Green Energy and Cultural Heritage Preservation: Case Studies from Serbia

1. Introduction

In the constant search to find ways and means to establish a balanced and sustainable development of its cities, settlements and regions, Serbia faces many different problems, a number of which relate to the quality of the environment and protection of its cultural and natural heritage. In order to confront them, different policies have been initiated or already have come into force. All of them are aimed at fostering sustainable and climate responsible development for the country.

Serbia signed and rectified the Kyoto protocol in 2007, whereby all participating nations committed themselves to reducing the emission of GHG by 5.2% (from 1990 levels) by the year 2012. As Serbia is a developing country, it is not subjected to the quantitative reduction of collective greenhouse gas emissions in this timeframe; by accepting the Kyoto Protocol however, Serbia has agreed to reduce its emissions through Clean Development Mechanism (CDM) program. Moreover, as a prospective EU candidate, Serbia must also meet the standards authorized outlined by the Council of Europe in February 2011, where the main goal is to reduce the emission of GHG by 80-95% (compared to 1990 levels) by the year 2050 (Marković et al., 2009).

In regard to the fact that 62% of Serbia's electricity is produced through the combustion of coal, the energy sector is one of the leading polluters in Serbia. Since the year 2000, there has been a constant growth in Serbia's electrical energy expenditure. For 2011, the overall energy consumption for Serbia – a nation of 7.3 million people (without Kosovo)- was targeted to be 25.663 GWh, while the actual amount in 2010 was 28.051 GWh. It has been predicted that this number will rise to 35.480 GWh by 2015 (Serbian National Company for Energy Production, 2011).

In 2008, Serbia adopted a National Strategy for Sustainable Development, whose priorities include: sustainable development of energy infrastructure, reducing the high consumption of energy in the Serbian economy, lowering environmental pollution, employing clean technologies and to increase the share of renewable energy resources in energy production. This has been further supported by the Spatial Plan for Serbia 2020 , which has also placed cultural heritage preservation and protection, as well as reconciliation between the protection of heritage and energy production, among its guiding principles and major spatial development priorities. Implementation of these strategies will create a new challenge in finding better solutions for the conflict between sustainable development and cultural heritage, in order to make these monuments energy efficient while not undermining their cultural and esthetic values.

2. Serbia: Energy Production and Cultural Heritage Concerns

For more than sixty years, big energy systems have dominated Serbian energy production: thermal power plants that utilize lignite combustion and hydro-systems that have a capacity ranging between 10 i 1200 MW are still in use today, even though they were mainly built in the second half of the 20th century. Currently, the thermo lignite capacity (5171MW) of the Serbian National Company for Energy Production (JP "Elektroprivreda Srbije"- EPS) accounts for 61.89% of energy production, while hydroelectric power plants account for 35.85 %. These hydro power plants are divided into different categories, among which are conventional which produce 368MW, run-of-the-water which produce 1849MW and pumped-

storage plants with a production capacity of 614 MW. The remaining 4% is produced by thermal power plants, i.e. heating plants, with a capacity of 353MW. The overall energy production of 2010 was 35.855GWh (Marković et al., 2009). Only 5% of the total amount of energy produced in 2010 was generated through cogeneration and from renewable resources of energy in thermal heating plants. While such a policy has proved insufficient to satisfy Serbia's energy demand, it has also led to high pollution, and has permanently changed the physical appearance and identity of many places throughout Serbia.

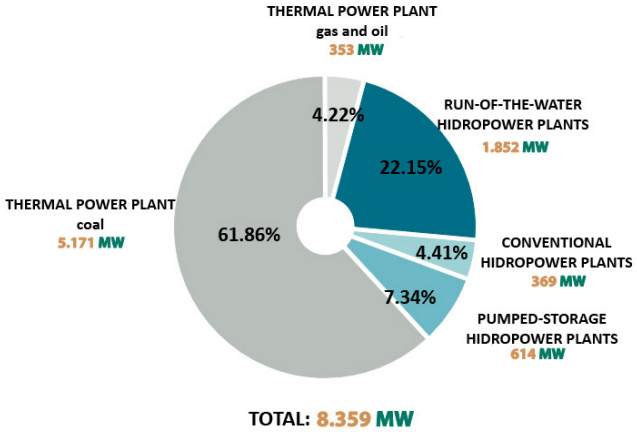

Figure 1 – Capacities of Serbian National Company for Energy Production (EPS), Source: Gavrić et al.,2009. Zelena knjiga Elektroprivrede Srbija Beograd:. JP "Elektroprivreda Srbije" Sektor za odnose sa javnošću. Available at: http://www.eps.rs/publikacije.htm

For example, surface mining in the Kolubara basin is continuously changing its natural and urban landscape, and endangering the rich cultural heritage of the area, which consists of 35 archeological sites, 19 architectural monuments, and several graveyards dating from the 18th and 19th century. (IAUS, 2008*)* Comparably, lignite open-pit mining of the Drmno Thermal Power Plant is located near and continues to threaten the archeological/cultural heritage site of Viminacium, which was once one of the most important Roman military camps on the Danube River and capital of the Roman province of Upper Moesia.

