Energy tourism in Serbia: online representation of the hydro energy tourism

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Abstract: Energy tourism is an emerging type of tourism that received increasing attention in the recent period. Hydro plants were part of the energy tourism offer that has been attracting the tourist throughout the time. Thus, revealing the online representation of their textual and visual content is of considerable interest for countries that aim to enhance this specific tourism activity. Serbia has an unfavourable structure of exploited energy sources with a significant share of renewable source, in contrast to considerable hydro energy potential, both for energy creation and tourism usage. By acknowledging the current state of the tourism use of hydro plants, understanding its attraction and experience value, and future activities that could derive from it is an initial step in formulating tourism management and marketing efforts.

1 Introduction

Nowadays, tourists are driven by unique and novel experiences. Thus, 'energy regions' [1] have become a novel tourism product that has the capacity to attract the considerable interest of the contemporary tourist. Population inhabited outside energy landscapes is not fully aware of the aesthetic, educational, experiential, spatial and environmental aspects of 'energy regions' in the tourism context [2], so visitation of these regions should generate substantial interest. Energy-tourism encircles various tourist initiatives: educational trails, exhibitions, guided tours to energy camps [3]. Finally, 'energy tourism has considerable societal relevance [3], especially regarding clean energy solutions, climate change and sustainability in general.

Energy tourism can be regarded as a segment of special interest tourism [4] and/or industrial tourism segment [5]. Energy tourism „involves visits by tourists to former, retired, or regenerated sites, as well as to still operational energy sites where some facilities, services, or activities have been provided specifically for tourists' use" [6, p. 1398]. According to Frantál & Urbánková [6] energy–tourism nexus conceptualization, the following three perspectives were highlighted: energy as a driver of tourism, energy as a constraint of tourism and energy as a tourist attraction. Jiricka et al. [3] proposed two approaches towards the creation of the energy tourism product. The first one is expert-based energy-tourism, while the second relies on energy experience tourism.

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Some previous studies [7,8,9] were focused on the nexus between energy and tourism, emphasizing the relationship between tourism turnover and energy consumption. Conversely, some recent studies [3,8,10] have initiated the energy tourism discussion that nurtures the value of energy tourism attractions and their visitation's experiential dimension. Thus, the proposed study follows the attraction/experience-based trend and investigates Serbia's underinvestigated energy tourism product.

The shift within energy tourism research was also made from traditional energy sources towards exploiting renewable energies in a tourism context [11]. First attempts at examining renewable energies as a niche tourism product have been made by Jiricka et al. [3]. Frantál & Urbánková [6] study of energy tourism has acknowledged both renewable and traditional energy sources as energy tourism examples. However, hydro energy and plants as the first known electric energy source have unfortunately not received well-deserved attention. Thus, the proposed study will further examine the phenomena by depicting the value and experience embedded in a hydro-plant facility and its tourism visitation.

Previous studies [3,6] have implemented demand and supply evaluation of the specific energy tourism sites, however, there is still limited understanding of their online representation, especially in the context of the (hydro) energy tourism supply. Thus, it was interesting to systematize and analyze the current tourism offer regarding Serbia's hydro energy, especially how this offer was textually and visually presented to the potential visitors.

Thus, the paper aims to identify and analyze the online content related to hydro energy tourism attractions and accompanying experiences in Serbia. In this way, the existing Serbia hydro energy tourism offer was systemized, leading to the enhancement of its visitations in the future. The contribution of the study was both theoretical and practical. Theoretically, energy tourism as a niche topic benefits the novel approaches, while practically it raises the awareness of its existence and importance of renewable sources for achieving sustainability.

2 Materials and methods

Serbia has a long history of hydro energy use. For example, hydro plant “Pod Gradom” was the first hydro plant in Serbia and, among the first ones in Europe, initially set in motion in 1900, solely four years after launching the Niagara Falls power plant. “Pod Gradom” was built following Nikola Tesla’s patents and inventions introduced by his close friend and collaborator professor Đorđe Stanojevic. Electrification of Serbia using hydro energy continued with the following hydro-power plants, such as Vucje built in 1903, Sveta Petka in 1908, Gamzigrad in 1909, Moravica in 1911, Temac in 1940, etc.

Serbia’s current energy policy is based predominantly on traditional energy sources (see Table 1). Thus, giving proper attention to its hydro energy potential and its valorisation as a tourism resource would strengthen an initiative of restructuring the current energy policy towards renewable energy sources, with particular attention given to hydro energy.

