Hydropower Projects on Balkan Rivers

2022 Update

August 2022

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for

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Image credit

Front page: Ulog HPP construction site on Upper Neretva, Bosnia & Herzegovina
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Impressum

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Contents

1. Summary

In 2022, **3,281 hydropower plants (HPPs) are planned, 108 under construction and 1,726 are operational in the Balkans.** Small-scale hydropower plants (SHPs) make up by far the largest share: 92% of the planned projects have an installed capacity of less than 10 megawatts (MW).

Since the last update of this kind in 2020, another 246 HPPs came into operation, leaving hundreds of kilometres of rivers and streams devastated, most of them in Bosnia & Herzegovina, Serbia and the Kosovo followed by Albania and North Macedonia. The vast majority of them are small-scale dams (244).

There has been a significant increase in overall hydropower development, with numbers of operating plants significantly increasing between 2015 and 2022 (from 714 to 1.726). Looking only at SHPs (<10 MW) the increase is nearly tripled (from 590 to 1.568).

On the country level, the numbers of projects planned and currently under construction are as follows:

Slovenia:	370 planned, one under construction
Croatia:	149 planned, one under construction
Bosnia & Herzegovina:	374 planned, 35 under construction
Serbia:	803 planned, 20 under construction
Kosovo:	89 planned, 10 under construction
Montenegro:	93 planned, two under construction
North Macedonia:	180 planned, 12 under construction
Albania:	403 planned, 13 under construction
Greece (only northern part):	477 planned, 11 under construction
Bulgaria:	319 planned, three under construction
Türkiye (European part only)	24 planned, none under construction

Another key finding of this assessment: **1,689 HPPs (50%) are planned or constructed inside existing and planned protected areas**, including 227 in national parks and 592 in Natura 2000 sites (in the Balkan EU countries Greece, Bulgaria, Croatia and Slovenia). The slight increase of percentage compared with the last update can be explained by the expansion of designated ecological networks and proposed protected areas, including Emerald for the Non-EU countries and by the completion of many projects in general.

2. Introduction

Between 2010 and 2012, the first inventory of existing and projected hydropower plants (HPPs) in the Balkan region was carried out within the "Save the Blue Heart of Europe" campaign (Schwarz 2012). The data was updated in 2015 (Schwarz 2015a), including for protected areas (Schwarz 2015b), in 2017 (Schwarz 2017), in 2018 in the frame of the Eco-Masterplan for Balkan Rivers (Riverwatch & EuroNatur 2018) and in 2020, giving for the first time an overview of the development since 2012 (Schwarz 2020).

The initial inventory included only larger plants with an installed capacity of above 1 MW. However, the analysis of planned projects in protected areas indicated a particularly alarming amount of small hydropower plants (SHPs; Schwarz 2015b). Therefore, the SHP category (0.1-<1 MW) was included in the 2015 update. Since the 2020 update, the category of large-size HPPs (>50 MW) was further divided into the categories 50-<100 MW and >100 MW respectively.

The continuous update of the database allows a comparison of HPP development from 2012 to 2022.

3. Data preparation

The study area comprises the EU countries Slovenia (SI), Croatia (HR), Bulgaria (BG) and the northern Balkan area of Greece (GR), as well as the non-EU countries Bosnia & Herzegovina (BA), Serbia (RS), Montenegro (ME), Kosovo (KV), North Macedonia (MK), Albania (AL), and the European part of Türkiye (TR).

The update was carried out according to the following approach:

1. High resolution satellite data allowed for a systematic scan of all HPPs in the existing database to see if any status had to be changed from "planned" to "under construction" or from "under construction" to "operating". Over the past two years, the seamless and quick streaming of high-resolution data provided by Google Earth has facilitated a reliable comparison of changes in HPP status within the time span of 2018-2022. In addition, Sentinel II scenes were checked regularly to detect recent construction works for medium and large-scale projects (for SHPs the optical resolution is insufficient).
2. Deep data mining in form of examining lists, newspapers, planning studies, projects by investment groups, or other inventories was necessary to get an overview of currently planned HPPs or those under construction. The category "planned" comprises projects in every step of the planning stage, from feasibility and hydroelectric potential studies to approved (licensed) ones. Further, existing national NGO-HPP inventories such as for Bosnia & Herzegovina[1], Bulgaria[2],

[1] http://voda.ekoakcija.org/bs/map/sve_mhe
[2] https://dams.reki.bg/Dams/About

Albania [3] and Greece were explored, providing often much more detailed information on individual HPPs.

3. Based on the six inventories 2012, 2015, 2017, 2018, 2020 and 2022, a comparison of data was prepared.
4. In addition to the update of HPP status, the data on protected areas (PA) in non-EU countries was updated and improved. However, many protected areas in non-EU countries are still provisional and in planning stage. Protected areas are divided in the following categories: 1. National parks, 2. Ramsar sites, Biosphere reserves and World Heritage sites, 3. Natura2000 areas, 4. Nature reserves, 5. Emerald areas and protected areas proposed for the Natura2000 network, and 6. Landscape protection areas.
5. Finally, the data was provided in GIS formats and maps (as included in this report) and the interactive online map on www.balkanrivers.net was updated with the new data.

Some technical issues explaining slight differences between the single datasets from 2012-2022 must be pointed out. In regards to transboundary issues (e.g. planned HPPs on Drina and Kupa), a pragmatic approach has been applied by attributing projects only to one country, even when they are developed bilaterally. Furthermore, by applying the most recent precise border polygons, some borders have shifted slightly in the database and thus HPPs located close to borders have been attributed to the neighbouring country. Another aspect of the regular updates is a slight shift for individual HPPs in their size class (e.g. a HPP was planned in size class <1 MW but was built >1 MW or vice versa). It must also be emphasized that the completeness of small plant data (SHPs 0.1-<1 MW) is not guaranteed due to the absence of systematic national inventories as well as missing information on operation, e.g. of old mills/turbines. Finally, changes in names and the position (e.g. of dam/water abstraction points/powerhouse) as well as the merging of turbines can lead to numbers differing slightly from official lists.

Data of protected areas (PAs) in the non-EU countries has been updated for Serbia, Bosnia & Herzegovina, Albania and the Kosovo. The most recent available datasets of Natura2000, World Database on Protected Areas (WDPA) [4] and Ramsar as well as Emerald have been applied for all countries. Natura2000 is an EU protection category and thus, proposed Natura2000 networks in non-EU countries are only preliminary designations – "candidate Nature 2000 networks", in other words. Their factual protection is weak, similar to most of the Emerald areas in those countries. Furthermore, in many cases, the definition of final boundaries has often not been decided.

Problematic is the overlay of several categories (polygons) for protected areas and different types of zoning (not only for national parks), in combination with the HPP inventory. Many protected areas overlap, resulting in the same HPPs being attributed to two or more protection categories. For overall results, duplicates were eliminated, so that projects, which fall in two or more categories are only counted in the highest category (e. g. 1. National park). Of course, the data provides also total numbers for a specific category.

[3] https://www.ecoalbania.org/wp-content/uploads/2017/05/HPPs_al_final-report_me-kapak.pdf
[4] https://www.protectedplanet.net/en/thematic-areas/wdpa

4. Results

4.1 Overall distribution of HPPs, overlay with protected areas and comparison in the time span of 2012 - 2022

In the entire project region, the total number of recorded and projected HPPs increased to 5,115, whereas 1,726 HPPs are operational. In the categories >1 MW a considerable increase of existing dams can be recorded since 2012, due to the completion of 473 plants.

The number of planned projects (3,281 in total) stagnates or slightly decreases, while no further large projects have been added. Progress in planning and construction cannot be assumed for all projects recorded previously, but there is no evidence that these projects have been abandoned, even though some of the them are politically no longer in discussion. In regards to very small HPPs, it is often very difficult to verify their status (even with satellite images) and most probably some more plants have already moved from the planning to the implementation phase.

Most projected HPPs fall in the categories 0.1-<1 and 1-<10 (a total of 3,014 projects or 92%). These plants, though small or medium, cause significant damage since they extend to almost every river in the region and are unfortunately often projected on rivers with high ecological value or even within protected areas (see fig. 1).

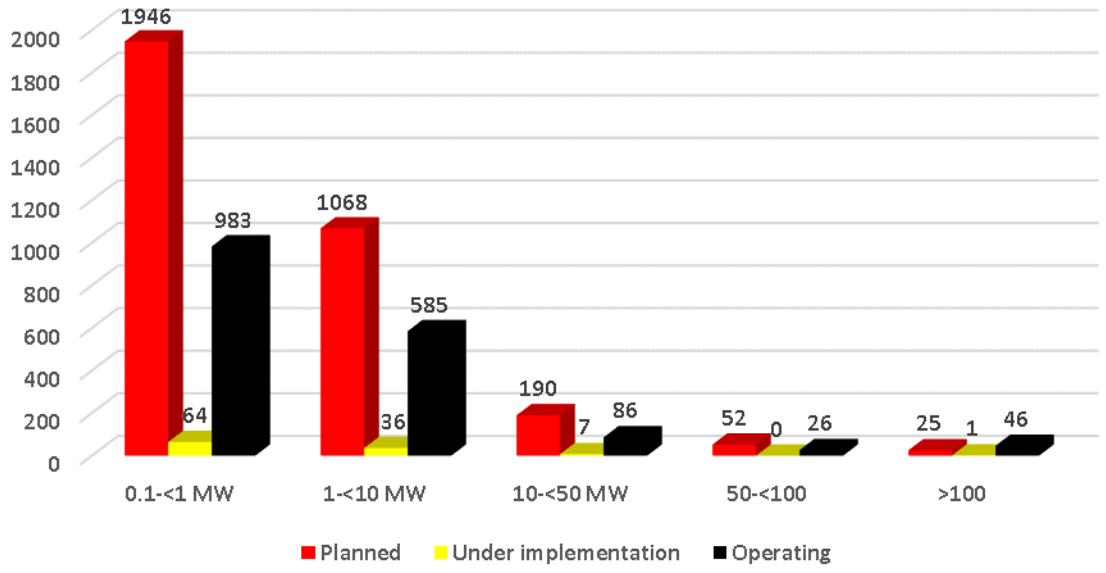

Figure 1: Total distribution of hydropower plants and size classes for the entire project area.

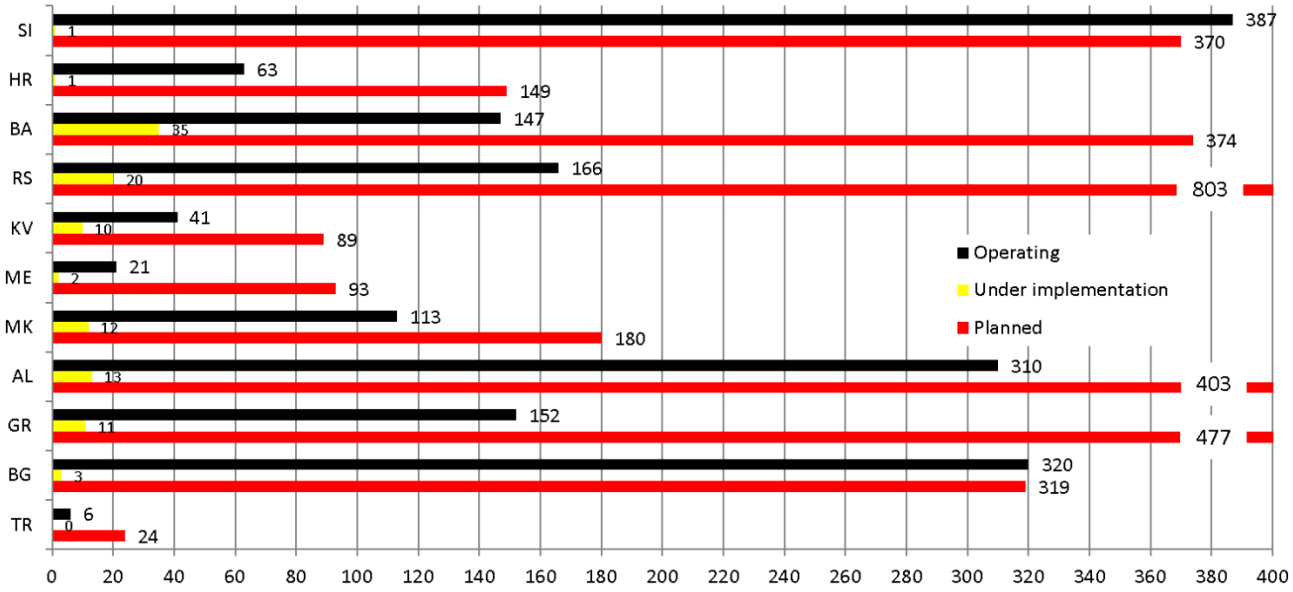

Figure 2: Country distribution of hydropower plants for the entire project area by status.

