

## ОБЩИЕ ВОПРОСЫ АВТОМОБИЛЬНОГО ТРАНСПОРТА

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## ESTET – NEW INNOVATIVE SPECIALTY FOR MASTER STUDENTS

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**Abstract. Problem.** Currently, new educational reforms are intensively being implemented in Ukraine. This is achieved, including, by the development and implementation of new innovative joint training programs. **Goal.** To improve higher education in accordance with the changing needs of economic and social spheres in the road transport sector due to the growth of innovative energy-efficient and energy-saving technologies. To increase the competitiveness of graduates in employment and the productive cooperation between the universities. To reduce energy consumption and to replace traditional sources by «green» forms of energy in the transport sector as well. **Methodology.** The analysis of existing joint educational programs for masters was conducted. There was accomplished the analysis and monitoring of the labor market with the determination of its urgent and future needs, taking into account the development of modern electric transport. **Results.** The project for implementation of the new innovative master's program in the specialty «Energy-saving technologies in transport» (ESTeT) has been developed. We have proposed the structure of a new specialty. The work packages that address specific tasks in the overall system of the ESTeT project implementation have been briefly described. The division of the new master's specialty into its constituting structural elements has been carried out. **Originality.** We proposed the new innovative educational joint program for masters ESTeT. **Practical value.** The implementation of new innovative joint specialties in the field of higher education in Ukraine provides an opportunity to increase the level of Ukrainian higher education itself. This will allow students to acquire the appropriate competencies in the field of study and expand their applications. Also, obtaining two diplomas (Ukrainian and European) by students will significantly expand their employment opportunities.

**Key words:** energy-saving technologies, transport, infrastructure, Smart roads, Master Program, energy-efficient systems

### Introduction

Currently, new educational reforms are intensively being implemented in Ukraine. In September 2017, the new Law of Ukraine «On Education» No. 2145-VIII took effect. One of the main components of this law is the modernization and reform of higher education in Ukraine. This modernization is based on the consideration of Ukraine's national priorities and close cooperation with leading European and American modern educational institutions. The most effective means of higher education reform is the implementation of modern foreign teaching methods and practices in the educational process. This is achieved, including, by the development and implementation of new innovative joint training programs. The urgency of the «Energy-saving technologies in transport» (ESTeT) specialty reflects the increasing interest in the intensive development of energy saving technologies and the improvement of environmental safety of road transport [1–3].

The constantly growing number of hybrid and electric vehicles requiring a completely new approach in the development of infrastructure for maintaining and repair work proofs this fact [4–6]. This approach should be based on the implementation of contemporary, innovative energy-saving and energy-efficient systems [7–9].

Thus, the successful implementation and promotion of environmentally friendly road transport are impossible without building a broad urban and suburban network of charging stations for electric vehicles and plug-in hybrid cars. These charging stations must be equipped in accordance with the latest standards of environmental safety with maximum usage of renewable and alternative energy sources such as solar panels, wind generators, etc. [10–12].

### Analysis of Publications

The development of modern transport network infrastructure also involves the implemen-

tation of a complex of different means under the general title "Smart roads" including: interactive road lighting, displaying the state of road surface in various weather conditions, wireless charging of electric vehicles on the road, active road marking with the possibility to redistribute fast modes and road lanes depending on the traffic capacity, etc. This type of road is a complex electrical and information system, it can work independently and provide electric energy not only for its needs but also for the requests of other electrical consumers. In particular, we are talking about the expansion and integration into the current transport infrastructure of energy-saving technologies in accordance with the requirements of present-day types of energy-efficient transport [13–15].

To plan and implement the stable development of energy-efficient road transport infrastructure the specially trained staff - specialists are required and they should be capable to develop and design such systems, as well as carry out the necessary maintenance and repair work of not only hybrid and electric vehicles but electric, electronic and information systems of this infrastructure.

The implementation into the educational process of such joint (for all project participants) educational program will result in standard (double, multilateral) Master's diplomas for the «Energy-saving technologies in transport» speciality. This conforms to the key national priorities of Ukraine (UA) in higher education (Category A: «Curriculum development projects»: Teacher training & education; Engineering and engineering trades).

The consequences of these innovations will encourage the modernization of higher education and the improvement of its quality and efficiency as well [16, 17].