Table 1. Electricity generated in Serbia (2018)

Coal	22,546 GWh	65.29%
Hydro	11,329 GWh	32.81%
Wind	124 GWh	0.36%
Solar	10 GWh	0.03%
Gas	399 GWh	1.15%
Biomass	120 GWh	0.35%
Total	34,525 GWh	100

A two-step content analysis approach was employed to propose a comprehensive understanding of Serbia hydro energy tourism's online representation. The first step includes

mapping a pool of sampled Serbia hydro energy tourist attractions (hydro-plants) and accompanying experiences and showing their visibility on Google. The second step encircles analysing online content of previously singled attractions and their accompanying experiences. In the first step, to identify Serbia's hydro energy tourism potential and chose the appropriate keywords for Google search, an examination of hydro energy tourism attractions (larger and smaller hydro plants) was deployed. Thus, to identify larger hydro plants names, the online energy portal was used [12], while small hydro-plants names were chosen based on the map proposed on elektroenergetika website [13]. As a final Google query, names of identified larger and smaller hydro plants were combined with the keyword "hydro plant energy tourism".

An index called "visibility ratio" [14] was calculated by dividing the number of results presented by the total number of Web pages indexed by Google containing the hydro-plant name. Only the first ten webpages retrieved through Google search based on the hydro energy tourism search were further analyzed regarding its content. The websites were analyzed to identify a direct resemblance to energy tourism, following the identified websites' content. A combined approach focus on both attractions [6] and accompanying experiences [3] was deployed.

3 Results and discussions

Initially, Serbia energy tourism and a more focused search term Serbia hydro plant energy tourism were examined within the Google trends search (both globally and on a national level), however, it has not generated enough data to implement analytics. Thus, a manual search was implemented in line with the methodology proposed by Xiang et al. [14].

Overall, 45,735,430 Web pages are related to 36 hydro-plants (11 large and 25 smaller) as hydro energy tourist attractions. However, only a very small fraction of indexed Web pages are shown as search results (mean=696 Web pages) accessible to a user (490.163), resulting in an overall visibility ratio of 0.010%. Considering that most engine users only view the first search result page, the actual visibility ratio is much lower. Djerdap hydro-plant, as an internationally renowned and largest hydro plant on the Danube in Europe, have a high visibility ratio of 0.113. Interestingly, some of the hydro plants that were small and not of such importance had indicated visibility ratios that are higher in comparison to Djerdap hydro plant, for example, it has been noted for Sicevo (0.705), Vucje (0.102) and Temac (0.264) small hydro plants (see Table 2).

Table 2. Google results for the Serbia hydro plants

Destination/site	Google results		
	Total Indexed	Results presented	Visibility Ratio
Large hydro-plants			
1. Djerdap	266.000	30.200	**0.113**
2. Pirot	5.680.000	28.400	0.005
3. Vrla	7.560.000	32.300	0.004
4. Bajina Basta	668.000	15.200	0.023
5. Uvac	536.000	28.700	0.053
6. Kokin Brod	157.000	3.480	0.022
7. Bistrica	7.140.000	33.000	0.005
8. Potpec	61.400	29.400	**0.479**
9. Zvornik	5.420.000	39.200	0.007
10. Ovcar Banja	78.200	863	0.011
11. Medjuvrsje	38.400	8	0.001
Total	**27.605.000**	**240.751**	**0.066**
Small hydro-plants			
12. Radaljska Banja	69.000	2.870	0.041

13. Vrelo	4.030.000	38.000	0.009
14. Pod Gradom	2.430.000	25.200	0.010
15. Turica	157.000	8	< 0.001
16. Kratovska reka	4.730	9	< 0.001
17. Seljasnica	240.000	8	< 0.001
18. Moravica	484.000	29.300	0.061
19. Raska	7.610.000	27.200	0.003
20. Sokolovacka	608.000	8	< 0.001
21. Gamzigrad	166.000	31.500	0.190
22. Jelasnica	317.000	9	< 0.001
23. Sicevo	37.700	26.600	**0.705**
24. Sveta Petka	1.610.000	13.000	0.008
24. Temac	254.000	25.900	**0.102**
25. Vucje	113.000	29.800	**0.264**
Total	**18.130.430**	**249.412**	**0.270**

Source: Author's research

Within the second phase of the research, each of the hydro tourism attraction and websites on its first search page has been individually examined regarding the online content. Based on the gathered data of large hydro plants presented in the previous table, the following conclusions should be made:

Only one sizeable hydro plant (Djerdap) (Figure 1) provide some reference to an organized tour of its facilities, however, only as a part of the tour package provided by a travel agency and not specifying details of what kind of experience they offer.

