Co-funded by the Erasmus+ Programme of the European Union

GIFT

Green initiative for tomorrow

Green horizons of vocational education

-Manual-

БЛАГОЕВГРАДСКА ПРОФЕСИОНАЛНА ГИМНАЦИЯ ИЛЧО БОЙЧЕВ

ПОЛИТЕХНИЧКА ШКОЛА ПОЖАРЕВАЦ

Istituto Tecnico Tecnologico Leonardo da Vinci Foligno

This manual is the result of cooperation between students from three secondary vocational schools from Serbia as the project leader, Bulgaria and Italy, guided by their teachers:

Teachers:

Vladislava Stević
Olivera Filipović
Anka Krstić
Zlata Jović
Jelena Dinić Milićević
Maja Kondić
Milica Obrenović
Đorđe Miladinović
Dušan Radovanović
Vesela Yanchovska
Kristina Petrova
Antoaneta Dzhermanska
Maurizio Torelli
Marco Manali
Angelo Riccioni
Leonardo Rosignoli
Anton Dragoev

Students:

Jelena Petković
Natalija Cvejić
Vukašin Petrović
Ognjen Vuklišević
Sara Antanasijević
Jelena Đorić
Iva Ždralović
isidora Milovanović
Andrej Bresler
Mateja Petković
Janko Bogdanović
Kiril Stoinov
Nikolas Malamov
Nikoleta Kocharkova
Radostine Treneva
Angel Kitov
Daniel Georgev
Dimitar Pandermarakis
George Kaimakanski
Gabriel Stefan Nikolić
Alessandro Lolli
Michelangelo Urbani
Marko Malešević
Matea Longarelli
Damian Sandu
Alessandro Reali
Alessandro Affinito

Content:

Introduction:

The GIFT - Green Initiative For Tomorrow project was designed as a strategic response to the increasingly urgent need to transform the way the education system, and especially vocational education, responds to climate challenges and environmental risks of modern society. The goals of the project are aimed at raising environmental awareness, developing the competencies of students and teachers for responsible resource management, understanding the impact of traffic on the environment, and applying specific technical solutions in everyday life and work. The focus is not only on learning about environmental protection, but on creating the ability to act - so that students know, understand, and work in accordance with the principles of sustainability. Through the cooperation project establishes a bridge between school classrooms and the real world of technology, ecology and sustainable mobility.Students play a central role in all project activities, they are not only treated as passive recipients of knowledge, but as active participants in learning processes through research, experimentation, observation and designing solutions. Whether analyzing the efficiency of car battery recycling, observing how pollution measurement sensors work, participating in technical inspection simulations or testing the performance of solar panels – students develop both environmental and technical literacy. Students are also promoters of change, through local activities and dissemination of acquired knowledge, they become bearers of sustainable development ideas in their community. The project methodology gives them the opportunity to be creative, to express themselves through research tasks and to strengthen their self-confidence through concrete results.

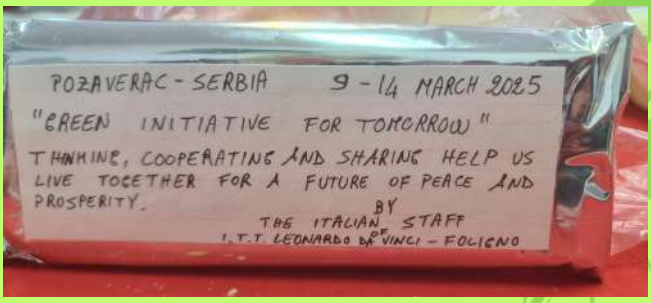
In the vision that the GIFT project promotes, sustainable transport is not just a concept, but a real, achievable practice that relies on technical innovation, rational use of resources and responsible behavior. Sustainable transport is reflected in the transition from fossil fuels to renewable energy sources - primarily solar and wind energy - as well as in the development of electric vehicles and hybrid systems that reduce CO_2 and harmful gas emissions. The vision also includes the optimization of the traffic infrastructure, the technical correctness of vehicles, the use of sensors for measuring air quality and smart mobility management systems. In this context, education plays a key role: it is necessary for young people to understand how technology works, but also to change their attitudes and habits - to become drivers, passengers and technicians of the future who think and act in accordance with the principles of ecology. In sustainable traffic, man, technology and nature are not in conflict, but in partnership. This vision also requires a new way of education - integrated, interdisciplinary and practical - which is exactly what the GIFT project is successfully developing through its activities and materials.