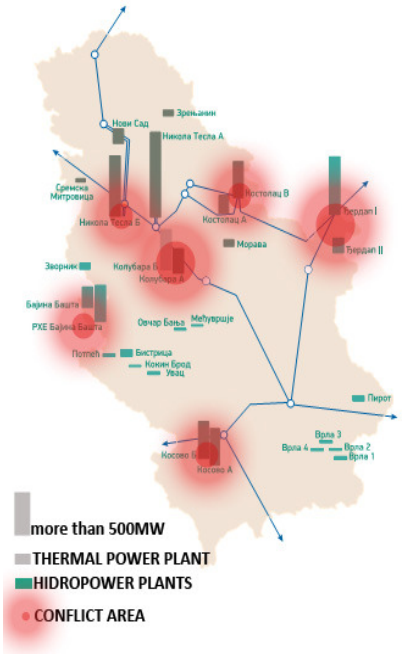

Figure 2 – The map of conflict zones. Source: own work using map from Marković et al.,(2009). Bela knjiga Elektroprivrede Srbije. Beograd: JP "Elektroprivreda Srbije" Sektor za odnose sa javnošću. Available at: http://www.eps.rs/publikacije.htm

As for Serbia's larger hydroelectric power plants, they also produce substantive negative effects on the environment, such as increasing the risk of potential landslides, as well as effecting the local micro-climate, water quality, flora and fauna. Even though these plants occupy about 170 km^2, the environmental damage they cause can be seen on a much wider scale (Serbian National Company for Energy Production, 2009). Well known examples of this damage is the construction of the Djerdap hydropower plant, whose construction originally forced the relocation of the inhabitants of 12 small settlements in the area and the loss of cultural heritage sites like Tabula Traiana from the Roman period, not to mention Lepen Whirl (Lepenski vir) from the Prehistoric era.

3. Cultural Heritage in Serbia

Judging by its specific natural characteristics, legislative and executive practices, as well as cultural and historical circumstances, Serbia may be seen as a territory rich in natural and cultural resources, also rich in well preserved natural areas and settlements that have great bio- and geo-diversity. Unfortunately, cultural heritage has been one of the most undermined sectors within Serbian society, whose development has been decelerated by an outdated legal system, and improper and partial designation and categorization of monuments. Therefore the preservation and conservation of Serbian heritage remains among national priorities and, as such, has been defined as a non-renewable resource in the Spatial Development Plan of Serbia 2020.

The approach to the problem within this plan has been based on modern international theory and practice, which has been adopted in numerous international documents in order to establish a unified classification of cultural heritage and cultural property on a national level (UNESCO, ICOMOS, and the Council of Europe). As a full member of the United Nations, the Republic of Serbia is a part of UNESCO and actively participates in its "World Heritage" program (for which the monasteries Studenica and Old Ras with Sopocane, medieval monuments in Kosovo and Gamzigrad-Romuliana are listed from Serbia) and the "Man and Biosphere" program (according to which, Serbia's national park of "Golija" was established

as a biosphere reserve Golija-Studenica in 2009)(National Tourism Organization of Serbia, 2011). Apart from UNESCO, the spatial development of Serbia is also coordinated with the UN Development Program (UNDP), UN Habitat and EU Cross border cooperation program (IPA).

Serbia's central database of national cultural heritage consists of 2,400 physical cultural properties (2,102 cultural monuments, 72 historic places, 155 archaeological sites and 71 cultural sites), all of which are recognized by UNESCO. Moreover, according to Serbia's National Law on Cultural Heritage, 155 cultural monuments, 11 historic places, 18 archaeological sites and 16 cultural sites are identified as being monuments of exceptional national importance, and 512 cultural monuments, 28 historic places, 25 archaeological sites and 17 cultural sites as monuments of great national importance (National Agency for Cultural Heritage,2011).

