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A COMPREHENSIVE ANALYSIS OF VENTILATION SYSTEM FOR ENHANCED ENERGY EFFICIENCY IN MARINE PROPULSION APPLICATIONS

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Abstract

Modern propulsion engines for energy systems demand increasing power output from limited displacement. This presents significant challenges for cooling and ventilation systems, which must efficiently dissipate heat in proportion to the engine's power. The energy efficiency of propulsion systems - whether utilizing conventional or alternative energy sources - relies heavily on the effectiveness of ventilation designs. This study investigates the design, operation, and performance of engine-room and crankcase ventilation systems in marine propulsion environments. The research evaluates the thermal, safety, and environmental functions of both natural and mechanical ventilation methods, focusing on airflow management, heat dissipation, and emissions control. Specifically for engine-room ventilation, the work analyzes various airflow routing configurations - including bottom-to-top, horizontal, and air curtain systems - and their impact on energy efficiency, temperature control, and equipment longevity. The analysis includes mathematical modeling of required ventilation airflow, and it examines the influence the system design has on engine performance, fuel consumption, maintenance and environmental impact. Results demonstrate that well-designed ventilation systems are critical for maintaining optimal operating conditions, reducing energy consumption, ensuring crew safety and regulatory standards adherence. The findings provide practical guidelines for engineers and naval architects aiming to optimize

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ventilation systems for improved energy efficiency, reliability, and sustainability in marine propulsion applications.

Keywords: ventilation system, marine application, engine room, energy efficiency

I. INTRODUCTION

Ventilation systems move air to meet the thermal, combustion-air and safety demands of a ship's power plant and the surrounding engine-room space (Caterpillar, 2019). Within the engine-room, the primary functions are to supply fresh, oxygen-rich air for fuel combustion, to extract the heat radiated by main and auxiliary engines, generators and other hot equipment, and to maintain a pressure environment that prevents the migration of flammable or toxic gases into adjacent compartments. Safety is paramount on ships, engine room fires are one of the most harmful types of ship fires, the development of which is closely related to the design of marine ventilation system (Lan, 2023). Beyond safety, ventilation systems are a primary driver of overall energy efficiency, accounting for up to 30% of the total energy usage on cruise vessels. Given that large cruisers consume 150-250 tonnes of fuel daily, the economic justification for efficiency retrofits is substantial, yielding a payback on investments in under two years (Halton, 2025).

To achieve these efficiencies, modern designs use demand-based systems with variable frequency drives (VFDs) adjust airflow to engine load, achieving 10% fuel savings by minimizing fan power. Further optimization involves direct air intake ducts to turbochargers bypass fans, further lowering electrical demand while maintaining overpressure for safety (ABB, 2025). Efficient air intake ensures cool, clean air for combustion, directly impacting propulsion efficiency in low-speed two-stroke engines. For example, moisture eliminators capture over 97% of salt spray, preventing corrosion and enabling automated controls that cut fuel costs via affinity law-based VFD operation (Centek Marine, 2024), while swirl control in intake ports optimizes gas charging, reducing NOx and boosting fuel economy by matching turbocharger pressure ratios to load conditions.

In the engine itself, ventilation - often referred to as crankcase ventilation - removes blow-by gases caused by piston-ring leakage, captures oil mist and depressurises the crankcase. To manage these internal pressures, marine engines utilize breather pads and pipes, though turbocharged variants require enhanced airflow to maintain performance (Diesel Pro Power, 2024). To meet these demands efficiently, closed crankcase ventilation (CCV) is becoming the industry standard, as this system filters and recirculates blow-by gases into the intake, reducing oil consumption by up to 20% and methane emissions. This technology complies with IMO regulations like Energy Efficiency Design Index (EEDI) and FuelEU Maritime by preventing pressure buildup and oil contamination that degrade efficiency.

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Combining CCV, demand ventilation, and intake optimizations yields 5-15% propulsion fuel reductions across vessel types, per ABS benchmarks, through hull-propeller-ventilation synergies. Future systems for alternative fuels like hydrogen will demand advanced filtration to handle higher power densities (Barone, 2025), requiring challenging balancing noise reduction in enclosed canopies with airflow where VFD fans outperform belt-driven alternatives for load-adaptive control. Guidelines emphasize CFD modelling for duct silencers, corrosion-resistant materials, and real-time sensors for occupancy or load-based operation to maximize ROI, while HVAC digital twins in electric propulsion further enhance savings up to 1.5% via predictive control.