Masters in the ESTeT speciality are now in great demand in the labor market, as modern manufacturing and designing companies are interested in reducing energy costs, the growth of their productivity and, eventually, increasing their competitiveness.

It must be noted that the creation and development of this program for higher education is an essential and crucial task in Ukraine and in Europe (EU) too. The most significant argument is a state policy of UA itself on higher education (Law of UA on Higher Education, 2014, №37-38), and renewable energy industry. To fulfill these obligations to the Energy Community, the UA government approved the «National Action Plan on renewable energy up to 2020» (Decree

of the Cabinet of Ministers of Ukraine on October 1, 2014 № 902-p) developed under the requirements of Directive №2009/28/EC to encourage the use of energy from renewable sources. The aim of this document is to increase up to 2020 to the 11 % share of the energy produced from renewable sources in the final energy consumption of the country [17, 18].

Therefore, not only the requirements in higher education, in the economic and social spheres of the country, but also the state policy itself of renewable energy policy therefore in the development of energy-efficient and energy-saving technologies prove the urgency, the need and demand for innovative educational master's degree programs for the «Energy-saving technologies in transport» speciality.

The implementation of this program into the educational process involves the training of teaching staff under the European norms and standards. Therefore, the project will require retraining, upgrading and advanced training courses of teaching staff of UA universities in EU educational institutions as well. This will ensure a proper level of higher education quality and increase proficiencies and competencies of university teachers themselves, which is also one of the key national priorities for UA in higher education (Category A: «Curriculum development projects» Teacher training & education) [16, 17].

### **Purpose and Task**

**Objective of the project.** To improve higher education in accordance with the changing needs of economic and social spheres in the road transport sector due to the growth of innovative energy-efficient and energy-saving technologies; to increase the competitiveness of graduates in employment and the productive cooperation between the universities; to reduce energy consumption and to replace traditional sources by «green» forms of energy in the transport sector as well.

**Tasks of the project.** To develop EU based advanced Joint Innovative Double Degree Master Program in ESTeT and introduce it in UA Universities participated in the Project since September 2019.

To improve educational environment and infrastructure of the UA Universities participated in the Project through:

- retraining of UA Universities' teaching staff;
- equipping specialized Resource Centres;
- elaboration and publishing necessary teach-

ing materials, including Laboratory Practicums and Case Studies.

To develop short-term courses for training and skills' upgrading of industry representatives and introduce them in operation during the 3rd Project year.

The aims and objectives set will enhance the implementation of joint educational MP developed within this project into the educational process of university and will ensure the ever-increasing need of EU and UA labor market and socio-economic spheres for highly qualified staffs of the ESTeT speciality. Also, the achievement of the aims set will provide the proper level of higher education quality in accordance with European standards, which will increase the competencies of university teachers and the participants of the project as well. All mentioned above meet the requirements of national UA priorities in higher education (Category A: «Curriculum development projects»: Teacher training & education; Engineering and engineering trades).

**Structure of ESTeT and impact**

ESTeT in general, can be divided into two compound groups – infrastructure and transport, Fig. 1 [14]. In turn, infrastructure is divided into the following elements: service stations; filling stations and energy-efficient technologies. Traditionally, highway transport can be divided into: buses, lorries and cars.

Developing major components of Master's ESTeT Program (It can be updated):

1. Compulsory disciplines:

a) Disciplines of human and socio-economic sciences of training – 10 ECTS: Philosophy; Business English; Fundamentals of Pedagogy and Psychology of Higher Education

b) Disciplines of fundamental, natural sciences and general economic training – 5 ECTS: Civil Defence and Labour Safety in the Industry; Fundamentals of Intellectual Property.

2. Disciplines of professional and practical training – 28 ECTS: Energy Efficient Technologies; Infrastructure of Electrical Motor Vehicles; Designing Hybrid and Electric Control Systems in Motor Vehicles; Modeling Operation Processes in Electric and Hybrid Motor Vehicles.

