



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
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Project Partners:



INTEC International Conference
February 2026
POLIS University, Tirana, Albania

INTEC>>>



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POLIS University, Tirana, Albania

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

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Abstract

Transport has always been a key component of the development of the global economy and the economy of every country. However, in addition to economic development, modern transport systems must ensure clean air, environmental protection, and human health, which can be achieved through the application of the sustainable transport concept. Economic development has led to an increased need for the transport of hazardous materials. These materials possess chemical properties that, in the event of an incident or accident, may have harmful effects on the environment, human life, and property.

Risk assessment was conducted using the ALOHA software, into which real field data were entered, such as meteorological conditions, storage temperature of the substance, and tank characteristics. To ensure the validity of meteorological conditions, data provided by the Institute for Hydrometeorology and Seismology were used. GIS software was applied to visualize the dispersion of hazardous materials following their release from the tank.

The results show that the wind speed at the accident location was 2.24 m/s, with a wind direction of 22.5° (NNE). The maximum thermal radiation in the downwind direction reached 10 kW/m² at a distance of 330 m, representing a lethal zone with fatal effects occurring within 60 seconds. A second threat zone was identified with thermal radiation of 5 kW/m² at 480 m, where second-degree burns may occur within 60 seconds. The outer impact zone represents a pain threshold, with thermal radiation of 2 kW/m² extending up to 740 m downwind from the accident site. These thermal radiation levels define critical impact zones that can be spatially integrated into GIS-based tools for risk visualization and analysis.

During the transport of hazardous materials, passing through urban areas is inevitable, which increases the need for the application of effective methods for risk assessment and management. The combined use of modern real-time vehicle tracking systems and ALOHA software represents a key strategy for the rapid identification of problems and risks, analysis, and response in emergency

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situations. These technological solutions enable proper planning and reduce risks to the environment and human health. For managers of hazardous materials transport, the rapid processing of data and assessment of risks to the population and the environment along the planned route is crucial. ALOHA software plays a key role in analyzing and modeling the hazards arising from chemical releases, which, when combined with GIS or Google Earth Pro, provides users with a visual representation of danger zones.

Keywords: Hazardous materials, risk assessment, risk visualization, case study

I. INTRODUCTION

The economy in Europe largely depends on transport, which moves various products to meet market demands (Eurostat, 2009). Some of these products are classified as hazardous materials, requiring special handling to ensure efficiency and safety. Hazardous materials have chemical properties that, in the event of an incident or accident, can cause significant harm to the environment, human health, and property. For this reason, the transport of hazardous materials is restricted. However, due to the growing demand and long-distance transportation, their transport is strictly regulated by international regulations (ADR, RID, etc.).

Hazardous materials differ from other materials due to the risk that is closely associated with their release in the event of an accident. Each transport unit has a pre-planned route for the transport of hazardous materials, where the transport route can be viewed as a source of transport risk, consisting of a large number of nodes and links. Transport risk is defined as the probability of a traffic accident occurring and the magnitude of its consequences. Furthermore, transport risk falls within the domain of technological risk, where accidents during transport are closely related to human activities. Various factors can influence the safe transport of hazardous materials, with particular attention required for the human factor, as people are prone to errors. (Tomasoni, 2010)

During road transport, it is often impossible to avoid passing through populated areas, where any incident or accident can have serious consequences, such as fatalities, environmental pollution, evacuation of residents, traffic disruptions, and similar impacts. In order to ensure adequate safety during the transport of hazardous materials, effective risk management is essential. Risk in the transport of hazardous materials can be assessed using various quantitative and qualitative methods. However, the main focus of this study is on the application of modern software tools that enable rapid data processing, analysis, and visualization. (Tomasoni, 2010)

For the purposes of this study, the ALOHA and GIS software tools were used. ALOHA software is primarily used to calculate the release rate of hazardous substances into the atmosphere within a

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defined accident scenario, as well as to determine instantaneous or time-averaged chemical concentrations downwind from the incident location (Energy, 2004.). The results obtained from ALOHA software are further processed and visualized using a GIS tool, which enables spatial representation of hazard zones and a clearer assessment of potential impacts on the population and infrastructure. The combined application of these two software solutions enables effective risk analysis, rapid data interpretation, and support for decision-making in the field of safe transport of hazardous materials.

