PLANING AND DESIGNING LARGE ENERGY SYSTEMS WITH A SPECIAL EMPHASIS ON THEIR IMPACT ON THE ENVIRONMENT

Veselin D. Luburić[a], *Saša* T. Bakrač[b], *Miško* M. Milanović[c]
[a] Public Enterprise National Parks of Montenegro, Podgorica
e-mail: veselinluburic@yahoo.com
[b] Military Geographical Institute, Belgrade,
e-mail: sbakrac@yahoo.com
[c] University of Belgrade, Faculty of Geography,
e-mail: milanovic.misko@gmail.com

DOI: 10.5937/vojtehg63-6412
FIELD: Technology Development
ARTICLE TYPE: Professional Paper
ARTICLE LANGUAGE: English

Summary:

This paper analyzes the impact of planning and designing large power systems on the environment, such as the DSP 400 kV optical cable from the Montenegrin coast to Pljevlja. It is a very complex and multidisciplinary project, and involves the analysis of a number of important factors and cause-effect relationships that such a system can produce. The analysis was guided by the fact that this is an atypical example, from the planned and implemented aspect unknown both on the national and wider regional level. For this reason, it is challenging to shed light on the consequences of any such system and structure, which is specific in many ways, and whose repercussions in the near future are still vague. The paper discussed European and international experiences as well as their perceptions of problems with similar solutions in practice.

Ključne reči: *systems for supplying electricity, environmental protection, spatial planning.*

Introduction

National, regional, continental and worldwide requirements and needs for new energy infrastructures go along with the increase of difficulties and scope of interventions in setting up large facilities. For these reasons, the design of mega energy systems is a very complex and multidisciplinary activity, and includes the analysis of a number of important factors, as well as cause-effect relations that could be produced by such systems. The case study for the DSP 400 kV optical cable from the Mon-

tenegrin coast to Pljevlja is guided by the fact that it is an atypical example, from the planned and implemental aspect unknown both on the national and wider regional level. For this reason, it is very challenging to shed light on the consequences of such a grandiose system and construction, which is specific in many ways, and whose repercussions in the near future are still to be determined. Therefore, European and world experiences and their perceptions of the problems with similar solutions in practice are valuable here.

The analyses of some European and/or American systems for the supply of electricity (California, for example) show that, in addition to economic conditions and substitution of needs for electricity, planers have treated high sensible environmental conditions and reduction of negative consequences on the natural environment (Barton, 2005, pp.374-376). In this context, it is stated that environmental restrictions are essential for the process of planning guidance (Vajjhala, Fischbeck, 2007, pp.650-671). In this respect, most of the attention has focused on physical conditions of a certain area, land, forest cover, as well as on the impact of structural and mechanical design constrains because may affect the price of performing such projects. Certainly, time and spatial components have to be taken into account together with their impact on the changes in the plant species diversity and impact on the movement of animal species and their habitat. Somehow, the time and spatial changes of the plant species diversity are in a direct connection with the scope and method of work execution, even if there is no change in the features of other factors affecting the diversity (Filipović, Vukićević, 2011). Almost identical scores may be given to the planned project in Montenegro, which is more complex if we take into consideration the size of the territory and the fact that Montenegro is the first declared ecological state in the world. That is incorporated in the Constitution of the country. On the other hand, the need to address the deficit of electricity, the electricity export opportunities, and therefore the increase of the economic sustainability are the key challenges with which the Montenegrin societyis faced, possessing potentials but also still a low level of economic development.

In this context, it should follow the world experiences in the design and tracing overhead lines. All countries try, for economic reasons, to avoid inaccessible areas, or large line lengths of the routes that increase the cost price of the operationalization of the system. Since the transmission lines have in general inflexible routes that primarily relate to factories for electricity generation, the avoidance of inaccessible regions is not always feasible in the practice.

Instead, planners make concessions between line attributes and the features of the very locations, and one alternative is rarely dominant as compared to others (Vajjhala, Fischbeck, 2007, pp.650-671).

The modern world needs production of electricity and transport channels. The crucial issue regarding these large-scale infrastructural systems is the extent to which citizens are willing to give up the quality of the living space for the sake of comfortable life, and that sets a crucial issue – how to make a balance between the need for economic development on the one hand, and environment protection conditions as the modern life needs in the planning process, on the other hand.

In order to properly abstract the problem that is in the focus of this plan, and to obtain the correct perception of the situation and needs of Montenegro in the generation and sale of electricity, it is necessary to prepare a general cross-section view of the total regional-political, economic, social and real needs of the society for such systems. The best picture of the actual situation and needs may be given through the analysis of the balance sheet of the energy sector in the country in the last years or last decades. Thus, the balance sheet of the energy sector of Montenegro includes hydro potential whose current utilization is only 15%, coal production in TPP Pljevlja, and low production of energy from renewable sources, primarily production of solar energy.

