MONTENEGRO

MINISTRY OF SCIENCE

RENEWABLE ENERGY SOURCES

Results of Entrepreneurial Discovery Process

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VISION

Montenegro recognized as a regional energy hub and a leader in production and use of energy from renewable energy sources.

SECTORAL GOALS

- Developing the energy sector in line with the goals of European energy policy, with a focus on full transition to renewable energy sources in production.
- Utilization of the potentials of various energy resources that Montenegro has at its disposal (hydro, wind, solar, biomass, coal, hydrocarbons, waste, etc.) and hybrid systems.
- Application of research results and technological innovations in transmission, distribution and consumption of electrical energy in order to increase the reliability and efficiency of the EES.

Increasing the use of renewable energy sources
Raising the level of energy efficiency
Achieving energy self-sustainability

2022 GOALS

- Increasing production from renewable energy sources to 42% when it comes to final consumption.
- Reducing overall energy deficit through the increase in use of renewable energy sources and stimulating end users to be producers of electric energy.
- Promoting research and innovation for creating technologies to reduce the level of environmental pollution.
- Raising the level of energy efficiency and using renewable energy sources in public buildings, enterprises and residential buildings.
- Use of eco-funds for adaptation of tourist and residential buildings.
- Transport electrification, with a focus on public transport.
- Application of the concept of smart networks.
- Preparation and start of implementation of strategies for environmentally friendly use of coal in various energy resources.

FOCAL AREAS AND TECHNOLOGIES

Identified focal areas and technologies that have great potential:

- Hydro energy.
- Wind energy.
- Solar energy for the production of electrical energy and heating.
- Hybrid energy systems (conventional + alternative energy sources).
- Energy production from biomass and waste.

- Energy efficiency, energy balance improvement, reduction of consumption and CO2 emissions (building renovation, LED technology, eco-active / passive buildings).
- Development of a system for storing energy.
- Smart facilities (houses, buildings, hotels, roads, intersections, etc.).
- Construction of electric vehicle charging stations (solar and hybrid).
- Encouraging distributed production and consumption response.
- Strategic positioning in European energy corridors for transit of energy and energy generating products.

EMPIRICAL FOUNDATIONS AND COMPETITIVE ADVANTAGE OF MONTENEGRO

The energy sector in Montenegro has undergone major changes in recent decades. The traditional, vertically integrated, monopolistic electrical energy system (EES) has been replaced by a deregulated system, with the electrical energy market as an important link in defining the price of delivered energy. Montenegro, as a pretender for EU membership, committed itself to respecting the relevant European regulations and policies, including an increase in the share of energy use from renewable sources. In this regard, numerous projects in the field of renewable energy sources have been implemented, or are in the process of implementation, such as the projects for the construction of mini hydro power plants, two large wind farms and large solar power plants. In addition to the aforementioned activities, the implementation of the project for the installation of an underwater electrical energy cable is in the final phase, which will enable the connection of the electrical energy systems of Montenegro and Italy. If the need for the implementation of storage capacities for energy is added to the above, primarily with the aim of increasing the reliability of consumers' supply, it becomes clear that the EES of Montenegro gets a completely new physiognomy. Accordingly, economical, environmentally friendly and reliable production, transmission and use of electrical energy, as well as a way of optimal management, become the main challenges of the modern electrical energy sector in Montenegro.

Montenegro has a great potential for renewable energy sources and although hydro energy already provides for two-thirds of the total energy production in the country, only 17% of the theoretical hydro energy potential has been exploited so far. Until recently, hydro energy has been the only renewable energy source that significantly contributes to energy production in Montenegro.

The potential of large hydropower plants on the main rivers in Montenegro is 9846 GWh, while on smaller rivers it amounts to 800-1000 GWh per year. Technically and economically justified useful potential on the main rivers in Montenegro is between 3.7 and 4.6 TWh / year. For comparison, the real useful potential for small hydropower plants is estimated at 400 GWh per year. Based on currently granted concessions, 20 small hydro power plants have been implemented, with a total installed power of about 33 MW. Overall, the theoretical potential for hydro energy in Montenegro is slightly less than 11 TWh / year, of which 5.7 TWh / year can be used in an economically quality manner.

Montenegro has a wind potential of 100 MW for high-speed zones, i.e. areas with wind speeds above 7 m/s. The potential increases to 400 MW if medium potential zones are considered as well. Energy produced from wind can reach up to 25% (925 GWh) of annual energy consumption in the country. The latest projects, such as the Krnovo wind farm (72 MW) and Možura (46 MW, under construction), point to the direction of the future development of the wind potential.

The average annual number of sunny hours in Montenegro is more than 2,000 hours, while the coastal regions have more than 2,500 hours of sunshine per year. Construction of the first large

solar power plant is planned as well, while the solar energy has so far mainly been used for solar thermal heating and cooling.

