



BOOK OF PROCEEDINGS

INTERNATIONAL CONFERENCE SUSTAINABLE MOBILITY

5-6 MARCH

2026

The INTEC International Conference brings together academics, researchers, policymakers and industry experts to discuss innovative approaches and collaborative solutions for a sustainable future in engineering and mobility. The conference will be hosted by POLIS University in Tirana, Albania, and co-organized by partners from across the EU as part of the Erasmus+ CBHE Project 101081873-ERASMUS-EDU-2022-CBHE-STRAND-2.



INTEC International Engineering Competence Centres to push sustainable mobility development in Albania and Montenegro
Project Reference: 101081873-ERASMUS-EDU-2022-CBHE-STRAND-2

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Project Partners:



INTEC International Conference
February 2026
POLIS University, Tirana, Albania

INTEC>>>



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TABLE OF CONTENTS

1. POLITICAL AND REGULATORY FRAMEWORK9

***RENEWABLE ENERGY PROCUREMENT (CPPA) AND TRANSPORT ELECTRIFICATION:
EUROPEAN PERSPECTIVES AND ALBANIAN CHALLENGE 10***

***REVIEW OF THE EVOLUTION OF INTERNATIONAL SHIP ENERGY EFFICIENCY
REGULATIONS AND THE ALBANIAN CONTEXT 20***

***THE EUROPEAN GREEN DEAL AND ITS NATIONAL IMPLEMENTATION: FROM STRATEGY
TO PRACTICE 30***

***THE CURRENT STATUS OF AUTONOMOUS VEHICLE TECHNOLOGY ADOPTION IN THE
BALKAN REGION 42***

***INTEGRATING EVENT DATA RECORDER (EDR) TECHNOLOGY INTO SUSTAINABLE ROAD
SAFETY FRAMEWORKS WITHIN THE EUROPEAN GREEN DEAL 56***

***INFRASTRUCTURE READINESS FOR SUSTAINABLE MOBILITY: EU FRAMEWORKS AND THE
CASE OF ALBANIA..... 70***

***FROM PREDICTION TO REGULATION: EVIDENCE PRODUCTION APPROACHES IN
AUTONOMOUS MOBILITY RESEARCH AND THEIR POLICY IMPLICATIONS..... 82***

REVIEWING THE EUROPEAN GREEN DEAL IN ENERGY, MOBILITY AND INDUSTRY 98

2. TECHNOLOGICAL INNOVATIONS 107

AUTOMOTIVE COOLING SYSTEMS SUSTAINABILITY: A FOCUS ON THE EXPANSION TANK
..... **108**

***EMPIRICAL COMPARATIVE STUDY OF STRUCTURAL CFRP SANDWICH STRUCTURE
INSERTS FOR OUT-OF-PLANE LOADS***..... **118**

***LIQUID COOLING SYSTEMS FOR ELECTRIC VEHICLE BATTERIES: IMPROVING SAFETY,
PERFORMANCE AND SUSTAINABILITY*** **132**

***DESIGN AND DEVELOPMENT OF A CONSTANT-VOLUME COMBUSTION CHAMBER FOR
OPTICAL INVESTIGATION OF HYDROGEN AND WATER INJECTION UNDER ENGINE-LIKE
CONDITIONS*** **138**

***ANALYSIS OF BATTERY CHARGING AND DISCHARGING BEHAVIOR FOR ELECTRIC VEHICLE
APPLICATIONS*** **148**

***IMPACT OF HEAT PUMP SYSTEMS ON WINTER ENERGY USE AND DRIVING RANGE IN
BATTERY ELECTRIC VEHICLES***..... **158**

THE ROLE OF INTERMODAL TRANSPORTATION FOR THE SUSTAINABLE MOBILITY..... **166**

***EMISSION REDUCTION OF MARINE PROPULSION SYSTEMS IN SECA ZONES THROUGH
THE INTEGRATION OF HYDROGEN TECHNOLOGIES*** **176**

***A COMPREHENSIVE ANALYSIS OF VENTILATION SYSTEM FOR ENHANCED ENERGY
EFFICIENCY IN MARINE PROPULSION APPLICATIONS***..... **190**