The core problem of the state is deficit in the production of energy, enormous imbalance between real potentials and what is actually used in production. Network losses, together with other factors have caused the country to rely permanently on imports of electricity for years. That is a burden for a small economy such as Montenegrin. The period of the 90s of the last century until the beginning of 2000, as regards the energy sector, is characterized by the lack of investments in distribution and transmission sectors, the lack of investments in new electricity generation systems, the use of existing ones, as well as the prices that are not market-based, but in large part subsidized due to the mainly illiquid industrial sector. The energy sector reform in Montenegro started in 2003 with the adoption of the Energy Law that was the basis for the establishing of the market concept in the energy sector in a way that led to the transformation of the single electricity supplier –Electric Power Industry of Montenegro (EPMNE) to four functional units, as well as the establishment of an independent entity for the regulation of the electricity market – Energy Regulatory Agency (ERA). The energy system reform got the most striking form during 2010 in a way that the new Energy Law is harmonized with the energy acquis which also requires additional adaptation and harmonization of secondary legislation, in line with EU Directives. As Montenegro is one of the Contracting Parties in the Energy Community, it has committed to follow the 3rd Energy Package and all its requirements.

Today electricity in Montenegro is produced from two hydro power plants, 'Piva' and 'Perućica', as well as from the thermal power plant 'Pljevlja'. The total installed generation capacity of the power plants is

868 MW. Compared to this capacity, 76% of the energy is produced in the hydro power plants (685MW), while 24% of energy is produced from the thermal power plant (210MW) (Jablan, at al., 2013). Based on these indicators, it was concluded that the existing resources lead to two-thirds of the substitution of the needs for electricity consumption, while one third of the energy (about 1.300GWh) is still imported, mostly from the European interconnections, neighboring countries, Romania, etc.

In the meantime, the Energy Development Strategy of the Republic of Montenegro by 2025 (Government of Montenegro, 2007a) has been made, together with the associated Action Plan for the period 2008-2012, and the Energy Police of Montenegro by 2030 (Official Gazette of Montenegro, 2011). All these documents have perceived existing and potential energy resources in the country. The emphasize is given to the use of hydro potentials, mainly through large (priorities are the Komarnica and Morača rivers), but also small hydro power plants (SPP). However, these documents have not paid enough attention to the possibilities of electricity savings and other forms of renewable sources. The biggest step forward in this part has been made in the Energy Police of Montenegro by 2030, where the following key priorities are mentioned:

1. Security of supply.
2. Sustainable energy sector development.
3. Competitive energy market development.
4. Rational use of domestic resources.
5. Special attention to the environmental protection (Official Gazette of Montenegro, 2011).

However, this document also does not include innovative resolutions in electricity generation which would rely mostly on energy generation from renewable sources, primarily through solar panels using solar energy as a resource, particularly in the southern part of the country. An important and also missing indicator is the fact that the country announces a major investment, i.e. the construction of the II block for TPP „Pljevlja" whose construction would increase significantly the generation of electricity in the country. In this context should be considered the announced construction of the system for the 400 kV optical cable from the Montenegrin coast to Pljevlja by which energy surpluses will be transposed to the EU countries (DSP 400 kV, Montenegro coast to Pljevlja). If we add to all this a possibility to connect this system with other systems in the neighboring countries (primarily Bosnia and Herzegovina and Serbia), then this system takes on broader, regional frameworks, and Montenegro gets the status of an energy hub and an important centre for the export of electricity surpluses.

The subject matter of this paper is the preparation of the Spatial Plan (DSP) for installing the 400 kV optical cable from the Montenegrin coast to

Pljevlja, with described locations for setting up the converter station and base substations on the planned spots in the space. The subject matter covers the analysis of all parameters that caused the need for its development, the analysis of different options in route planning, and a general assessment of the rationality of the resolutions adopted in the plan, their implications for the space. Also the subject of the research focuses on the variant selected, but also on different models, scenarios which existed as a legitimate option and were more favorable in terms of environmental protection and impact on the space, but economically less sustainable for customers of the planning resolution development and potential investors.

In this way, a clear identification of all defined factors that more significantly affected such determination of the plan will be made, but also alternative variants will be given and their detection in important aspects. A particular attention is paid to the key points in the space, such as: the choice of initial cells for the converter station, selection of routes affecting the narrower and wider gravity space of the Lovćen National Park (NP), as well as the key indicators and measures to mitigate negative consequences for the environment (Bakrač, 2013, pp.587-594). In the following interactions we will see why this process and the planned system are very specific, not only for Montenegro but also for wider, regional environment.

Methodology

The analysis and verification of the results obtained in this paper include scientific methods known in the theory and practice. The basic starting scientific hypothesis is a method of the analysis that is based on the identification and interpretation of data collected and facts related to the phenomenon and processes that accompanied the development of DSP for the 400 kV optical cable. By the analysis of the data obtained, it is possible to make a comparison between the results of the planning document and hypothetic assumptions in the case of different scenarios that are again grounded in the national, regional, and modern European practice and experience. The analytical breakdown of the phenomenon and the processes is the basis for the creation of some conclusions that may be used as a platform for new knowledge-based processes and phenomena and facts logically linked to them. In this way, we move into the next methodological phase and framework, which we call the method of synthesis in the scientific application. It will be used in this research. Finally and fragmentary, and particularly in relation to the results of research and conclusions, we will use the deductive-inductive method which will serve to explain the facts, then the prediction of future events, and the disclosure of new facts in the planning.

Determination of potential routes and impacts on the environment

Transmission line route planning includes the analyses of variants and proposed optimal solutions whose corridor is 1 km wide. These variants and solutions have the least negative effects on the space. The corridor passes through eight Montenegrin municipalities: Kotor, Budva, Cetinje, Nikšić, Plužine, Šavnik, Žabljak and Pljevlja. The area of the intervention according to cartographic measurements is about 14.412 ha. The lenght of the corridor is about 181 km.