Figure 2 compares hydropower development between countries. Bosnia & Herzegovina, Serbia and Kosovo, but also Albania and North Macedonia are current hotspots of HPP construction. Slovenia being an Alpine country has the largest number of operating plants, but the increase of additional projects planned is most marked in the central Balkan region from Bosnia & Hercegovina to northwestern Greece.

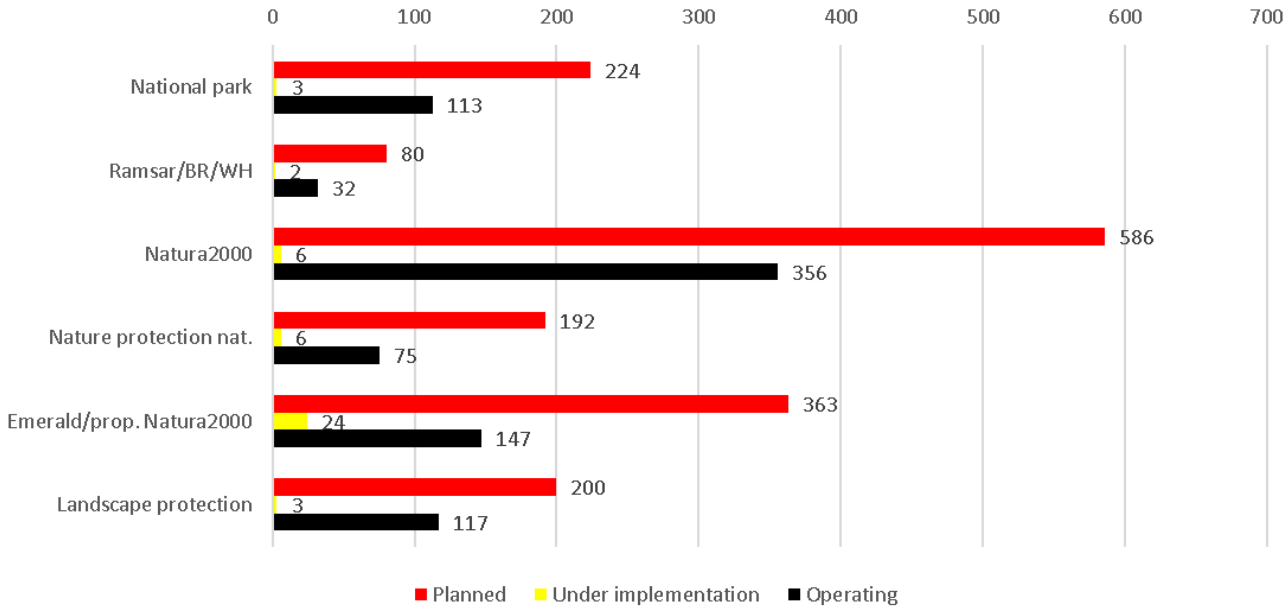

Figure 3: Overview of hydropower plants in protected areas.

The numbers of hydropower plants in protected areas remain high. Despite the provisional designation of protected areas, previously planned HPPs are now falling within protected area boundaries, as for example in Bosnia & Herzegovina, Serbia,

Albania or the Kosovo. The high number of projects under implementation in Emerald/proposed Natura2000 areas reflects this. Although the allocation and protection status and regime are very heterogeneous, nearly 50% of all hydropower plants fall in existing or planned protected areas.

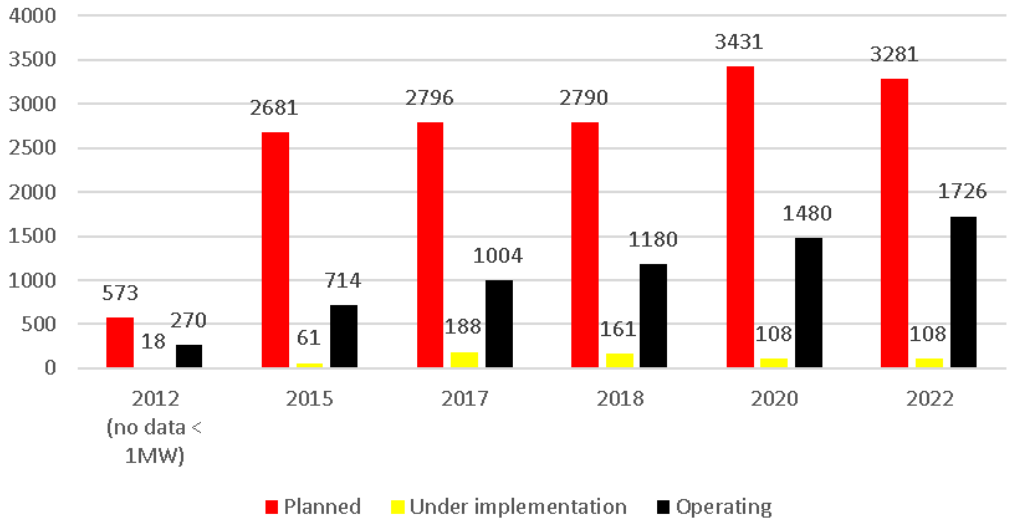

Figure 4: Overall comparison between years (2012-2022).

Figure 4 shows overall hydropower development since 2015. In 2012 no data on small hydropower was included. There has been a significant increase in hydropower development, with numbers of operating plants between 2015 and 2022. The decrease of HPPs indicated as being "under implementation" cannot be understood as a reverse trend for the booming development. Especially in the case of SHPs it is difficult to recognize construction sites on satellite imagery, and moreover this class is of high fluctuation.

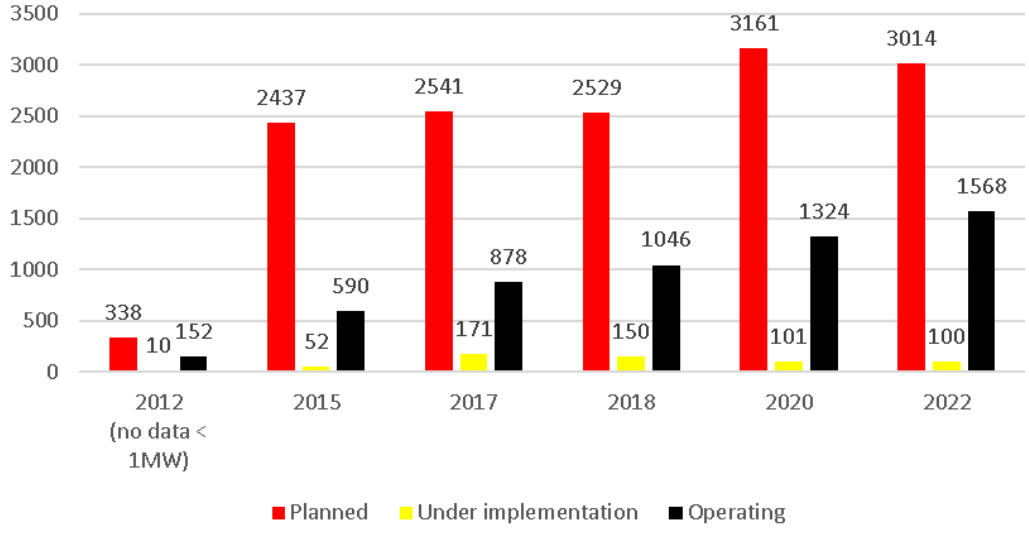

Figure 5: Overall comparison for SHPs (0.1- <10 MW) between years (2012-2022).

Figure 5 focuses on HPPs between 0.1 and 10 MW. These plants have been increasing even more, from 590 in 2015 to 1568 in 2022, and the number continues to rise. The development of small and medium-sized HPPs leads to hundreds of kilometres of abstracted rivers, and the water is conveyed through pipes partially across catchment boundaries. Nearly all rivers are affected and each year new SHPs of 1MW or just below appear, often summing up to class 1-10 MW over entire valleys or smaller catchments.

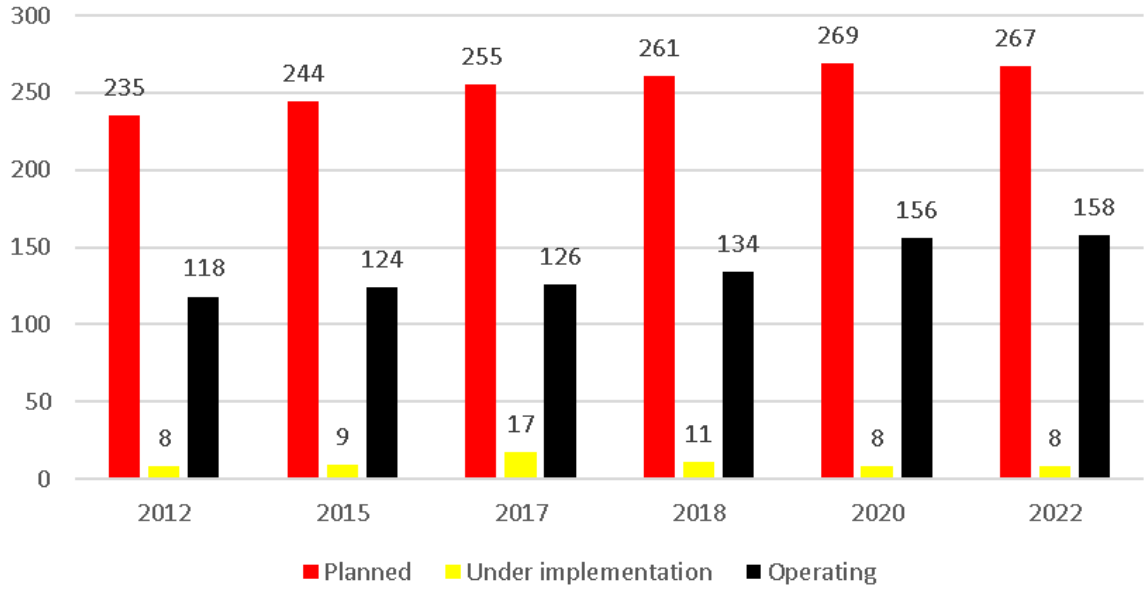

Figure 6: Overall comparison for HPPs >10 MW for 2012, 2015, 2017, 2018, 2020 and 2022.

Figure 6 summarizes the development of larger dams for the full range of time steps. The number of operating plants increases by 35% in the past ten years, from 118 in 2012 to 158 in 2022, including many medium and large river stretches in the project area. Plants on larger, water-rich rivers are still primarily planned in narrow valleys in the upper catchment, but there are also sites in the lower river courses, such as those foreseen on Bosna, Drina or Morača. Two huge dams realized in the past years are those on Sava (Brežice HPP) and on Devoll (Moglicë HPP). New “old” projects appeared also in the Greenfield lists of the EU, such as those on Morača and Lim for Montenegro and the tendering was relaunched recently.