***DESIGN AND TOPOLOGY OPTIMIZATION OF A LIGHTWEIGHT CHAIN SPROCKET FOR
ELECTRIC MOTORCYCLE APPLICATIONS***..... **200**

3. ECONOMIC AND BUSINESS PERSPECTIVE **211**

***FEASIBILITY OF ELECTRIC BUS DEPLOYMENT IN MONTENEGRO: A CASE STUDY OF
BUDVA***..... **212**

***MANAGING RENEWABLE ENERGY RESOURCES AS A FOUNDATION FOR SUSTAINABLE
MOBILITY TRANSITIONS*** **224**

4. SOCIAL AND ENVIRONMENTAL IMPACT..... **231**

***SMART MOBILITY TECHNOLOGIES AND THEIR IMPACT ON URBAN SUSTAINABILITY:
INSIGHTS FROM EUROPEAN AND WESTERN BALKAN CITIES***..... **232**

THE DISAPPEARING SQUARES: SOCIAL AND ENVIRONMENTAL IMPACTS OF URBAN MOBILITY PLANNING IN DURRËS.....	244
THE CITY THAT DEMANDS CONTINUOUS MOVEMENT: THE DISAPPEARANCE OF THE RIGHT NOT TO MOVE WITHIN THE FRAMEWORK OF SUSTAINABLE MOBILITY.....	256
COMPARISON OF LIFECYCLE EMISSIONS OF A SUV WITH FUEL CELL AND BATTERY ELECTRIC POWERTRAINS.....	264
BETWEEN RHETORIC AND REALITY: DISCURSIVE FRAMINGS, GREENWASHING AND OUTCOMES IN SUSTAINABLE MOBILITY.....	272
TOWARDS SUSTAINABLE TRANSPORT: A COMPARATIVE ANALYSIS OF ELECTRIC VEHICLE ADOPTION IN MONTENEGRO AND ALBANIA.....	284
LINKING MORPHOLOGY, PERCEIVED SAFETY, AND SUSTAINABLE MOBILITY IN POST-SOCIALIST URBAN CONTEXTS	296
REIMAGINING THE CITY THROUGH GREEN MOBILITY STRATEGIES: THE CASE OF TIRANA	304
5. CONTROVERSIES AND CHALLENGES	313
THE ADOPTION OF ELECTRIC VEHICLES IN ALBANIA: A COMPARATIVE STUDY WITH OTHER WESTERN BALKAN COUNTRIES	314
APPLICATION OF QUALITY TOOLS IN THE ANALYSIS OF FACTORS INFLUENCING THE DEVELOPMENT OF ELECTROMOBILITY IN MONTENEGRO.....	326
6. CASE STUDIES AND GOOD PRACTICES	335
CHILDREN PATHS AS AN URBAN REGENERATION STRATEGY: NAIM FRASHËRI'S CASE STUDY.....	336
7. FUTURE SCENARIOS.....	345
GENAI LITERACY AS A TRANSVERSAL SKILL FOR EMERGING PROFESSIONALS: IMPLICATIONS FOR SUSTAINABILITY-CRITICAL KNOWLEDGE WORK	346
CYBERSECURITY VULNERABILITIES IN ELECTRIC VEHICLE OPERATING SYSTEMS: A GLOBAL AWARENESS ANALYSIS.....	362

CYBERSECURITY CHALLENGES IN MODERN VEHICULAR COMMUNICATION NETWORKS
..... **372**

MAPPING DISTANCE AND TIME: LEVERAGING ISOCHRONE INTELLIGENCE IN EMERGING CITIES..... **382**

THE HISTORICAL DEVELOPMENT OF ARTIFICIAL INTELLIGENCE AND ITS INFLUENCE ON THE JOB MARKET IN AUTOMOTIVE ENGINEERING **394**