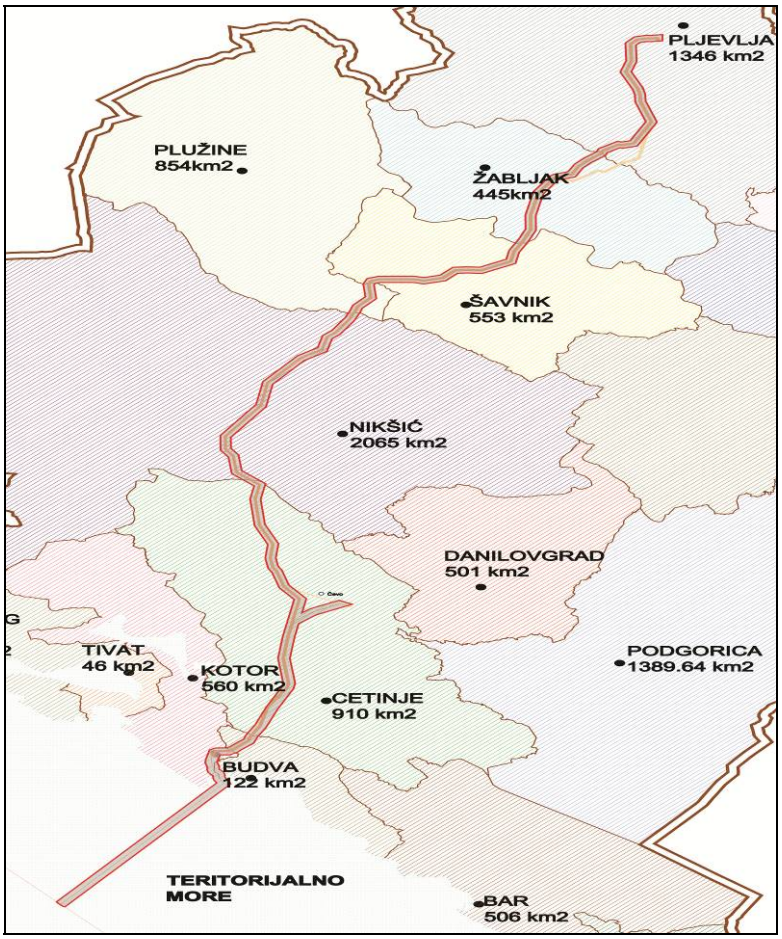

Figure 1 – Route map for 400 kV (Government of Montenegro, 2007b)
Slika 1 – Karta trase za 400 kV (Government of Montenegro, 2007b)
Рис. 1 – Карта трассы кВ (Правительство Республики Черногория, 2007b)