On the other hand, Serbia's natural heritage (463 preserved natural areas: 5 national parks, 16 natural parks, 16 areas of significant natural beauty, 73 natural reservations and 313 natural monuments) has been also legally preserved within the Spatial Development Plan of Serbia 2020. The national preservation concept of these areas has been coordinated with the European eco network NATURA 2000, having the main goal of establishing an efficient system of monitoring and management of these identified natural heritage areas (National Agency for Cultural Heritage,2011).

Figure 3 – Protection and Sustainability of Serbian cultural heritage, based on map from: Kurtovic-Folic,Nađa.(2010). Kulturno nasleđe – neobnovljiv resurs u strategiji održivog razvoja, in Bajić Brković, M. (ed.) Kreativne strategije za održivi razvoj gradova u Srbiji. Beograd: Arhitektonski fakultet, Univerzitet u Beogradu

Throughout history, serious attempts have been made to preserve, adopt and reuse cultural heritage according to current social, economic and spatial factors, as well as important cultural and practical reasons. As the Spatial Development Plan of Serbia 2020 aims to encompass these interests, it defines the term "cultural area" as a unity of people, their community, culture, traditions, customs and immediate natural and built surroundings (Ministry of Environment, Mining and Spatial Planning et al.,2011). Therein, these values of cultural areas are to be fostered by maintaining environmental values of the venue, where such cultural heritage is located, i.e. the cultural landscape is to be included in all attributes of sustainable use of land and preservation of biodiversity. In accordance with this goal,

natural and cultural heritage is to be treated as a product with various purposes as one in the same. In this sense, this may be reached if Serbia's heritage is approached as a developing resource, which is not only to be protected, but also connected and interwoven into current development processes in Serbian society. With this as a given, contemporary cultural heritage preservation corresponds to the omniscient management of cultural heritage potential and constant conciliation between preservation doctrine and inevitable changes. In terms of international practices, this approach is called "culturally sustainable economic preservation and revitalization of cultural and natural heritage"(Kurtović Folić, 2011).

Sustainable development promotes new ways of intervening in cultural heritage areas, in order for them to be applied to current needs and also to be kept for future generations as to provide them with inherited social and cultural values and fortify their national identity. Hence, the main concept of preservation, adaptation and reuse of cultural heritage is defined as flexible but regulated and stable, liberal, democratic, efficient and pragmatic (Ministry of Environment, Mining and Spatial Planning et al.,2011). Its general aim is to incorporate its principles into national policies in order to prevent the exhaustion of natural resources and to foster their revitalization.

Seen from this standpoint, the Spatial Development plan of Serbia and its implementation policies have been adapted to the chief principles of sustainable development in Europe, outlined in the European Spatial Development Perspective (Potsdam 1999) , The Hannover Principles - Design for Sustainability (2000), and The Council of Europe Conference of Ministers Responsible for Spatial Planning – CEMAT (2000, 2003). The principle issues highlighted in these directives not merely create the proper legal framework, but also install a sustainable model of integral and strategic policy of spatial planning.

4. Strategies for Energy Production in Serbia

New strategies concerning energy resources in Serbia aim to resolve conflicts caused by hitherto irresponsible development and non-integrative planning models. A possible solution lies in sustainable and renewable energy resources, which makes local users independent from regional and national energy systems and establishes a foundation of decentralized energy system on a national level for further development (Marković et al., 2009).

In view of this, one of the most important priorities of the Serbian National Strategy for Energy System Development 2015 (adopted in 2005), is the greater usage of renewable energy resources and the implementation of new, energy efficient and clean technologies, facilities and installations in the Serbian energy sector. According to the Spatial Plan of Serbia 2020, the most significant operating goals in the sustainable energy sector include:

- Regional and local projects, plans and implementation strategies for the use of renewable energy resources are to be fully adjusted to EU regulations and implementation models.

  As a prospective candidate for the EU membership, Serbia strives to adopt the EU policies and the directive measures and recommendations. For example, in accordance with Directive 2001/77/EC of the European Parliament and of the Council of Europe, 12 % of gross national energy consumption was to be generated from renewable resources in overall national electricity consumption by 2010, which some EU member countries were not able to succeed in doing. Simultaneously, the European Parliament authorized a package of regulations concerning climate change in order to reduce the emission of greenhouse gases by 20% , to increase energy efficiency by 20% and the use of renewable energy resources by 20% in total energy consumption by the year 2020, compared to levels and usage in 1990(2009/28/EC)

- to create a favorable environment for the usage of renewable energy resources, which includes clearly defined spatial and ecological criteria and legal framework

(necessary changes in tax policy, simplification of administrative procedures, stipulation of administrative and tax advantages and free market policy for the promotion of renewable energy resource development)

- to increase the production of electrical energy generated from renewable resources by 7.4% by the year 2012 (in relation to 2007); i.e. an increase to 19% by 2020.

