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Engineering curricula modernization in renewable energy in Albanian Universities

ENGINE

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Report for Albania HEIs

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Abbreviations

- ENGINE – Engineering curricula modernization in renewable energy
- MSc – Master of Science
- MP – Master Professional
- BA – Bachelor Degree
- RE – Renewable Energy
- SoSE – System of systems engineering
- VET – Vocational Education & Training

Universities & Institutions:

- EU – European Union
- HEI – Higher Education Institution
- KHAS – Kadir Has University
- PUT – Polytechnic University of Tirana
- UAMD - University Aleksander Moisiu of Durres
- UET – European University of Tirana
- KPT –Professional College of Tirana

Programs & Profiles:

- CE – Civil Engineering
- ChE – Chemical Engineering

- EE – Electrical Engineering
- EnE – Energy Engineering
- IDA – Integrated Degree in Architecture
- IE – Industrial Engineering
- IT – Information Technology
- ME – Mechanical Engineering
- MoO – Management of Organizations
- TE – Transport Engineering
- T&IE – Transport & Infrastructure Engineering
- UP – Urban Planing

Summary

This document presents the main findings of the desk research related with the ENGINE project in Albanian HEIs. This deliverable thus corresponds to task D.1.1. of WP1: "In-depth desk research assessment and report for Albania and partner HEIs", led by KHAS and co-lead partner UAMD.

Following are highlighted the major pillars of the desk research:

- Firstly, Engineering education has a key role to play in helping to meet the challenges associated with prosperity and sustainability in Albania. These challenges are dynamic and as such engineering curricula have to be adapted to the times and social needs.
- There is an urgent need to develop and implement new courses that prepare engineers, scientists and energy planners to work with energy and renewables[1] industries to produce sustainable[2] energy generation systems.
- There is a need to find the right combination of technical and professional skills that the graduates might need in a competitive job market.

[1] "Renewable energy is energy that is derived from natural processes (e.g., sunlight and wind) that are replenished at a higher rate than they are consumed. (ScienceDirect)

[2] Sustainable energy can be defined as a form of energy that can be utilized again and again without putting a source in danger of getting depleted, expired, or vanished. (ScienceDirect)

1. Introduction

One of the main objectives of higher education is the transformation of society towards sustainable development in all aspects of life. The main directions in which higher education aims to develop, is to require qualitative universities, oriented towards scientific research. In Albanian universities are applied the study programs according to the Bologna system divided into three levels: BA (3 years), MSc (2 years) / MP (1 or 2 years) and PhD (3-5 years). At the same time, VET programs are applied (2 years study). Vocational education has been a priority in recent years, being seen as an opportunity to meet the ongoing need for employees specializing in various professions. Based on the statistics developed by INSTAT, in the Table 1.1 is given the number of students enrolled in recent years in Albania in the Engineering Faculties and Information Technology.

Table 1.1. The number of students Enrolled in education

School / academic year	2015-16	2016-17	2017-18	2018-19	2019-20
The Number of Students Enrolled in Tertiary	**148,277**	**141,410**	**131,833**	**139,043**	**130,264**
Engineering, manufacturing and construction	18,005	18,480	18,730	20,019	20,775
Information and communication technologies	8,260	7,487	8,228	10,016	8,883
Vocational education	1,521	1,803	2,439	3.174	

http://www.instat.gov.al/al/temat/trequ-i-pun%C3%ABs-dhe-arsimi/arsimi/#tab2

Table 1.2 shows the number of students enrolled in the Engineering Faculties and Information Technology in Albanian partner HEIs in the academic year 2019-2020.

Table 1.2. Students enrolled by Faculty and Programmes, academic year 2019-2020, in Albanian partner HEIs.

University & Faculty	Total	
	Total	Female
Total students of these follow the Program:	**104,802**	**64,544**
Bachelor	**69318**	**42018**
1.Polytechnic University	**19004**	**14989**
-Faculty Electric Engineering	1480	117

-Faculty of Information Technology	1593	596
2.University "Aleksandër Moisiu" of Durrës	**12401**	**7320**
- Faculty of Information Technology	2376	738
- Faculty of Professional Study	1275	885
3. European University of Tirana	**1005**	**509**
4. Professional College of Tirana	**228**	**7**
Master ose equivalent	**29454**	**19724**
1.Polytechnic University	**4005**	**1878**
-Faculty Electric Engineering	379	61
-Faculty of Information Technology	417	176
2.University "Aleksandër Moisiu" of Durrës	**3966**	**2632**
- Faculty of Information Technology	268	134
- Faculty of Professional Study	316	243
3. European University of Tirana	**916**	**599**

http://www.instat.gov.al/al/temat/tregu-i-pun%C3%ABs-dhe-arsimi/arsimi/#tab4

Engineering Education in Albania includes 14% of students in Engineering, Manufacturing and Construction and 7% in Information and Communication Technologies. The number of students enrolled is almost the same, with a slight increase in recent years, but engagement in research does not follow the same ratio. Only 12.3% of researchers are engaged in both of these fields.

The power industry worldwide is undergoing a substantial transformation during the last two decades, where the economic optimization and friendly environmental development are the primary objectives. The deregulation of the energy markets, power trading and the upgraded and improved quality of services are the new challenges in the management and the operation of the power systems.

Special attention is paid to the curricula in Electric Power Engineering so that students or engineers through Master studies or continuing education courses gain new knowledge and competencies related to: Energy resources, energy transformations and onsite energy consumption. (so-called zero energy buildings); Demand management and energy management strategies in industry and buildings (switching to smart grids); Implementation of programs for energy management and environmental protection; Review of the legal framework and Implementation of quality standards.

On the other hand, the scientific research activity is of vital importance for the existence of the University itself as well as for the preparation of the graduated students with the contemporary levels. World technology paces in different aspects of power system operation are very high.

A successful strategy for opening new or updating study programs requires initially a thorough study of the current situation of the country, the labour market, the demands and market needs for the professionals who will study in this program.

ENGINE stands for Engineering curricula modernization in renewable energy in Albanian Universities. The project's aim is upgrading and internationalization of VET and bachelor curricula in engineering for renewable energies in the targeted universities in Albania through modernisation of syllabuses in line with the new development in the area and the employment market demand. Albania's energy sector is a strategic source for sustainable economic development, given the diversity of energy sources and its geographical position. Over the last decades, Albania has demonstrated a clear reliance on energy imports, mainly during summer periods. This high dependency on an unstable hydrological regime possesses a clear risk of failure if combined with high losses and negligent behavior towards energy consumption.

The project's specific objectives are:

- To analyse the educational needs in engineering for renewable energies through problem and job analysis, and to define the necessary knowledge, skills and competencies of engineers in the sector of renewable energies in terms of learning outcomes.
- To design syllabi and course content and assessment for compulsory and elective courses in VET and bachelor engineering education for renewable energy to meet the market needs and upgrade the university academic offer accordingly.
- To develop new e-learning courses with modular structure for the innovated curricula of Partner HEIs and to establish a platform for knowledge sharing between Albanian HEIs and program partner institutions.
- To innovate the laboratory equipment and to perform a pilot test and to start the implementation of the joint modules/courses' delivery during the last project year.

The project implementation will not only produce an overview of market and education in the energy field but will also provide a gap analysis and create instruments which open the gate to further and systematic improvement.

1.1 PUT Practice - Matching Current Education Offer with the Job Market

Power System Department as part of Faculty of Electrical Engineering at Polytechnic University of Tirana is one of the oldest departments of the faculty. The Department is responsible for development and improvement of teaching curricula for Electrical Power System Studies with the symbiosis of education and research as well as for optimal integration into the labour market.

The curricula and teaching policies are increasingly focusing on the analytical, methodological, conceptual and communicational skills which will enable a university graduate to adapt to power sectors challenges and be innovative throughout his or her carrier. Such changes of perspectives require new ways of organizing curricula and the teaching process itself.

The degrees related with ENGINE project offered by Electric Power System Department, part of Electrical Engineering Faculty are as following:

1) Bachelor in Electric Engineering- Electric Power System profile
2) Master of Science in Electric Engineering- Electric Power System profile
3) Master Professional in Electric Power System

With the skills acquired during the academic years, our students have the opportunity to be employed in public or private institutions where the demand for specialists is quite high. The key employment sectors are:

- In enterprises of production, transmission and distribution of electricity
- In electrical network design studios.
- In studios and companies designing electrical installations of civil and industrial facilities.
- Electricity storage and saving managers
- In testing, calibration and certification laboratories for compliance with European norms of electrical installations.

- In different companies in the role of electrical energy managers.

