASK	
11.4	Coummunity Building Events

Dates	05.03.-06.03.2026
City	Tirana
Meeting venue	POLIS University Entrance Hall
Address	Rr. Bylis 12, Kodi Postar 1051, Kutia Postare 2995, Tirana, Albania

05.03.2026	
Entrance Hall, POLIS University	
8:30 – 9:00	**Registration**
9:00 – 9:30	**Opening Performance**
Welcome session – Auditorium A5 (Ground floor)	
9:30 – 10:00	**Opening Remarks** **Dr. Elona Karafili** (Vice Rector, POLIS University) **Dr. Flora Krasniqi** (Head of Office of Projects and Internationalization, POLIS University) **DI Daniela Wenzl** (INTEC Project Coordinator)
Auditorium A5 (Ground floor)	
10:00 –11:00	**Keynote speakers** **DI Horst Pflügl AVL** Collaborative Research for sustainable Mobility **DPSHTRR Representative** – (General Directorate of Road Transport Services in Albania)
11:15 – 11:30	**Coffee break (Moving into parallel sessions)**

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11:30	SESSION 1: POLITICAL AND REGULATORY FRAMEWORK AULA B1	SESSION 2: TECHNOLOGICAL INNOVATION AULA B4
11:30 – 11:45	**Opening Session:** Prof. Emeritus dr Nataša Gospić (FSKL)	**Opening Session:** Associate Prof. Ivan Tolj (US)
11:45 – 12:00	**Integrating Event Data Recorder (EDR) Technology into Sustainable Road Safety Frameworks within the European Green Deal** Eriselda Alimeti, Parid Milo, Mentor Çejku, Anis Sulejmani, Odhisea Koça	**Empirical Comparative Study of Structural CFRP Sandwich Structure Inserts for Out-of-Plane loads** Imre Kovács
12:00 – 12:15	**Infrastructure Readiness for Sustainable Mobility: EU Frameworks and the Case of Albania** Ervin Kalemaj, Parid Milo, Mentor Çejku, Anis Sulejmani, Odhisea Koça	**The Role of Intermodal Transportation for the Sustainable Mobility** Márton Kovács
12:15 – 12:30	**Review of the Evolution of International Ship Energy Efficiency Regulations and the Albanian context** Dr. Blenard Xhaferaj, Doklejda Hodaj	**Impact of Heat Pump Systems on Winter Energy Use and Driving Range in Battery Electric Vehicles** Luis Henrique Pereira Martins
12:30 – 12:45	**Renewable Energy Procurement (CPPA) and Transport Electrification: European Perspectives and Albanian Challenge** Antonio Ndoci, Anis Sulejmani, Odhisea Koça, Mentor Çejku, Parid Milo	**Liquid Cooling Systems for Electric Vehicle Batteries: Improving Safety, Performance and Sustainability** João Miguel de Almeida Ribeiro Silva
12:45 – 13:00	**The Current Status of Autonomous Vehicle**	**Analysis of Battery Charging and Discharging Behavior for Electric Vehicle Applications** Leona Markic, Luka Filipović

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	Technology Adoption in the Balkan Region Darjana Lopičić, Oliver Popović, Miloš Ilić, Bojan Kocić	
13:00 – 14:00	**Lunch**	
14:00 – 14:15	**Reviewing the European Green Deal in Energy, Mobility and Industry** Veselinka Calasan, Ivana Ognjanovic	**Automotive Cooling Systems Sustainability: A Focus on the Expansion Tank** Ana Inês Barbeiro Casimiro
14:15 – 14:30	**The European Green Deal and its National Implementation: From Strategy to Practice** Blerina Bektashi, Andi Bektashi	**Design and Development of a Constant-Volume Combustion Chamber for Optical Investigation of Hydrogen and Water Injection Under Engine-like Conditions** Julius Hollerith, Prof. Dr. Bhavin Kapadia
14:30 – 14:45	**From Prediction to Regulation: Evidence Production Approaches in Autonomous Mobility Research and Their Policy Implications** Sadmira Malaj	**Emission Reduction of Marine Propulsion Systems in SECA Zones Through the Integration of Hydrogen Technologies** Motalleb Miri, Ivan Radaš, Marija Mandić, Ivan Tolj
14:45 – 15:00	**Questions and Discussion**	**A Comprehensive Analysis of Ventilation System for Enhanced Energy Efficiency in Marine Propulsion Applications** Sara Blašković, Gojmir Radica, Jakov Šimunović

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15:00 - 15:15		**Design and Topology Optimization of a Lightweight Chain Sprocket for Electric Motorcycle Applications** Teo Čolović, Ivo Marinić-Kragić
15:15 - 15:30	**SESSION 3: ECONOMIC AND BUSINESS PRESPECTIVES + CASE STUDIES AND GOOD PRACTICES** Aula B1 **Opening Session:** Dr. Anis Sulejmani (PUT)	**Questions and Discussion**
15:30 - 15:45	**Managing Renewable Energy Resources as a Foundation for Sustainable Mobility Transitions** Deivi Sinanaliaj, Martin Bektashi	
15:45 - 16:00	**Feasibility of Electric Bus deployment in Montenegro: A Case Study of Budva (Erasmus+ INTEC / IECC Context)** Anastasija Mrkajic, Vinko Nikic.	
16:00 -16:15	**Children Paths as an Urban Regeneration Strategy: Naim Frasheri Study Case** Dejvi Dauti	
16:15 - 16:45	**Questions and Discussion**	