Divided into its types, the production of electricity from renewable resources in Serbia is shown in Figure 4.

The set of capacities envisioned by Serbia's Spatial Plan until 2012 is to build at least 45MWe of small hydroelectric power stations, 45MWe of wind power plants, 5MWe of solar photo voltage plants, 2MWe biomass plants and 5MWe biogas plants (Ministry of Environment, Mining and Spatial Planning et al.,2011).

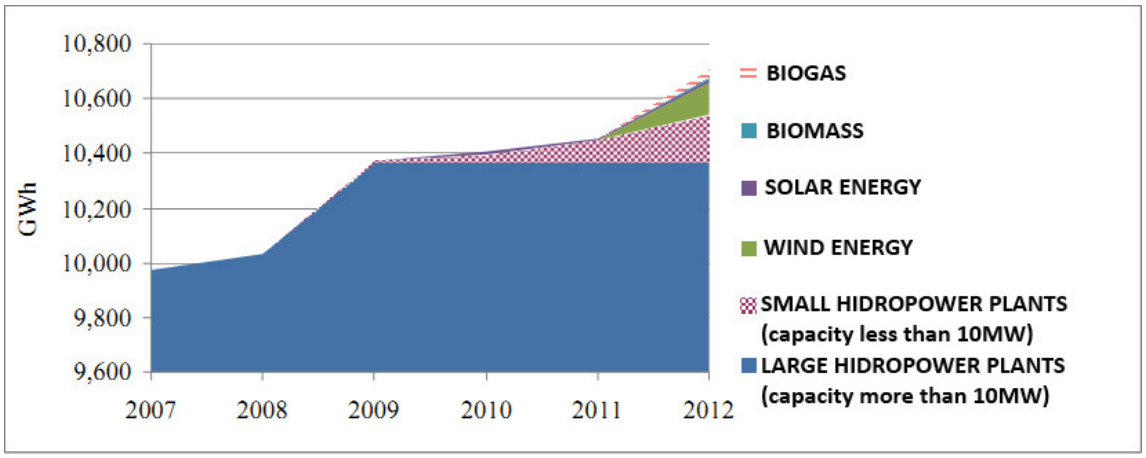

Figure 4 – Production of electricity by different sustainable resources, Source: Ministry of Infrastructure and Energy, 2007, 2009. Program ostvarivanja stategije razvoja energetike Srbije od 2007. do 2012. godine (Implementation Program for Strategy of Energy Development by 2015). Belgrade: Službeni Glasnik Republike Srbije.

It is considered that small hydropower plants are the one with generating capacity of up to 10 megawatts (MW). There are 856 locations in Serbia for such plants and many new locations could be transformed for their use if there are local initiatives for such projects. The natural potential of small waterways - which are the most favorable locations for these types of power stations - is about 3% of Serbia's total potential for renewable energy). However, if the potential for small scale hydroelectric power stations in Serbia were to be used in full, it would even be possible to produce about 4.7% of Serbian energy supplies (34,400 GWh was produced in 2006); about 15% of Serbia's present electric production comes from hydropower plants (10,900 GWh per year).

Under the motto "Small is beautiful", there are certain worldwide trends for the construction of small scale hydroelectric power stations, which are capable of completely meeting local needs. It is possible to have these small scale systems work independently of large scale electrical systems; but, if necessary, they can still be connected to larger power grids. These power stations have the potential to boost economic development of local communities; since their construction is based on simple technology solutions, they are suitable for supplying energy in isolated and scattered communities in mountainous regions, they support agricultural development, water security, tourism and other local activities. They work reliably, do not disturb local habits, traditions and the natural environment. Additionally, they are of great importance for the integration of cultural heritage, as they are able to be built in the proximity of cultural heritage sites and maintain their historical and esthetic values (Pucar et al., 2009).

Further on in this paper two positive examples of small scale hydropower systems in Serbia shall be presented and elaborated.

5. Reconciliation of Energy Production and Cultural Heritage Protection

5.1. Studenica Monastery

Studenica is a Serbian medieval monastery which has been established as a cultural heritage site of exceptional national importance and has been inscribed on the " List of World Heritage Sites" by UNESCO. It is located in central Serbia, on the slopes of the Golija and Cemerna mountains, near the Ibar river and a high trafficked road which connects the north and south of Serbia. The monastery dates from and the Middle Ages; its complex is situated in completely natural surroundings of densely forested highland terrain and encircled by a rapid mountain river of the same name. Its position was chosen for strategic reasons to be in a high inaccessible location, far from any human settlement.