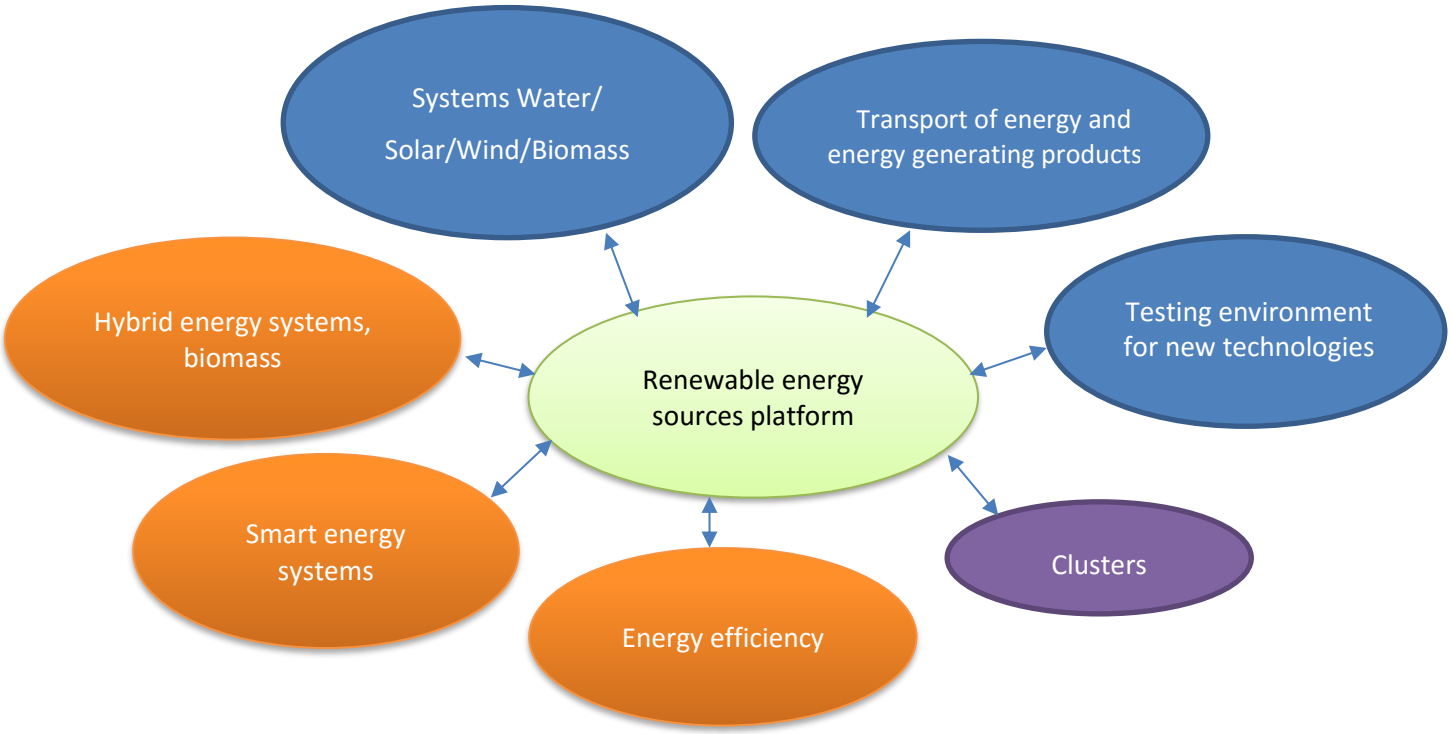
Montenegro has great potential to use the biomass energy potential, which primarily relates to the forestry sector. The annual increase in the amount of wood, as the most important energy source of this type, is estimated at 2.6 m^3 / ha per year, while the current level of wood consumption is estimated at about 1.03 m^3 / ha per year. The estimated tree increment is between 850 thousand m^3 / year and 1,060 thousand m^3 / year. In Montenegro, the wood waste energy potential amounts to 400 MW.

The construction of a new underwater electrical energy cable between Montenegro and Italy will start operating in 2019, which enables us to take the position of a regional energy exchange hub. From the standpoint of the construction of wind farms, Montenegro has positioned itself as a testing environment for the application of technologies in extreme conditions, because the wind farm at Krnovo is located at the highest altitude in Europe so far.

SYNERGISTIC EFFECTS IN RELATION TO OTHER PRIORITY SECTORS

	Examples of synergy with renewable energy sources
Sustainable agriculture and food value chain	• Biomass as an energy generating product • Energy efficient and smart management of agricultural production • Energy from waste / landfills
New materials and sustainable technologies	• Energy efficient management of production plants Efficient operation of electrical construction machines • Development of new materials for solar panels
ICT	• Optimal management of the EES and networks • Energy and data transmission • Managing data for smart use of energy sources or engaging network capacities • Cyber security • Smart energy systems – smart energy and data transport • Smart trading and electrical energy management – energy market • Management of data on energy research on the state and potential in energy • Development of a business intelligence system in energy.
Health and sustainable tourism	• Energy efficiency • Hybrid energy systems • Solar energy • Electric vehicle charging stations

PROPOSED RENEWABLE ENERGY SOURCES PLATFORM



The Ministry of Economy, Ministry of Sustainable Development and Tourism, Ministry of Agriculture and Rural Development and other relevant public institutions, with the support of the Chamber of Economy of Montenegro (through organization of clusters) and civil society organizations, are crucial for the creation and implementation of a strategy that enables the achievement of the set goals for development of renewable energy sources. In addition to designing and implementing the strategy on renewable energy sources and the action plan, clusters enable the integration of available resources, organizing and executing projects and playing a significant role in attracting investments in the energy sector.