In this paper, investigation of the design, operation, and performance of engine-room and crankcase ventilation systems in marine propulsion environments is performed and results of numerical investigation are analysed.

II. METHODS

A properly designed engine room ventilation system should maintain air temperatures within 8.5 to 12.5°C above ambient conditions (Caterpillar, 2019). In larger, multi-engine installations, achieving this temperature rise may result in excessive or uncomfortable air velocities. In this case, the ventilation system must promote a bottom-to-top airflow pattern to effectively remove heat. In all cases, the engine room or enclosure design must ensure that the air temperature surrounding the engine does not exceed 50°C. Accurate calculation of the required ventilation airflow depends on the radiant heat output from the engine and associated driven equipment.

Ventilation systems of the engine-room can be part of one of these groups: natural and mechanical. Natural ventilation relies on temperature-driven buoyancy and wind pressure, using strategically placed inlet grilles low in the compartment and exhaust openings high up. Mechanical ventilation employs powered fans or blowers - axial, mixed-flow or tube-axial types - to force the required airflow, allowing precise control of volume, pressure and temperature. Such systems are typically required for larger or enclosed installations where natural ventilation is insufficient, with standards like ISO 8861:1998 prescribing the minimum air-changes-per-hour and inlet-duct sizing for diesel-engine rooms. Hybrid arrangements often combine natural supply with mechanical exhaust (or vice-versa) to reduce power consumption while meeting the design airflow calculated from engine-power and heat-load data.

The required ventilation airflow is a function of the target engine room temperature and the combined cooling air and combustion air demands. In many engine-room configurations, combustion air is supplied directly from outside the engine room through low restriction ductwork capable of handling large airflow volumes. Such systems have minimal impact on the overall

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ventilation design. In other cases, however, the engine draws combustion air directly from the engine room. In these cases, combustion air demand becomes a critical factor in the ventilation system design.

The total ventilation air requirement $\left(\dot{V}\ [\mathrm{m}^3/\mathrm{min}]\right)$ for an engine room can be approximated using the following formula:

$$\dot{V} = \left(\frac{H}{D \cdot c_p \cdot \Delta T} + \dot{V}_{ca}\right) \cdot F \tag{1}$$

where H is radiated heat (engine, generator, aux), D is air density at corresponding temperature of 38 °C, c_p is specific heat capacity of air, ΔT is permissible temperature rise in engine room, $\dot{V}_{ca}$ is combustion air requirements, and F is routing factor based on the ventilation type. When combustion air is supplied to the engine via dedicated ductwork, the term "combustion air" should be excluded from the ventilation airflow calculation.

Engine room ventilation systems are typically designed to maintain either a slight positive or negative pressure, depending on operational requirements. Positive pressure should not normally exceed 0.050 kPa (0.2 in. H_2O) and offers the following advantages:

Prevention of dust and dirt ingress;

Creation of an outward draft that expels heat and odours from the engine room.

In marine applications where the engine room is adjacent to living quarters, a slight negative pressure is preferred, generally not exceeding 0.1275 kPa. The benefits of maintaining negative pressure include:

Compensation for thermal expansion of incoming air;

Creation of an inward draft that confines heat and odours to the engine room.

Proper routing of ventilation air is essential for the effective operation of a ship's engine room. Maintaining recommended air temperatures and ensuring adequate cooling and combustion air supply require careful consideration of airflow paths. Fresh air inlets should be positioned as far as practicable from major heat sources and located low within the engine room, while exhaust outlets should be situated at the highest points, ideally directly above primary heat-generating equipment, such as engines and generators. The design must prevent recirculation of exhaust air back into the system, and airflow paths should avoid stagnant zones or pockets of air. Supply ducts should not direct cool air directly onto hot engine components and, in installations where engines draw combustion air from the engine room, the routing should ensure the coolest possible intake air. Additionally, ventilation inlets must be designed to prevent seawater ingress, and generator cooling air should be filtered to minimize the intake of salt and debris, thereby protecting sensitive

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components such as turbochargers. Adherence to these principles facilitates efficient heat removal, uniform temperature distribution, and reliable engine operation, while maintaining a safe and comfortable environment for personnel.