Theoretical framework:

Green Initiative for Tomorrow project fosters education about modern challenges related to waste management and sustainable transport, as well as on the development of practical knowledge and environmental awareness among students. The starting point is an understanding of basic concepts such as sustainable development, electrical and traffic waste, recycling, green transport and the environmental impacts of human activities. Through workshops, the students analyzed specific sources of pollution, especially those that arise in the transport sector and the auto industry, such as waste oil, used batteries, alternators, electric motors, as well as sensors for detecting gases and alcohol vapors. The theoretical part allowed them to familiarize themselves with the regulations on the storage and disposal of hazardous waste, as well as with the technologies used for its purification or reuse.

By comparing local examples of good practice, students gained insight into different models of waste management, including closed material cycles, digital waste monitoring, but also simple mechanical and physical methods of waste separation and processing. In a workshop on waste oil management, students studied how motor oils are collected, purified and returned to circulation, as well as the challenges of soil and water contamination. In particular, they covered topics related to the proper disposal of lead-acid batteries, their impact on human health and nature, as well as the possibilities for recycling metals and electrolytes.

In addition, students participated in the analysis of components of auto-electrical systems (starter, alternator), which expanded their technical knowledge and trained them to understand the circular economy in the field of vehicles. In the workshop dedicated to green mobility, the students analyzed the types of fuel, the advantages of electric and hybrid vehicles, as well as the methods used by cities to reduce gas emissions (bicycle paths, public transport, pedestrian zones). They paid special attention to MQ sensors, thus connecting IT competences with ecology - simulating the work of sensors for detecting harmful gases and understanding their application in preserving health and the environment.



The theoretical part also encourages thinking about the long-term consequences of irresponsible waste management and unsustainable transport, as well as how changes in individual and community behavior can contribute to environmental preservation. Although topics such as carbon footprint and renewable energy sources were not the direct focus of the workshops, through the entire process of learning and research it is clearly noticeable that the activities and conclusions of this project contribute to the creation of a generation of young people who understand the importance of reducing harmful gas emissions and moving towards more sustainable models of energy and traffic.

Theoretical framework:
Background

Polytechnic School from Požarevac, founded on October 5, 1990, is a key educational institution in the GIFT project because it provides a solid foundation for tomorrow's green experts with its profiles and local influence. It is located in the building of the former Home of Trade Youth, symbolically combining historical heritage and modern vocational education. The school is accredited for educational profiles in the fields of traffic and electrical engineering, such as motor vehicle driver, road traffic infrastructure technician, auto electrician, electrician and electro-mechanic for heating and cooling devices. Within the school structure, there is also a Driver Training Center, which enables practical training and passing exams for B and C category, with provided driving capacities. This combination of professional teaching and practical training makes the Požarevac Polytechnic School the ideal project carrier, with a strong local foothold and professional reach.

On the other hand, ITT "Leonardo da Vinci" from Foligno (Italy) represents a multidimensional technical school with a rich offer of educational profiles, from electronics, electrical engineering, mechanics, mechatronics and energy, to informatics, telecommunications, construction, architecture, biotechnology and ecology. Numerous projects and innovative initiatives are implemented at the school, and it also has a rich laboratory infrastructure that enables the combination of theory and practice through digital tools, workshops and research approaches. This partner was entrusted with an important international role in the implementation of the GIFT project.

Blagoevgrad Vocational High School "Ichko Boychev" from Bulgaria, brings the values of professional orientation through specialties such as automotive mechatronics, computer engineering and technology, electrical equipment for production, CNC systems, as well as logistics and transport. The high school is active in implementing international Erasmus projects and maintaining partnerships with local business entities, which strengthens the practical value and regional relevance of its educational programs.