SWOT ANALYSIS

STRENGTHS

- The geographical position of Montenegro and implemented capital energy projects make Montenegro the energy hub of the Balkans.
- Montenegro is a small energy system, but it is therefore very flexible and efficient.
- EES has been decentralized in Montenegro. The newly-formed energy entities (production, transmission, distribution and market, as well as the regulatory agency) are successfully following European directives and frameworks.
- Montenegro has a distinct diversity of production capacities: hydro, solar, wind and thermal.
- In Montenegro there is a long-term policy in the field of energy.

WEAKNESSES

- The main challenges in business operations of enterprises are bureaucratic problems.
- Lack of local energy plans, despite the legal obligation imposed on local governments to pass them.
- Unavailability of adequate and sufficiently educated staff.

OPPORTUNITIES

- Unused potential in renewable energy sources.
- Wind power plant in Krnovo – Gvozd should be used as a testing energy environment due to the high altitude on which it is located, which is a comparative advantage.
- The development of smart transport of energy and information can be a subsector within the sector. Similarly, an analysis of the state of the electrical energy market can be a subsector, and so can the scanning of the electrical energy sector.
- In Montenegro, the construction of electric vehicle charging stations is planned, which will contribute to a better tourist offer.
- Investments / tests are in progress in smart facilities (houses, buildings, hotels, roads, intersections, etc.), as well as in smart energy networks.
- Transmission and transit of energy (cable, electrical energy transmission network and gas pipeline).
- In Montenegro, hybrid energy systems are being developed (most often it is a combination of solar-diesel systems, but there are also plans for wind-solar systems, wind-diesel systems, etc.), especially in areas where there is no electrical energy network.

THREATS

- There is a problem of cyber security as a potential challenge in business operations and energy systems management (trade in energy, production capacity management, generator engagement, etc.).
- Potential problems of physical security of energy facilities due to natural disasters.
- Competition at the regional and global level.

SECTOR SUPPORT POLICIES

- Detailed, transparent and clear local energy plans.
- It is necessary to harmonize local energy plans with the plans for the development of the electrical energy network and infrastructure.
- Defining in detail the status of a privileged electrical energy producer in order to achieve sound market competition.
- In order to increase energy efficiency, the Law on Construction should stipulate the obligation to install a central heating and cooling system when constructing new buildings.
- Possibility to obtain subsidies for the construction of solar power plants on the ground (soil) as well, not only on roofs.
- Adapting administrative procedures at all levels, especially in the case of investments in renewable energy sources.
- Including the opinions of businessmen when adopting regulations at the state level, at all stages.

- It is recommended to introduce more concrete professional practice for highly educated personnel, as well as dual education for workers with secondary education.
- Simplifying procedures for obtaining licenses for small and micro energy facilities.
- Stimulating eco funds for co-financing building renovation, purchasing more efficient machines and electric vehicles.
- Incentives for transition from diesel to electric vehicles (free parking, tax incentives, etc.).
- Promoting the importance of using the appliances with A +, A ++, A +++ certificates.
- Trade in green certificates.
- Establishing a unified tax system that would facilitate procedures and shorten the time for issuing licenses.

EDP ACTORS

COMPANIES

EPCG, CGES, CEDIS, Montenegrobonus, Montenegro energy, IGMA energy, Hidroenergija Montenegro, ZETA energy, BB Solar, System MNE, Mezon, Ramel, Eminent

BUSINESS ASSOCIATIONS

Chamber of Economy of Montenegro, Montenegrin Employers Federation, MBA, Association of Oil Companies of Montenegro

PUBLIC INSTITUTIONS

Ministry of Economy, Ministry of Science, Ministry of Public Administration, Ministry of Education, Ministry of Sustainable Development and Tourism, Energy Regulatory Agency of Montenegro, Montenegrin Electrical Energy Market Operator

SCIENTIFIC AND EDUCATIONAL INSTITUTIONS

University of Montenegro / Faculty of Electrical Engineering, Faculty of Mechanical Engineering, Faculty of Civil Engineering, Faculty of Economics

University of Donja Gorica (UDG) / Faculty of Polytechnics, Faculty of International Economics, Finance and Business

CIVIL SECTOR

Academy of Engineering Sciences, CG KO CIGRE (Montenegrin National Committee for the International Council on Large Electric Systems)

INDICATORS

Indicator	2018	2022
Share of energy in GDP	6%	8%
Increase in production from renewable energy sources in relation to final production	33% (2017)	42%
CO2 emissions	3178 Gg (2013)	2800 Gg
EEER – Indicator of energy efficiency in residential and public buildings	240 kWh/m2	200 kWh/m2
Level of energy dependence	34.7% (2016)	32%