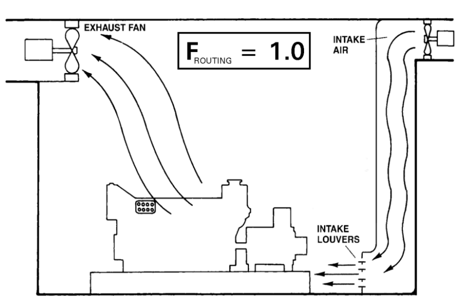
Ventilation type 1: This system provides the best ventilation with the least amount of air required, figure 1a. In addition, the upward flow of air around the engine serves as a shield which minimizes the amount of heat released into the engine room.

Ventilation type 2: Type 2 ventilation systems (figure 1b) are similar in principle to Type 1 systems. However, Type 2 airflow is directed beneath the engine and generator, discharging upward across these components to provide effective cooling. The most economical approach to implementing this configuration involves utilizing the service platform as the upper boundary of the airflow duct. For this purpose, the service platform must be constructed from solid, non-skid plate rather than perforated or expanded grating, ensuring proper containment and direction of the ventilation air.

Ventilation type 3: Type 3 ventilation systems (figure 1c) require approximately 50% more airflow compared to previous configurations, corresponding to a routing factor of 1.5. In this system, outside air is introduced into the engine room at the lowest possible point. While the airflow effectively dissipates heat from the engine, a portion of the generated heat will still radiate to adjacent surfaces within the engine room. This design provides adequate ventilation primarily for the engine located closest to the air inlet, making it less effective for uniformly cooling multiple engines in the same space.

Ventilation type 4: This configuration represents the least efficient form of engine room ventilation, requiring approximately two and a half times the airflow of Type 1 systems, corresponding to a routing factor of 2.5. In this case, the incoming cool air mixes with the hottest air within the engine-room, causing a less effective heat removal process, figure 1d.

a)



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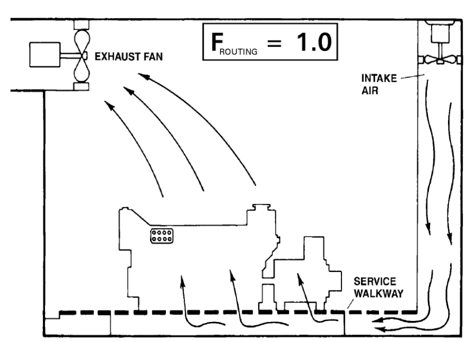

c)

d)

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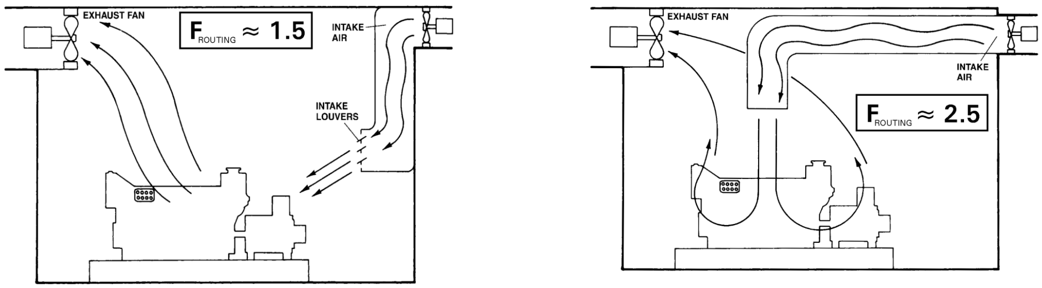

Figure 1. Ventilation system in machinery room: a) ventilation type 1; b) ventilation type 2; c) ventilation type 3; d) ventilation type 4.

III. RESULTS

The primary functions of a properly designed engine room ventilation system are to supply cooling air and combustion air. Cooling air circulates within the compartment to dissipate radiant heat generated by the engine, generator, and auxiliary equipment, thereby maintaining safe operating temperatures for all system components. Combustion air, on the other hand, provides the oxygen necessary for efficient fuel combustion within the engine. A proportion of the fuel energy released during combustion is emitted as waste heat into the surrounding air. Additional heat sources, such as generators, exhaust manifolds, and piping, can contribute thermal loads comparable to or even greater than the engine's own radiant output.