ALOHA software is an efficient tool for rapid risk assessment in the event of hazardous material releases. Its main advantage lies in its design, which allows it to provide sufficiently accurate results in a short period of time, making it particularly useful during real emergency situations. The program includes its own database of physical properties for approximately 1,000 common hazardous chemicals, eliminating the need for manual entry of complex technical data. ALOHA generates various types of output specific to a defined scenario, including hazard zone maps, location-specific threat information, and source intensity charts. A hazard zone represents an area where a particular impact exceeds the user-defined Level of Concern (LOC). The software allows the calculation of chemical release rates from tanks, liquid surfaces, and pipelines, as well as predicting changes in these rates over time. It also supports modeling of different release scenarios, including toxic gas clouds, fires, and explosions. (NOAA, NOAA's Office of Response and Restoration, 2020)

When estimating the concentration of material released from a tank, ALOHA assumes that the released material immediately mixes with the air, using the Gaussian dispersion model. It is important to note that during the analysis, ALOHA does not account for the byproducts of combustion resulting from fires, explosions, or chemical reactions, nor does it consider hazardous fragments or "flying" debris from the surrounding area or the tank itself. This limitation is directly related to the BLEVE scenario, where the pressure and explosion of the tank result in the release of hazardous fragments and the occurrence of "flying" debris. Therefore, it can be said that a key limitation of applying ALOHA in this analysis is its inability to assess the consequences of released hazardous fragments or flying debris. Additionally, the analysis can be affected by low wind speeds, as well as ALOHA's assumption that the terrain is flat. (NOAA, Office of Response and Restoration, 2012)

II. METHODOLOGY

In this study, risk assessment related to the release of benzene from a storage tank was conducted using the ALOHA software, which is designed to analyze and model three key types of hazards resulting from chemical releases of hazardous substances: fire, explosion, and toxic gas dispersion. A GIS software tool was applied to visualize the spatial spread of the hazardous substance. The research was conducted in the Stari Aerodrom area of the city of Podgorica.

The research methodology was implemented through the following sequence of steps:

- **Step 1:** Definition of the boundaries of the study area – Stari Aerodrom (Podgorica), including precise determination of the accident location coordinates where the release of the hazardous substance occurs. In this step, all relevant facilities and locations that attract a large number of people were identified and mapped;
- **Step 2:** Definition and input of all essential data into the ALOHA software, including the name of the city and country, accident coordinates, date and time of the event, type of hazardous material, meteorological conditions, tank dimensions, types of surrounding structures, and the presence of natural obstacles. It is important to note that meteorological data were obtained from the Institute for Hydrometeorology and Seismology, ensuring greater reliability of the results and realistic simulation of field conditions;
- **Step 3:** Selection of the release model in the ALOHA software. ALOHA uses four release rate estimation models: the direct source model (instantaneous release from a single point), the pool model (formation of a liquid pool following release), the tank model (direct release into the atmosphere or pool formation), and the pipeline model (Administration & Agency, 2016). For the purposes of this study, the tank model was applied, assuming direct release of the substance into the atmosphere with the occurrence of a BLEVE (Boiling Liquid Expanding Vapor Explosion), which involves the explosion of a boiling liquid (Administration & Agency, 2016);
- **Step 4:** Generation of hazard zones in the ALOHA software and their integration with a GIS software tool to visualize the dispersion zones of the hazardous substance. This approach enabled clear identification of affected areas, assessment of risks to the population and the environment through AEGL analysis, and the formulation of recommendations for response measures in the event of a hazardous material release.

III. RESULTS

The study area is the capital city of Podgorica, specifically the Stari Aerodrom area (42°25.7' N, 19°16.3' E). The aim of the study is to use a projected scenario of hazardous material release from a tank to predict its impact on the general public and determine the concentration levels of the

released substance in the environment. The basic information about the location is presented below (Figure 1):

- The elevation of the city of Podgorica is 45 m (148 ft);
- The geographic latitude of the Stari Aerodrom area is 42°25.7' N;
- The geographic longitude of the Stari Aerodrom area is 19°16.3' E;
- GMT offset of -1:00;
- The air exchange rate for a single-story building is 0.60 per hour;
- The building is classified as sheltered, with surrounding vegetation such as shrubs and trees;
- The accident location coordinates are 42°25'42.55" N and 19°16'15.95" E.