Departure to Đerdap HE plant and a tour of one of the largest HE plants in Europe [15]

Fig. 1. Djerdap (Iron Gate) hydro plant
Source: http://www.tos.org.rs/node/990

Moreover, considerable attention was also given to the artificial lakes that have been formed as a result of the existence of the investigated hydro plants (Bajina Basta, Potpec, Uvac, Bistrica, Zvornik and Kokin Brod). For example, Trip Advisor's textual content was directed to the lake-related activities and opportunity to experience them as a tour-package activity, however, limited to the lake itself, ignoring the context of the hydro plant experience:

Where there are hydro power plants, there are also lakes, and on the, of course, beaches. On the developed beach in Perućac, during the summer, five to six thousand people come every day to cool down. Next to the lake there is a hotel with bungalows, open plane, and a

restaurant. From there you have a beautiful view over the lake and the 90 meter high and 461 meter long dam. Reservations for the hotel in Perućac can be made through the agency "EPS turs" [16].

The Perucac artificial lake has been extensively visualized, however, solely one photo of the Bajina Basta hydro plant was proposed.

Finally, some interest was given to hydro plants' investments (Bistrica HP, Zvornik HP, Ovcar Banja and Medjuvrsje) (see Table 3).

Table 3. Large hydro-plants content analysis

Attraction	Website address	Textual content	Visual content (Number of images)
1. Djerdap	https://serbianadventures.com/en/adventure/view/197/djerdap-gorge-and-rajac-wine-cellars	√	/
2. Pirot	/	/	/
3. Vrla	/	/	/
4. Bajina Basta (Perucac)	https://www.tripadvisor.com/Attraction_Review-g1028708-d10365086-Reviews-Perucac_Lake Bajina_Basta_Central_Serbia.html https://www.nacionalnarevija.com/en/tekstovi/Br%2021/Osvetljavanje%20-%20Drinsko-limske%20elektrane.html	√	**1**
5. Uvac	http://www.serbia.com/visit-serbia/natural-beauties/unique-nature/uvac-a-natures-masterpiece/ https://www.republiktours.com/explore/uvac-lake/ https://balkangreenenergynews.com/eps-gets-approval-in-serbia-for-gornja-drina-hydropower-project-in-bih/	√	
6. Kokin Brod			
7. Bistrica			
8. Potpec	https://www.intellinews.com/vast-tide-of-floating-waste-threatens-balkan-hydropower-plants 199558/?source=serbia/	√	/
9. Zvornik	https://turizamrs.org/en/zvornicko-jezero/ https://renewablesnow.com/news/serbias-eps-to-complete-overhaul-of-zvornik-hpp-by-end-2019-599334/	√	/
10. Ovcar Banja	https://www.ekapija.com/en/news/188866/revitalization-of-hydroelectric-power-plants-on-the-drina-river-finally-started-first\	√	/
11.Medjuvrsje	/	/	/

Based on the gathered data of smaller hydro plants presented in table 3, the following conclusions should be made:

Most of the figures were identified within the group of smaller hydro plants. For example, the ratio between larger and smaller visual (photographic) representations of hydro plants was 1:27. The smaller hydro plants' photo content was directed to their architecture and equipment (mainly designed based on Tesla's principles in power plant operation and electricity transmission implemented in practice by Djordje Stanojevic as a close friend of Nikola Tesla).

In contrast to larger hydro plants that have been interpreted within a broader tourism context, the smaller hydro plants were generally tourism-focused and widely discussed as tourism attractions within the analyzed website content. Several of the smaller hydro plants (Pod Gradom, Sveta Petka and Vucje) were attracted the interest of ERIH (European Route of Industrial Heritage) as they act as anchor points under the patronage of ERIH (Figure 2).

Fig. 2. Hydro plant Pod Gradom (left) and Vucje (right)
Source: https://www.erih.net/i-want-to-go-there/site/pod-gradom-hydroelectric-power-plant; https://www.erih.net/i-want-to-go-there/site/vucje-hydroelectric-power-plant

Cultural route 'Tesla Ways' has included most of the smaller hydro plants (Vrelo, Turica, Pod Gradom, Moravica, Sicevo, Sveta Petka, Temac and Gamzigrad) as locations along the route. In 2019 'Tesla Ways' has become the first official cultural tour of the Council of Europe dedicated to a scientist. Involving them as a part of the route has increased their tourist potential and positioned them in the broader international context (see Table 4).