Referring to the survey about the employment of our graduates of the Master degrees of Electric Power System Engineering for the period 2010-2016 it is noticed that 53% of the graduated students are employed at Distribution System Operator (DSO), 18% at Transmission System Operator(TSO) and 15% in KESH (Albanian Power Corporation).

1.2 UAMD Practice - Matching Current Education Offer with the Job Market

UAMD focuses on linking academic life and professional development with the labor market. Through Office of Communication, Alumni and Career at UAMD, students are instructed and advised to clarify academic and career goals, create career plans, develop job search skills and make a successful transition from university to the job market. Through close collaboration with Departments, the Center assists students in developing and articulating cross-curricular experiences that will help them be competitive in their efforts to build a successful career [www.uamd.edu.al/index.php/sq/karriera].

The Faculty of Vocational Studies, as a provider of vocational education, aims to create a modern and quality system of vocational education in the country. Such a system will contribute to the creation and continuous development of professional skills and citizenship of the new generation, through the provision of professional qualifications, not only in accordance with the requirements of economic and social development of the country, but also beyond [www.uamd.edu.al/index.php/sq/fakulteti-i-studimeve-profesionale].

Also, the academic staff at the Faculty of Information Technology aims to form and prepare new specialists in the fields of Information Technology based on modern and quality curricula appropriate to the labor market in Albania and other Western Countries [www.uamd.edu.al/index.php/sq/fakulteti-i-teknologjise-se-informacionit/departamenti-i-teknologjise-se-informacionit].

Based on the needs and demands of the labour market as well as stakeholders, UAMD has opened new study programs and improve existing programs, related to electricity and renewable sources.

The Faculty of Professional Studies has opened in recent years several new study programs, such as professional study program “Specialist in air conditioning systems”, as well as 4-month postgraduate courses related to energy management, energy auditing in buildings, energy audit in transport.

In the last academic year, the Faculty of Information Technology has opened the professional study program "Electronic Equipment Specialist" with a focus on the maintenance and development of electronic technology and modern systems (including systems with converters and sensors in the field of energy). In addition to opening new programs, UAMD has continuously improved curricula. The academic staff, through application in various national and international projects has improved laboratory equipment for the development of professional practices as well as the increase of practical skills through professional simulation programs.

1.3 UET Practice - Matching Current Education Offer with the Job Market

Taking in consideration the requirements of stakeholders, such as high school graduates, as well as the requirements of beneficiary groups, such as possible employers for students after completing their university studies, UET University has tried to create and implement a fruitful strategy in opening new study programs.

Thus, the opening of study programs and relevant profiles in them, has been a step preceded by genuine studies of demand and need, the current situation of the country and market needs for professionals who will emerge from this program.

In this way UET seeks to better achieve its goals in terms of training skilled professionals, for example technicians and researchers, people with analytical skills to solve problems and optimize technical processes and research. The current domestic labour market, with the expected developments of the Albanian economy as an emerging economy, aims at its full integration into the single European market. In this context, all sectors in the study are in a phase of continuous development and progress, which is increasingly helping to create a competitive economy, based on energy, environmental modernization and construction in general. The application and development of new technologies enable a higher quality of life for citizens and greatly facilitate academic and business life, with very positive effects that are observed in all social and economic sectors of the country.

The complexity of the current industrial reality and the increase of competition, both national and international, requires more and more advanced competencies. These competencies, on the one hand, have to face an interdisciplinary need, on the other hand, a specialization need. In any industrial environment, even the design and production of a simple plant (such as electrical appliances, solar energy recovery system, etc.), requires mastery of knowledge covering areas from mechanical to electrical, from control (to give systems intelligence), in production management, from the types and characteristics of materials to the chemistry of their transformation.

In fact, there is more and more talk of "system of systems"[3].

To enable the fulfilment of these requirements set by the stakeholders and beneficiary groups, it is imperative to form an efficient engineering in a panorama which is rapidly and continuously changing. For this, the study programs initially aim at a general and methodological education of students and then move towards a deepening in the specific field of industrial engineering, which is made possible through the provision of solid basic knowledge (mathematics, geometry, physics, chemistry, informatics), in order for the professional to be able to face complex problems with a rigorous approach and at the same time to be able to adapt to different needs in transformation and continuous development.

For these reasons, in addition to the basic courses, there are also active courses / profiles that enable specialization in slightly specific and specific fields, in accordance with step by step with the developments of the labour market. Based on the realization of a learning process as above, after the first cycle of studies, graduates can enter the labour market directly with the status of technician in various institutions / firms in this field.

From a methodological point of view, the market study was conducted in the form of Focus-groups with the Labor Market Board. Activation of the Programs and Profiles as above, has also arisen from the constant requests of graduates during visits to high schools. This process is further enriched

[3] System of systems engineering (SoSE) is not a new discipline; however, this is an opportunity for the systems engineering community to define the complex systems of the twenty-first century (Jamshidi 2009). While systems engineering is a fairly established field, SoSE represents a challenge for the present systems engineers on a global level. In general, SoSE requires considerations beyond those usually associated with engineering to include socio-technical and sometimes socio-economic phenomena.

through the continuous taking of students' opinions. The target group in this process are general and vocational high school graduates, as well as all other persons who wish to continue their studies in a second study program. The members of the Labor Market Board have continuously supported these Programs and Profiles, due to the demands of the labor market. They have recommended the opening of new profiles which are in line with the needs and demands of the labor market, listing and noting the various reasons which require increasing the number of students in these fields.

1.4 KPT Practice - Matching Current Education Offer with the Job Market

The Professional College of Tirana (KPT) is a non-public professional higher education institution that prepares professionals with practical skills. The College is licensed to offer professional education, at the end of which the student is awarded the "Professional Honour". It operates under the Bologna System. The College corresponds to Level 5 in the Albanian Qualification Framework as defined under Law no. 10247, dated 04.03.2010 "On the Albanian Qualification Frame", as amended and approximates to Level 5 of Bologna System as well. Each study program of the College has 120 credits for a normal duration of 2 years in full time.

The College is composed of two departments that offer 12 non-university full-time study programs, of a professional character, following the secondary education.

- Department of Information Technology:

  "Information Technology and Communication"

  "Electronics"

  "Database and Web design"

  "Technology of Electrical Installations"

  "Office Administration"

- Department of Electro-Mechanics and Applied Systems:

  "Electro mechanics"

  "Vehicle Technology"

  "Mechatronics"

"Airing and Conditioning Technology"

"Geodesy"

"Construction Technology"

"Gas Technology"

Since three years now, KPT in collaboration with National Ozone Unit and Ministry of Environment organizes different interactive trainings for the students with regard to the environment, its protection and renewable/ green energy.

The professional study programs, altogether with their courses and curricula are projected and prepared after a detailed analysis of the labor market and demand in the country and the related local and regional studies in this regard and considering their dynamics as well. The mission of KPT is to be a bridge between academic education and vocational training, strongly supporting students to smoothly and efficiently integrate in the labor market, including the update of the curricula and training of the students with the driving trends in the industry.

For KPT, the close collaboration with the business is of crucial importance not only in the provision of the professional practices, but also in the creation of employment opportunities and the enrichment/improvement of the Curriculum /study programs.

Since its establishment KPT conducted surveys in the market and meetings with various business representatives, for a better and in depth understanding of the labor market and its needs. It is the business that defines the needs and in the same time, it is the business that sponsors these needs. Such collaboration is in the focus of KPT and it is one of its core strengths as well. The close collaboration has helped in the labor-market oriented curricula development. The expertise in working with business sector and the capacity to mobilize businesses, the wide network of business of KPT shall be used in the frame of the project.

2 Current Engineering Educational Programs related with "ENGINE" in Partner Albanian HEIs

Engineering Education is shifting the focus to defining competencies as basic principles for structuring the university curriculum. While the Bachelor level gives mainly the basic knowledge, the

competencies in the energy aspects are taught at the master level and further at the doctoral level. Engineering Education directly affects the development of the Energy Sector in Albania with effects on all social and economic sectors of the country. Based on the National Energy Strategies, Power Engineering is prepared as defined by CIGRE, in all three directions (the so-called triple E-factors Engineering, Economics and Environment). Cooperation with colleagues from European universities in the framework of European Community programs have served as support in this regard.

2.1 Current Engineering Educational Programs related with "ENGINE" in PUT

In this paragraph will describe the current degrees related with ENGINE project as well as the competencies obtained in these programs.

2.1.1 Bachelor in Electric Engineering- Electric Power System profile

Bachelor in Electric Engineering- Electric Power System profile degree will equip students with knowledge of how the industry works, as well as giving them the engineering skills and technological knowledge needed to design, assess and improve electrical equipment and electrical power systems. Study program learning outcomes are represented by knowledge, skills and competencies.