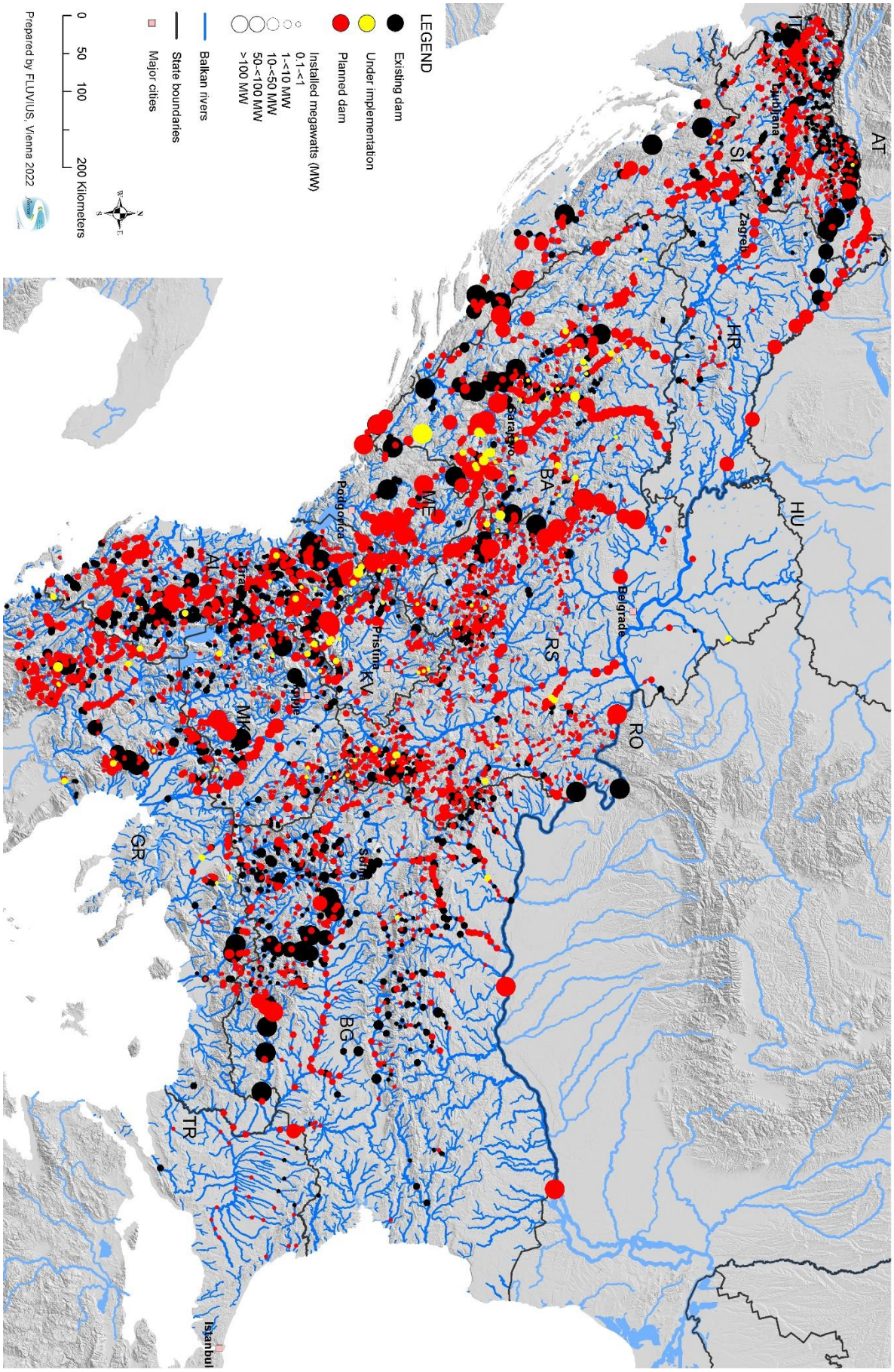

Figure 7: Overview of the distribution of HPPs in the Balkan region.

4.2 Distribution of HPPs in Slovenia

Since the completion of the large Brežice HPP on Sava no other large-scale projects such as the completion of the HPP chain on Upper Sava entered the implementation phase. Slovenia being an Alpine country has the biggest number of existing plants, the majority of which are SHPs.

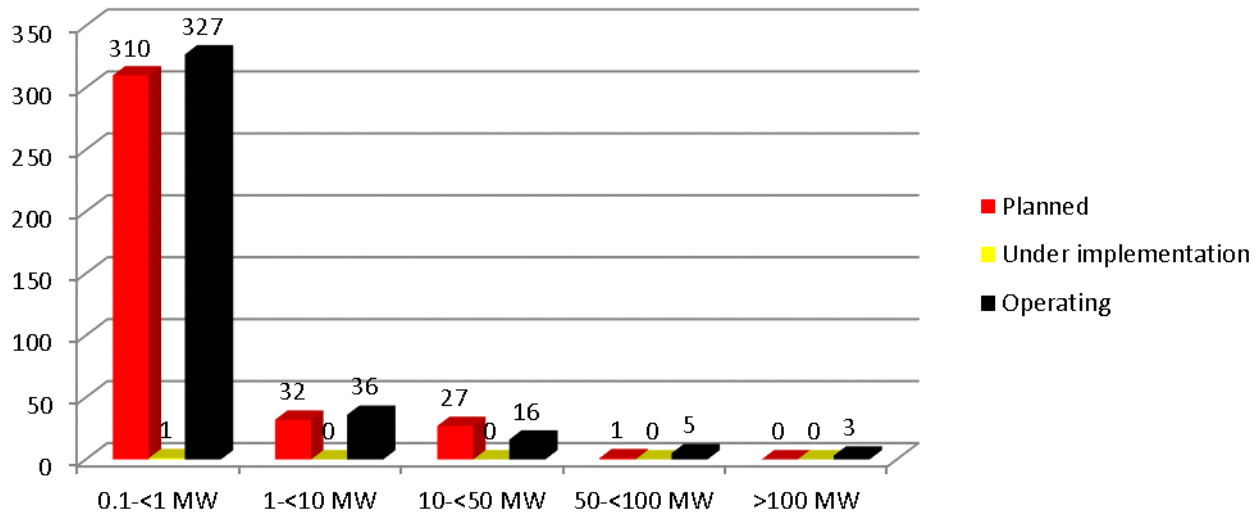

Figure 8: Distribution of HPPs in Slovenia.

Figure 9: SHP Vaska Vaz is the renovation and extension of an old mill on Krka river (GE 2022).

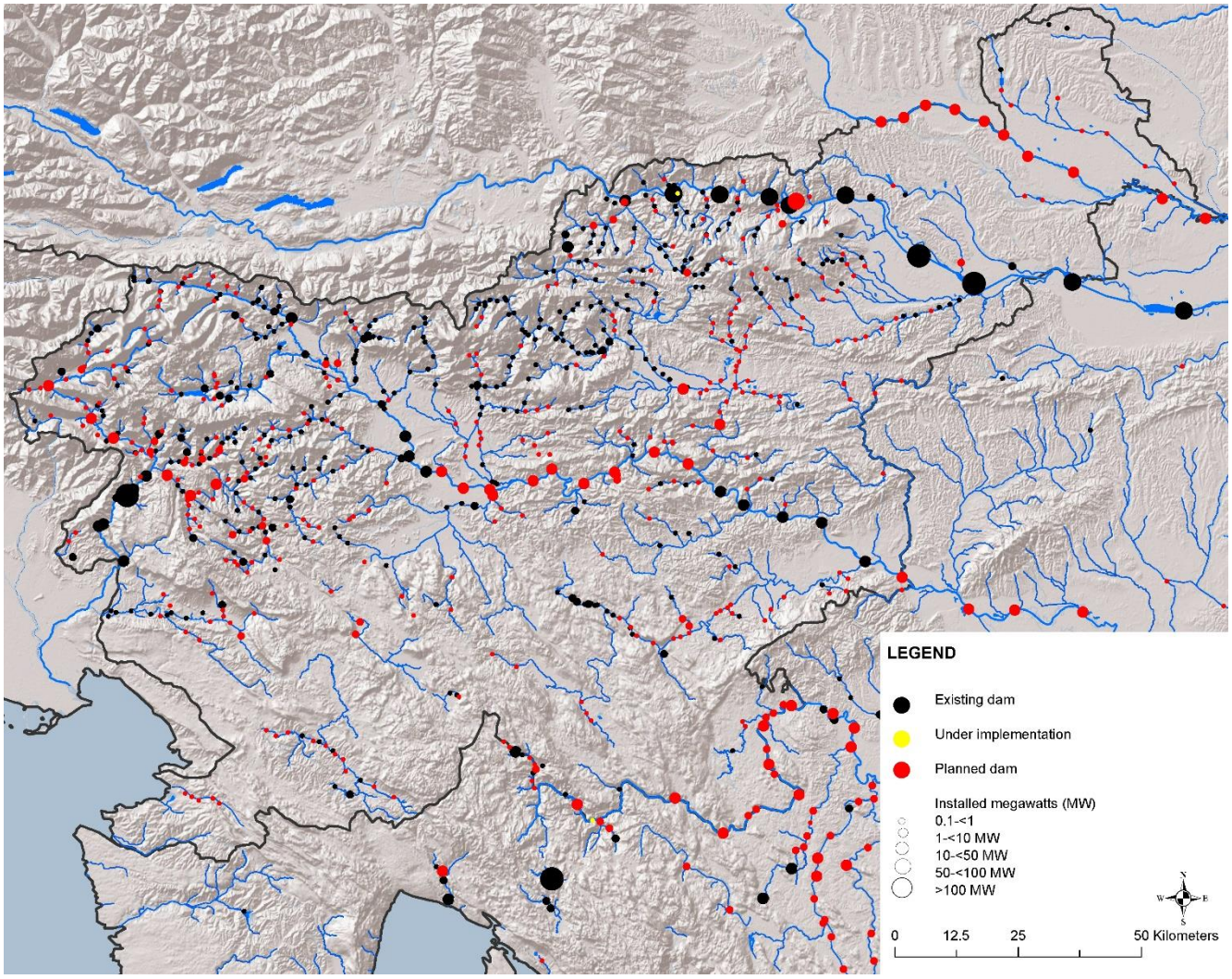

Figure 10: Distribution map of HPPs in Slovenia.

4.3 Distribution of HPPs in Croatia

Similar to Slovenia, the development of larger HPPs on Sava, Kupa and karst areas has stalled. But also for SHPs the development remains slow.

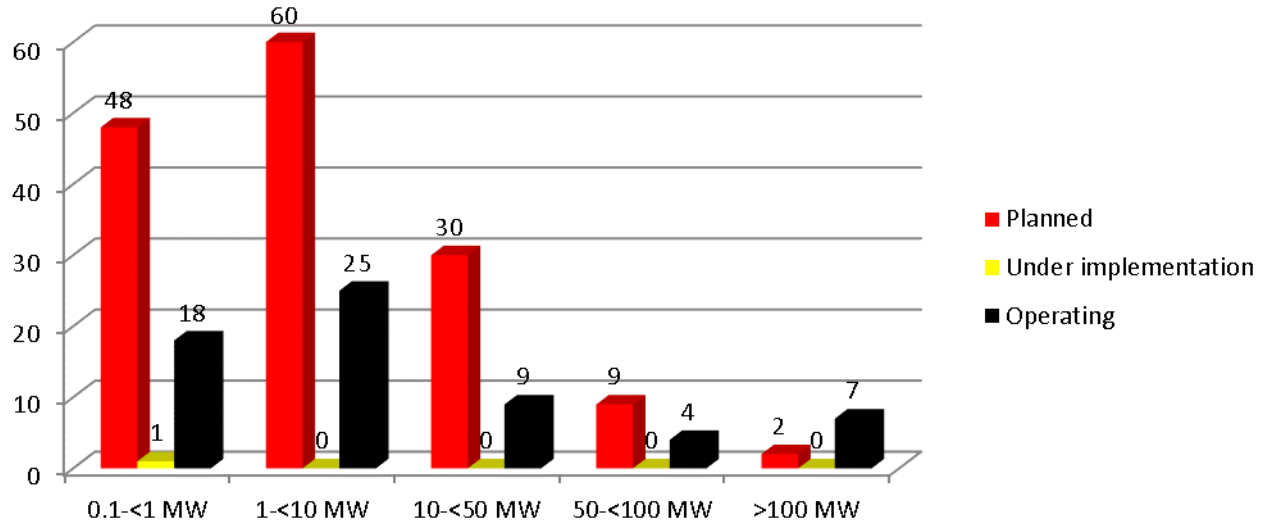

Figure 11: Distribution of HPPs in Croatia.