These three partners, each with their own specific expertise, together build a synergy that the GIFT project makes the most of: Požarevac Polytechnic School as the carrier provides strategic coordination, local infrastructure and practical field orientation; ITT Foligno contributes to modern technologies, interdisciplinary laboratories and international projects; while Blagoevgrad High School brings practical-academic strength in mechatronics, automation and logistics. Their joint mission is shaping an educational model that connects ecology, technology and traffic through the creation of young experts capable of responding to the challenges of sustainable transport and environmental protection.

Activity 1 - Serbia

Environmental challenges associated with traffic and electronic waste are becoming more and more present and require systemic solutions, both at the local and international level. The presentations analyzed within the GIFT project show a comprehensive insight into the types of waste that are most often generated in the transport and electronic sectors, their consequences for the environment, but also possible ways for their sustainable disposal.

The company Litas, which has been operating in Požarevac for over 80 years, deals with the transport and repair of vehicles and therefore generates several types of waste every day: industrial waste oil, tires, batteries, electronic and electrical waste. In accordance with current laws and EU standards, this company separates all types of waste into special warehouses and transports them to certified companies that perform recycling or safe destruction. Batteries are stored until a certain amount is reached, after which they are sent for recycling. E-waste is broken down and components are reused or recycled, while tires are turned into rubber granules used for flooring and pitches.

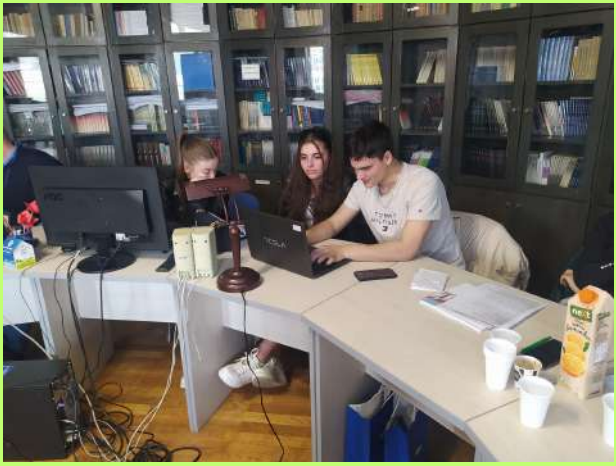
A special challenge is the management of waste oil, which is created during engine and vehicle servicing. The oil is stored in specially designed barrels and collection points, and then it is sent to companies that have permission to regenerate or thermally destroy it. Although the current practice is satisfactory, the authors of the presentation suggest that Litas, if it develops internal capacities, could take over part of that process within its own infrastructure, which would reduce the risk of pollution during transport.

More broadly, traffic waste - such as tires, engine oil, brake linings - and electronic waste - batteries, devices, cables - pose a serious risk to the environment. Tires are difficult to break down and release toxins, motor oil can pollute millions of liters of water, while batteries contain lead and other heavy metals that are extremely toxic. Globally, only 20% of e-waste is adequately recycled, while the rest ends up in landfills or in informal streams

Countries like Sweden, Japan and Germany have achieved a high degree of success in waste management thanks to strict regulation, the introduction of a circular economy and the use of smart technologies. In this context, the example of Litas and students researching local practices contributes to raising awareness and initiating change in local communities.

The key messages are:

- Application of the three R principles (Reduce, Reuse, Recycle) as an individual responsibility of every citizen.
- The potential of the green economy to create new jobs through the waste management sector.
- Systemic state support is needed, especially in countries with poorly developed recycling systems, such as Serbia.
- Technological innovations, such as smart bins, sorting robots and waste-to-energy plants, represent the future of sustainable waste management.

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Activity 2 - Bulgaria

Contemporary challenges of climate change and energy efficiency in transport require innovative solutions that combine renewable energy sources and modern technology. Within the framework of the GIFT project, examples of good practice through the use of photonic (solar) systems and advanced electromechanical components in vehicles, which directly affect the sustainability of the transport sector, were analyzed.

The company G-Energy is an example of the introduction of hybrid photovoltaic systems that combine independence and efficiency. Their systems enable the simultaneous use of solar energy and the stability of the connection to the electrical grid, which ensures a constant supply of electricity, even in adverse weather conditions. The key parts of the system are: solar panels, solar controller, battery block, hybrid inverter and monitoring system. These systems work by having photovoltaic cells (most commonly made of silicon) absorb sunlight, convert it into direct current (DC), which is then converted by an inverter into alternating current (AC) suitable for households and commercial establishments

Photonic systems play a key role in green transportation. Solar panels on vehicles or electric car charging stations enable the direct conversion of solar energy into electricity, which contributes to reducing carbon dioxide emissions, dependence on fossil fuels and the cost of using the vehicle. In addition to environmental benefits, solar energy significantly contributes to energy efficiency and long-term cost savings in the transportation sector.