Knowledge: The study program of the first cycle in the field of Electrical Engineering, Profile Power System offers basic engineering knowledge not only of general sciences, but also of basic sciences of electric engineering, employed and maintenance of electric power system.

Skills: On the other hand, this program gives the graduate the abilities to be employed in the applying of engineering projects, maintenance and assisted control of engineering systems in electric industry, in assisted projection etc.

Competencies: In terms of training in the field of electric power system engineering, the graduate acquires competencies in: Medium and low voltage network services, maintenance and assisted control of equipments, developing electric distribution network, protection, monitoring, and safety in electric network.

For getting graduated the student has accumulated: 36 ECTS points – in general sciences, 96_ECTS points – in fundamental specific sciences, 18 ECTS points – similar or/and integrated disciplines to

fundamental specific sciences, 12 ECTS points – in optional courses the institution offers, 8 ECTS points – in the area of foreign language and communication, 4 ECTS points – in practical stages, 5 ECTS points – for Final formation examination.

Course related with ENGINE project are:

1. Quality, Standards and Technical Legislation (5 ECTS points)

The program aims to give students basic knowledge on national and international standards and normative organizations, the ways of risk assessment of engineering products and systems, maintenance and quality. The quality management systems, environmental management systems, and public health workers management systems, etc. are part of the program. It also provides an assessment of technical legislation in force and the approach to technical legislation in European Community.

Technical standards and legislation, values and typology of technical normative, national and international standards, national and international normative organizations. New approach and harmonized norms, conformity, certification, accreditation, CE mark, modules. Global market and technical standards. Assessment of safety and risk, maintenance of plants and apparatus, quality and quality management systems according to ISO 9000 family. Standards of environmental management system and working environment. Systems for social administration, health protection and safety of workers. Electromagnetic compatibility and electromagnetic Pollution.

2. Renewable Energy Sources (Selected Courses) (5 ECTS points)

Environmental pollution in general and its effects in the atmosphere. International environmental conventions and concrete tasks. Types and main characteristics of renewable energy sources. Photovoltaic, wind, hydro, geothermal, biomass plants etc. Technical and economical characteristics. Different countries initiatives to promote their construction. Possibilities of their use in terms of Albania. Green card as an enabling factor for the use of renewable energy sources.

2.1.2 Master of Science in Electric Power System Engineering profile

Master of Science in Electric Power System Engineering (MS-EPSE) provides graduate students a thorough understanding of the tools, methods, and practice of electric power engineering. The program goal is to provide an education that is directly applicable to a career in industry and is suitable for a new or recent graduate, as well as experienced professionals who want to receive the necessary retraining to change careers. The program is designed to educate a new type of engineering workforce which is currently in high demand. The program consists of two years of full-time studies, giving a total of 120 ECTS credits. The plan of study combines traditional topics in power generation, transmission, and distribution with cutting-edge topics such as energy market and the integration of renewable energy sources. Study program learning outcomes are represented by knowledge, skills and competencies.

Knowledge: The curriculum of the second cycle "Master of Science" offers advanced scientific knowledge and education for exercising initiative and decision-making skills in complex and unpredictable situations; to work in design and maintenance of the electrical power generation, transmit ion and distribution. The graduate acquires skills and intellectual tools to plan and to carry out innovative research on electric power system.

Skills: The graduate acquires skills and intellectual tools to plan and to carry out innovative processes, proper of applied research field. The knowledge of engineering skills enables the master's degree owner to use tools and methodologies to treat information and to plan solutions in the field of real systems.

Competencies: The graduate acquires skills and intellectual tools to plan and to carry out innovative processes, proper of applied research field. The knowledge of engineering skills enables the master degree owner to study, design and realize electric power system and network of different voltage, the design of the system of protection, monitoring and control of power system and networks of power supply of enterprises. The graduate combines technical, scientific and communication skills with context culture, which enables him/her to work in international high-profile positions.

For getting graduated the student has accumulated: 10 ECTS points - in general sciences, 60_ECTS points - in fundamental specific sciences, 20 ECTS points - similar or/and integrated disciplines to

fundamental specific sciences, 12 ECTS points - in the internship, 18 ECTS points - for preparing and sustain the diploma.

Course related with ENGINE project is

1. Distributed Generation and Energy Efficiency (5 ECTS points)

The course aims to provide students with comprehensive knowledge on advanced knowledge nowadays power production, mainly of renewable energy sources and to study in practice the energy efficiency. This graduate level course provides detailed explanations of the physical mechanisms that control phenomena related to Power Quality. It addresses concepts that underlie harmonic generation and harmonic flow, and the modeling of voltage sags and swells. The effects of such disturbances on equipment (transformers, rotating machines, lamps, relays and converters) performance are studied by means of actual field cases. Others topics covered are Power Quality measurements in the era of smart grid, Power Quality problems caused by Renewable Generators.

2.1.3 Master Professional in Electric Power System

Master Professional in Electric Power System aims to provide students with in-depth professional knowledge specific in the field of Electric Power System. Graduates of the Professional Master in the field of Electric Power System gain knowledge in methodological and applied aspects of and be able to use this knowledge to interpret various problems in practice. They form the necessary skills for the design of the electricity distribution network, power supply networks of enterprises and processes, which are closely related to the field of protection and automation of the Power System and other electricity supply networks. They are able to perform experiments, analyze and interpret the data obtained from them. Study program learning outcomes are represented by knowledge, skills and competencies.

Knowledge: The second cycle curriculum offers advanced scientific education for exercising initiative and decision-making skills in complex and unpredictable situations; to work in design and maintenance of the electrical power generation, transmission and distribution.This cycle of studies in Electrical Engineering has the objective to provide students with in-depth knowledge in specific professional Power Engineering. Gain in-depth knowledge of methodological and applied aspects and be able to

use this knowledge to interpret various problems in practice. Generally and in depth recognize the Electrical Engineering fields in which to be able to identify, formulate and solve problems using methods, techniques and modern equipment's.

Skills: The diploma holder combines technical, professional and communication skills with the cultural context, which gives him the opportunity to work in high-profile functions at national and international level.

Competencies: Form the necessary skills for electricity distribution network, networks of power supply enterprises and processes design, which are closely related to the protection and power system automation and other networks power supplies. Acquire skills for organization, administration and economic aspects of enterprises.

For getting graduated the student has accumulated: 10 ECTS points – in the area of general sciences, 34 ECTS points – in the area of fundamental specific sciences, 5 ECTS points – similar or/and integrated disciplines to fundamental specific sciences, 3 ECTS points – for professional practice, 8 ECTS preparing and sustain the diploma.

Course related with ENGINE project is

1. Energy Efficiency and Smart Grid (5 ECTS points)

The course aims to provide students with comprehensive knowledge on the energy efficiency and smart grid. The course is divided into two parts. The first part provides explanations of the physical mechanisms that control phenomena related to Power Quality. It addresses concepts that underlie harmonic generation and harmonic flow, and the modeling of voltage sags and swells. The effects of such disturbances on equipment (transformers, rotating machines, lamps, relays and converters) performance are studied by means of actual field cases.

The second part aims to provide students with knowledge about some key elements of smart grids, to understand the interaction of different disciplines in smart grids, knowing the historical, institutional and technical aspects of electricity transmission and distribution networks, existing theories and methods in the field of smart networks.

2.1.4 Needs for Improvement in the current programs

Currently, there are limited information on Renewable energy, Energy efficiency management, Smart Grids, RES integration and storage in smart grids, Intelligent grid control and telemetering, Power quality and RES, Communications & Computer networks & Smart Grid, Energy & Market & Environment Sustainability. It is considered that such courses should be included in the current curricula of BA, MSc or MP by offering them in groups of elective courses or by including them as compulsory courses. These courses should stimulate students to think on a broader prospective in issues related alternative energy sources, technologies, processes, etc., for improving the final efficiency, solving energy problems and protecting the environment in the future. At the same time these courses should be supported with the necessary laboratory and computer equipment.

2.2 Current Engineering Educational Programs related with "ENGINE" in UAMD

Table 2.1 shows the current Education Programs related with ENGINE Project in UAMD.

Table 2.1 - Programs & Profiles related with ENGINE in UAMD

Profiles	Programs	Credits
Electrical Technician	Proffesional Study Program	120
Electronic Equipment Specialist	Proffesional Study Program	120
Specialist of air conditioning systems	Proffesional Study Program	120
Energy audit in buildings	Postgraduate Study Program	30
Energy audit in transport	Postgraduate Study Program	30
Energy Manager	Postgraduate Study Program	30

2.2.1 Professional Study Program "ELECTRICAL TECHNICIAN"

The 2-year Study Program, Professional Diploma in "ELECTRIC TECHNICIAN" offers an important direction for which there is a great need for skilled specialists and analysts and the purpose of this program is the training and education of professionals in the field of electricity.