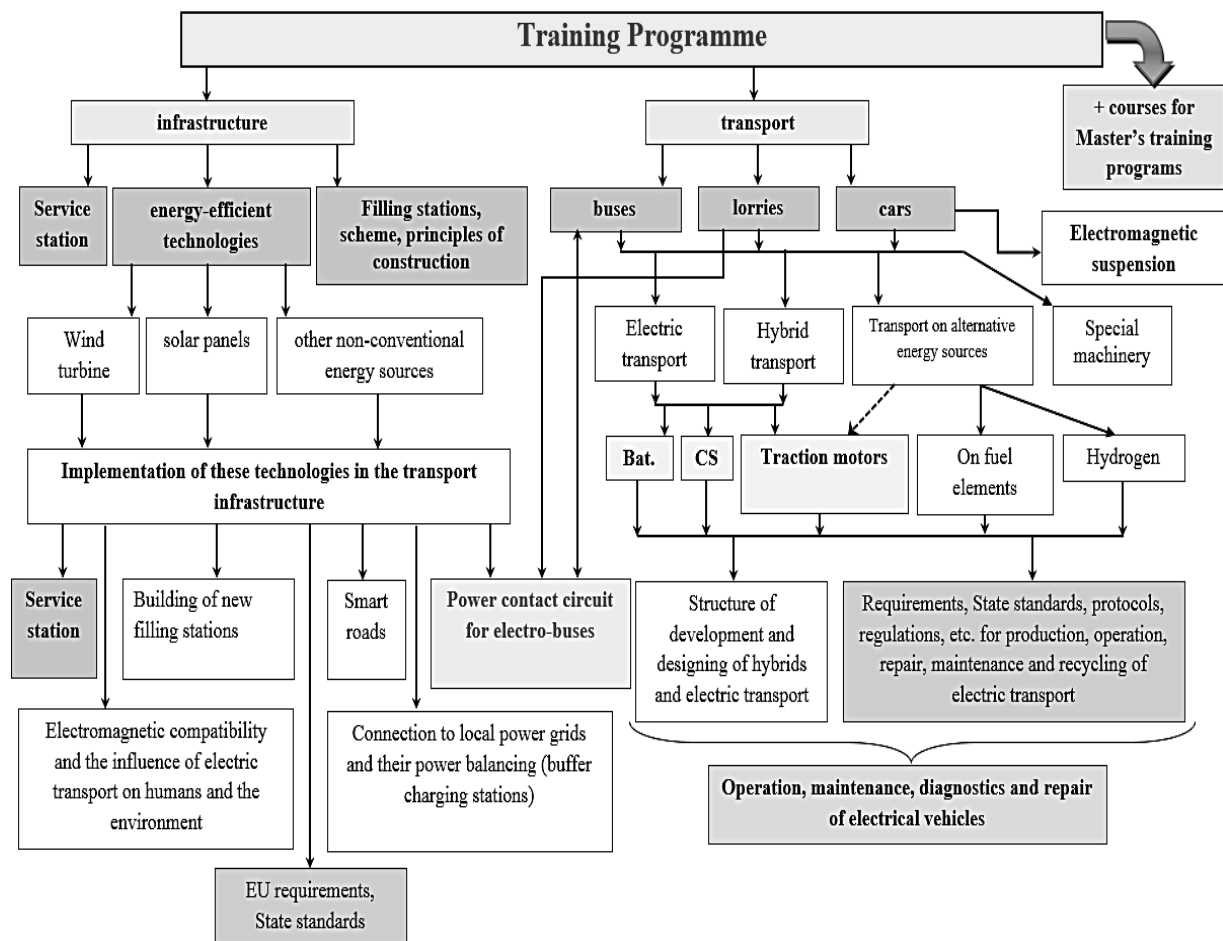


Fig. 1. Structure of new innovative specialty for master students

## 3. Elective disciplines:

a) Disciplines chosen by an educational institution – 8 ECTS: Methods of Planning Scientific Research in Motor Vehicles; Advanced Technologies in Transport Infrastructure; Innovation Strategy Management; Electro-Magnetic Compatibility in Industrial Electronic Equipment

b) Disciplines chosen by a student – 6 ECTS: Biosphere Monitoring of the Environment; Supervising of Scientific Project; Innova-

tion and Investment Enterprise Activities; Special Course of Evaluating the Effectiveness of Engineering Solutions.

4. Practice and Graduate Work – 33 ECTS: Scientific Traineeship; Graduate Work.

For the purpose of implementation ESTeT – Joint Innovative Double Degree Master Program and its practical realization, we proposed to develop work packages (WP).

A brief description of WP is presented in Table 1.