GREEN TRANSITION IN ALBANIA: CHALLENGES AND FUTURE ACTIONS..... **406**

OPTIMIZING PUBLIC TRANSPORT CORRIDORS USING AI-BASED SCENARIO MODELLING: A CASE STUDY ON TIRANA’S RING ROAD **414**

USE OF AI IN THE PROCESS OF GREEN TRANSFORMATION AND IMPACT ON PUBLIC HEALTH..... **426**

EFFECTS OF TECHNICAL TRAFFIC CALMING MEASURES..... **432**

CAN AI DEVELOP ITS OWN “TASTE” AUTOMOTIVE DESIGN?..... **440**

THREAT LANDSCAPE AND MULTI-LAYERED PROTECTION MECHANISMS FOR AUTONOMOUS AND ELECTRIC VEHICLE SYSTEMS **448**

DEVELOPMENT OF A RISK ASSESSMENT MODEL FOR THE TRANSPORT OF HAZARDOUS MATERIALS USING ALOHA AND GIS SOFTWARE TOOLS..... **460**

DEVELOPMENT OF AN AUTOMATIC TRAFFIC SIGN DETECTION SYSTEM USING YOLOV8
..... **470**

**APPLICATION OF QUALITY TOOLS IN THE ANALYSIS OF FACTORS INFLUENCING THE
DEVELOPMENT OF ELECTROMOBILITY IN MONTENEGRO**

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Abstract

The continuous increase in the number of motor vehicles in Montenegro has significantly affected air quality and the overall state of the environment. These trends have created the need to develop sustainable forms of mobility, with electromobility emerging as one of the key directions in the evolution of modern transport. The aim of this paper is to conduct a systematic analysis of the factors influencing the development of electromobility in Montenegro and to identify potential solutions for its improvement. Based on the 7M approach (Man, Machine, Methods, Material, Measurement, Mother Nature, Management), a multidisciplinary team will identify the key groups of factors affecting the advancement of electromobility in the country. Each of these groups will

then be further analyzed and broken down into sub-levels to ensure a comprehensive understanding of their impacts and interrelations. For this purpose, the Ishikawa diagram (Fishbone diagram or Cause-and-effect diagram), will be applied as an effective quality tool for the systematic and multi-level analysis of cause-and-effect relationships. The results of the analysis will serve as a basis for defining guidelines and recommendations that can support the further development and enhancement of electromobility in Montenegro.

Keywords: electromobility, quality tools, cause and effect diagram

I. INTRODUCTION

Environmental protection and climate change mitigation represent one of the key challenges of contemporary society. The transport sector plays a particularly important role in this process, given that it is one of the main sources of greenhouse gas emissions and air pollution. Numerous studies confirm that the transport sector significantly contributes to global CO₂ emissions, with road transport having a dominant share (Ferrer & Thomé, 2023; IPCC, 2014; Andong & Sajor, 2017; Solaymani et al., 2025). At the European level, road transport accounts for approximately 25% of total CO₂ emissions, while passenger cars and light commercial vehicles make up about 15% of total CO₂ emissions in the European Union (Lopez-Aparicio et al., 2025).

The latest Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) indicates that transport is one of the significant and growing sources of greenhouse gas emissions at the global level. Therefore, the IPCC emphasizes the need to implement transformative measures in the transport sector, among which the accelerated electrification of vehicles and the transition to low-carbon electricity sources occupy a particularly important place (IPCC, 2022; IPCC, 2023). These positions are also reflected in international climate and energy policies, which increasingly promote the decarbonization of transport and the deployment of low-carbon technologies. As a result, electromobility has developed over the past decade into one of the most significant pathways of the energy and technological transition. According to data from the International Energy Agency (IEA), electric cars accounted for approximately 18% of total global new vehicle sales in 2023, alongside continuous market growth and an expanding range of manufacturers (IEA, 2024).

Despite strong global trends, the pace of electromobility development varies significantly among countries and depends on a range of factors such as economic conditions, the regulatory framework, the level of development of charging infrastructure, and user awareness. Numerous studies indicate that the high purchase price of electric vehicles and insufficiently developed infrastructure represent the main barriers to their wider adoption, particularly in smaller and developing economies (World Bank, 2024).