Table 4. Small hydro-plants content analysis

Attraction	Website address	Textual content	Visual content (Number of images)
12. Radaljska Banja	/	/	/
13. Vrelo	http://www.hotelitara.mod.gov.rs/en/day-trips/reka-vrelo-i-stecci-u-peruccu	√	/
14. Pod Gradom	https://www.erih.net/i-want-to-go-there/site/pod-gradom-hydroelectric-power-plant http://e2012.drustvotermicara.com/english/news/conference-excursion http://nmuzice.org.rs/locations-of-the-national-museum-uzice/hidroelectric-power-plant/?lang=en	√	**11**
15. Turica	/	/	/
16. Kratovska reka	/	/	/
17. Seljasnica	/	/	/
18. Moravica	https://ivatourism.org/en/tourist-offer/what-to-see/cultural-monuments.htm https://serbianadventures.com/en/adventure/destinations/218/Ivanjica http://tonp.rs/water/?lang=en	√	**1**
19. Raska	/	/	/
20. Sokolovacka	/	/	/
21. Gamzigrad	https://serbianadventures.com/en/adventure/view/377/nikola-tesla-s-route-industrial-heritage-of-nis-area-three-day-tour https://serbianadventures.com/en/adventure/view/130/magical-eastern-serbia-2-days http://www.istnews.com/ebanje34.htm	√	**2**
22. Jelasnica	/	/	/
23. Sicevo	/	/	/
24. Sveta Petka	http://visitniskabanja.org/en/hidroelektrana-sveta-petka/ https://www.erih.de/da-will-ich-hin/site/sveta-petka-hydroelectric-power-plant	√	4

24. Temac	https://www.masina.rs/eng/private-hydropower-plants-destroying-natural-resourses/	√	1
25. Vucje	https://www.atlasobscura.com/places/vucje-hydroelectric-plan http://kmi.vtsns.edu.rs/KMI_2020/radovi/5-KMI_Razno/KMI_razno-5.pdf https://naturetraveloffice.com/en/team-building/avantura-porecje-vucje/ https://www.erih.net/i-want-to-go-there/site/vucje-hydroelectric-power-plant	√	8

4 Conclusions

Based on the Google web pages analysis, Serbia's hydro energy tourism attraction's overall visibility is relatively low, especially since most of the identified and analysed web pages (within the analysed first ten) is not related to the keyword search. Moreover, a large number of searches was limited only to one search result page.

The textual and visual online representation of the Serbian hydro energy tourism offer was grounded on a combined expert and experience-based energy tourism approach [3]. An expert-based approach could be referred to hydro plant "Pod Gradom" visitation as a part of the social programme within the International conference on power plants. Analysis of the online content has recognized an initial effort to create hydro plant experiences, both as a 'stand-alone' offer or tour packages (especially those within the ERIH route and Tesla Ways). Unfortunately, this offer has a limited correlation with the 'traditional tourism offers', thus, additional effort should be invested in complementing artificial lake activities formed by larger hydro plants with the hydro plant experience itself. Thus, this issue deserves additional attention, especially considering future tourism management and marketing efforts.

Visual content follows abundant textual material identified within the small hydro plants' content analysis. The particular interest was given to the smaller hydro plants' architecture and technology in line with their importance of industrial heritage guardians acknowledged by ERIH and the Tesla Ways route. The majority of analyzed small hydro plants examples were driven by the value and uniqueness of its technical facilities, which are opened to the public via guided tours. Thus, the analyzed offer is predominately driven by its industrial heritage and educational purposes that derive from it. It is in line with the Kolblmüller and Bärntaler [17] argument that knowledge transfer (technological facts and benefits discussed during guided tours or seminars) was an essential element of energy-tourism. To some degree (primarily for small hydro plants), environmental education and raising environmental awareness were pointed out, which could direct awareness towards renewable energies, especially considering Serbia's energy structure and its comparison to EU countries. Unfortunately, other tourist experiences that derive from the hydro plant visitation are neglected.

Finally, looking from a perspective of the scale of the facilities, surprising results were obtained. One could expect that larger hydro plants will dominate the offer, however, except Djerdap HE, other larger hydro plants were not considered as tourist attractions per se, yet only in the context of their dams and accompanying artificial lakes and experiences that derive from it. Thus, it could be concluded that based on the current online representation, their value was recognized only as a part of broader natural scenery. Moreover, analysis of Djerdap hydro plant energy tourism web pages, regardless of its continental importance, has limited reference to tourism, especially regarding opportunities of its visitation and proposed experiences. The main reason behind that acquired findings is that these facilities are considered essential energy suppliers in public property, so their visitation is strictly forbidden as a strategic national importance resource.

The study was also faced with several limitations. Analysis of the Google search results reflect the specific point in time, and thus it is challenging to make generalizable conclusions based on these findings. The study was also faced with the limited material written in English, the issue expected for the initial phase of the energy-tourism development and its perception on a national scale. Thus, future research endeavours should be directed in evaluating the existing online offer on the Serbian language, as it will provide a more realistic insight into the investigated phenomena.

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