Figure 12: Only some minor new constructions can be registered within the last two years as the equipment of an existing ramp on Kupa near Brod na Kupi (GE 2022).

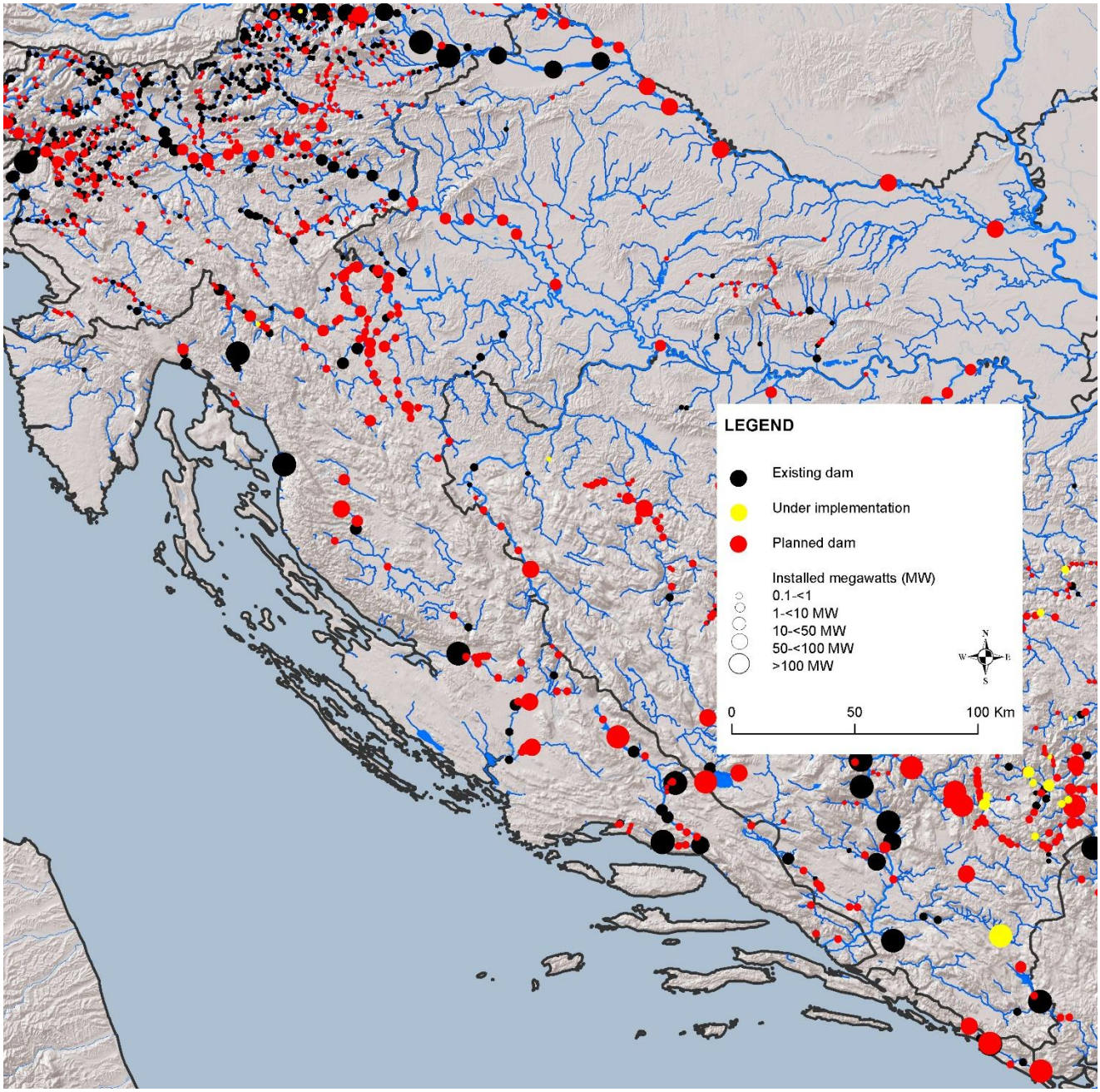

Figure 13: Distribution map of HPPs in Croatia.

4.4 Distribution of HPPs in Bosnia & Herzegovina

Bosnia & Herzegovina remains one of the hot spots for hydropower development in the Balkans. Especially the construction of smaller HPPs (0,1-<10 MW) has been booming in recent years, however the implementation speed slightly decreased. While projects in the pristine headwaters of Neretva seem to have been stopped for now, the Ulog dam construction site proceeds (compare figure 16).

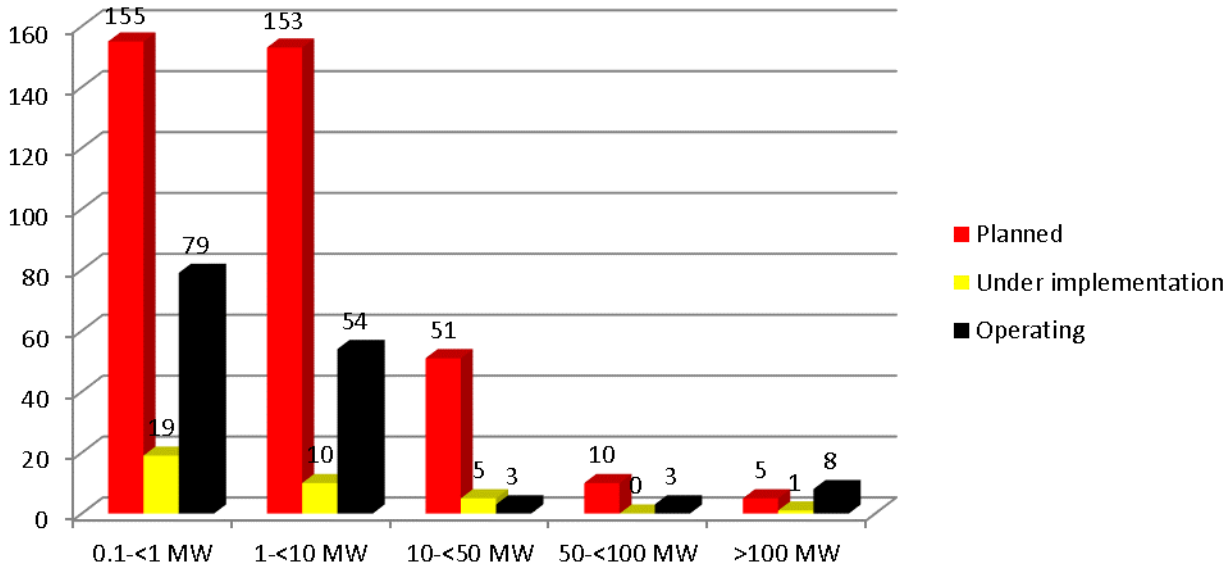

Figure 14: Distribution of HPPs in Bosnia & Herzegovina.

One of the biggest hydropower projects across the Balkans, apart from a few major dams and pumped storage plants on Drina, is the Upper Horizon[5] HPP system, which connects karst poljes of different altitude by collecting and tunnelling the flood water for energy production. Construction works for this old-fashioned and environmentally dangerous project (due to karst aquifer interruption in the underground and flood dynamic alteration in the karst poljes by abstraction, tunnelling and storage of river flow) started already around 2012 and seem to have relaunched recently (compare figure 17).

[5] https://ejatlas.org/conflict/dabar-hydro-power-plant-bosnia-and-herzegovina

Figure 15: Spreča SHP, illustrating the typical construction site for a run-of-the-river plant including the regulation and reinforcement of the impoundment stretch upstream and the erosive downstream reach (GE 2022).

Figure 16: Ulog dam construction site on Upper Neretva (© Vladimir Tadić).

Figure 17: The HPP Dabar construction site as part of the large-scale Upper Horizon project (GE 2022).

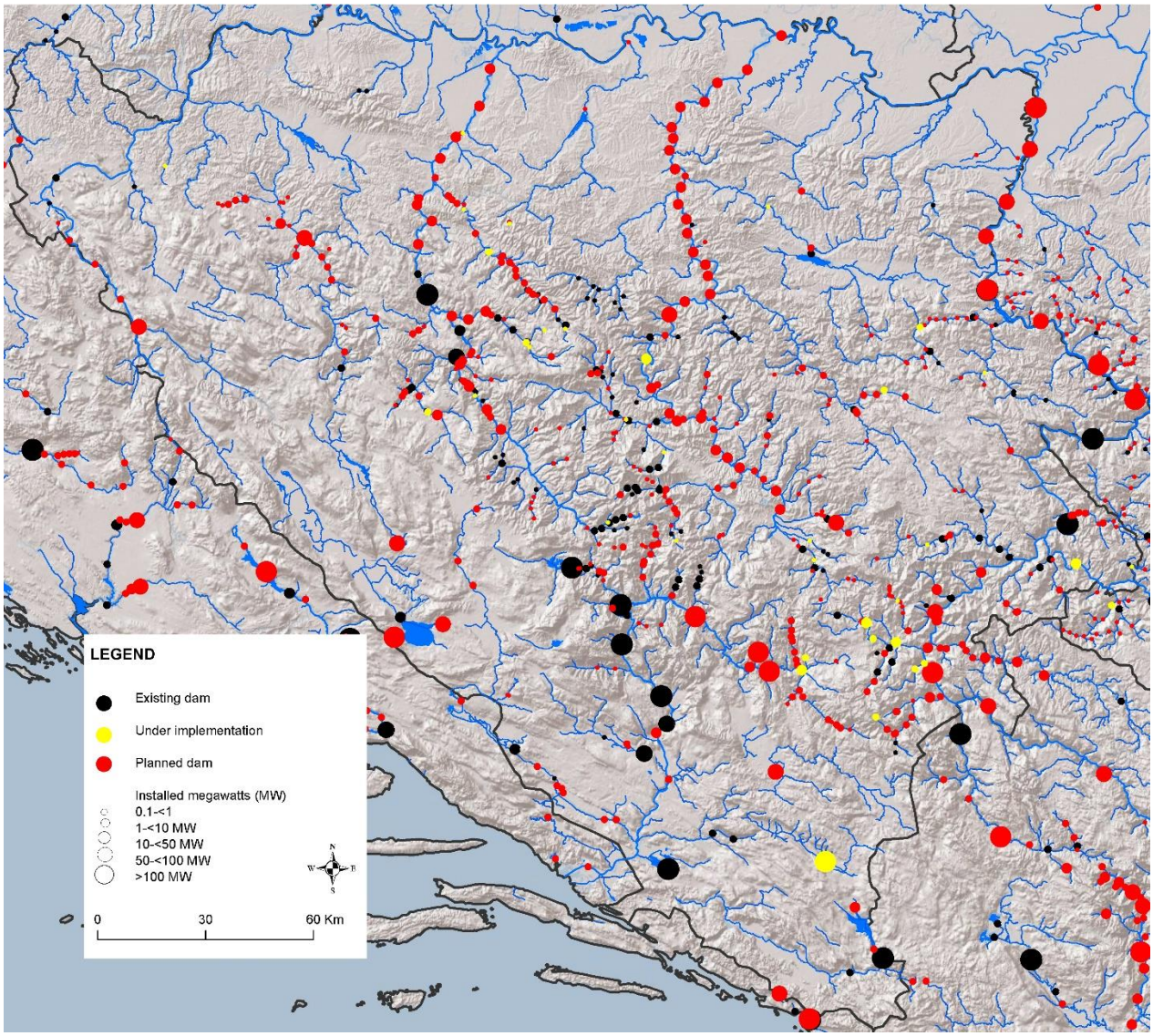

Figure 18: Distribution map of HPPs in Bosnia & Herzegovina.