Table 1 – Logical framework matrix

Month	Outputs (tangible) and Outcomes (intangible)	Indicators of progress	How indicators will be measured	Assumptions & risks
1	2	3	4	5
month 1-5	WP 1(PREP) Project Strategy Development	<ul style="list-style-type: none"> <li>– Approved concept of project implementation and distributed roles and functions.</li> <li>– 1 Conference</li> <li>– Review reports on training programs with the analysis of using energy-efficient and energy-saving technologies in UA curricular.</li> <li>– Reporting documentation on the study of existing teaching materials in the field of energy-efficient and energy-saving technologies.</li> </ul>	<ul style="list-style-type: none"> <li>– Reports</li> <li>– Statistics</li> <li>– Reviews.</li> </ul>	<ul style="list-style-type: none"> <li>– Existence of high-level information infrastructure in UA.</li> <li>– UA Universities' administration and educational authorities are committed to the project goals.</li> <li>– Other universities are interested, willing and able to participate in innovation activities and network.</li> <li>– Relevant Ministries and authorities in UA support innovation development</li> <li>– Availability of public databases in UA universities and free access to them.</li> </ul>
month 3-23	WP 2 (DEV) EU-UA Joint Master's ESTeT Program	<ul style="list-style-type: none"> <li>– Draft of Master's ESTeT Program</li> <li>– Curricula and Syllabi of Master's ESTeT Program.</li> <li>– 2 Seminars on project progress results.</li> <li>– Normative documents for the accreditation and licensing.</li> <li>– Textbooks, course books.</li> <li>– Agreements between EU and UA Universities.</li> </ul>	<ul style="list-style-type: none"> <li>– Reports</li> <li>– Syllabi of disciplines (EQC and EPP, Curricular)</li> <li>– 2 seminar programs</li> <li>– Methodical support of disciplines are available on project's WEB-site</li> <li>– Project WEB-site statistics</li> <li>– 2 course books</li> <li>– Agreements.</li> </ul>	<ul style="list-style-type: none"> <li>– The general shift of adjusting UA Higher Education System to the EU one will be the major and motivation-raising factor of the project.</li> <li>– Master's ESTeT Program at UA Universities will require the relevant accreditation.</li> </ul>
month 3-35	WP 3 (DEV) UA teachers' skills upgrading and infrastructural support	<ul style="list-style-type: none"> <li>– 3 Web-based seminars.</li> <li>– Retraining and upgrading courses for teaching staff Teaching Materials.</li> <li>– Equipment.</li> <li>– Web-portal.</li> </ul>	<ul style="list-style-type: none"> <li>– Reports.</li> <li>– Officially published data.</li> <li>– Officially placed data on project's WEB-site.</li> </ul>	<ul style="list-style-type: none"> <li>– Possible mobility of retrained UA teachers leaving Universities and changing working place.</li> </ul>

1	2	3	4	5
month 5-36	WP 4 (DEV) International Quality Assurance System (IQAS)	– IQAS developed and launched since September 2019.	– Approved Regulations on IQAS and printed Guide on the IQAS use	– Lack of knowledge of UA teaching and administrative staff as for latest IQAS of EU Universities and absence of common approaches to perform quality assessment in UA.
month 15-36	WP 5 (DEV) Pilot ESTeT students' training	– Orders on students' admission. – 1 Conference. – Orders on Teachers' exchange between EU and UA Universities. – Orders on Students' training in other country universities. – Diplomas of Master's degree on the ESTeT speciality.	– Reports. – List of students enrolled for training. – Orders of UA Rectors. – University registry. – Officially placed data on the project's WEB-site.	– Substantial number of training materials in English as well as academic lecturing delivered by EU Universities teachers also in English require the appropriate level of English language skills of UA Master's students.
month 4-33	WP 6 (QPLN) Project Quality Control & Monitoring	– Approved and implemented Quality Plan, internal and external reviews.	– Quality assessment reports.	– Students' training in PC Universities requires confidence that it will be implied at EU Standards' level.
month 1-36	WP 7 (DISS & EXP) Dissemination & exploitation project results	– 3 Seminars on project progress results; 3 Conferences; 3 Web-based seminars; 2 Short-term courses. – Dissemination of advertising materials via the Internet – Number of published and other teaching materials.	– Reports. – Officially published data - Publications in scientific, technical and methodological periodicals. – Officially placed data on web-sites & Project web-portal. – 3 Seminar and Conference programs. – 2 Short-term courses.	– Many UA Universities are interested in approximation of their training programs to modern European ones. – The stable budget support of ESTeT and Energy Effective Technologies will ensure the institutional and financial sustainability of project results. – Economic crisis in Partner Countries limits opportunities of Ministries of Education, national enterprises and industrial organizations to support financially international students' mobility.
month 1-36	WP 8 (MNGT) Management of the project	– Distribution of tasks among all partners. – PMC Decisions. – Regular meetings of management and administration team and reports on monitoring project activities and budget.	– Package of agreements signed. – Project reports. – Number of updated courses and e-components. – Project Work Plan and progress reports.	– Timely money transfer from the EC to Grant Holder and from Grant Holder to project partners.