Vocational Diploma provides a professional training able to meet the typical design problems in the electrical sector, understand and direct innovations in all disciplines of the electrical sector, industrial electronics and power, automation and system electro-energetic in general.

This study program forms the electrical technician with enough knowledge to cover problems such as:

- ✓ Electricity generation in power plants;
- ✓ Transmission and distribution of electricity;
- ✓ Use of electricity in industrial plants, in urban and rural systems;
- ✓ Electricity management applications in the electricity market;
- ✓ Electrical installations and their maintenance in apartments, various private and state facilities, etc.

Employment opportunities:

- ✓ In the electricity generation system;
- ✓ In the electricity transmission system;
- ✓ In the electricity distribution system;
- ✓ In companies for the design, implementation and servicing of high, medium and low voltage power systems;
- ✓ In the company for the sale and purchase of electricity;
- ✓ It can also be employed in the Manufacture of Electrical Appliances and Equipment.

Course related with ENGINE project are:

- Renewable Energy Sources
- Electrical Installations
- Electrical measurements
- Electric Machine
- Electrical Systems in Buildings (Elective)
- Distribution and use of Electricity (Elective)

2.2.2 Professional Study Program "SPECIALIST OF AIR CONDITIONING SYSTEMS"

The two-year study program, Professional Diploma in "AIR CONDITIONING SYSTEM SPECIALIST" offer for the students the opportunity to develop their knowledge and professional skills in the field of air conditioning systems, HVAC. This program helps critical thinking and analysis to understand the challenges in various technical situations on these systems.

2-year study program: Professional Diploma "Air Conditioning Systems Specialist" aims to train specialists with a professional profile in the field of installation, maintenance and service of heating - ventilation - air conditioning systems (HVAC) in buildings and all air conditioning systems in various machinery or means of transport.

A) The main objectives of this professional study program are:

- ✓ Gain technical knowledge on HVAC plants and systems;
- ✓ Gain knowledge on the installation of HVAC electrical and hydraulic systems;
- ✓ Gain knowledge on the performance and energy efficiency of air conditioning systems in buildings;
- ✓ Gain knowledge about the equipment and components of these systems;
- ✓ Operation, maintenance and servicing of air conditioning equipment and plants;
- ✓ Management of HVAC systems and equipment in multifunctional buildings
- ✓ Management of HVAC systems and equipment in vehicles, etc

B) Employment opportunities:

- ✓ Installation of heating-ventilation-air conditioning (HVAC) systems;
- ✓ Hydraulic and electrical network management of HVAC systems;
- ✓ Servicing and maintenance of HVAC equipment,
- ✓ Technical services on air conditioning systems and installations, etc.

- ✓ Technical services in air conditioning technologies for navigation and any other means of transport.

Course related with ENGINE project are:

- Basics of energy efficiency
- Energy consumption

2.2.3 Professional Study Program " ELECTRONIC EQUIPMENT SPECIALIST"

Evolution in the field of electronics requires professionals with deep interdisciplinary knowledge that will allow them not only to solve the problems encountered in the use of electronic devices, but also to design, build and work with them. The market study shows that in the conditions of our country is seen as a need of the "day" the preparation of specialists with practical knowledge for the design, simulation, construction, and implementation and maintenance of electronic circuits. The program combines courses in electronic technology with a General Education curriculum. Students will gain the necessary knowledge to face the challenges of the labor market in the field of Electronics and relevant systems. The main training objectives of the two-year study program "Electronic Device Specialist" are:

- ✓ To train students on the development of electronic products;
- ✓ To train students in the maintenance and repair of existing and new electronic and electric equipment;
- ✓ To train students in the knowledge of components of electronic devices, circuits, semiconductors and systems, photovoltaic systems, etc.
- ✓ To provide students with the necessary knowledge in order to be able to constantly adapt to the conditions of change;
- ✓ To combine theoretical and practical knowledge in the field of electrical energy and electronics to perform various tasks;

B) Employment opportunities

Students at the end of the two-year study program "Electronic Equipment Specialist" can be employed in the private and public sector, such as: as an electronic technician, electronics equipment specialist, prototype manufacturer and more for companies specializing in simple electronic design, production, service and development of electronic circuits.

Course related with ENGINE project are:

- Computer software for editing electrical circuits
- Sensors and converters

2.2.4 Postgraduate Study Program "ENERGY AUDIT IN BUILDINGS" (AE)

The “Energy Audit in Buildings” (AE) program raises performance standards in energy auditing in buildings and industry and improves the practice of energy auditors through the application of national and international methodologies for calculating energy performance in buildings and innovative equipment. AEC is a 3-month training program for professionals who want to be trained in energy auditing services in buildings and industries.

This program aims to train professionals in specialization and diagnostics of energy auditors in buildings, specialization in a set of systematic surveys, collection and analysis of parameters relative to specific consumptions and operating conditions of the building and its plants.

A) Program Objectives

✓ To provide a theoretical training for the AE course specialist

✓ Determining the ENERGY balance in BUILDINGS

✓ Definition of technological requalification interventions

✓ Evaluation for each intervention of technical and economic opportunities

✓ Improving comfort and safety conditions

✓ Reduction of management costs

✓ Management of new energy efficiency applications

B) Employment opportunities

✓ Public, central or local administration

✓ Entrepreneurship and business companies

- ✓ Public institutions that design and implement energy projects
- ✓ Sectors of the economy
- ✓ Institute of Cultural Monuments
- ✓ Design studio
- ✓ Other private sectors

Course related with ENGINE project are:

- Energy efficiency legislation
- Preparation for energy audit
- Inventory and measurement of energy use
- Energy efficiency and environmental protection
- Energy management
- Energy efficiency in electrical equipment
- Design and implementation solutions for energy optimization

2.2.5 Postgraduate Study Program “ENERGY MANAGER”

This program aims to train professionals in the specialization and diagnostics for "Energy Manager”, specialization in a set of systematic surveys, collection and analysis of parameters relative to specific consumption and operating conditions of the building of its plants.

A) Program objectives

- ✓ to provide a theoretical training for the specialist of the study program
- ✓ determination of the energy balance
- ✓ determination of technological requalification interventions
- ✓ evaluation for each intervention of technical and economic opportunities
- ✓ improvement of comfort and safety conditions
- ✓ reduction of management costs
- ✓ management of new energy efficiency applications

B) Employment opportunities

- ✓ public, central or local administration
- ✓ entrepreneurship and business companies
- ✓ public institutions that design and implement energy projects
- ✓ sectors of the economy
- ✓ institute of cultural monuments
- ✓ design studio
- ✓ other private sectors

Course related with ENGINE project are:

- Energy efficiency legislation
- Energy management
- Design and implementation solutions for energy optimization
- Energy Financial Management
- Use and Integration of Renewable Energy Sources
- Energy efficiency and environmental protection

2.2.6 Postgraduate Study Program "ENERGY AUDIT IN TRANSPORT"

This program aims to train professionals in the specialization and diagnostics for "Energy Audit in Transport", specialization in a set of systematic surveys, collection and analysis of parameters relative to specific consumption and operating conditions in the field of transport.

At the end of the training, participants who are positively evaluated are provided with the certificate "Energy audit in transport" in accordance with applicable law.

A) Program objectives

- ✓ to provide a theoretical training for the specialist of the study program
- ✓ determination of the energy balance in transport

- ✓ determination of technological requalification interventions
- ✓ evaluation for each intervention of technical and economic opportunities
- ✓ improvement of comfort and safety conditions
- ✓ reduction of management costs

B) Employment opportunities

- ✓ public, central or local administration
- ✓ entrepreneurship and business companies
- ✓ public institutions that design and implement energy projects
- ✓ sectors of the economy
- ✓ other private sectors

Course related with ENGINE project are:

- Energy efficiency legislation
- Analysis of energy bills
- Design and implementation solutions for energy optimization
- Energy efficiency and environmental protection
- Energy management

2.2.7 Needs for Improvement in the current programs

The need for Improvement of current programs comes mainly from technological changes in the field of renewable energy sources. UAMD academic staff aims to include several factors in the process of academic and professional education, which directly and indirectly affect the improvement of curricula, such as:

- Inclusion with a special course in the curriculum of the latest technologies in the field of renewable resources, the smart network and their implementations
- Study of renewable energy sources with virtual technology

- Using of the most contemporary literature for the study of new technologies
- Use of simulation programs for different courses
- Creating opportunities for the development of professional practices in energetic sector
- Students of the "Electrical Equipment Specialist" study program should get more information on energy efficiency.

Improving study programs should be in line with increasing the level of academic staff.