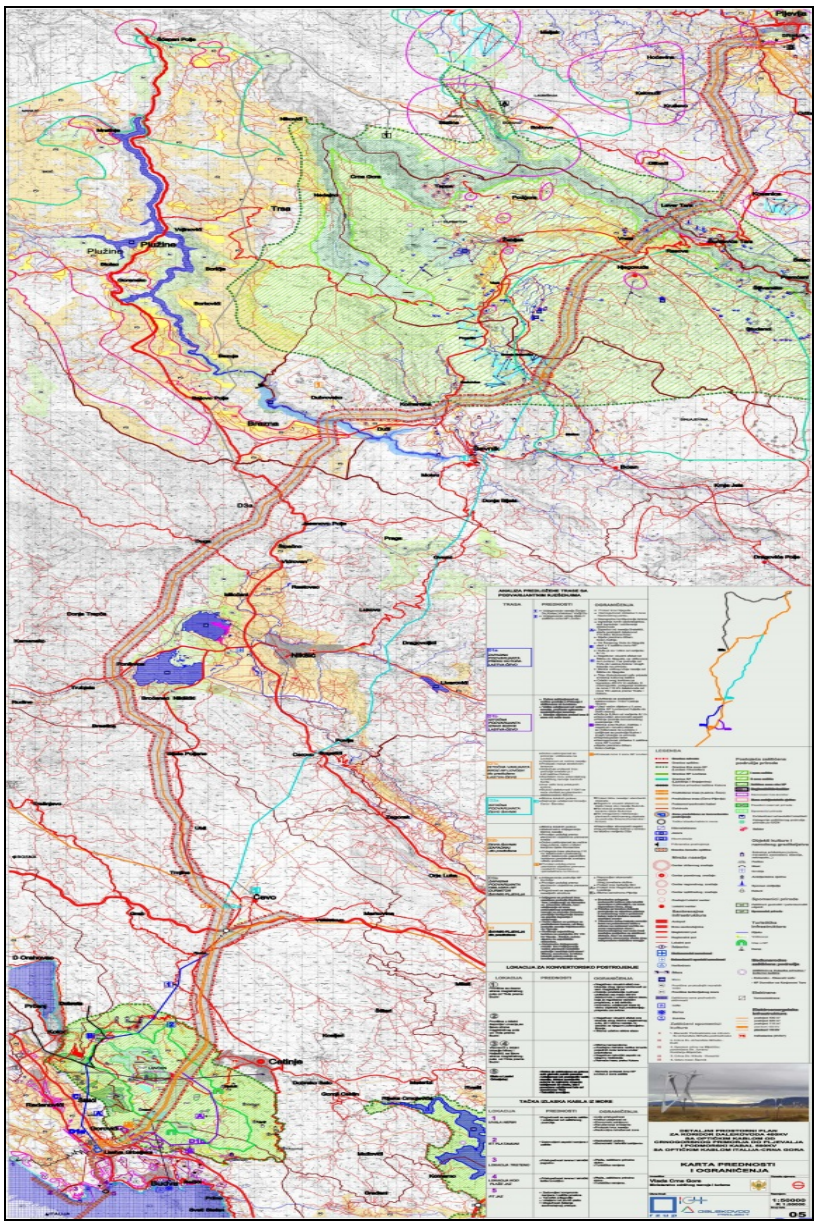

Figure 2 – Overview and a reduced scale map from the report on the environmental impact with a detailed analysis of the impact (Government of Montenegro, 2007b)
Slika 2 – Pregledna i umanjena karta izveštaja o uticaju na životnu sredinu sa detaljnom analizom (Government of Montenegro, 2007b)
Рис. 2 – Обзорная мелкомасштабная карта с анализом воздействия на окружающую среду (Правительство Черногории, 2007b)

The first analysis on route selection for the transmission line started with the assumption that a converter station on the Montenegrin coast can be located on two positions – in *Tivat municipality* or *Bar municipality*. The analyses conducted during the development of the Energy Development Strategy showed that the location Grbaljsko polje (Tivat) is more optimal in terms of resolving the issue of stable supply of electricity to the Montenegrin coast. Therefore, from the beginning of the development of the study on connecting Montenegro with Italy through a submarine cable, the construction of the substation in Tivat municipality was discussed as a basic variant.

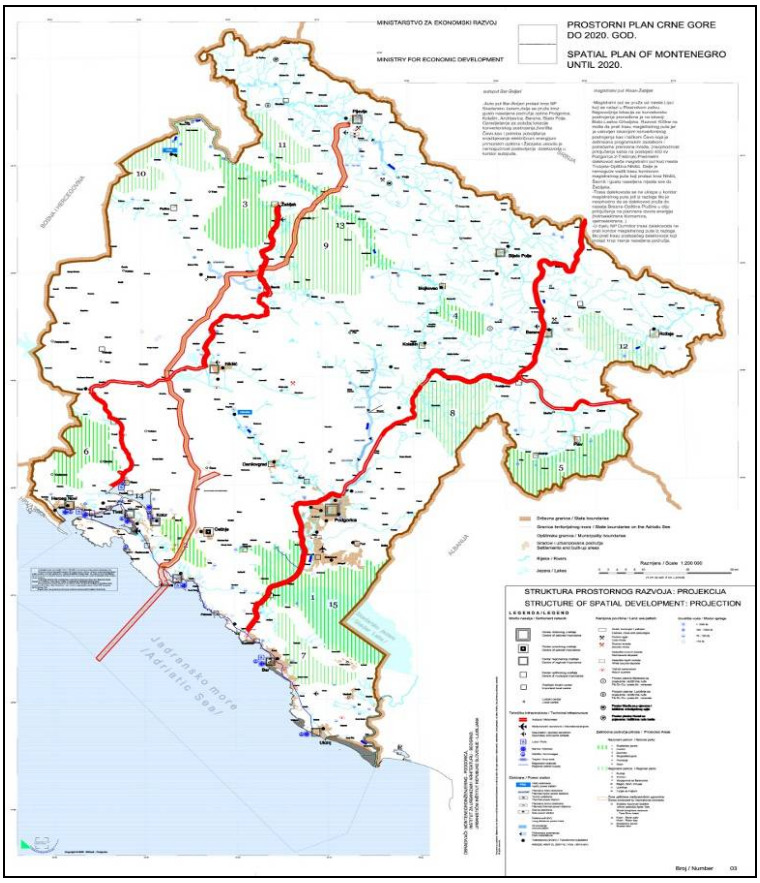

Figure 3 – Overview and a reduced scale map of the selected route and a potential one with the initial and final locations (Government of Montenegro, 2007b)
Slika 3 – Pregledna i umanjena karta izabrane i potencijalne trase sa početnom i krajnjom lokacijom (Government of Montenegro, 2007b)
Рис. 3 – Обзорная мелкомасштабная карта, с прокладкой выбранного маршрута от точки к точке прибытия (Правительство Республики Черногория, 2007b)

The feasibility study for the suggested connection between Italy and Montenegro is made based on the analysis of a range of factors and parameters. This study pointed out a number of advantages of the first option. The space restrictions of the option have been used as the most important argument, or to set Bar municipality as a starting point for the optical cable. The crucial disadvantages of this option in the study are as follows:

- Impossibility to supply electricity in the Western part of the Montenegrin coast;
- Preliminary space analysis which indicated that setting of the cable and the construction of the converter station in Bar would result in a significantly larger length of the transmission line;
- The problem of the transmission line crossing over the Skadar Lake National Park;
- The presence of archeological sites in the offshore zone around Bar, that could be jeopardized by possible laying of a submarine cable to Italy.