4.5 Distribution of HPPs in Serbia

Similar to Bosnia & Herzegovina, Serbia is subject to extensive SHP development, mainly in the mountainous southern districts. The number of SHPs nearly doubled over the past two years. The development of large-scale projects, e.g. on Drina or Morava with its major tributaries is very slow.

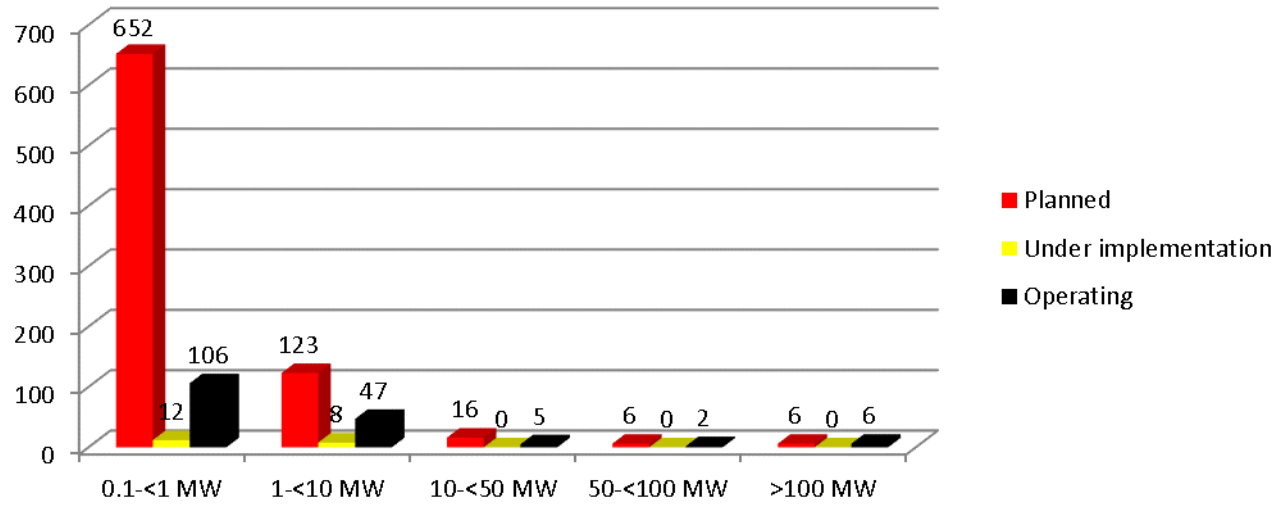

Figure 19: Distribution of HPPs in Serbia (the chart is rather distorted due to the extraordinarily high number of planned SHPs).

Figure 20: Korbevačka valley: Here, as so often, river by river will be turned into nearly dry residual stretches, beginning at the lower course and taking water from the middle and upper reaches (GE 2022).

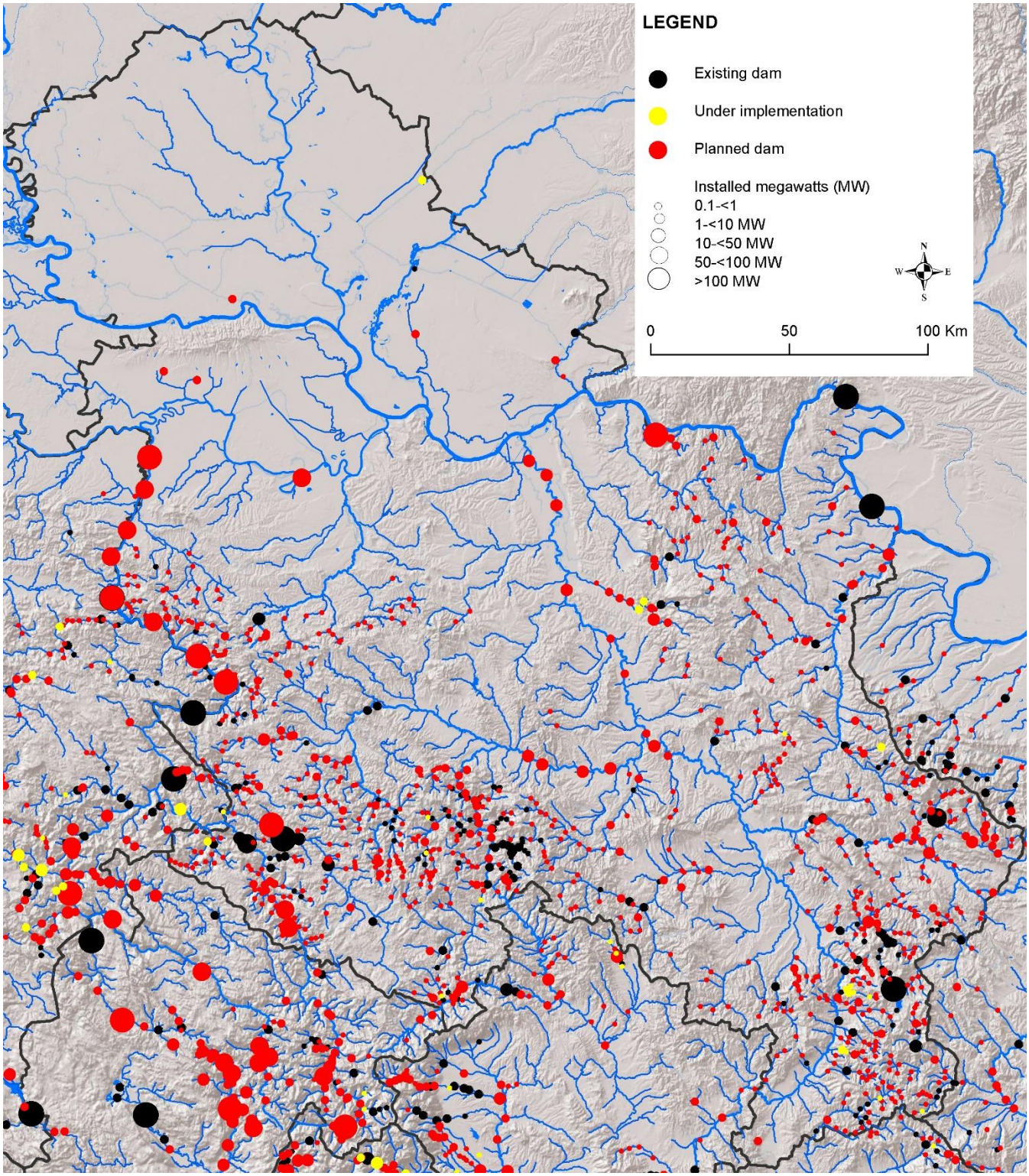

Figure 21: Distribution map of HPPs in Serbia.

4.6 Distribution of HPPs in Kosovo

The development increases but remains unclear for several sites. Aside of the excessive and uncoordinated sediment extraction from the river channels, several river regulation works (ramps and groynes) have been established in recent years. On the other hand, some already constructed HPPs had to be temporarily shut down due to licensing issues.

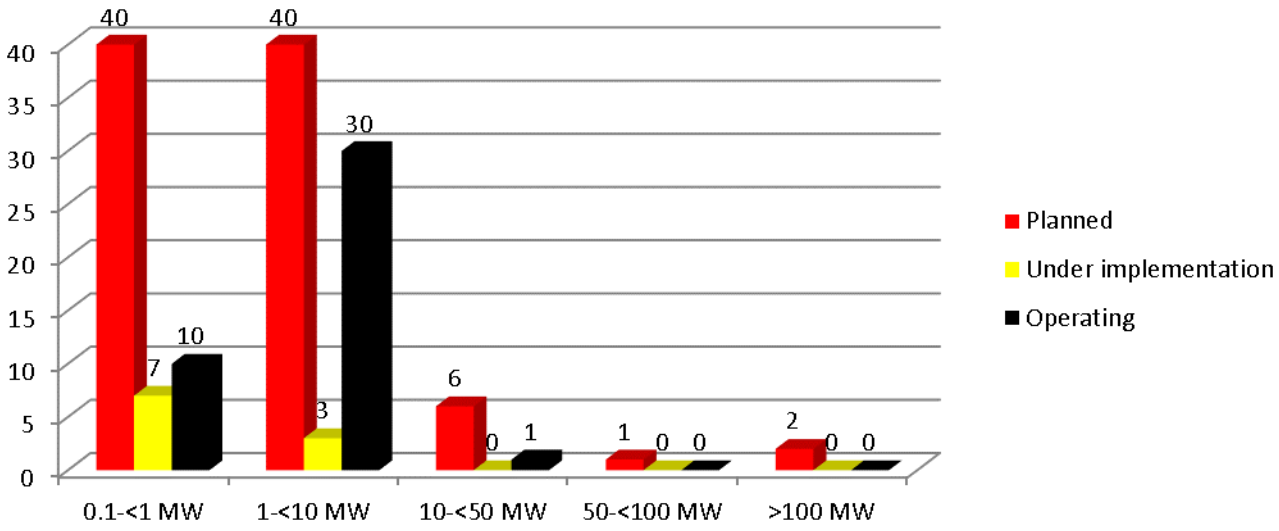

Figure 22: Distribution of HPPs in Kosovo.

Figure 23: Aside of several SHPs under construction also several construction works can be observed along bigger rivers, as such on the White Drin, near Ozdrim. It is not obviously clear for all cases if those "ramps" will be further be used to produce energy, but in any way, they are obstacles for migratory species (GE 2022).

Figure 24: The further construction of the Lepenci cascade impact the entire reach within the Sar planina Nature park (GE 2022).