2.2.8 New IT tools to be included

UAMD focuses on the inclusion in the academic process of the most up-to-date knowledge in the field of Information Technology and Innovation. The increase of the academic and professional level of the staff in accordance with the trends of technological development helps to increase their level on the one hand and on the other hand transfers this knowledge to the students, who are preparing for the labor market. UAMD IS the Leading Institution of the project "Accelerating Western Balkan's University Modernization by Incorporating Virtual Technologies" [www.vtech-project.eu].

UAMD aims to incorporate these new technological tools:

- Capacity building of academic staff to incorporate Virtual Technologies in teaching
- Develop teaching methodologies aided by technology and/or ICT tools
- Equip students with competences to use/access tools, software and platforms
- Increase interaction between teachers and students

2.3 Current Engineering Educational Programs related with "ENGINE" in UET

When deciding to open e new program UET has in considerations the needs of potential students and labor market. Given the necessities of participants, such as high school graduates, as well as the requirements of beneficiary groups, such as potential employers for students after completing their university studies, UET University created and applied a successful policy in opening new study programs. Thus, the opening of study programs and relevant profiles in them, has been a step preceded by genuine studies of demand and need, the current situation of the country and market needs for professionals who will emerge from this program.

In accordance with the above, in the field of the ENGINE Project, in the Department of Engineering and Architecture, at the Faculty of Engineering, Informatics and Architecture, this University has activated the following Profiles within bachelor, master of integrated studies:

Table 2.2 - Programs & Profiles related with ENGINE in UET

Profiles	Programs
Electrical Engineering	BA / Industrial Engineering
Mechanical Engineering	BA / Industrial Engineering
Civil Engineering	BA / Civil Engineering (Construction)
Energy Engineering	Msc. / Industrial Engineering
Mechanical Engineering	Msc. / Industrial Engineering
Transport Engineering	Msc. / Industrial Engineering
Transportation & Infrastructure Engineering	Msc. / Civil Engineering (Construction)
Urban Planning	Msc. / Civil Engineering (Construction)
Urban Planning	Integrated Degree in Architecture

2.3.1 Needs for Improvement in the current programs

Currently, courses in energy in UET are offered as a profile of main BA or Master Programs. There are not distinct degrees in:

- Renewable energy;
- Alternative energy technologies;
- Energy efficiency management;
- Energy and Environment Sustainability;
- etc.

It is deemed that such courses would help undergraduate students to receive more intensive education in fields of energy efficiency and RE. However, the needed human and technical resources related to energy efficiency and RE is a hot topic for the future of engineering and sustainable development. Contents of energy still need to improve and highlight the importance and raise awareness among students on the RE.

To summarize beside preparing good technicians, courses should aim:

- Energy education courses and/or programs at the university level should aim to develop understanding and awareness among students about the nature and causes of energy crises, energy classification, and conversion processes of conventional and RE sources and technologies.
- Also, these courses should stimulate students to think on a broader prospective in issues related alternative energy sources, technologies, processes, etc., for improving the final efficiency, solving energy problems and protecting the environment in the future.

2.3.2 New IT tools to be included

Currently the didactic activity is articulated in classroom lectures, applied exercises, projects, practical laboratories, aiming to give the studentds the first glimpse of the professional world. The objectives of the absorption, clearly defined by the Didactic Regulation of the Course of Study, can be summarized as follows:

- Basic knowledge focused on the disciplines of mathematics, geometry, general physics and rational mechanics;
- Professional disciplines of civil engineering pertaining to the science and technique of construction, the quality of the built environment (with opportune references to thermal, acoustic, lighting), environmental impact, technological services, giving a congruent relief to economic aspects, operational, organizational, legal and those related to the more general concept of development sustainability. The purpose of these disciplines is to enable the engineer to acquire the necessary knowledge to then develop specific capacities in project development;

- Professional engineering disciplines that highlight the technical aspects as well as economic or legal aspects that allow to plan interventions on the territory, and to design works in accordance with specific requirements but also in accordance with the environment, its protection and preservation, etc.;
- Finalized linguistic and computer knowledge to improve the inclusion capacities of the engineer in the world of work and in other European countries.

- The Study Course presents in the meantime a wide and articulated offer of elective profiles, advisable for attending students, which allow the student to develop specific knowledge in the following sectors:

  Electrical Engineering;

  Mechanical Engineering;

  Chemical Engineering;

  Information Technology;

  Management of Organizations.

Also, in order to enable the best possible connection of students with the demands of the labor market, within the teaching process, importance has been given to practicle aspects and loboratoty activities.

Following the studies in these profiles, students develop the capacity to reflect on the arguments of the study, on their skills and on the absorption processes by combining information of different subjects. This study programs approximates contemporary models of education and academic and professional qualification in accordance with the standards of recognized universities at the regional, European and wider level. Anyhow, as it is mentioned at the begining of the report, the current domestic labour market, with the expected developments of the Albanian economy as an emerging economy, aims at its full integration into the single European market. In this context, there is always room for improvement to offer students more up to date technologies/tools within engineering field.

Given all the above, and considering the ever-increasing demand of the labor market, both national and international active participation in the ENGINE project will help UET to present updated curricula, modern practices and up to date technologies within their studies. The help and assistance of other EU Partners with more academic experience in these curricula will be an excellent first step toward continous improvement.

Through ENGINE, UET will update and implement relevant recommendations having in mind the following objectives:

- An increasing compliance with the objectives of the program and the different market demands;
- Closing the gap between electrical engineering and electrical engineering technology;
- To be pro-active in the innovated curricula and establishment of a platform for knowledge sharing between Albanian HEIs and program partner institutions, which is one of the ENGINE objectives.

Taking in consideration the broader perspective, all the above will benefit not only UET as a university and its students, but all partner HEIs in Albania and consequently the job market in the country.

2.4 Current Engineering Educational Programs related with "ENGINE" in KPT

The professional study programs, altogether with their courses and curricula are projected and prepared after a detailed analysis of the labor market and demand in the country and the related local and regional studies in this regard and considering their dynamics as well. The mission of KPT is to be a bridge between academic education and vocational training, strongly supporting students to smoothly and efficiently integrate in the labor market, including the update of the curricula and training of the students with the driving trends in the industry.

KPT has faced an increasing demand from the business in terms of practice-oriented specialists for renewable energy especially in terms of photovoltaic panels etc.

One of the most important challenges the society faces, is to create an efficient education system capable of keeping up with the rapid technological change. In countries like Albania, the importance is even greater given the national goal of integration into the European family. The increased attention toward renewable energy sources which are available, the active approach of the business to this type of industry whose concerns are already shared with KPT, create an immediate need that should be addressed with practice oriented highly trained workforce. In the context of market (business demands), government and objectives of KPT as a HEI, the update of the curricula and training of the students with the driving trends in the industry is a sensitive matter.

2.4.1 Needs for Improvement in the current programs

In the frame of the ENGINE project, the professional study programs of KPT deemed to be more relevant and related to the project are:

"Electro mechanics"

"Vehicle Technology"

"Airing and Conditioning Technology"

"Construction Technology"

"Technology of Electrical Installations"

The overview with regard to RES, with a special focus in the curricula of KPT provides the following conclusions:

1. The focus on renewable energy worldwide has generated rapid changes market with an increasing demand for skilled professionals in the sector.
2. EU integration process and the changes in the global market have triggered such a demand even in Albania. The number of companies operating with RES is increasing, with the photovoltaic panels, Smart Home etc. being among them.
3. Given the daily implementation of more and more of IoT family technologies used in the market there is even more need for specialists or systems integrators.
4. Vocational education is an optimal solution for entering the labour market in a short term and will practice – oriented skills, which education is able to provide the market with a skilled labour force. Although emphasize is put on the importance of vocational education, youth need to consider it as an opportunity to higher education and labour market. Women participation as students is low.
5. Technologies which are part of the IoT family (Internet of Things) such as Smart City, Industrial IOT (IIOT), Smart Farming, Smart Grid and more of Smart Home / Buildings need to be an integral part of the curricula, as well as the integration of these technologies with renewable energy such as photovoltaic panels etc.
6. There is need to improve the current curricula, by improving the current courses and / or offering new ones with regard to RES and their use, provided that the respective well established in-house infrastructure and internship are in place.

7. There should be a stronger networking and collaboration between HEI – s and business in this regard.

3 Market in energy sector

The energy production system in Albania is totally based on hydro power plants. The demand for electricity, in accordance with the Albanian Market Model, is fulfilled by the production of public company Albania Power Corporation (KESH), the import of eligible suppliers to supply eligible customers, Electricity Distribution System Operator (EDSO), which is obliged to cover losses in the distribution network, and the generation of small and medium size hydro power plants (SPPs) connected direct to the transmission and distribution network. The activities of the Power System in Albania are exercised by entities licensed pursuant to Law no. 43/2015 "On Power Sector", as amended.