On the other hand, the presentation about the Monea company provides an insight into the functionality and maintenance of the key electro-mechanical parts of the vehicle - the alnaser (starter) and the alternator. Starters are used to start the engine, while alternators produce electricity during engine operation and charge the battery. Both systems convert mechanical energy into electrical energy, thus ensuring the operation of all electrical systems in the vehicle. Monea uses a highly professional approach with quality materials, emphasizing recycling as an important segment in the production process - recycled materials are used to make new components, which reduces pollution and emissions of harmful gases.

It is also important to point out that both systems (solar and electromechanical) can be integrated into the broader concepts of circular economy and energy independence, especially in rural and industrial environments. While G-Energy promotes smart energy management and real-time consumption monitoring, Monea provides reliable solutions for the restoration and maintenance of auto parts that would otherwise become hazardous waste.

From the point of view of education and professional guidance of students in the field of traffic and electrical engineering, examples like this can serve for understanding:

- how renewable energy systems work and how to integrate them into transport solutions;
- what are the key components of vehicle electrical systems and how can they be used sustainably;
- how recycling and rational use of resources contribute to the reduction of greenhouse gas emissions;
- how the application of innovations and new technologies creates green jobs in the sectors of the future.

In conclusion, both examples represent significant moves towards environmentally conscious transport solutions.

Activity 3 - Italy

The focus of the project being raising the awareness of students and teachers about the environmental challenges associated with traffic waste, waste oil management, electronic and electrical components, as well as the use of sensors and renewable energy sources, and given that, through a series of workshops and educational materials gathered by partners key problems were identified and innovative solutions based on the STEM approach were proposed.

Battery and waste oil management are important segments of environmental protection. The presentation on car batteries explains the recycling process - from the collection of old batteries, through the separation of lead and electrolyte, to their processing into new products, with strict safety and environmental protocols. Also, waste oils are a big problem if they are stored inadequately - one liter can pollute a million liters of water. Proper storage, filtration and regeneration are key. Through these materials, the students gained insight into the legal regulations, risks and examples of good practice in the EU.

In the documents on pollution and global climate challenges ("Global Stocktake" and "Pollution"), the connection between industry, transport and the emission of greenhouse gases (CO_2, NO_x) is highlighted. Students learned about the difference between natural and anthropogenic pollution, with special reference to the role of renewable energy sources (solar and wind energy) as a key alternative for the future.

Practical workshops in Italy included a visit to the "Spacchetti" technical inspection center, where the students saw what a pre-inspection looks like, analysis of gases from exhaust systems, as well as a technical check of brakes, lights, suspension and safety systems of vehicles. The use of modern diagnostic equipment contributed to the understanding of the importance of preventive vehicle maintenance in order to reduce emissions and increase safety.

A notable segment of the project was the MQ-3 and MQ-9 sensors, which measure the presence of alcohol, carbon monoxide and flammable gases. They are used in Arduino projects and related to the topic of traffic safety. The sensors use a tin oxide layer that changes conductivity in the presence of gases, and the data is further interpreted by a microcontroller. These workshops strengthened students' competencies in programming, electronics and application in environmental protection.

Finally, the Italian partners presented the "Genergy" initiative, which promotes green technologies – such as electric vehicles, solar panels, wind turbines and efficient LED lighting. The goal was to show how modern technology can respond to climate challenges and contribute to sustainable cities and communities.

Overall, the documents and presentations from the GIFT project provided multidimensional knowledge about the environmental problems of the modern world.

By introducing concrete tools and visits to real locations, students and teachers combined theory and practice, strengthening environmental literacy and digital skills in line with sustainable development goals.