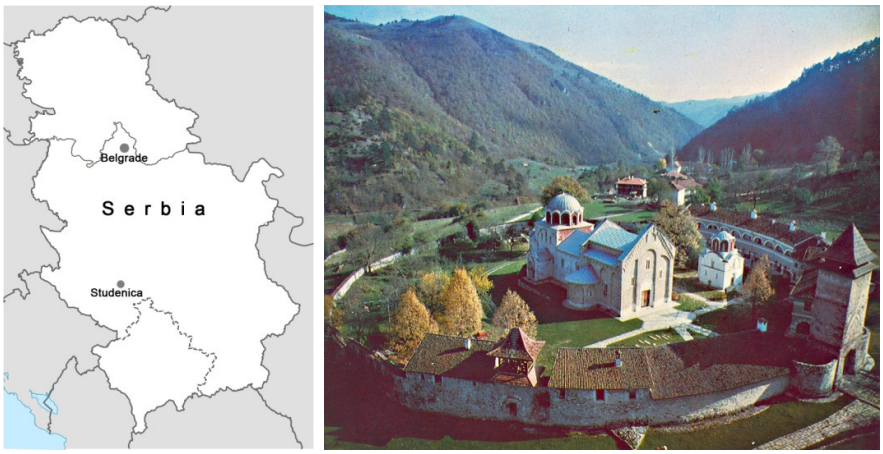

Figure 5 – The Studenica Monastery, Source: Šakota, M.,1990.Manastir Studenica.Beograd: Republički zavod za zaštitu spomenika kulture, Beograd

The monastery was built in the 12th century by Stefan Nemanja, founder of the Serbian medieval state. It occupied the central position in Serbian state of that time and became a cultural, political, spiritual and medical center of medieval Serbia under the leadership of Stefan Nemanja's son Sava. The architecture of the monastery reconciles two styles, the Romanesque and the Byzantine. Churches have been continuously added inside the monastery complex, but only three of them (The Virgin's Church, the Church of Saints Joachim and Anna and the Church of St. Nicholas) have survived to the present day.

The Studenica Monastery is part of the biosphere reserve Golija-Studenica, the first natural resort in Serbia protected by MAB UNESCO and a first category natural park, according to Serbia's Law on Serbian Cultural Heritage. The monastery is the most significant part of the reserve, due to its cultural value, and its connection to its surroundings, where an image of medieval natural and cultural environment is still preserved (National Agency for Spatial Planning, 2011).

In addition, the monastery complex is used during the summer, as a venue for numerous artistic activities (music, paintings, theatre…). In view of all this and according to the spatial plan of Golija, the Studenica Monastery represents a pivotal center of in the area's regional development.

5.1.1. Small Hydroelectric Power Station on the Studenica River

The small hydroelectric power station on the Studenica River is built in the immediate surroundings of the Studenica Monastery and supports all electrical needs inside the monastery complex. The project was initiated by monastery authorities in cooperation with the Norwegian government. It may be of interest to note that this initiative originated from a traditional community.

This hydroelectric power station is situated on the river, on the grounds of the monastery. The Studenica River originates from an altitude of 1,615 m of the Golija Mountain. This river is renowned for its extremely crystal-clear, cold, non polluted water, which is rich in oxygen and fish species, such as trout and grayling.

This hydroelectric power station is actually a reconstruction of an older one which had been built in the middle of the previous century and had been in working condition for a short time. According to this first project, which was created in 1927, a bigger hydroelectric power station had originally been planned, but was not ever built. Another project was to incorporate a water supply and hydroelectric power station; it started in 1984, but also has never been finished. Later in 2004, documentation for a new project was made: the construction started in 2007 and was finished in April 2011. Facilities from the old hydropower station (remains of the old dam, ground canal, power house, and the outtake and intake penstock), though all in a bad state and mostly non-functional, been re-used for the new power plant (Jaroslav Černi Institute for the Development of Water Resources, 2004a).