A dilemma occurred between professionals and scientists and there was a strict division of opinions in the selection and final orientation between these two options. In the beginning, a more preferred variant was a so-called Western variant which would avoid the possibility of putting the route of the cable through the protected area, such as the Lovćen NP, but in the end, the second variant was chosen. The key reason for this option was sublimated in the perception that a so-called Western variant is more degrading for the space, as in that case the cable route would go through the Kotor serpentines (as a kind of architectural phenomena), and further continue through Njeguši village, where some economic capacities are planned to be built in the future Lovćen NP. Proponents of this option used this as an argument, emphasizing particularly the possibility to compromise the visual integrity of Kotor-Risan bay (under the UNESCO protection).

By the analysis of special components, as well as the adherence to the modern trend pattern in Spatial Planning, and the overall complexity of natural elements, this option has had some advantages compared to the finally selected one. The alternative one, a so-called Western variant of the transmission line, would definitely avoid the possibility of crossing the Lovćen NP, and endangering the visual impression of the space is the option existing in both possible variants.

In the further planning of the transmission line corridor, the particular attention was paid to the analysis of possible locations for landing points.

The Strategic Environmental Impact Assessment (SEIA) was done parallelly for the DSP 400 kV optical cable. Generally, and based on more measurable scientific methods valid in modern European practice and some indicators, it stated that they had chosen the route with the least negative points compared to other options, taking into consideration negative consequences for the environment.

The planned concept defined the segments of the infrastructural corridor starting with the submarine cable from the entrance in the territorial waters of Montenegro to the landing points of the submarine cable, the underground cable to the future converter station and substation and the overhead transmission line to Pljevlja. The natural features of the transmission line corridor, the created values and the plans for the next planned period present the basis for the assesment of the ecological capacity of the space and the prevention of potential conflicts in the space.

In regard to the use of indicators, the negative impact of the chosen route was rated as the least likely, the duration of the impact of transmission lines with associated infrastructure systems as generally short-term, and the frequency of negative parameters of the route as occasional. Using these indicators, the Strategic Environmental Impact Assessment compared to the chosen planning route really has shown the least possible negative impact for the environment, but there is definitely the other dilemma that the results of the assessment could have been different if they had used other scientific methods which are also scientifically based and very credible in modern European practice, and which could establish a different assessment of the impact on the route selected (Bakrač, et al., 2012, pp.165-178).

One cannot help feeling that the choice the parameters was the most adequate since the least possible impact of the route is just at a place where it cuts two protected areas (Lovćen NP and Durmitor NP). The Durmitor NP has double protection: domestic and international framework (UNESCO). Due to its overall natural values, this park was proclaimed a national park at the national level in 1952, while the ambiance representativeness of the space and wealth of natural elements recommended it for a dual international protection at the highest level (Official Gazette of Montenegro, 1997). Therefore, in 1977, the river Tara basin (the major part of the river flow is in the Durmitor NP framework) was proclaimed as a Biosphere Reservation under the MAB-Program - „Man and Biosphere", and the overall massif of the Durmitor NP was put on the ENESCO list in 1980 as the area of a universal value from the aspect of natural and cultural values and rarities. Observing the specific facts which have shown dominantly the „correctness" of the resolution achieved, it is possible that the assessment is correct, taking into consideration individual parameters (the chosen route passes the least populated areas, there is the least cutting of the forest cover, the least concentration of biological diversity and the least important ecosystems and habitats out of the national park zone). For these reasons, it could be concluded that such an outcome of the route chosen is adequate.

As particularly valuable in the whole concept of the protection of the elements of the environment, the SPU paid a special attention to the following: landscaping concept and general guidelines for landscaping. The guidelines for landscaping have planned planting of greenery in the func-

tion of: visual protection – Z1 and greenery in the function of protection – Z2. The guidelines for the arrangement plan the following:

- connection of green spaces into a simple system of dense and high vegetation;
- maximum preservation of the existing trees;
- preservation of the existing configuration of the field;
- landscape design harmonized with the ecological specifics of an district;
- landscaping is to provide synergy between nature and infrastructures constructed;
- make a selection of plant material that is reversible on ecological environment in accordance with compositional and functional requirements.

Based on the analysis of the documents predicting the mitigation of the effects of the convertor station and the whole cable route in the entire territory in general, it could be concluded that this document was prepared in accordance with the heritage of modern scientific achievements known in European practice that there are high-quality resolutions to minimize the impacts on the area.

However, in terms of a total spatial aspect (visual route impact), as well as the mentioned facts that the selected options influence the areas of two national parks, then certainly there is a dilemma whether the planning outcome and some other alternative resolution in the planning choice would be more optimal and acceptable, from the aspect of the protection of the natural values of the area.

Example of the substation

Taking into consideration the character of the terrain in the entire Montenegrin coast, which obviously complicates finding an appropriate, relatively flat terrain of large dimensions requred for locating the convertor station and substation, the analysis of several potential locations that meet required criteria has been conducted.