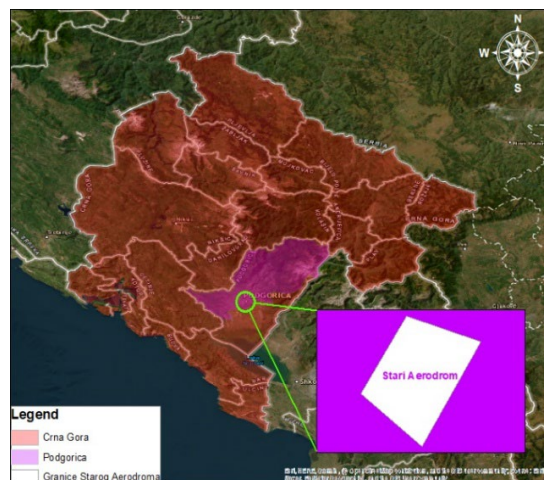


Figure 1: Study area – Stari Aerodrom, Podgorica

The second step involved selecting the hazardous material used for risk analysis and assessment. For the purposes of this study, benzene was chosen, which is a colorless, flammable liquid with an odor similar to petroleum. Benzene can ignite under a wide range of conditions, and indicators of exposure may include facial redness, shortness of breath, headache, dizziness, chest tightness, nausea, vomiting, and, in severe cases, coma. Benzene belongs to hazard class 3 and has the UN number 1114 (NOAA, CAMEO chemicals, 2017).

After selecting the hazardous material, the next important step in the analysis is to define the failure characteristic. The BLEVE effect was chosen as the failure characteristic, as it represents one of the most dangerous incidents that can occur in the chemical industry or in transport. An example is the San Juanico incident (Mexico), where the occurrence of a BLEVE resulted in 503 fatalities, 926 serious injuries, and the evacuation of approximately 60,000 people (Baraza, 2023). The Center for

Chemical Process Safety defines the BLEVE effect as follows: “A BLEVE is the sudden release of a large mass of superheated liquid under pressure into the atmosphere” (Baraza, 2023).

Table 1: Data entry into the ALOHA software tool and safety measures (NOAA, CAMEO chemicals, 2017)

Category	Name	Value
Weather conditions	Wind speed	2.24 m/s
	Wind direction	NNE
	Surface roughness	Urbanized area
	Air temperature	26 °C
	Atmospheric stability class	D
Tank and substances parameters	Diameter	2 m
	Length	10.53 m
	Tank volume	33,081 l
	Stored	Stored as a liquid
	Storage temperature	Ambient temperature
	Mass in the tank	25.4 t
	Tank filling level	80 %
	Failure characteristics	BLEVE
	Tank pressure during release	67.9 psia
Tank temperature during release	137.9 °C	
Safety measures in case of accident / incident		
1. For small spills, evacuate people from the affected area at least 50 m in all directions		
2. For large spills, evacuate people at least 300 m away from the affected area		
3. In the event of a fire, evacuate people at least 300 m from the affected area		
4. Extinguish the fire from the greatest possible distance or use unmanned aerial vehicles (drones)		
5. Remove all ignition sources from the affected area		
6. Do not touch the substance		
7. Prevent the substance from entering waterways or the sewer system		
8. The substance must be absorbed by trained personnel and covered with soil		
9. Monitor the color of the tank and withdraw immediately if any change is observed		
10. Wear protective clothing, goggles, and gloves		

-
11. A contaminated person must remove the substance from the skin and
 rinse thoroughly
-
12. Call emergency medical services
-

After all the data required for scenario implementation had been defined and entered, it was necessary to select the so-called LOCs (Levels of Concern), which are used to assess potential adverse effects on human health. It is important to note that these values are substance-specific (NOAA, CAMEO chemicals, 2017). For the purposes of this study, the following levels of concern were defined:

- LOC (red threat zone) = 10 kW/m²;
- LOC (orange threat zone) = 5 kW/m²;
- LOC (yellow threat zone) = 2 kW/m².