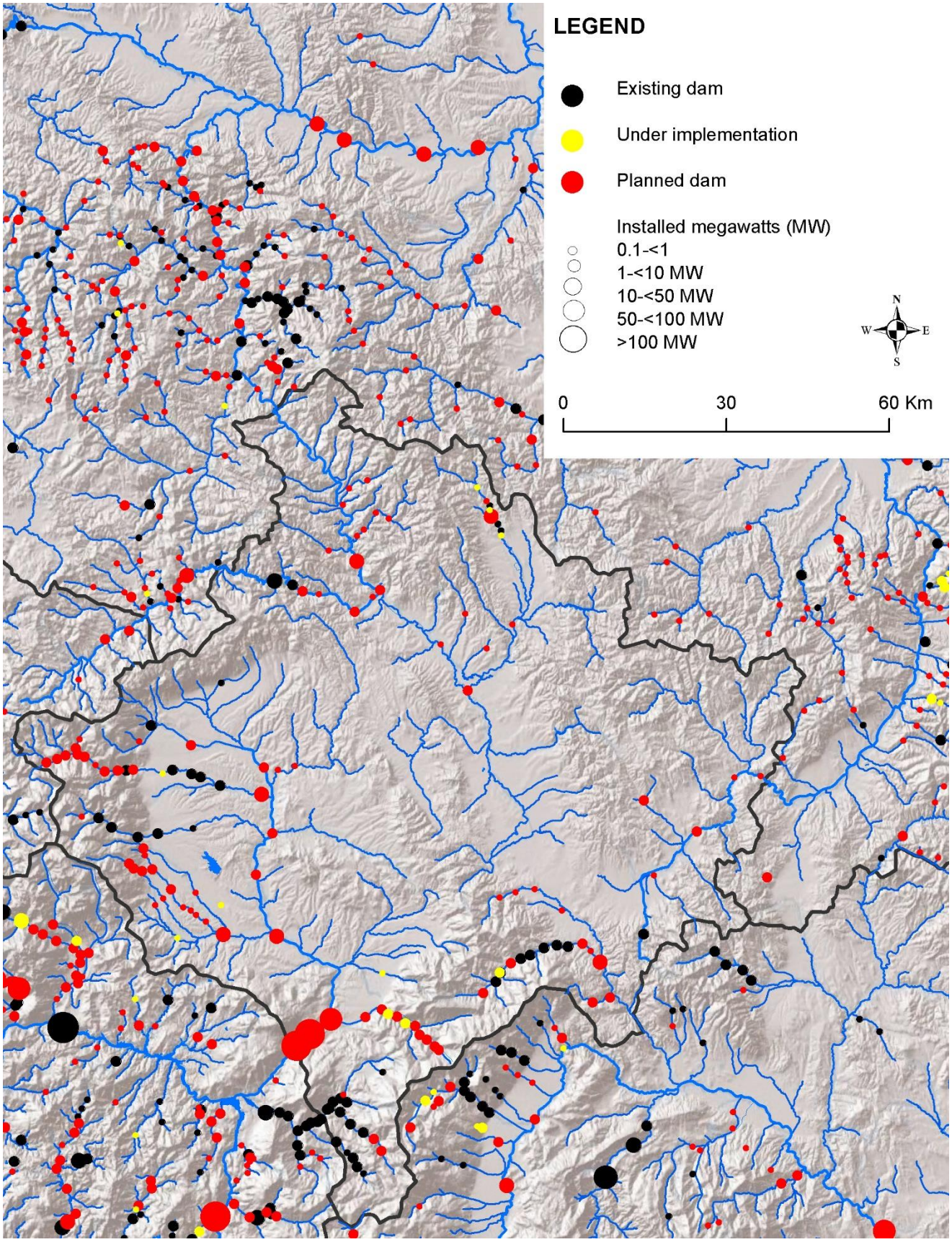

Figure 25: Distribution map of HPPs in Kosovo.

4.7 Distribution of HPPs in Montenegro

No new construction sites for HPPs can be found in Montenegro, but some existing sites with unclear status remain in the "construction" class. However, new efforts to tender again the major Morača dams could be observed in recent years.

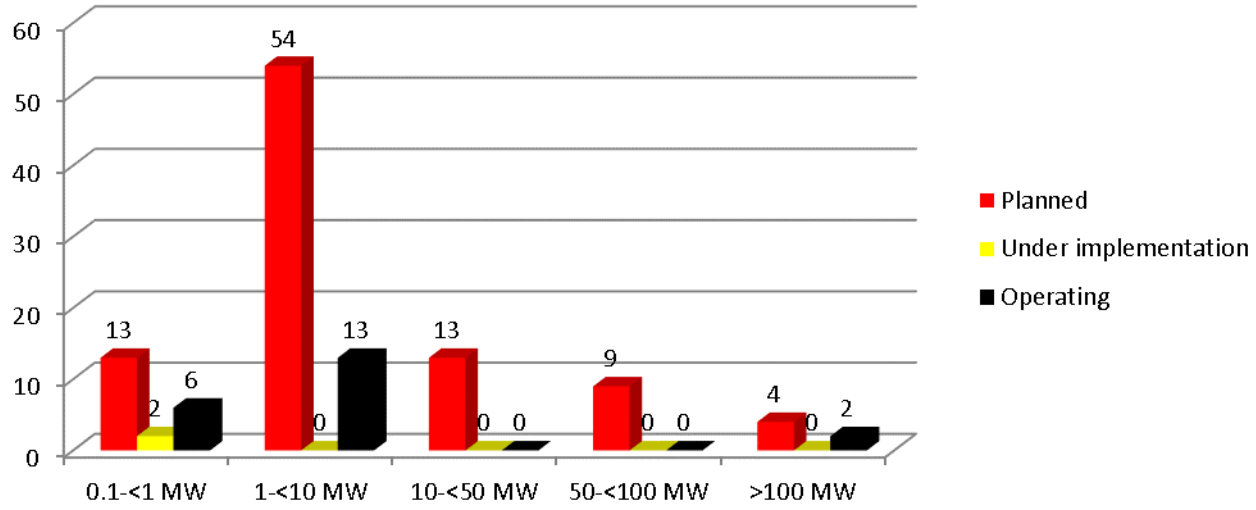

Figure 26: Distribution of HPPs in Montenegro.

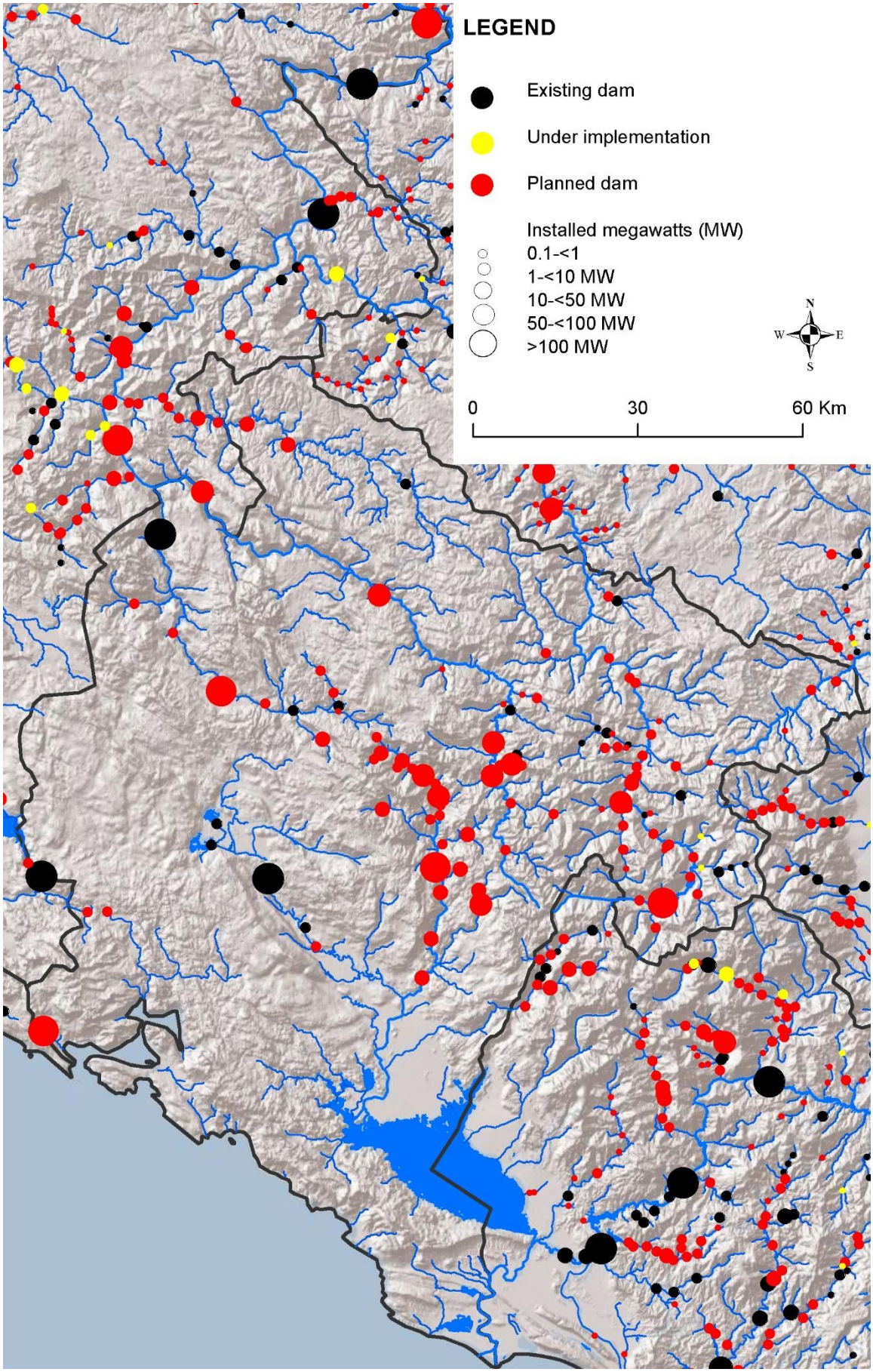

Figure 27: Distribution map of HPPs in Montenegro.

4.8 Distribution of HPPs in North Macedonia

The development of SHPs in North Macedonia is slow but steady and numerous projects already exist. In particular, the Upper Vardar basin is affected by HPP construction and recently the first HPP on Vardar main river has been completed (figure 29).

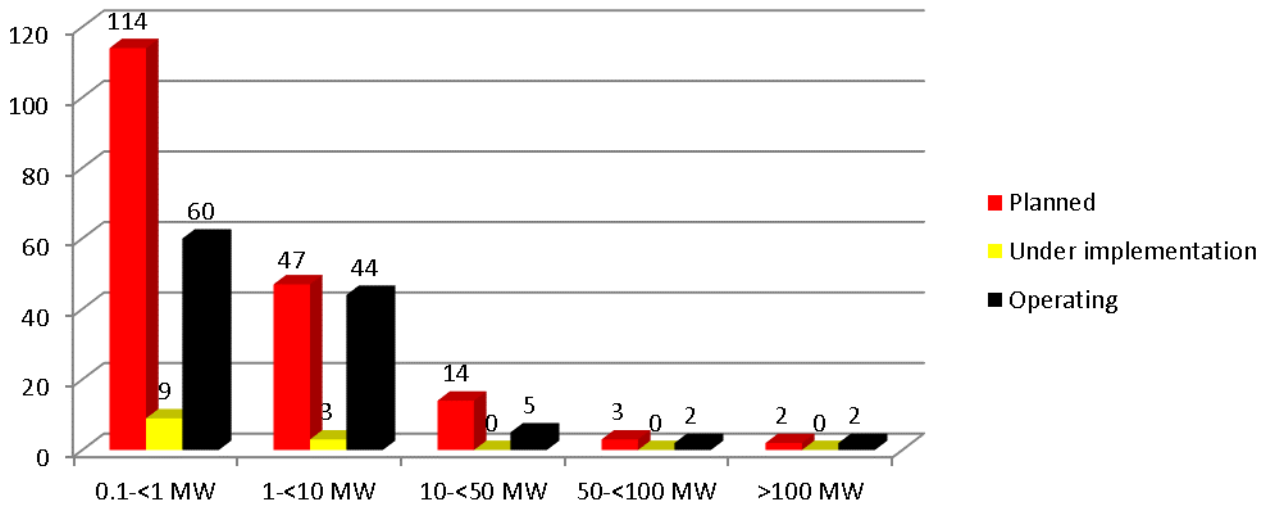

Figure 28: Distribution of HPPs in North Macedonia.

Figure 29: Gradište on Upper Vardar, cutting off the Polog plain, a huge lowland around Tetovo (GE 2022).