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International conference on sustainable mobility

Agenda

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Dates	05.03.-06.03.2026
City	Tirana
Meeting venue	POLIS University Entrance Hall
Address	Rr. Bylis 12, Kodi Postar 1051, Kutia Postare 2995, Tirana, Albania

06.03.2026		
First Floor Hall, POLIS University		
8:30 – 9:00	Registration	
9:00- 9:15	SESSION 4: SOCIAL AND ENVIRONMENTAL IMPACT AULA B1	SESSION 5: FUTURE SCENARIOS AULA B4
9:00 – 9:15	Opening Session: Prof. Dr. Bhavin Kapadia (FHF)	Opening Session: MA Adrian Millward-Sadler (FHJ)
9:15 – 9:30	**Comparison of Lifecycle Emissions of a SUV with Fuel Cell and Battery Electric Powertrains** - Bhavin Kapadia, Alper Sayin, Sandra Eisenträger	**GENAI Literacy as a Transversal Skill for Emerging Professionals: Implications for Sustainability-Critical Knowledge Work** – Adrian Millward-Sadler
9:30 – 9:45	**Smart Mobility Technologies and their Impact on Urban Sustainability: Insights from**	**Effects of Technical Traffic Calming Measures** – Filip Perović

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	European and Western Balkan Cities – Alma Gjonaj, Vjola Ziu	
9:45 – 10:00	**The Disappearing Squares: Social and Environmental Impacts of Urban Mobility Planning in Durres –** Arjola Sava	**Cybersecurity Vulnerabilities in Electric Vehicle Operating Systems: A Global Awareness Analysis -** Aleksa Radević
10:00 – 10:15	**The City that Demands Continuous Movement: The Disappearance of the Right not to Move within the Framework of Sustainable Mobility –** Avrili Meshi	**Development of a risk assessment model for the transport of hazardous materials using ALOHA and GIS software tools –** Marko Radetić
10:15 – 10:30	**Between Rhetoric and Reality: Discursive Framings, Greenwashing and Outcomes in Sustainable Mobility –** Kejsi Veselagu	**Mapping Distance and Time Leveraging Isochrone Intelligence in Emerging Cities -** Andia Vllamasi, Erjon Cobani
10:30 – 10:45	**Reimagining the City Through Green Mobility Strategies: The Case of Tirana -** Vjola Ziu, Alma Gjonaj	**Can AI develop its Own "Taste" Automotive Design? -** Gregor Andoni, Kristjana Meço
	Coffee Break	
11:00 – 11:15	**Linking Morphology, Perceived Safety, and Sustainable Mobility in Post-Socialist Urban Contexts-** Sindi Doce	**Optimizing Public Transport Corridors Using AI-Based Scenario Modelling: A case Study on Tirana's Ring Road -** Erjon Çobani, Julian Beqiri, Merita Guri
11:15 – 11:30	**Towards Sustainable Transport: A Comparative Analysis of Electric Vehicle Adoption in Montenegro and Albania -** Radmila Milić	**Threat Landscape and Multi-Layered Protection Mechanisms for Autonomous and Electric Vehicle Systems -** Marko Asanovic, Oliver Popović, Zoran Avramović, Nataša Gospić

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11:30 – 11:45	Questions and Discussion	**Cybersecurity Challenges in Modern Vehicular Communication Networks** - Aleksandar Grgurević, Nataša Gospić, Oliver Popović
11:45 – 12:00		**Green Transition in Albania: Challenges and Future Actions** - Erik Kushta, Andi Hyka, Enea Nasto
12:00 – 12:15	SESSION 6: CONTROVERSIES AND CHALLENGES Aula B1 **Opening Session:** Prof. Kristofor Lapa (UV)	**Use of AI in the Process of Green Transformation and Impact on Public Health** - Esmeralda Hamiti, Federika Alliaj, Kristi Metushi
12:15-12:30	**The Adoption of Electric Vehicles in Albania: A Comparative Study with Other Western Balkan Countries** - Doklejda Hodaj, Andrea Lapa	**Development of an Automatic Traffic Sign Detection System Using YOLOv8** - Valentina Vojinović, Luka Filipović
12:30-12:45	**Application of Quality Tools in the Analysis of Factors Influencing the Development of Electromobility in Montenegro** - Jelena Šaković Jovanović, Draško Jovanović, Mirjana Grdinić Rakonjac, Marko Lučić, Miloš Perović, Aleksandar Vujović, Gordana Radulović	**The Historical Development of Artificial Intelligence and Its Influence on the job market in Automotive Engineering** - David Josef Pilgram
12:45 – 13:45	Questions and Discussion	Questions and Discussion
13:45	**Lunch**	

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