In Montenegro, sustainable mobility has gained additional importance due to the continuous growth in the number of registered vehicles. According to data from the Statistical Office of Montenegro (MONSTAT), a total of 306,686 road motor vehicles and trailers were registered in 2024, confirming a long-term trend of increasing motorization (MONSTAT, 2025). Although an increase in the number of electric vehicles and the initial development of charging infrastructure have been recorded in recent years, their share in the total vehicle fleet remains negligible, indicating that electromobility in Montenegro is still at an early stage of development (Lučić et al., 2025).

Given the complexity and interdependence of factors influencing the development of electromobility, a systematic analytical approach is required. This paper applies an Ishikawa diagram based on the 7M approach, which enables a structured identification and grouping of key causes affecting the development of electromobility. A particular contribution of this research lies in the fact that the Ishikawa diagram will be developed using the Brainstorming method with the participation of representatives of various relevant stakeholders in Montenegro.

II. METHODS

This paper applies a combined approach based on quality management tools, with the aim of systematically identifying and analyzing the factors influencing the development of electromobility in Montenegro. The central element of the approach is the application of the Ishikawa diagram, also known as the cause-and-effect diagram or fishbone diagram, which represents a graphical quality tool for systematizing potential causes of the analyzed outcome (problem) and grouping them according to predefined categories. Its application facilitates the identification of dominant areas that contribute most significantly to the occurrence of the considered outcome and provides a basis for further decision-making and the definition of corrective measures. Contemporary research confirms the effectiveness of the Ishikawa diagram when combined with brainstorming and other cause analysis methods across various fields, including quality management, managerial decision-making, and process optimization (Sakdiyah et al., 2022; Ardha et al., 2023; Oljira & Dinsa, 2023; Soković et al., 2009).

The Ishikawa diagram will be developed through a brainstorming process and structured according to the 7M approach, ensuring a comprehensive classification of the identified causes into clearly defined categories. The particular value of the applied methodology lies in the fact that the cause identification process incorporates contributions from representatives of various relevant stakeholders in Montenegro.

Brainstorming is a teamwork technique used to identify problems and generate potential causes through the exchange of ideas among participants with diverse knowledge and experience. The literature emphasizes its application in the early stages of complex system analysis, when it is necessary to capture the broadest possible range of factors and reduce the risk of overlooking important causes of the problem (Krivokapić, 2011; Soković et al., 2009).

In structuring the Ishikawa diagram, the 7M approach will be applied, which involves classifying causes into seven basic categories: people (Man), methods (Methods), machines (Machines), materials (Materials), measurement (Measurement), management (Management), and environment (Mother Nature). The application of the 7M approach enables a structured assessment of the factors influencing the development of electromobility, including infrastructure, the institutional and regulatory framework, market conditions, and user behavior. In this way, a clear and systematic basis is provided for identifying key groups of causes that have the greatest impact on the observed outcome (Nadiyah & Dewi, 2022; Oljira & Dinsa, 2023).

Such an approach, involving representatives of various stakeholders in Montenegro, enables an integrated analysis of interrelated factors and provides a reliable basis for identifying key areas with the greatest influence on the observed problem, as well as for formulating recommendations aimed at improving public policies and strategic planning in the field of electromobility.

III. RESULTS

The Ishikawa diagram shown in Figure 1 (Cause-and-effect diagram) was developed based on the results of a brainstorming process, during which the relevant factors influencing the observed problem were identified in accordance with the 7M approach. However, due to the specific nature of the issue, certain related categories of the 7M approach were merged into five main categories, namely: Man (Human and Social factors), Machine and Materials (Technology and Vehicles), Management and Methods (Policies, Governance and Planning), Mother Nature (infrastructure and environment), and Measurement (Monitoring and market conditions).