Elevated engine-room temperatures can adversely affect personnel comfort, maintenance operations, and the performance and durability of engines and generators. The most effective approach to achieve adequate cooling airflow involves introducing ventilation air near the floor level at the aft side of the machinery package and ensuring efficient exhaust pathways for the removal of heated air.

This study presents an analysis of various airflow routing configurations: namely bottom-to-top, horizontal, and air curtain ventilation systems, which influence overall energy efficiency, temperature regulation, and equipment longevity. The specific air consumption for the engines is adopted in the range of 7.5–8 kg/kWh. Figure 2 illustrates the relationship between the required ventilation air and engine load for different routing factors (F), excluding combustion air. Figure 3 shows the corresponding relationship when the combustion air demand is included.

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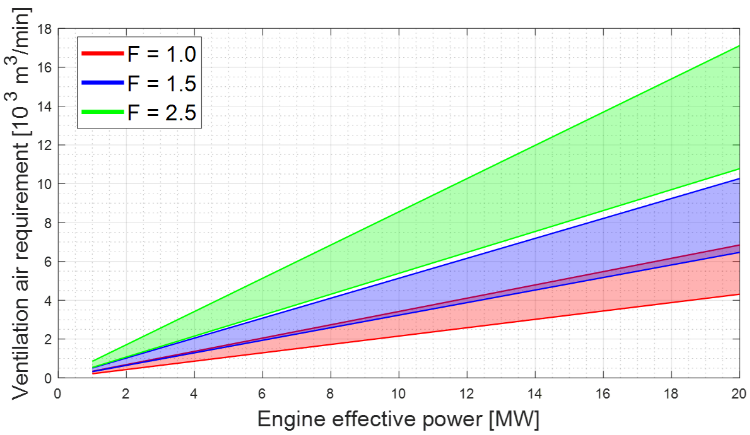

Figure 2. Total ventilation air requirement without combustion air.

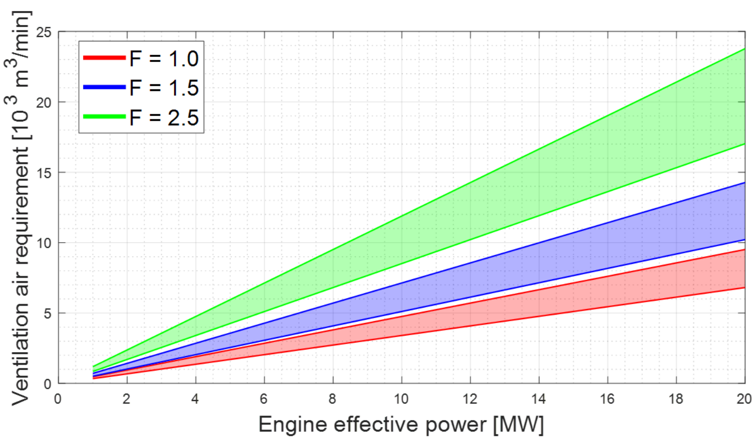

Figure 3. Total ventilation air requirement with combustion air.

The results indicate that a properly designed ventilation type 1 (F = 1) can achieve up to a fourfold reduction in the total air volume required for both engine room ventilation and engine combustion compared to Ventilation type 3 (F = 2.5). This efficiency improvement directly contributes to maintaining optimal operating conditions, reducing overall energy consumption, enhancing crew safety, and ensuring compliance with regulatory requirements in marine vessels.

IV. CONCLUSION

To conclude and summarize, effective ventilation is a fundamental requirement for the safe and efficient operation of naval propulsion systems. Both engine-room and crankcase ventilation systems play crucial roles in keeping desired thermal conditions, preventing hazardous gas accumulation, and protecting both machinery and personnel.

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The engine room ventilation system, whether natural or mechanical, ensures a continuous supply of fresh air for combustion and cooling, while the crankcase ventilation system manages blow-by gases and pressure.