After the simulation was performed in the ALOHA software, three impact zones were generated and subsequently integrated with a GIS software tool in order to spatially visualize the hazard zones and identify the areas affected by the release of the hazardous substance.

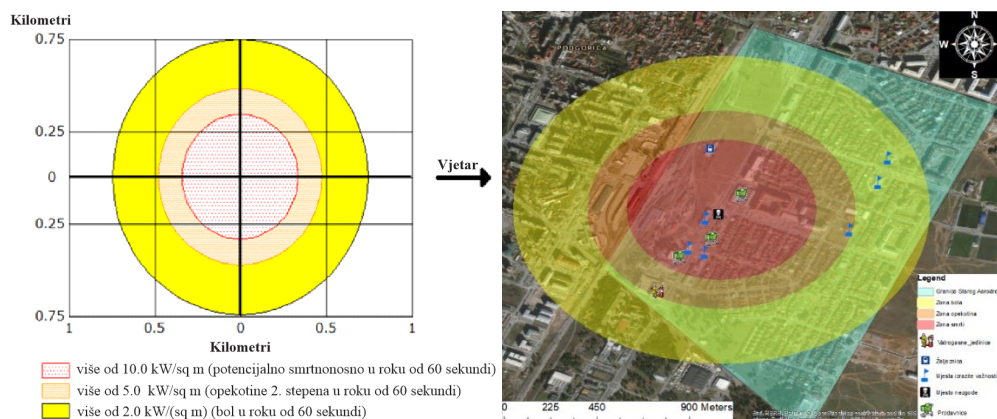


Figure 2: Impact zone of the substance and field visualization

Based on the data presented above, it can be concluded that the wind speed at the accident location was 2.24 m/s, while the wind direction was 22.5°, designated as NNE. The maximum thermal radiation downwind at the maximum distance of the red threat zone, 0.33 km (330 m) measured from the center of the accident, reached 10 kW/m², at which fatal effects occur within a period of 60 seconds. The maximum thermal radiation for the orange threat zone was 5 kW/m² downwind, at a maximum distance of 0.48 km (480 m) from the center of the accident, where second-degree burns occur within 60 seconds. The third zone represents the pain zone, with a maximum thermal radiation of 2 kW/m² downwind, at a maximum distance of 0.74 km (740 m)

measured from the center of the accident. The unit kW/m^2 represents the amount of thermal energy transferred to a surface area of 1 m^2 within 1 second.

IV. DISCUSSION

The transport of hazardous materials is a complex and high-risk process that can have serious consequences for the population, infrastructure, and the environment, particularly in urban areas. Failure to comply with safety guidelines prescribed by ADR during loading, transport, unloading, and storage can result in severe outcomes. Since transit through populated areas is often unavoidable, the application of modern methods for transport risk assessment and management becomes essential.

The results of this study, based on the worst-case scenario of benzene release due to a BLEVE effect, indicate an extremely high level of risk to people and critical facilities within the accident zone. The red threat zone, with a maximum thermal radiation of 10 kW/m^2 and fatal effects occurring within 60 seconds, extends to a radius of 330 m from the accident center, affecting facilities that attract a large number of people at the selected time of the incident. A particularly high risk is associated with the proximity of a fuel station, as secondary explosions may trigger a chain reaction and lead to catastrophic consequences. Furthermore, it should be emphasized that the orange and yellow zones include the "Pavle Rovinski" Primary School, the "Dragan Radulović" kindergarten, the health center in the Stari Aerodrom area, and other facilities of significant importance. Based on the obtained results, it is recommended that certified hazardous materials transport safety advisors be mandatorily involved in all phases of transport planning and implementation. In addition, specialized teams should be established for the supervision, control, and regulation of hazardous materials transport in urban areas. It is also necessary to predefine transport routes with the lowest possible risk, enhance the training of drivers and relevant emergency services, and develop clear emergency response and evacuation plans.

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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 - Doklejšda 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	