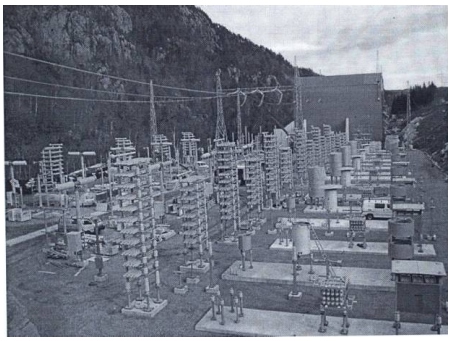

Figure 4 – Appearance of the planned base station
Slika 4 – Izgled planirane bazne stanice
Рис. 4 – Внешний вид планируемой базовой станции

Figure 5 – Lastva Grbaljska location on with the converter station will be built
Slika 5 – Lastva Grbaljska mesto gde će biti izgrađena konvertorska stanica
Рис. 5 – Ластва Грбальска, местность под строительство станции конвертера

The location selected as the most favorable is on the left side of the main road from Tivat to Budva. It is well sheltered from almost all main road directions, and, as a possible route of the 400 kV transmissions line, provides the passage through the Lovćen NP by the eastern variant over Budva. Besides the positive visual effect, we can emphasize the character of a field inappropriate for some other purpose, its distance from the existing larger settlements, the vicinity of the existing roads to the shortest possible distance to the coast (leaving the optical cable from the sea), and the corresponding distance from the Tivat airport.

Results of the research

Based on the analyzed elements, valid and scientifically based postulates as the ultimate achievements of the research subject with a particular emphasis on the DSP for the 400 kV optical cable, it could be concluded that the planning and the development of the document are mostly based on the economic parameters and perceptions used by the energy sector in Montenegro together with potential investors – TERNA company from Italy. Their perception was to achieve the connection for the future supply of electricity through a submarine cable by which electricity would be transmitted from Montenegro to other countries with the fewest investments in the infrastructure or the least rehabilitation of negative consequences on the situation and environmental processes. From these reasons the results implicate the planning of such public communications and participations relating to transmission lines as well as other very dominant structures that are or to be made by man in nature.

The research results for this country in general, and the mentioned case in particular, have shown the whole duality of efforts to make a balance between interests and economic logic, on the one hand, and a strict criterion in the protection of social and environmental conditions, on the other hand. In that context, it is very hard and challenging for spatial planners, want to base their development strategy on a sustainable basis according to the proclaimed Millennium Goals from Rio (1992), to plan and maintain the balance between economic, socio-demographic, ecological and other optimal needs of a system.

As one of the key results in the analysis of general perceptions, with a special focus on the case study, we should stress the lack of involvement and the level of required knowledge of certain structures of the local and regional character that indirectly relates to local communities and associations, NGO Sector, etc. Insufficient public involvement and the lack of transparency in making such important decisions may certainly complicate the subsequent implementation and better understanding of the whole process. In this way, significant results could be achieved in obtaining legitimacy of the process, which would be ultimately grouped into the following facts:

1. The public has information (a broader basis of collective knowledge).
2. More innovative resolutions.
3. Quality control.
4. Better implementation.
5. Knowledge dissemination and awareness.
6. Opportunity to impact the processes of increasing the transparence of the process when planning these mega systems for electricity generation.

Discussion and conclusion

The increase of electricity consumption and connection of new lines and neighborhoods for the purpose of supply calls decision makers to design energy lines in a way to minimize effects on the health of population, conservation of landscape values, reducing the harassment of wildlife and conservation of values of the whole biodiversity. Energy lines can have a significant impact on the environment both during the construction and implementation phases. Therefore, this is a very complex subject in very populated places or sensitive ecosystems.

Such planning and approach to planning processes open many dilemmas and controversies how and in which way to install such large systems, with the preservation of the essential values of the space and the environment. This is a particularly complex issue as the Montenegrin

territory is especially small (13.812 km^2), the configuration of the terrain is such that it is dominated by high mountain ranges, that rivers cut deeply into their vallies, weather conditions are caused by the field exposition with very visible snow cover during winter months, etc. It is challenging and very complex to plan the development of such a system on such a small territory with 5 national parks and other forms of protected, in a habitat that will, in the next period, quite likely be proclaimed the NATURA 2000 site, and, on the other hand, to plan economic growth and development which will not significantly compromise the original values of the nature and threaten ecological processes and regularity.

Spatial planners and other complementary professions will face a difficult but achievable goal - to plan measures for natural resources protection in such a small and spatially complex territory, and to meet the needs of the society for optimal growth and development (including a construction of large energy systems, such as the installation of the optical cable for 400 kV with a converter station and associated infrastructure elements during the chosen route).

By the analsis of various solutions in the broader context, it can be concluded that certain solutions imply larger or smaller negative effects on the space, which is an inevitable price of socio-economic development. Bearing in mind the general assessment alternative solutions compared to the elements of sustainable development, the most favorable alternative solutions chosen are those which are evaluated as the most acceptable compared to the defined goals of the spatial development.

While defining the location of the landing points, the location of the converter station and the route of the transmission line corridor, although the attention was paid to the protection of landscapes and ambiental values by placing facilities on sheltered positions, it is possible to expect certain negative effects on the micro-sections. A special problem in this respect is passing the transmission line through the Tara river Canyon, in other words, the area designated as a zone with the first level of the protection regime. In this context, it is necessary to consider the possibility to minimize this impact and to use the route of the existing corridor.

Carefull tracing of the transmission lines avoids the impact of the elements of the transmission system on settlements, populaton and human health, aa well as on the protection of immovable cultural properties by their traversing. In addition, the offered solution is technically and economically acceptable. Finally, the implementation of the project will have a positive impact of national importance, which will create the preconditions for the development of various economic sectors, espcially tourism and energy.