Conclusion:

The common denominator of all the workshops is sustainability in the transport and energy sectors, viewed through the prism of real-life examples and concrete technological solutions. Whether it is G-Energy's hybrid solar systems, lead-acid battery recycling or Arduino sensors that measure alcohol in the breath, the message is clear: environmental problems require technical solutions, and these solutions require educated and responsible young professionals. In this sense, the project activities enabled the participants to understand both the environmental consequences of transport (CO_2, NO_x emissions, particulate matter), and the technical infrastructure needed to mitigate them (solar panels, alternators, sensors, waste oil filtration systems).

The symbiosis between digital competences and environmental literacy was also observed – students used sensors, microcontrollers and programming to measure and analyze pollution. They went through all stages of system design and testing – from theory and schematics, through soldering and assembly, to data visualization. This integration of STEM fields with real environmental challenges represents an innovative model of vocational education that meets the needs of the 21st century.

All three workshops promote a circular economy, through component recycling (batteries, alternators), system renovation, rational use of energy, as well as the use of renewable sources. Through visits to real facilities – such as the "Spacchetti" technical inspections and G-Energy systems – students learned about the mechanisms of implementing sustainable solutions in practice and had the opportunity to observe professional standards of work, safety and diagnostics.

The common methodological framework of these workshops relies on project-based learning, teamwork, problem solving and the combination of multiple disciplines – ecology, electronics, mechanics, chemistry, IT and transport. Such an approach motivates students to research, propose and test their own solutions. These experiences strengthen not only their technical and digital skills, but also their awareness of responsibility towards the environment and the community.

Appendix: Glossary

- **Biofuel** - A fuel obtained from plant or animal materials, such as biodiesel and bioethanol, which is used as an ecological alternative to fossil fuels.
- **Circular economy** - An economy based on reuse, repair, recycling and extending the life of products to reduce waste.
- **Ecodesign** - An approach to the design of products and systems that takes into account the entire life cycle and reduces the negative impact on the environment.
- **Ecological Footprint** - A measure of the impact of an individual, organization or community on the natural resources of the planet, expressed in the area needed to support their way of life.
- **Sustainable mobility** - The movement of people and goods in a way that minimizes damage to the environment, while maintaining efficiency and affordability.
- **Smart City** - A city that uses information and communication technologies (ICT) to improve service efficiency and reduce environmental impact.
- **Carbon footprint** - The total carbon dioxide emissions associated with the activities of a person, product or organization.
- **Zero-emission vehicles** - Vehicles that do not emit harmful gases during operation, such as electric cars.
- **Green transport** - A form of transport that has a minimal negative impact on the environment (bicycles, electric cars, public transport, walking).

- **CAN-bus** - Communication system that enables the exchange of data between electronic components in the vehicle.
- **Digital instrumentation** - The use of computers, sensors and software tools in measuring, diagnosing and optimizing vehicle performance.
- **Photovoltaic panel** - A device that converts sunlight into electrical energy, also used in vehicle energy.
- **Hybrid vehicle** - A vehicle that uses a combination of an internal combustion engine and an electric motor for propulsion.
- **Connected in-vehicle systems** - Modern cars have a network of sensors and controllers that enable devices to communicate with each other.
- **Traffic infrastructure** - Facilities, roads, signaling and installations that enable the safe and efficient flow of vehicles and people.
- **Emission measuring devices** - Instruments used for the detection and measurement of exhaust gases in order to control pollution.
- **Internal combustion vehicle** - A classic type of vehicle that uses gasoline or diesel to run the engine.

- **Cooling system check** - Inspect the radiator, thermostat, and coolant hoses.
- **Exhaust system check** - Check for leaks, catalytic converter, silencer, and overall condition of the exhaust system.
- **Brake system check** - In addition to checking the brakes, this might include checking brake lines, pads, and discs.
- **Fluid levels check** - Engine oil, brake fluid, coolant, and windshield washer fluid.
- **Battery check** - Inspect charge levels, clean terminals, and verify starting capacity.
- **Filter inspection** - Air and oil filters, essential for optimal engine performance.
- **Catalytic converter** - Check that the catalytic converter is functioning properly to reduce harmful emissions.
- **Oxygen sensors** - Check the sensors to ensure the correct air/fuel mixture ratio.
- **Exhaust system** - Check the rear parts (silencer and pipes) for damage or leaks.