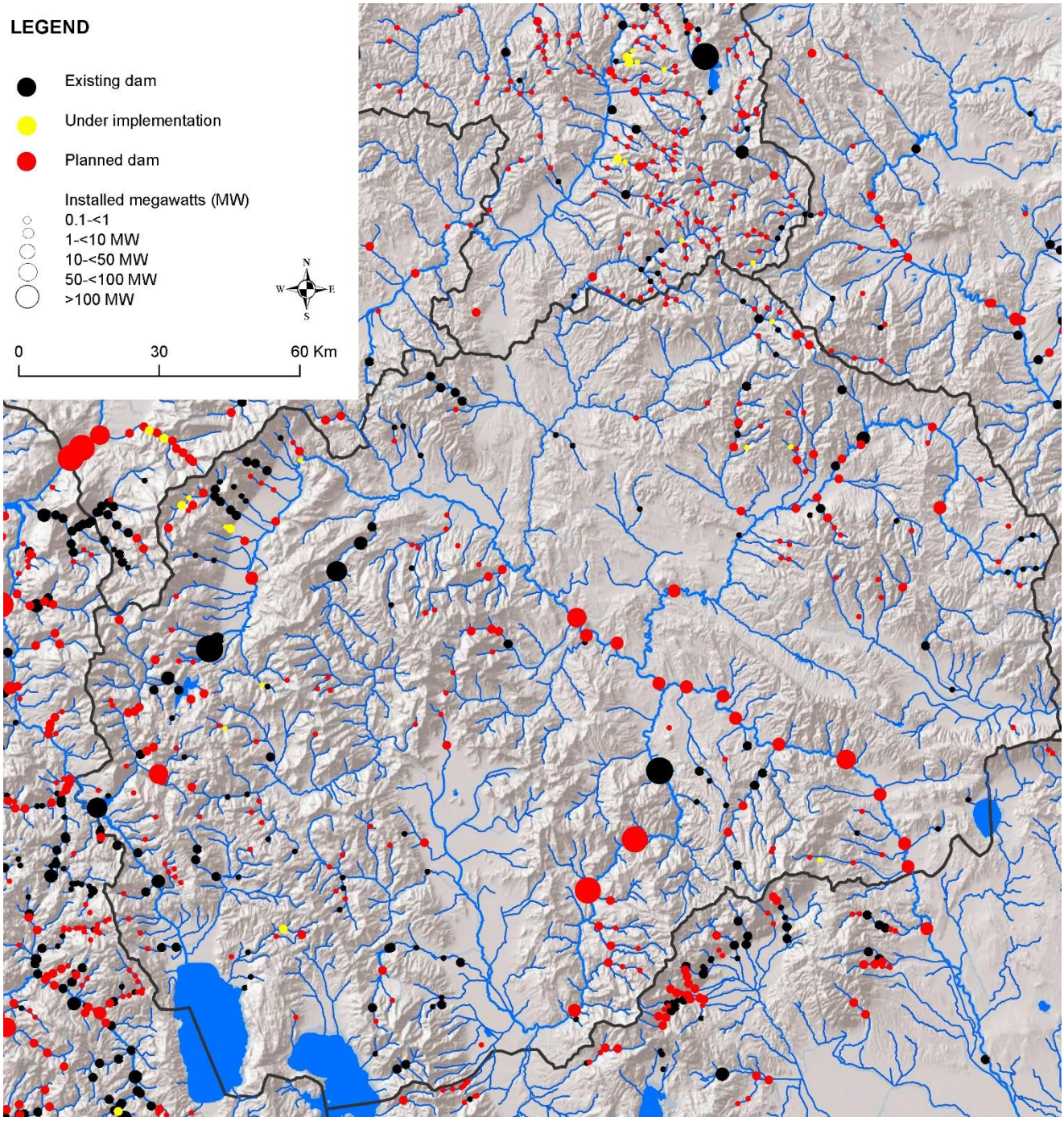

Figure 30: Distribution map of HPPs in North Macedonia.

4.9 Distribution of HPPs in Albania

Albania remains one of the top countries in terms of hydropower development, even though recent years indicate a little slower development. Unfortunately, many projects of different sizes are realised river by river mainly in the northern Drin and Mat basins.

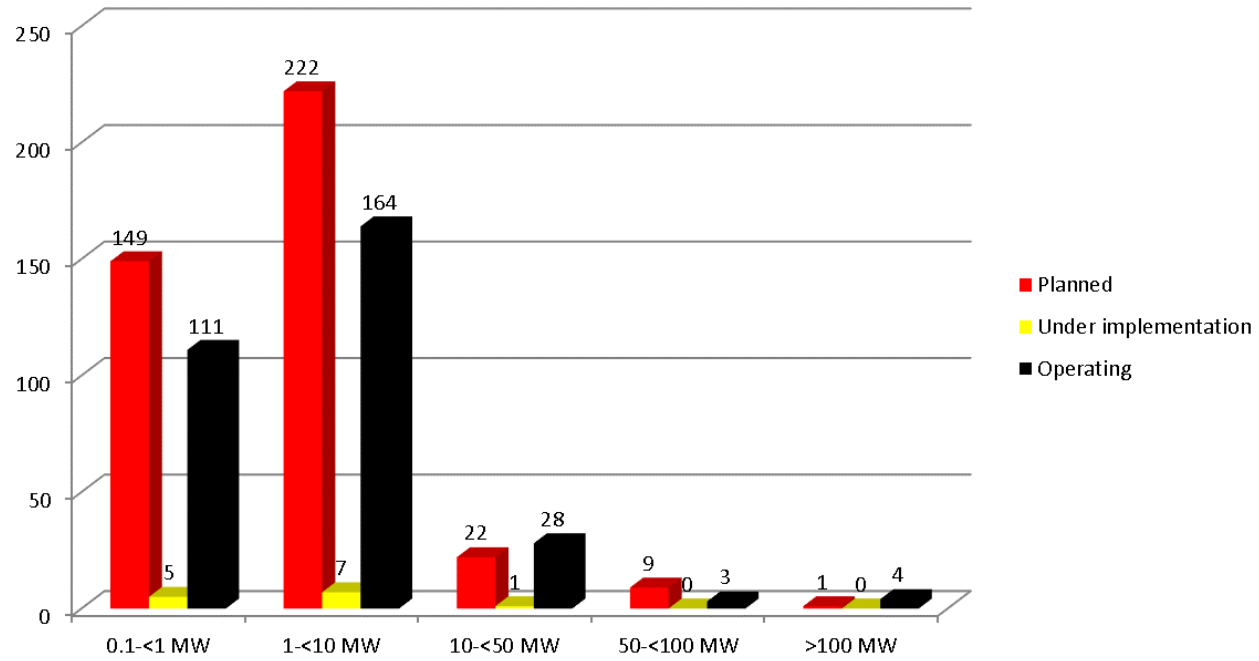

Figure 31: Distribution of HPPs in Albania.

Figure 32: HPP development in the famous Valbona Valley (Albanian Alps) proceeds (GE 2022).

Figure 33: HPP on Skatina River: The "new concrete river" with total water abstraction (GE 2022).

Figure 34: HPP Truenit cascade on Përroi I Vomës River abstracts the entire lower river course (GE 2022).

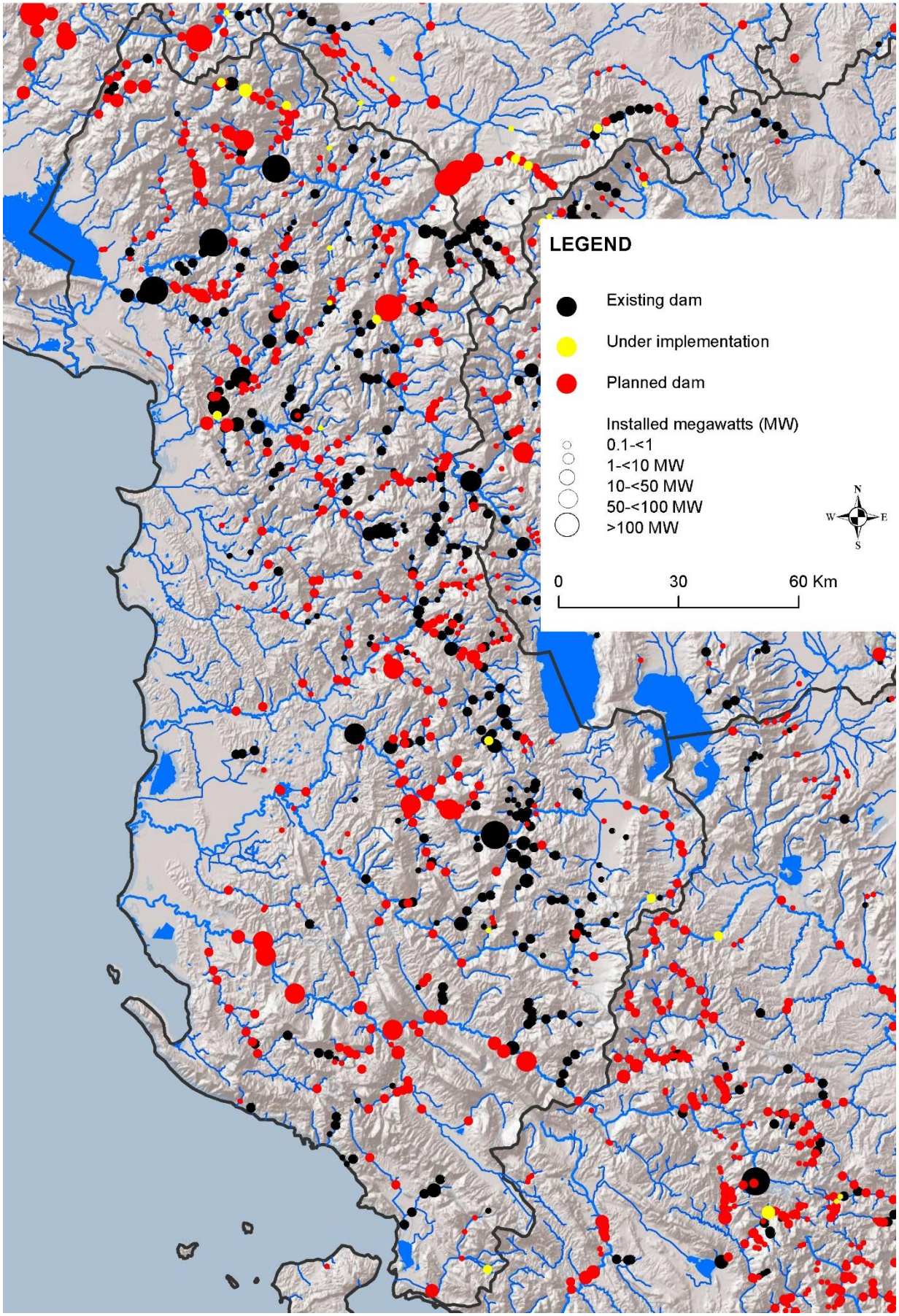

Figure 35: Distribution map of HPPs in Albania.

4.10 Distribution of HPPs in Bulgaria

Some smaller projects were completed in recent years, while the chains of HPPs planned for the major rivers like Iskar and Maritsa, but also single projects on Struma and Mesta, are pending cases and no construction sites can be found.

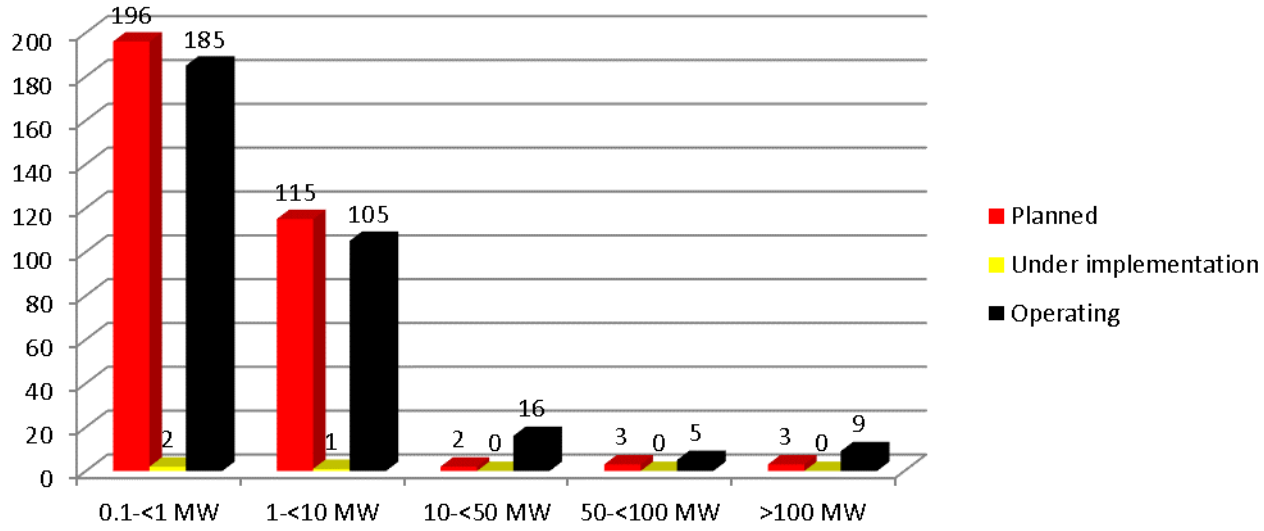

Figure 36: Distribution of HPPs in Bulgaria.