Together, these systems act as the lungs of a ship. Proper design, installation and maintenance of these ventilation systems are crucial to ensuring a lasting engine performance, crew safety and long-term operability of the vessel. In an era of increasing environmental awareness and strict regulatory standards, efficient ventilation remains a key factor in achieving both technical and ecological objectives in naval architecture.

REFERENCES

ABB. (2025). *Energy efficiency*. https://new.abb.com/marine/energy-efficiency

Barone G., Buonomano A., Del Papa G., Giuzio G., Palombo A., Russo G. (2025) Towards sustainable ships: Advancing energy efficiency of HVAC systems onboard through digital twin, *Energy*, Volume 317, https://doi.org/10.1016/j.energy.2025.134435

Caterpillar. (2019). *Application & Installation Guide. Engine Room Ventilation*. Carolina Cat. https://carolinacat.com/content/uploads/sites/4/2023/02/Engine-Room-Ventilation-Application-Installation Guide.pdf

Chen G., Zhu M., Liu Z., Liu T., Su S., Cao Y. (2014). Study on Air Intake and Cooling System for Marine Diesel Engine, *TELKOMNIKA Indonesian Journal of Electrical Engineering*, Vol.12, No.2, pp. 998 ~ 1004, DOI: http://dx.doi.org/10.11591/telkomnika.v12i2.4213

CENTEK Marine. (2024). *The High Cost of Poor Airflow: Optimizing Your Commercial Vessel's Ventilation System*, https://centekmarine.com/the-high-cost-of-poor-airflow-optimizing-your-commercial-vessels-ventilation-system/

Diesel Net Technology Guide. (2021). *Crankcase Ventilation*. Hannu Jaaskelainen. https://dieselnet.com/tech/engine_crank.php

Diesel Pro Power. (2024). *Crankcase Ventilation System*. https://dieselpro.com/blog/crankcase-ventilation-system-comprehensive-guide-for-detroit-diesel-v71-engines-6v71-8v71-12v71-16v71

Halton. (2025). *Ventilation Upgrade Reduces Fuel Consumption*.

https://www.halton.com/news/ventilation-upgrade-reduces-fuel-consumption-by-10-percent-in-cruise-ships/

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Hifi Filter. (2024). *Understanding the Crankcase Ventilation System*. Hifi Filter. https://hifi-filter.com/en/understanding-the-crankcase-ventilation-system

Lan Q., Han F., Liu H., Li. W, Wang Z., 2023. Effects of ventilation system design on flame behavior and smoke characteristics for mitigating marine engine room fire hazards, *Ocean Engineering,* Volume 281, https://doi.org/10.1016/j.oceaneng.2023.114890

Solberg. (2025). *Gestione del Blow-By del Motore con i Sistemi di Ventilazione del Basamento*. Jason Cox. https://www.solbergmfg.com/it/blogs/blog/managing-engine-blow-by-with-crankcase-ventilation-systems

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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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Co-funded by the European Union

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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<table>
<tr><td>15:00 - 15:15</td><td></td><td>Design and Topology Optimization of a Lightweight Chain Sprocket for Electric Motorcycle Applications
Teo Čolović, Ivo Marinić-Kragić</td></tr>
<tr><td rowspan="2">15:15 - 15:30</td><td>SESSION 3: ECONOMIC AND BUSINESS PRESPECTIVES + CASE STUDIES AND GOOD PRACTICES
Aula B1</td><td rowspan="7">Questions and Discussion</td></tr>
<tr><td>Opening Session:
Dr. Anis Sulejmani (PUT)</td></tr>
<tr><td>15:30 - 15:45</td><td>Managing Renewable Energy Resources as a Foundation for Sustainable Mobility Transitions
Deivi Sinanaliaj, Martin Bektashi</td></tr>
<tr><td>15:45 - 16:00</td><td>Feasibility of Electric Bus deployment in Montenegro: A Case Study of Budva (Erasmus+ INTEC / IECC Context)
Anastasija Mrkajic, Vinko Nikic.</td></tr>
<tr><td>16:00 -16:15</td><td>Children Paths as an Urban Regeneration Strategy: Naim Frasheri Study Case
Dejvi Dauti</td></tr>
<tr><td>16:15 - 16:45</td><td>Questions and Discussion</td></tr>
</table>

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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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