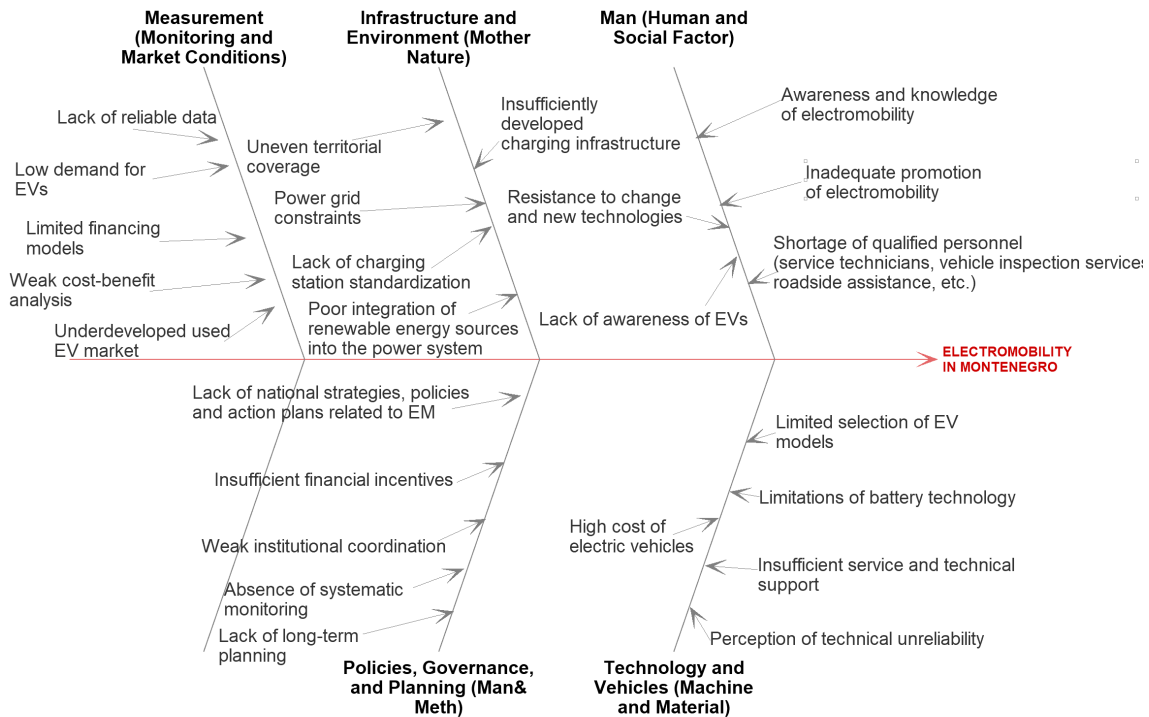


Figure 1. Ishikawa diagram for the outcome: Electromobility in Montenegro.

The outcome (problem), defined as Electromobility in Montenegro, is placed in the “head” of the Ishikawa diagram. The identified cause categories represent the primary causes of the observed outcome, after which a more in-depth analysis was conducted to identify, within each category, the factors that make the most significant contribution to its occurrence and that simultaneously represent secondary causes of the observed outcome. Accordingly, the Ishikawa diagram was developed using the Minitab software package (license no. REN11013509).

Tertiary causes are presented in Table 1. It is important to emphasize that the same tertiary cause may be associated with multiple different secondary causes.

Table 1. List of tertiary causes of the outcome: Electromobility in Montenegro.

Categories of factors (causes)	Tertiary causes by categories
Man (human and social factors)	Lack of educational campaigns and informational programs Habits of using internal combustion engine (ICE) vehicles Fear of unknown costs and technological risks

	Lack of local practical experience and reliable information on EV performance Insufficient formal training of service technicians and technical staff Limited presence of electromobility in the media Lack of trust in battery condition and durability
Technology and Vehicles (Machine and Materials)	High import costs and small market size Weak competition and a limited number of distributors Limited battery lifespan and high battery costs Lack of specialized service centers and spare parts Lack of reliable information on the reliability and safety of EVs Lack of reliable information on the environmental impact and durability of batteries
Infrastructure and Environment (Mother Nature)	High costs of charger installation Weak coordination among local authorities Slow and complex permitting and grid-connection processes for chargers Insufficient capacity of the distribution network Lack of harmonization of technical standards Insufficient system flexibility (balancing, frequency regulation) Limited capacity to integrate variable generation (wind/solar) Underdeveloped balancing market mechanisms
Policies, Governance, and Planning (Management and Methods)	Absence of clearly defined targets Limited and unstable subsidy budgets Lack of coordination among institutional responsibilities Lack of monitoring and reporting mechanisms
Monitoring and market conditions (Measurement)	Absence of a central database Limited market size, high prices, and uncertain resale value Insufficient availability of leasing and credit services Lack of transparent economic analyses