Under the framework of unbundling system in Albania, starting from 2004, Transmission System Operator (TSO) is established as an independent company 100% owned by state. Distribution System Operator was legally established in Albania in 2007, followed by privatization process which resulted unsuccessful ones and since 2014 the Distribution System Operator has the status of public company 100% owned by state. According to the provisions of the Power Sector Law, since January 2020 the distribution company is unbundled and the new companies are established, respectively the Universal Service Supplier and Electricity Distribution System Operator, enabling a safe, transparent and qualitative service to end use customers company.

Albanian Power Corporation (KESH sh.a) is the public company which manages the production of the Drin River cascade with a total installed capacity of 1350 MW (excluding Ashta HPP) and is charged with the public service obligation for the Electricity supply of the Universal Supplier with a regulated tariff approved by Regulatory Body. The total installed capacity managed by KESH accounts for 1448 MW including Vlora Thermo Power Plant and constitutes about 63.47% of the total installed capacity in the country.

Other electricity production companies are private generation companies, such as the priority and independent producers of electricity, as well as Lanabregas HPP, with a total installed capacity of 827 MW or about 36.53% of the total installed capacity in our country

Short overview of the results of the incentive policies applied in the development of generation facilities in the last decade

It is already known that Albania is a net importer country of electrical energy. The approach of satisfying the country needs with electrical energy through import it is not a feasible alternative from view of the security of power supply in the conditions of limited capacities of transmission lines, as well as from economic point of view, taking into account that the import prices are not stable and are subject of fluctuation.

Focusing and referring to the national and regional development of electrical energy market, in the frame of power sector reforms and use of incentive mechanism with the aim to increase and absorb the private investment in the field of electrical energy generation, it was considered as a high priority the exploitation of national resources in general and of hydro power potentials particularly.

The optimal use of hydropower potential resources through the massive constructions of small and medium size HPPs has other preferences and country benefits except the increase of the energy production. The geographical expansion of HPPs in country has notably improved the power quality and has positively impacted in network loss reduction and at the same time increase the efficiency use of electrical energy. These positive impacts are experienced after the commissioning and put in commercial operation of new HPPs or after the complete rehabilitation of the existing hydropower facilities.

Design, construction, implementation projects of hydro power plants and their connection to the distribution network is a process that have been growing up rapidly in the last two decades and according the studies is going to be the same trend also in the near future.

The total HPPs installed capacity is 2,214.5MW with average annual energy production of 5.8 TWh during the last decade, while the estimated potential for HPPs capacity installation is about 4,500 MW with average annual energy production of 16 TWh. So, only 42 % of hydropower potential is utilized.

As a result of the still unexploited hydro capacities, almost all plants are built as HPPs, and a large proportion of those with installed capacity less than 15 MW. These power capacities are connected to the transmission and distribution network, turning the distribution network into an active network. The implemented projects of small and medium size HPPs through private investment partnership or concessions schemes have had a very positive impact in energy production and reduction of the import in Albania.

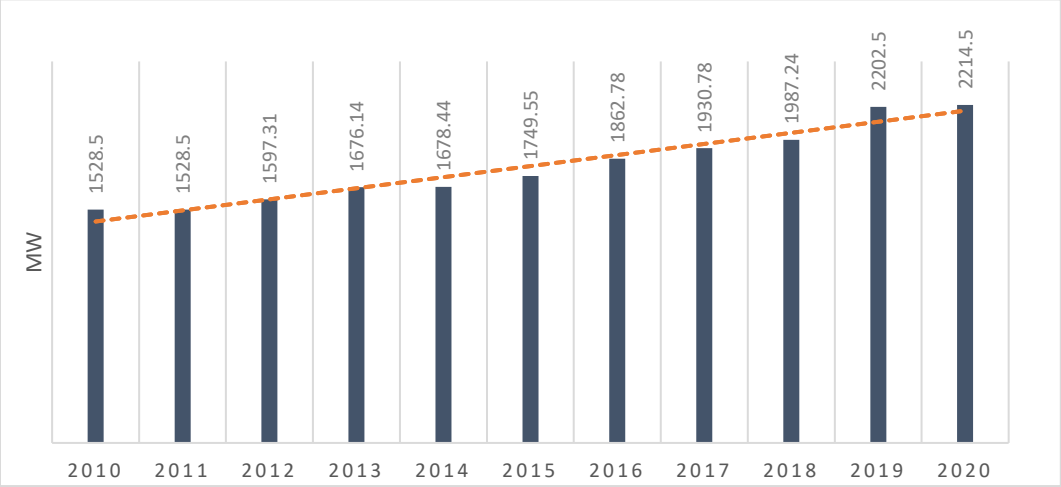

Figure 3.1 Total Installed capacity on the Transmission network. (Source TSO)

In the Figure 3.1 it is evident the development of hydro generation schemes in Albania and their contribution in the increase of the energy production in the last decade. The installed capacity of the power plants connected in the transmission system for 2020 was 2214 MW

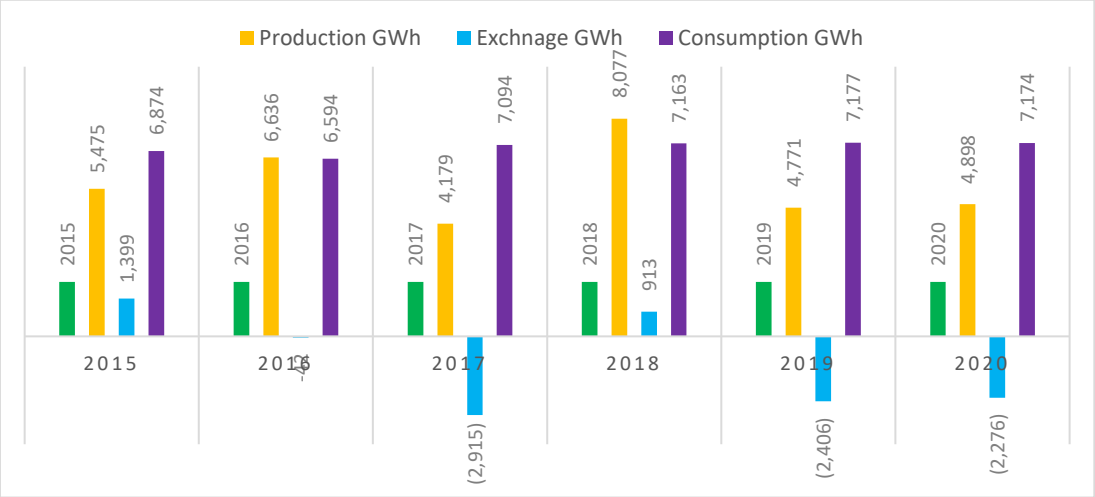

Figure 3.2 Energy Balance (Source: TSO)

The Figure 3.2 demonstrates the country energy balance during the period 2015-2020. As far as the country energy balance is concerned it results that during 2020 the import of energy was 2276 GWh, compared with 2406 GWh of import in 2019.

In the 220 kV network there are connected also private HPPs owned by AYEN, namely Peshqesh (28MW) and Fang (72MW). In the recent years there have been many run of river hydropower plants connected to the Albanian power system, whereas most of them have been connected into 110kV (Fig.3.3) and distribution system. All this exploitations of Albanian rivers and consequently increase of installed generation capacity has led to a less dependent situation from imports for country adequacy.

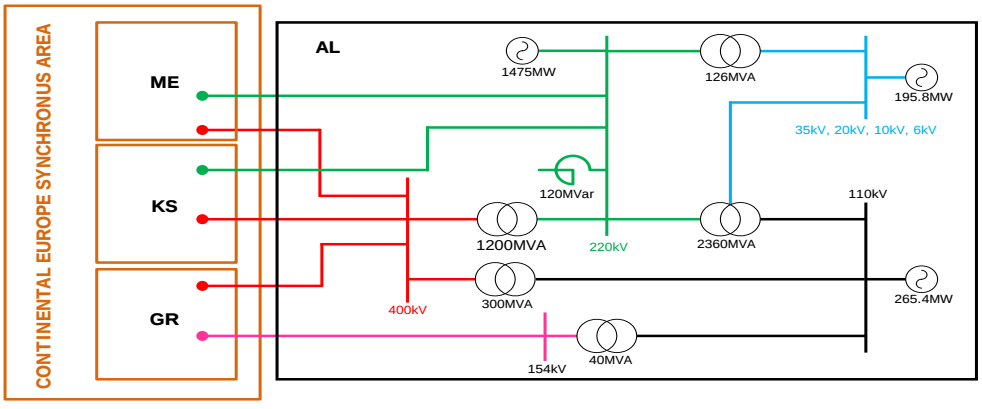

Figure 3.3 Hydro Generation Capacity according to the network connection point

The installed capacity of the plants connected to the distribution network is 280 MW. This installed capacity of the plants in the distribution network consists of 265 MW of the installed capacity at Hydro resources and 15 MW is the installed capacity in photovoltaic plants. The production realized by the hydropower plants connected to the distribution network during 2020 is in the amount of 646 366 MWh, while the production realized by the photovoltaic plants is in the amount of 22 190 MWh.