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ПЛАНИРОВАНИЕ И ПРОЕКТИРОВАНИЕ КРУПНЫХ ЭЛЕКТРОЭНЕРГЕТИЧЕСКИХ СИСТЕМ, С УЧЕТОМ ИХ ВОЗДЕЙСТВИЯ НА ОКРУЖАЮЩУЮ СРЕДУ

Веселин Д. Лубурич [а], *Саша* Т. Бакрач [б], *Мишко* М. Миланович [в]
[а] ГП Национальные парки Республики Черногория, г. Подгорица
[б] Военно-географический институт, г. Белград
[в] Географический факультет Белградского университета

ОБЛАСТЬ: технологическое развитие
ВИД СТАТЬИ: профессиональная статья
ЯЗЫК СТАТЬИ: английский
Резюме

В работе представлен анализ планирования и проектирования крупных электроэнергетических систем и прогноз воздействия на окружающую среду по проекту: «Детальный ландшафтный план (ДЛП) 400 кВ и волоконно-оптические линии связи от Черногорского побережья до г. Плевле.

В статье применяется комплексный междисциплинарный анализ ряда релевантных факторов, а также приведен прогноз причинно-следственных связей при эксплуатации энергосистем.

Анализ основывается на том, что данный пример атипичен, как в аспекте планирования, так и в аспекте выполнения, а на национальном и региональном уровне недостаточно исследован. Поэтому считаем особо важным пролить свет на последствия строительства энергоустановки и ее эксплуатации, нестандартной во многих вопросах, которые в настоящий момент сложно предусмотреть.

В работе также представлены подобные, воплощенные в жизнь, проекты за рубежом и обсуждаются позиции зарубежных специалистов по данному вопросу, основанные на практическом опыте.

Ключевые слова: *системы электроснабжения, охрана окружающей среды, ландшафтное планирование.*

PLANIRANJE I PROJEKTOVANJE VELIKIH ELEKTRO-ENERGETSKIH SISTEMA I NJIHOV UTICAJ NA ŽIVOTNU SREDINU

Veselin D. Luburić [a], *Saša* T. Bakrač [b], *Miško* M. Milanović [c]
[a] JP Nacionalni parkovi Crne Gore, Podgorica
[b] Vojnogeografski institut, Beograd
[c] Univerzitet u Beogradu, Geografski fakultet

OBLAST: tehnološki razvoj
VRSTA ČLANKA: stručni članak
JEZIK ČLANKA: engleski

Sažetak

U radu se analizira uticaj planiranja i projektovanja velikih elektroenergetskih sistema na životnu sredinu, kao što je Detaljni prostorni plan (DPP) postavljanja 400 kV optičkog kabla od Crnogorskog primorja do Pljevalja. To predstavlja vrlo kompleksan i multidisciplinaran posao i podrazumeva analizu niza bitnih faktora, kao i uzročno-posledičnih veza koje jedan takav sistem može proizvesti. U analizi se rukovodilo činjenicom da se radi o atipičnom primeru, s planerskog i izvedbenog aspekta nepoznatog na nacionalnom, ali i širem regional-

nom nivou. Zbog toga je bilo potrebno rasvetliti posledice jednog ovakog sistema i konstrukcije, koji je specifičan po mnogo čemu, i čije se reperkusije u bližoj budućnosti tek mogu nazreti. U istraživanju su razmatrana evropska i svetska iskustva, i njihova percepcija posmatranja problema sa sličnim rešenjima u praksi.

Uvod

Nacionalni, regionalni i ukupni svetski zahtevi i potrebe za novom energetskom infrastrukturom idu paralelno s povećanjem poteškoća i obima intervencija u postavljanju velikih objekata. Analiza nekih evropskih i američkih sistema za snadbevanje električnom energijom (primjer Kalifornije) pokazuje da su se, osim ekonomskih uslova i potreba za električnom energijom, planeri odgovorno odnosili prema uslovima životne sredine i umanjenju negativnih posledica po prirodno okruženje. U tom kontekstu se navodi da su ograničenja životne sredine suštinska briga u procesu usmeravanja planiranja (Vajjhala, Fischbeck, 2007, pp.650-671). Zato se velika pažnja posvećuje fizičkim uslovima određenog prostora: zemljištu, šumskom pokrivaču, izgledu predela, uticaju na strukturna i mehanička ograničenja projektovanja i slično. Gotovo identične ocene mogu se izreći i za planirani poduhvat u Crnoj Gori, koji je još komleksniji ako se ima u vidu veličina teritorije. Planirana izgradnja sistema 400 kV optičkog kabla od Crnogorskog primorja do Pljevalja omogućiće povezivanje ovog sistema sa drugim sistemima u okolnim državama (Bosna i Hecegovina, Srbija i druge)*, čime poprima šire, regionalne okvire.*

Predmet istraživanja

Predmet istraživanja je usvojeni DPP za potrebe postavljanja 400 kV optičkog kabla od Crnogorskog primorja do Pljevalja, sa opisanim lokacijama za postavljanje konvertorskog postrojenja i baznih trafostanica na planiranim tačkama u prostoru. Predmetom istraživanja obuhvaćena je analiza svih parametara koji su uslovili potrebu njegove izrade, analizu različitih opcija trase u planiranju, kao i generalnoj oceni o utemeljenosti usvojenih rešenja iz Plana i njihovim implikacijama na prostor.

