Circular Economy and Electromobility: Technologies, Materials and Sustainable Solutions for Industry

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Foreword

Dear members of the professional community, readers, and friends,

we are pleased to present this publication of the National Association UNIVNET – a university, industrial, and research-educational platform. The main objective of the association is to carry out forecasting and research and development activities focused on the search for new technologies and techniques for efficient smart waste recovery with the aim to minimize negative environmental impacts on conserving primary energy and raw material resources.

The UNIVNET platform was established through an agreement signed between the Ministry of Education, Research, Development and Youth of the Slovak Republic (MŠVVaM) and the Slovak University of Technology in Bratislava (STU), which serves as the lead partner of the consortium. In addition to STU in Bratislava, the consortium includes The University of Economics in Bratislava, the Technical University of Košice, the University of Žilina, the Technical University in Zvolen, and the Automotive Industry Association of the Slovak Republic as partner organizations.

The publication you have just started browsing is a continuation of the previous five publications presenting the achievements of the association over the past six years. This publication builds on the objectives of the Research and Innovation Strategy for Smart Specialisation of the Slovak Republic (SK RIS3 2021+). The strategy outlines the innovation policy framework conception, aiming to support innovation at the national, regional, and international levels and thereby contribute to the national economic growth and prosperity.

The book focuses on innovative approaches to sustainable industrial production, innovative solutions in waste recovery and recycling, energy recovery from waste, and efficient energy production with minimal environmental impact. Furthermore, it also addresses the use of renewable energy sources, the circular economy, and the reduction of the carbon footprint.

The topics addressed will facilitate the transfer of scientific findings into practical innovations, supporting solutions for a sustainable and competitive economy in Slovakia. By providing relevant information, the publication brings together academics, entrepreneurs, and public administration representatives, fostering dialogue and creating synergistic processes that support the effective implementation of innovative solutions. New information, their transparent sharing, experiences, know-how, and innovative solutions enable the faster implementation of the latest trends in environmental protection and contribute to the achievement of the strategic objectives of smart specialisation in the field of the circular economy.

The publication consists of eight interrelated and logically organized chapters.

Innovative solutions related to waste material recovery are discussed in Chapters 1, 2, and 5. The first chapter presents a patented technology for the recovery of multilayer materials. The second chapter focuses on the development of an original technology for the conversion of waste polyurethane foam into shaped thermal insulation elements. The fifth chapter

describes an innovative approach to the recovery of rubber waste from the automotive industry through its incorporation into wood-cement boards.

Chapters 3 and 4 discuss issues related to health protection. Chapter 3 presents research into the reduction of transport noise through the application of noise barriers. Based on measurement results, it highlights the benefits of their use from both the health and economic costs perspectives. Chapter 4 focuses on energy recovery from waste textiles.

Smart waste economy is discussed in Chapter 6. It relates to the application of industrial building ventilation systems using IoT and Smart Industry. It examines the impact of their application from the perspectives of air quality protection, energy savings, and investment costs during the building operation.

Chapters 7 and 8 provide economic and statistical analyses. Chapter 7 deals with the analysis of the amount and structure of waste from the automotive industry. It provides analytical inputs for discussions related to the development of processing capacities and more efficient industrial waste management in Slovakia. Chapter 8 focuses on scenarios of electric vehicle sales in EU countries, as well as the effectiveness of fiscal incentives in the transition towards electromobility. It also examines the impact of this transformation on the national economy of Slovakia. The chapter's findings show that the restoring the competitiveness of the Slovak processing industry should be considered one of the key economic policy priorities.

We wish you pleasant reading and believe that the publication will provide you with the necessary information on the current state and challenges of waste management in the automotive industry.

Bratislava, 15.07. 2026

Martin Lábaj
Ľubomír Šooš