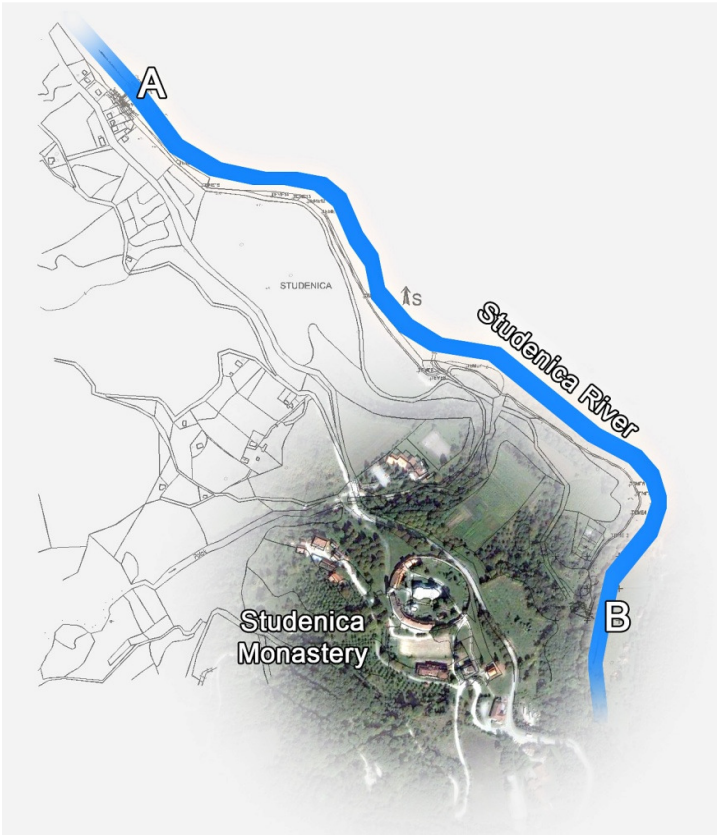

Figure 6 – The Studenica Monastery site, own interpretation, based on images from Google Earth and Jaroslav Černi Institute for the Development of Water Resources, 2006. Main Design of Small Scale Hydropower Plant "MHE Studenica" Reconstruction. Beograd

Bearing in mind that Studenica is on the World Heritage List, protected by UNESCO and Serbia's National Law on Cultural Heritage and is situated inside biosphere reserve Golija-Studenica, the construction of the hydroelectric power station on this site has to obey a certain set of regulations; namely, selective and confined usage of natural resources and controlled small scale construction and operations.

Due to the strict restrictions and specification of the construction site, the National Agency for Cultural Heritage Protection and Natural Agency for Environmental Protection participated in the planning procedure of this hydroelectric power station and established the key requirement for the construction:

- Environmental and contextual values, i.e. the usage of local materials, the traditional architectural style which corresponds to the style of the complex as a whole, the integration of old and new buildings, especially in regard to the underground infrastructural elements, were to be preserved.
- The penstock was to be completely buried underground in order not to undermine the natural surroundings. The construction was not to reduce the stability of the slope and the surface layer of soil above the construction was to be planted.
- The construction process had to be constantly monitored by archeologists, materials were not to be prepared on the site and the preparation of concrete and maintenance of machinery were strictly forbidden.
- The underwater ecosystem in the Studenica River is to be preserved at all times.
- During the plant's construction and afterwards, it has been obligatory to provide the sufficient amount of water flow required by official regulations.
- All the buildings and technical installations were to be built underground if allowed for, and aboveground constructions were to have a ground cover with grass and appropriate vegetation.
- Trees were not to be felled, the terrain morphology was to be protected and preserved, and any kind of vegetation elimination was not allowed.
- This hydroelectric power station is an independent system for electricity production and can provide parallel, insular production process independent from the electricity distribution system.

The Studenica hydropower plant is one unit headrace type with capacity of 95KW and expected annually output of about 600 MWh/yr. The length of the headrace tunnel is 1278 m, and net head is 10.48m. The average water flow of the river is approximately 6.28m3/s, and installed discharge is 1m3/s (1/6 of average water flow). If the water flow falls below 2.4m3/s, the energy production process is to be suspended until the minimum, ecologically required water flow of 1.4 m3/s is reached again.

The buildings planned for construction and reconstruction are: water entrance with a deposit, spillways, fish ladder, cobbled bottom and the embankment, headrace tunnel, water chamber, intake penstock l=12m, outtake penstock l=7m, power house with the aggregate.

Important examples of construction which are sustainable and in accordance with the Studenica power plant's immediate surroundings include:

- the power house is located approximately 300m away from the monastery, completely covered in greenery and is the only structure of the hydroelectric complex which is aboveground
- a "Tyrolean type" water entrance disrupts the natural river flow as little as possible and does not dam the river completely, a sit consists of four functionally dependent parts.
- a fish stream is located on the left bank which secures the unhindered migration of fish in the river.