Incentive Policies

The incentive policies applied during period 2003 -2017 can be classified as follows:

Till 2008 - Calculation methodology of selling price for small and medium size HPPs named "Cost Plus" was likely the traditional approach Cost of Service/ Rate of Return i.e. calculation of selling price of energy for each HPPs was based in their respective costs (installed capacity and operation) added as well a rate of return.

2008-2014–The uniform price of all licensed producers of hydro energy from HPPs with an installed capacity up to 10 MW, constructed and in commercial operation before 2007, was calculated as follows:

$$P\_U=(P\_R\ 〖-P〗\ \_T\ )*(1-L\_D\%) \quad (1)$$

Where:

P_U – Unit price in leke/kWh

P_R – Retail average price in leke/kWh

P_T– Tariff of transmission network use

L_D– Technical losses in the distribution network

2008-2014 – The uniform price of all licensed producers of hydro energy from HPPs with an installed capacity up to 15 MW, constructed and in commercial operation before 2007, was calculated as follows:

$$P\_U=P\_I*1.1*REX \quad (2)$$

Where

P_U – Unit price in leke/kWh

P_I– Import price in euro cent/kWh

REX – exchange rate in euro/leke

2015-2016 the approach that was followed to define the fix tariff to be paid to the private producers was calculated as follows:

P_U=P_A*1.24*REX (3)

Where

P_U – Unit price in leke/kWh

P_A– Annual Average price of Hungarian Power Exchange (HUPX) in euro cent/kWh

REX – average exchange rate in euro/leke for the last year

Year 2017under the framework of Law Nr. 7/2017 " On the promotion of the use of energy from renewable sources “the unit price of selling energy from private and concession HPPs is going to be defined according Feed in Premium approach FIP, i.e. a bonus over the market price considering that Albanian Power Exchange (APX) should be established in July 2021

Transmission System Operator

Transmission System Operator (TSO) actually is responsible for the functions of Transmission Network Operator, Market Operator and Dispatch System Operator and perform it activity completely separated from the activities of generation, distribution, trade and supply of electricity, in compliance with the Power Sector Law Provisions. Transmission System Operator since March 2017 became a full member of ENTSO-Es.

The Albanian power System is a meshed network with a vertical profile. The structure of the Albanian Power System is characterized by the concentration of generating capacities in the northern part of the country while the loads are mainly concentrated in the central and southern part of the country leading to a physical flow direction from the northern part to the south. (Fig.4)

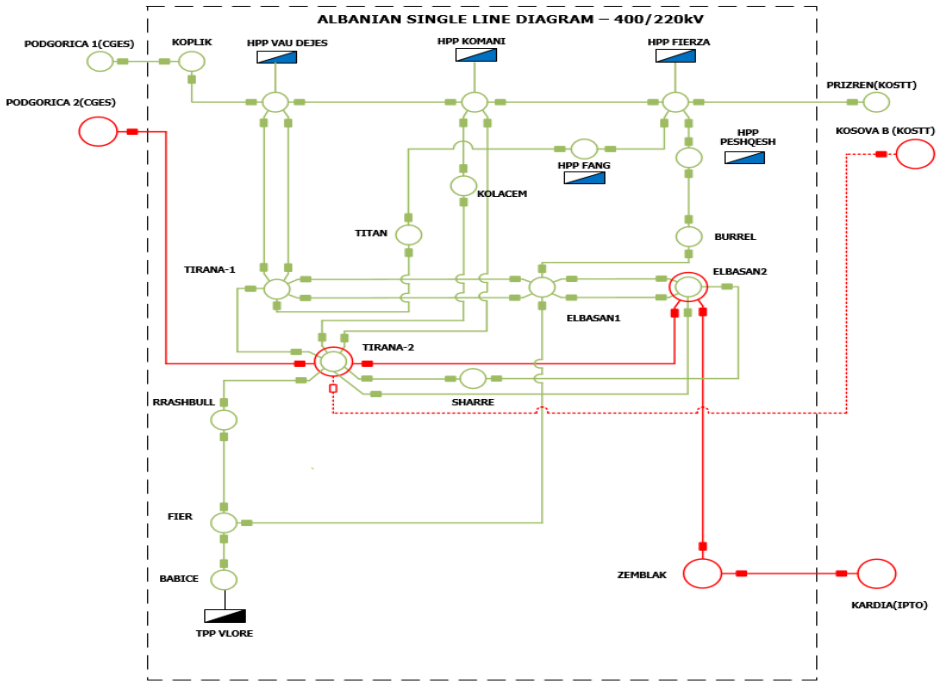

Figure 3.4 Singler Line Diagrame 400/220 kV

The Transmission Network has the following voltage levels: 400kV, 220kV, 154kV and 110kV and is well interconnected with other neighbors' countries: 2 tie lines with Montenegro (400kV, 220kV); 2 tie line with Kosovo (400kV that was put in operation on December 14, 2020, as well as the line 220kV); 2 tie lines with Greece (400kV, 154kV).

The main generation capacities are connected with the load consumption centers through 220 kV network followed by transformation substations 220/110 kV, (110 kV network supplies all distribution substations 110 kV that mainly represent the load nodes) The network of 110 kV is developed in all urban areas in Albania and supplies all 110 kV substations that belong to the Electric Distribution System Operator as well as to the other clients that are directly connected to this network

The new situation for the power system with a self-sustained 110kV network from the balance point of view, has changed the physical flows in the network, consequently in certain months of the year with high hydrology, the country has a positive balance exporting through the tie lines.

In terms of network control technology, TSO, uses SCADA/EMS systems, which enable the real time communicates also with neighboring Transmission Companies.

Through this platform all transmission nodes are operated, monitored and commanded in real time, generators are commanded to reduce / increase the generation depending on the need of the system not to deviate from the cross-border exchange program, as well as to maintain the system frequency, in accordance with the planned values. Currently under Automatic Generation Control are 5 hydropower plants, Fierze, Koman, Vau Dejes, Banja, and Fangu.

Market Operator,

Market Operator actually is part of Transmission System Operator and is responsible for the Register of all market players following all respective registration procedures defined in the Transmission Code System and market Rules.

During Year 2019, in the register of Market are registered and administrated the following contracts among parties:

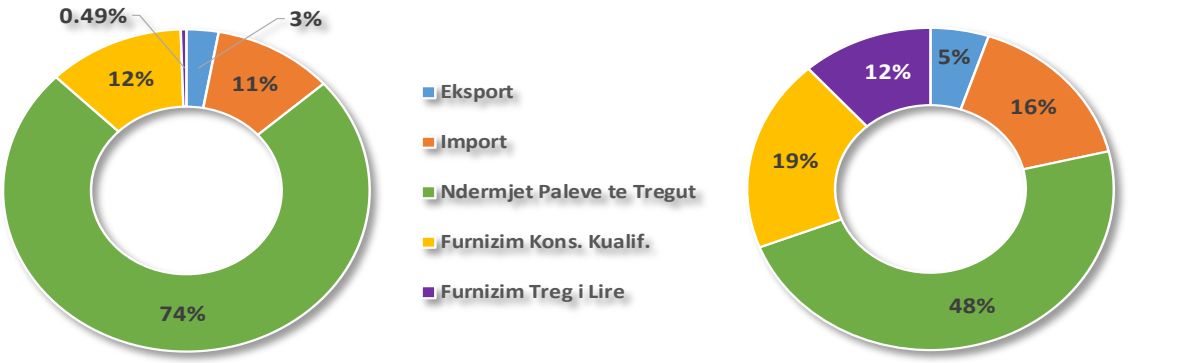

Figure 3.5 Singler Line Diagrame 400/220 kV

The number of producers and consumers that will joint the liberalized market is going to be increased upon a full market liberalization and It will be fully operative The day Ahead Market and Intraday market To enable the operation of a liberalized electricity market, it is ongoing the procedure for establishing a functional balancing market and ancillary services which will contribute to an optimal and realistic cost of such services.

The process of creation and functional operation of the Albanian Power Exchange and the procedure for the selection of stock exchange shareholders is ongoing and it is foreseen to be fully operative by June 2021. The establishment and operation of the exchange shall enable market operators, producers, suppliers, traders and customers to have a reference price which will result in long term in a decrease of the cost of energy.