Each of the WP solves a specific task in the overall implementation system of the ESTeT speciality.

**Conclusion**

The description of Joint Innovative Double Degree Master Program «Energy-Saving Tech-

nologies in Transport» is presented. Major components of Master's ESTeT Program are developed and overview of short and long term impact indicators is presented.

National priorities of Ukraine in the higher education system are Transport services, Teacher training & education. The implementation of

project program into the educational process will provide both the training of qualified specialists in developing and maintaining modern automobile vehicles, and the training of teaching staff under European norms and standards. This will increase the level of higher education quality and university teachers' competencies.

#### Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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**ESTET – НОВА ІННОВАЦІЙНА  
СПЕЦІАЛЬНІСТЬ ДЛЯ МАГІСТРІВ****Гнатів А.В., Аргун Ш.В., Ульянець О.А.,  
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**Анотація.** На цей час в Україні активно впроваджуються нові освітні реформи. Це досягається, зокрема, шляхом розробки та впровадження нових інноваційних спільних навчальних програм. До того ж, через зростання інноваційних енергоефективних та енергозберігаючих технологій важливо поліпшувати вищу освіту відповідно до змін у потребах економіки та соціальної сфери у секторі автомобільного транспорту, підвищувати конкурентоспроможність випускників у сфері зайнятості, впроваджувати продуктивну співпрацю між університетами. До того ж, енергетичні й екологічні проблеми в Україні змушують знижувати споживання енергії та замінити традиційні джерела на «зелені» види енергії в усіх сферах життя і діяльності держави, зокрема і в транспортному секторі, що сприяє приєднанню навчального процесу до вирішення цих проблем. Проведено аналіз існуючих спільних освітніх програм для магістрів. Проведено аналіз та моніторинг ринку праці з визначенням його поточних та майбутніх потреб, з урахуванням розвитку сучасного електричного транспорту. Розроблено проект впровадження нової інноваційної магістерської програми зі спеціальності «Енергозберігаючі технології на транспорті». Запропоновано структуру нової спеціальності. Коротко описані робочі пакети, що стосуються конкретних завдань у загальній системі реалізації проекту «Енергозберігаючі тех-

нології на транспорті». Проведено поділ нової спеціальності магістрів на структурні елементи. Реалізація нових інноваційних спільних спеціальностей у сфері вищої освіти в Україні дає можливість підвищити рівень самої вищої освіти України. Це дозволить студентам набутти відповідних компетенцій у галузі навчання та розширити їх застосування. Крім того, отримання студентами двох дипломів (українського та європейського) значно розширить можливість для працевлаштування

**Ключові слова:** енергозберігаючі технології, транспорт, інфраструктура, розумні дороги, магістерська програма, енергоефективні системи.

**ESTET – НОВАЯ ИННОВАЦИОННАЯ  
СПЕЦИАЛЬНОСТЬ ДЛЯ МАГИСТРОВ****Гнатів А.В., Аргун Ш.В., Ульянець О.А.,  
ХНАДУ**

**Анотація.** Предлагается внедрение в образовательный процесс в ВУЗах Украины новой инновационной специальности для магистров «Энергосберегающие технологии на транспорте» (ESTeT). Описаны стратегические цели данного проекта, предложена структура новой специальности, описаны рабочие пакеты, которые решают конкретные задачи в общей системе реализации проекта ESTeT. Проведено разделение новой магистерской специальности на ее составные структурные элементы.

**Ключевые слова:** энергосберегающие технологии, транспорт, инфраструктура, умные дороги, магистерская программа, энергоэффективные системы.