Such an approach ensures a clear identification of cause-and-effect relationships influencing the development of electromobility in Montenegro.

IV. DISCUSSION

The results obtained through the application of the Ishikawa diagram indicate that the development of electromobility in Montenegro is conditioned by interrelated factors encompassing social, technological, infrastructural, institutional, and market aspects. Through the application of brainstorming and the Ishikawa diagram, and based on the 7M concept, five main categories of causes that most strongly influence the development of electromobility in Montenegro were identified.

Within the Man category (human and social factors), a low level of awareness, a lack of educational campaigns, and a pronounced resistance to change were identified as the dominant causes. These findings are consistent with the results of studies conducted in Montenegro, which indicate that public perception, fear of unknown costs, and distrust in battery durability significantly influence the acceptance of electric vehicles (Lučić et al., 2025).

The Technology and Vehicles category indicates that the high purchase price of electric vehicles, a limited choice of models, and constraints related to battery technology represent significant barriers to the development of the electric vehicle market.

The analysis of the Infrastructure and Environment category indicates that an insufficiently developed charging network, high installation costs, and limitations of the electricity grid represent the key infrastructural barriers. Within the Policies, Governance and Planning category, the results point to a lack of clearly defined targets, unstable subsidy budgets, and weak institutional coordination.

The Measurement category (measurement, monitoring, and market conditions) highlights the lack of reliable data, an underdeveloped second-hand electric vehicle market, and limited financing models. Similar conclusions are also found in the international literature (IEA, 2024; World Bank, 2024).

The obtained findings confirm that accelerating the development of electromobility requires an integrated approach that simultaneously encompasses improvements in the institutional framework, infrastructure development, strengthening of market mechanisms, and increasing user awareness and trust.

V. CONCLUSION

This paper examined the key factors influencing the development of electromobility in Montenegro through the application of quality management tools, primarily the Ishikawa diagram based on the 7M approach. The analysis was conducted with the support of the brainstorming method and the active participation of relevant stakeholders, which enabled the problem to be considered from multiple perspectives in a structured manner.

The research results indicate that the development of electromobility depends on a complex combination of human and social factors, technological and market constraints, infrastructural challenges, as well as shortcomings in the areas of policy, governance, and planning. These factors are interrelated and do not operate in isolation, but jointly influence the pace of electric vehicle

adoption, which is particularly pronounced in the context of a small market and the early stage of electromobility development in Montenegro.

The application of the Ishikawa diagram enabled a clearer understanding of the problem structure through the identification of primary, secondary, and tertiary causes, thereby confirming this tool as effective for analyzing complex issues in the field of sustainable mobility. In this way, a solid basis was provided for understanding the interrelationships among different groups of factors.

Given that the obtained results are based on qualitative analysis, a need was identified to further deepen the findings through a quantitative approach. Future research may be directed toward quantifying the significance of the identified factors, with the application of ABC analysis emerging as a suitable tool. By combining the Ishikawa diagram and ABC analysis, it is possible to more precisely define priority areas for action, which can facilitate decision-making and contribute to the faster development of electromobility in Montenegro.

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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	Community 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)

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

	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 Ognjanović	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 Motaleb 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

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

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	Community 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

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

	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

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	Use of AI in the Process of Green Transformation and Impact on Public Health - Esmeralda Hamiti, Federika Alliaj, Kristi Metushi
	Opening Session: Prof. Kristofor Lapa (UV)	
12:15-12:30	The Adoption of Electric Vehicles in Albania: A Comparative Study with Other Western Balkan Countries - Doklelda 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	