Albanian Electric Distribution Network

Electric Distribution System Operator manages 102 substations with 35/10/6kV and about 1130km of 35kV lines that stretches across the country.

The EDSO assets like 35/10/6kV substations as well as the 35kV lines connecting these substations have a 40 - 42 years utilization period and consequently have high aging and depreciation. The overloaded work regime in which they worked has led EDSO to face difficulties in managing the network, which are reflected in the quality of customer supply: the number of outages, their duration as well as the level of losses.

Electricity Consumption

The new social-economic developments and the free moving of the population, change significantly the electricity consumption in Albania (Figure 4). The rapid increase of the power demand and the reduction of available capital have resulted in a need for improvement in production and use of electricity, the increasing of the international connections and exchanges, and more extensive justification of new system facilities. The first approach to overcome these challenges it was the increase of the international connections and exchanges.

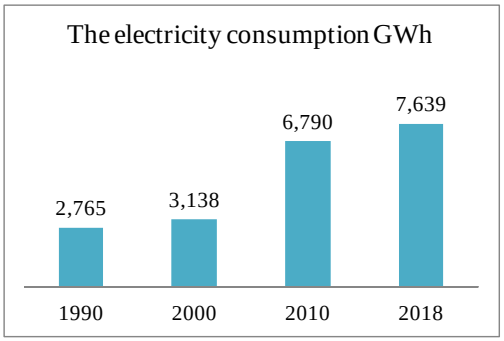

Figure 3.6 The electricity consumption during last decades

The electricity demand has not only been increased extremely, but the significant changes have been in its structure as well. In Figure 5 is shown the structures of electricity consumption in three different periods. The character of load is changed from industrial to residential/commercial. These kinds of loads consume small reactive power. So, the load is more active power.

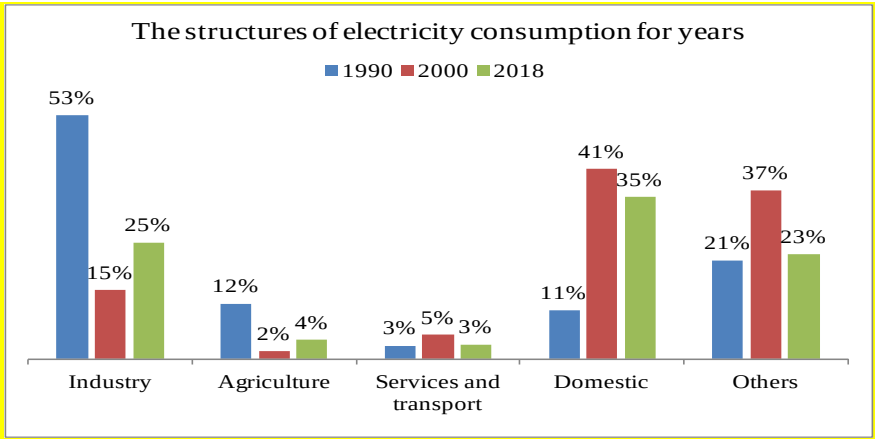

Figure 3.7 The structures of electricity consumption in three different periods

The electric energy consumed in the electric distribution network is concentrated in the regions of Tirana-Durres (about 50% of the total energy consumption), while the major part of the new generation capacities are installed in rural areas with low consumption of energy (about 17% of total consumption).

Most of the HPPs connected to the distribution grid are run-of-river, i.e. they do not create large water reserves and do not require the construction of large dams or reservoirs so due to the non-energy storage there is a weak correlation with grid load request, especially during night when there is low energy demand and when power generated by HPPs may be at its peak favored by weather conditions as water flows. Under these conditions occurs the reverse power flow to Transmission System Operation (TSO).

Meantime, the major part of the new generation capacities are installed in remote rural areas, where the distribution network, despite the periodical maintenance faces an increased number of outages, deficiency in the transformer and transmission capacities to welcome the injection of generation of the new hydropower plants.

Distribution network continuously is closed to the limit of normal operation due to the fact of high penetration of energy generated from the new HPPs. Such constrains includes technical constrains referring to the allowed limit of the level of the voltage to be maintained, level of losses of loads, specific requests of Transmission System Operator etc.

4. Tailoring educational programs to job market in energy sector (Best Practices)

In a highly computerized society, modern technologies play an important role for employees' performance, in terms of quality and cost. The economic growth based on knowledge relies on the human capital with competencies that help companies to surpass competition. Therefore, the business environment demands employees with a solid education background, but also with transversal skills (ability to learn, to take initiative). Moreover, there is a higher interest in professional skills than in degree-specific knowledge.

Nowadays, worldwide one of the main concerns in labor market is the assumption that students and employers do not share the same perception regarding the employability skills.

Vocational education and training (VET) systems need to deliver the right mix of skills both to meet student needs and to match the requirements of the labor market. Determining the supply of VET programs through central planning is fraught with information problems. A good balance between generic and specific skills is also important.

- VET graduates need occupationally specific skills allowing for a smooth transition into the labour market without lengthy additional training.
- They also need generic transferable skills to carry them through their working career, including the ability to adapt to fast-changing workplace requirements.

There is a need to find the right combination of technical and professional skills that the graduates might need in a competitive market.

Since the academic system provides fundamental and specialized training in a specific area, students have the possibility to choose between continuing the educational development through PhD programs or post-graduate specialization, or to find jobs in their area of expertise.

There is a need for cooperation between universities and the business environment in order to align the university teaching with the on-the-job needs.

- The companies will stay close to the academic field, since they are involved in business and have little time for research.
- The university staff may provide knowledge and scientific results that might help the firms in using new materials and technologies for a sustainable development.

The universities may take advantage of the cooperation with the companies because every notion they deliver has to be linked with practice, therefore the teachers have the opportunity to update the courses and applications accordingly. At the end of the chain are the students, who will acquire both theoretical and practical knowledge, which will result in better career planning: either choosing research or practice.

5. Challenges with ENGINE and related study programs

Through participation and development of the ENGINE Project, it is thought to achieve graduates in the above study courses:

- To raise awareness in issues, like RE, efficient energy management and sustainability;
- To know appropriately the methodological-operational aspects of the treated subjects and to be able to use this knowledge to interpret and describe the problems of engineering;
- To know appropriately the methodological-operational aspects of engineering science, both in general and in a comprehensive way, to be able to identify, formulate and solve problems using updated methods, techniques and tools;
- Be able to use techniques and tools for designing components, systems and processes;
- Be able to conduct experiments, analyze and interpret data;
- Be able to understand the impact of implant solutions in the social and physical-environmental context;
- Recognize their professional and ethical responsibilities;

- To know the contexts of enterprises and the culture of enterprises in their economic, managerial and organizational aspects;
- Recognize contemporary contexts of IT tools and energy;
- Possess the basic cognitive instruments for continuous updating of personal and professional knowledge.

To accomplish the above objectives, all partner HEIs should take in consideration risks such as:

- Not all partners are actively involved in the successful project implementation;
- Lack of interest from students;
- Delay in the licensing and accreditation procedures;
- Poor quality of deliverables and delays;

To mitigate the above listed risk and other potential threats to the successful project implementation, a detailed risk mitigation is needed involving the active participation of all partners in the consortium.

6. Conclusions

It is important to say that the unavailability of human resources with the required knowledge and skills might potentially be a key reason for poor dissemination of energy efficiency and renewable energy technologies in the country. Thus, as being done in other parts of the world, educating individuals, at different levels, about energy efficiency and renewable energy empowers their capacity and preferences to support and take part in sustainable development efforts. This calls for an immediate action, at all levels, in fields of energy and renewable energy education and training in order to provide the desired technical staff, i.e., professional engineers and technicians, to support local industry.

- Engineering education has a key role to play in helping to meet the challenges associated with prosperity and sustainability. These challenges are dynamic and as such engineering curricula have to be adapted to the times and social needs.

- The utilization of renewable energy sources is growing rapidly since such sources are considered as good solutions to many problems, i.e. concerns about oil depletion and prices, climate change, etc. On other hand, engineers and technicians are not trained to use these renewable energy technologies and some are not aware of the principles of sustainability.
- There is an urgent need to develop and implement new courses that prepare engineers, scientists and energy planners to work with energy and renewables industries to produce sustainable energy generation systems. The new needed energy education should include a study of conversion processes, technologies, resources, systems design, economics, environmental dimensions, industry structure and policies in an integrated package. Such approach would prepare the graduates to design technically, financially and environmentally sound systems from amongst available options.
- Sustainable clean energies have the potential to minimize environmental impacts, including waste production, and increase social welfare based on current and future needs.
- Education for sustainability has the purpose of preparing the students with the skills, knowledge and habits of mind to participate in the development of a sustainable and prosper future.