- the river bottom is cobbled over in order to protect the river flow from erosion; in addition, all access roads are made of gravel in order not to undermine the natural environment (Jaroslav Černi Institute for the Development of Water Resources, 2006).

This small hydroelectric power station inside the World Heritage Complex is a proper example of construction without any major disturbance to its natural surroundings: there was no deforestation and the surrounding greenery was preserved, even favored to cover areas that would otherwise be concrete or asphalted over. In order to preserve cultural, historical, architectural and esthetic values of the Golija-Studenica complex, all of these operations followed preservation framework set down by the National and International Regulations on Cultural Heritage Protection. Although the planning and construction process were done according to these regulations, the monitoring of maintenance and usage of the complex and natural ecosystem is of essential importance for the future development of the area.

5.2. Drvengrad

Drvengrad was built in 2004, when the famous Serbia film director Emir Kusturica was filming his movie “Life is a Miracle” in a near-by area. One hilltop caught his eye since it received so much sunlight (and was therefore very suitable for filming on) that he decided to build a mock village there, designed to resemble those from the Tara and Zlatibor mountains in the 19th century. This sunny location, located in the vicinity of the Zlatibor Mountain and Tara National Park, is also located in the national natural park Mokra Gora-Sargan, which falls under the protection of the Serbian National Conservation Act and represents significant cultural heritage of this region.

Figure 7 - Drvengrad, Source: http://www.panacomp.net/montenegro?mesto=timbild%20splav%20ibrom%20i%20drina

The area is a true, untouched nature preserve: most of it is protected, development has been kept low and is under strict control, no industrial plants are located in the vicinity or area proper, and there are no towns or large urban centers around it. Mokra Gora has been left in such pristine condition not only due to Serbia’s strict Conservation Act which protects it, but also due to its rather peripheral position vis-a-vis major urban areas, and severe natural and climatic conditions. Nevertheless, the area is close to a major motorway and can be accessed quite easily.

This cultural heritage site has been developing in a unique and rather informal way for more than 10 years. What is now referred as the Mokra Gora natural park, is a sole product of the enthusiasm of locals and their efforts to make their environment better and its spatial development has been taken on by craftsmen and artists. Mokra Gora is an example of organic spatial growth, which was initiated completely by local residents, with a minimal

assistance of professionals. Still, the results obtained very much resemble professional work and are in accordance with professional planning standards, although planners have stood aside with the specific role to carefully monitor the whole process, only to note whether all the standards and regulations have been met. In 2010, when the Spatial Plan for Tara Region was authorized, Drvengrad was established among Serbian national natural and cultural sites, which enabled further institutional development of its concept.

The operational beginning of this project was the reconstruction of the old railroad "Šargan 8" (Šarganska osmica), which once was a part of an older railway line from Belgrade to Sarajevo. In the 1990s, a group of local people came up with the idea of revitalizing the old railroad to put it back in operation. The idea was to create a tourist attraction which would give impetus to tourism development and to economic recovery of the area. Moreover, there is an open air museum nearby, which presents the old means of rail transport system.

The project of railroad revitalization was developed and executed quickly, and only after a couple of years, the railroad "Sargan 8" was opened to public again. This project has revived the Mokra Gora village. Soon afterwards the Drvengrad village was founded as one of the train stations on the "Sargan 8" railway. This village - Drvengrad, as its name denotes (literally translated: "Wooden city"), was built only from wood - no new materials, tools or modern machines were allowed. The wood for the construction was supplied from the area, and local carpenters and small firms - skilled in traditional building operations - were contracted for the project. Today, Drvengrad is a small town. All the buildings (lodges, the church, the library, the art gallery, the sport center, and the cinema theater) have been entirely integrated into their immediate natural surroundings.

Recently this "Drvengrad" concept has evolved in an environment friendly direction and is still growing with numerous innovative projects. New pioneer service centers have been created inside this complex: a system for recycling water, a small hydroelectric power station, a cultural center that holds an annual film festival, a center for ecology with conferences, seminars, workshops and gatherings on various topics; these sustainable projects have directed the development of even newer projects.

5.2.1. Small hydroelectric power station - Mokra Gora

Inside the natural park Mokra Gora, on the river Beli Rzav small hydroelectric power station has been planned to be constructed, which would be capable of providing the whole village of Drvengrad with electricity. This project has just started this year. The construction site is located approximately 1.3km upstream from the village Kotroman. The building of this hydroelectric power station is in an untouched part of the area and is not visible from any spot inside the village.