Predmet istraživanja fokusiran je na izabranoj varijanti, ali i na drugačijim modelima, scenarijima koji su postojali kao legitimna opcija, a koji su možda bili povoljniji sa aspekta zaštite životne sredine i uticaja na prostor, ali ekonomski manje održivi za naručioce izrade planskog rešenja i potencijalne investitore. Naročita pažnja posvećena je ključnim tačkama u prostoru, kao što su: izlazak kabla iz mora, izbor početnih stanica za konvertorsko postrojenje, izbor trasa koji tangiraju uži i širi gravitacioni prostor, kao i ključnih indikatora i mera za ublažavanje negativnih konsekvenci po stanje životne sredine (Bakrač, 2013, pp.587-594).

Metodologija

U analizi i verifikaciji dobijenih rezultata korišćen je metod analize, kojim se vršila identifikacija i interpretacija prikupljenih podataka i činjenica. Analizom dobijenih podataka vršeno je upoređivanje dobijenih rezultata planskog akta i hipotetičkih postavki u slučaju drugačijeg scenarija. Na osnovu analitičkog preseka pojava i procesa dobijeni su određeni zaključci koji mogu poslužiti kao platforma za nova utemeljena znanja, procese i pojave i s njima logički povezanim činjenicama, što čini sledeću korišćenu metodološku fazu – metod sinteze.

Na kraju, upotrijebljena je deduktivno-induktivna metoda, naročito u delu koji se odnosi na rezultate istraživanja i zaključke, a radi objašnjenja postojećih i otkrivanja novih činjenica i predviđanja budućih događaja u planiranju.

Određivanje potencijalnih trasa i uticaj na životnu sredinu

Tokom planiranja trase dalekovoda analizirane su varijante i predložena optimalna rešenja čiji je koridor širine 1 km, a koja imaju najmanje negativnih efekata na prostor. Prema kartografskom merenju površina iznosi oko 14.412 ha, a dužina koridora je oko 181 km.

Prve analize na temu odabira trase dalekovoda započete su polazeći od pretpostavke da se konvertorsko postrojenje na Crnogorskom primorju može locirati na dve pozicije – u opštini Tivat ili opštini Bar. Konačno, izabrana varijanta je tzv. Istočna varijanta.

Analizom prostornih komponenti, kao i poštovanjem zakonitosti modernih trendova u prostrornom planiranju, ali i sveobuhvatnom kompleksnošću prirodnih elemenata smatramo da je ova opcija imala određene prednosti u odnosu na konačno izabranu. Alternativna, tzv. Zapadna varijanta dalekovoda, izbegla bi mogućnost prelaska preko NP Lovćen, a ugrožavanje vizuelne impresije prostora jeste opcija koja postoji u obe moguće varijante.

Prilikom daljeg planiranja koridora dalekovoda, posebna pažnja posvećena je analizi mogućih lokacija za izlazak kabla iz mora (landing point).

Rezultati istraživanja i zaključak

Na osnovu svih analiziranih elemenata može se izvesti zaključak da se planiranje i izrada dokumenta uglavnom zasnivala na ekonomskim parametrima i percepcijama kojim se, pre svega, rukovodio energetski sektor u Crnoj Gori zajedno sa potencijalnim investitorom – kompanijom TERNA iz Italije. Uočeno je, kao nedostatak planiranja, nedovoljno uključivanje javnosti i netransparentnost prilikom donošenja ovako značajnih odluka.

Analizirajući varijantna rešenja, može se zaključiti da određena rešenja impliciraju veće, a neka manje negativne efekte na prostor. Imajući u vidu generalnu ocenu varijantnih rešenja, u odnosu na elemente održivog razvoja, kao najpovoljnija varijantna rešenja izabrana

su ona koja su u odnosu na definisane ciljeve prostornog razvoja ocenjena kao najprihvatljivija.

Iako se prilikom definisanja lokacije izlaska kabla iz mora, lokacije konvertorskog postrojenja i definisanjem trase koridora dalekovoda vodilo računa o zaštiti predela i ambijentalnih vrednosti, postavljanjem objekata na zaklonjene pozicije, moguće je očekivati određene negativne efekte na mikrodeonicama. Kao poseban problem ističe se prelazak dalekovoda preko kanjona reke Tare, odnosno prostora koji je označen kao zona sa I stepenom režima zaštite. U tom kontekstu neophodno je sagledavanje mogućnosti minimiziranja ovog uticaja i korišćenja trase postojećih koridora, kako bi se ovakvi uticaji sveli na najmanju meru.

Pažljivim trasiranjem dalekovoda izbegnut je uticaj elemenata prenosnog sistema na naselja, stanovništvo i ljudsko zdravlje, kao i na zaštitu nepokretnih kulturnih dobara njihovim zaobilaženjem. Pored toga, ponuđeno rešenje je tehnički i ekonomski prihvatljivo. Na kraju, realizacija projekta imaće pozitivan uticaj od nacionalnog i regionalnog značaja koji će stvoriti preduslove za razvoj različitih privrednih grana, pre svega turizma i elektroenergetike.

Ključne reči: *sistemi za snadbevanje električnom energijom, zaštita životne sredine, prostorno planiranje.*

Datum prijema članka / Paper received on / Дата получения работы: 07. 07. 2014.
Datum dostavljanja ispravki rukopisa / Manuscript corrections submitted on / Дата получения исправленной версии работы: 04. 04. 2015.
Datum konačnog prihvatanja članka za objavljivanje / Paper accepted for publishing on / Дата окончательного согласования работы: 06. 04. 2015.