According to the Spatial Plan of Special Purpose Area of National Park Tara, the downstream of Beli Rzav belongs to a third category protection zone, but where small scale hydroelectric power stations are still allowed to be built. This is due to the nature protection of the Mokra Gora National Park, where 700 species of vascular flora and 60 species of fauna live. 29 of these species have been identified as rare or endangered; consequently any construction is strongly restricted and regulated by national law.

Figure 8 – The existing dam spillway, Source: Jaroslav Černi Institute for the Development of Water Resources, 2010. *Main Design of Small Scale Hydropower Plant "MHE Mokra Gora",* Beograd

This hydroelectric power station shall reuse the existing dam, which has a net head of 29.8m and the accumulation power generated reduces overall operations on the free flow of the river. The average river flow of the Beli Rzav is 0.396m3/s, while the ecologically acceptable minimum for the hydro plant is 0.061m3/s. The hydroelectric power station shall consist of an accumulating dam, water intake, a penstock 1020m long, reservoir, outtake penstock and power house. The overall hydroelectric power of the station is rated at 101 KW and is predicted to yield an annual production average of about 423000KWh.(Jaroslav Černi Institute for the Development of Water Resources, 2010).

In terms of architecture, the power station is planned to be a traditional building, corresponding to the main style of Drvengrad. It will be built from natural local materials, to the maximum possible extent technology shall allow.

The architecture of this hydroelectric power station is fully adjusted to the prevailing style of Drvengrad, namely folklore architecture which is mainly constructed in wood and stone. It is designed to be integrated into its natural surroundings in order not to undermine the environment surround it and the local identity. Therein, the structures that are to be built must follow the technical and technological regulations for hydropower stations, which denote the use of materials and modern technological solutions. In order to reach a consensus of an architectural solution for the power house (the only building of the complex), reinforced concrete is used for the construction, but the façade is wooden and has a wooden sloped roof that fully corresponds to the general traditional architecture of the Drvengrad village.

This project is still in its initial phases and much remains to be done in order it to reach the level of the Studenica project elaborated on above. In other words, the project needs to be developed further in order to:

- preserve environmental and contextual values: infrastructural elements (such as the penstock) need to be planted underground or somehow camouflaged with grass and appropriate vegetation and must not reduce the stability of aboveground construction
- constantly have archeologists monitor the construction process
- preserve the fish ecosystem in the Beli Rzav river
- protect and preserve the terrain morphology; i.e. protection of local vegetation

6. Conclusion

The examples elaborated herein show how small scale hydroelectric power stations have been integrated into cultural heritage sites and how beneficial they are for their immediate surroundings, while still allowing for local development:

- Their construction and maintenance do not endanger the environment
- They do not occupy large areas
- While in construction or operation, they do not flood and destroy villages and cultivated areas
- They are regarded as beneficial projects of small investment
- Their production is ecologically clean
- Their construction helps to revive isolated cultural heritage sites and abandoned settlements
- These small scale power plants make isolated areas energy independent and improve the quality of life in these areas
- Since these projects are made using local traditional styles and natural materials, they give additional recognition to these areas and boost their local identity
- Such an active attitude towards cultural contexts, emphasizing their regional identities as a source for sustainable tourism, may transform them into a profitable and beneficial economic resource of the local community
- These improvements in cultural heritage energy efficiency and orientation towards sustainable consumption of energy include: defining influences and problems induced by these infrastructural projects, optimization of performance, reduction and monitoring of energy consumption in a simple and profitable manner and following legal restrictions in order to implement strategic priorities.
- This type of sustainable preservation, protection and the use of cultural heritage generates dynamic change in the community and sustainability of the local economy (enabled by carrying out a range of possibilities and opportunities for future investment and the use of local natural and human resources)
- These projects promote legally regulated, locally conditioned and non-formal modes of participation in the decision making process, and permit them to influence regulations on all levels inside Serbian society

The aim of these examples is not to present a universal solution to the problem of non-sustainable energy production in Serbia; numerous possible solutions exist. The choice of an adequate renewable energy source for a specific location depends on its characteristics and natural potential.

These examples are a positive trend in the field of using renewable energy in Serbia and it shows its potential to be widely utilized. Namely, there are more projects for the construction or the reconstruction of small scale hydroelectric power stations and some of them are in the vicinity of cultural heritage sites, which are used to supply energy for such sites. Generally speaking, this case can become a positive practice among many sites in Serbia.

7. References

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