Figure 37: SHP on Ogosta River, still not operating; construction started already in 2017 (GE 2022).

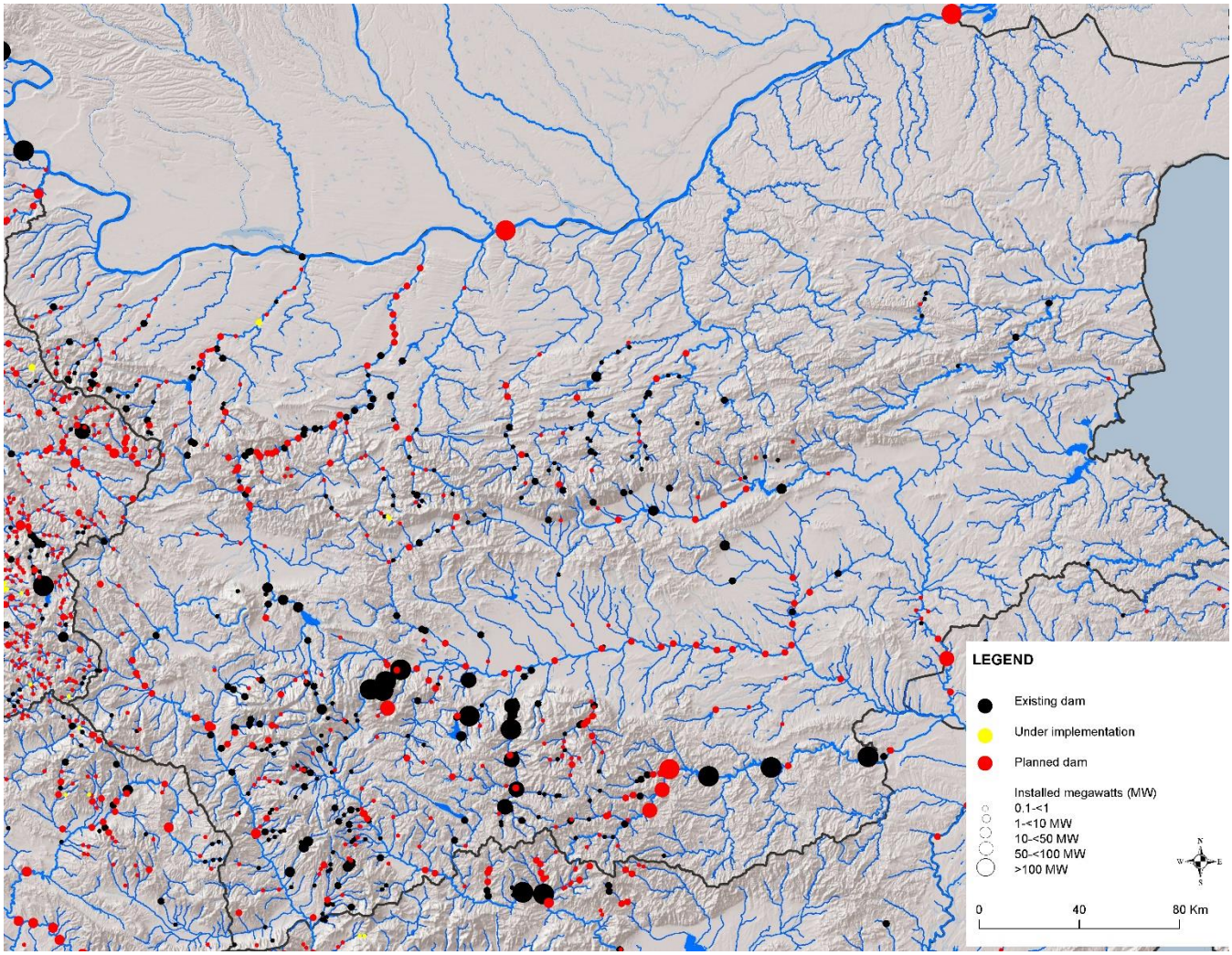

Figure 38: Distribution map of HPPs in Bulgaria.

4.11 Distribution of HPPs in northern Greece

After some years with no considerable implementation of the numerous planned SHPs <10 MW, several new construction sites and several completed plants were recorded recently. Using updated RAE (Greek Regulatory Authority for Energy) data[6] reduces the total number of planned HPPs slightly due to refused permissions and retired projects.

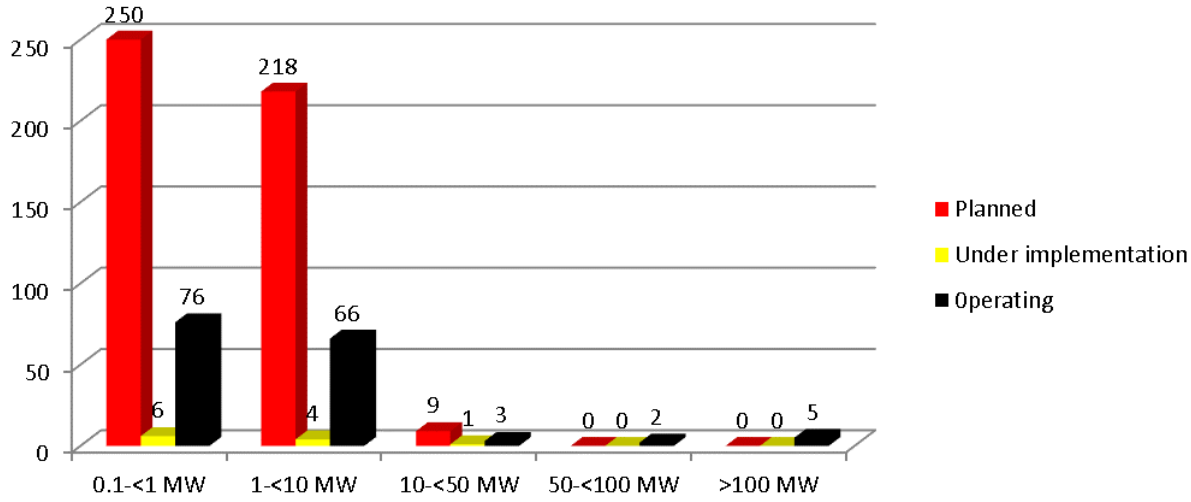

Figure 39: Distribution of HPPs for northern Greece.

Figure 40: On Aliakmonas, the largest river north of the Aoos catchment, hydropower construction has already begun and SHPs are planned to be developed in the upstream of this sparsely populated area. While this picture features a bigger SHP with some 7 MW, many of the 0.1-<1 MW SHPs look similar to those in Albania, with long pipes diverting the river water, causing very little discharges in the former river bed (GE 2022).

[6] https://geo.rae.gr/?lang=EN&lon=25.4892390503636&lat=38.55269780549767&zoom=6

Figure 41: SHP on Grevena River whose tailrace canal cuts off the entire valley meander (GE 2022).

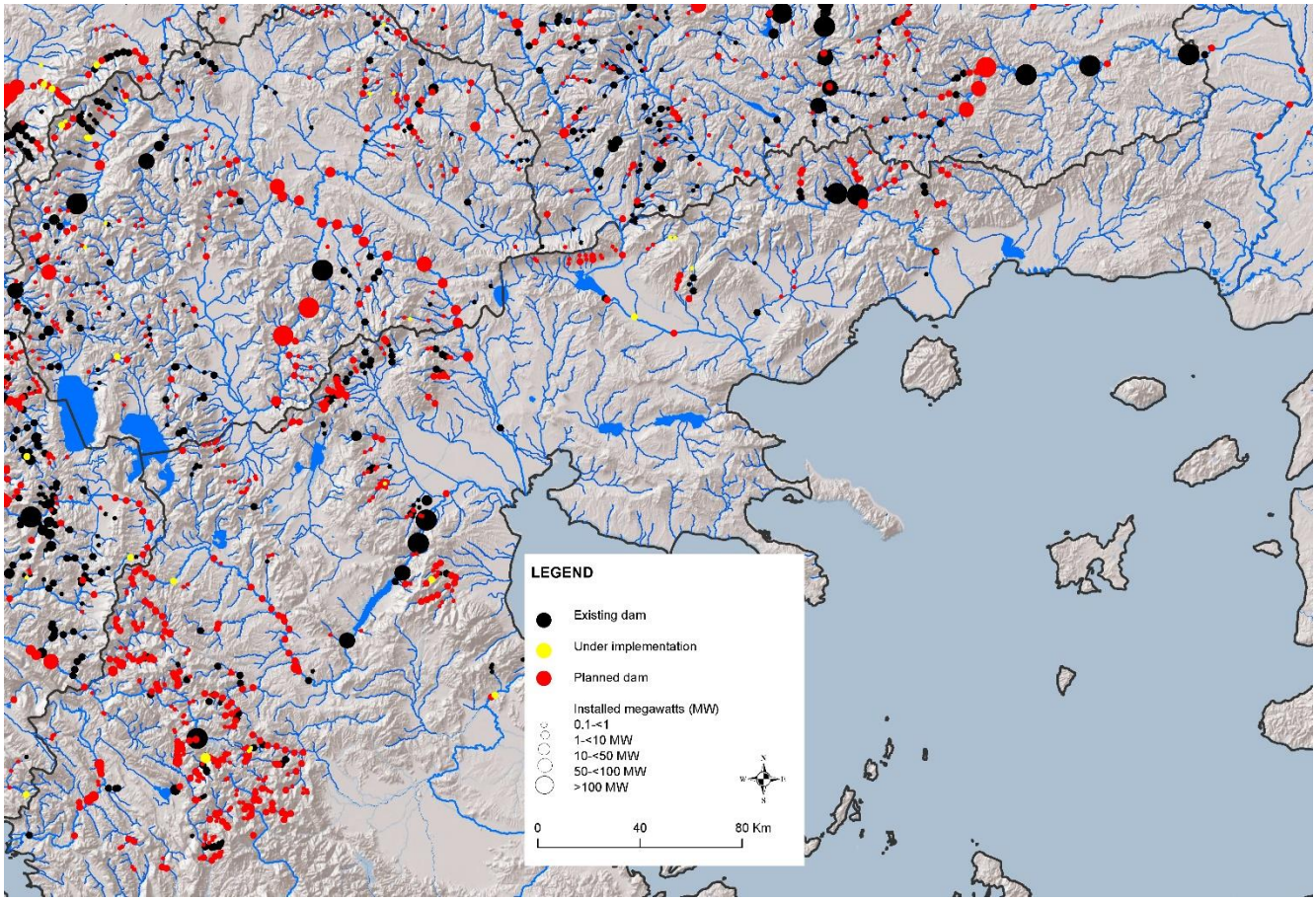

Figure 42: Distribution map of HPPs in Greece.

4.12 Distribution of HPPs in the European part of Türkiye

No development or planning of new projects could be observed for this area. Large plants in the transboundary area with Greece and Bulgaria don't seem to be on the current political agenda.

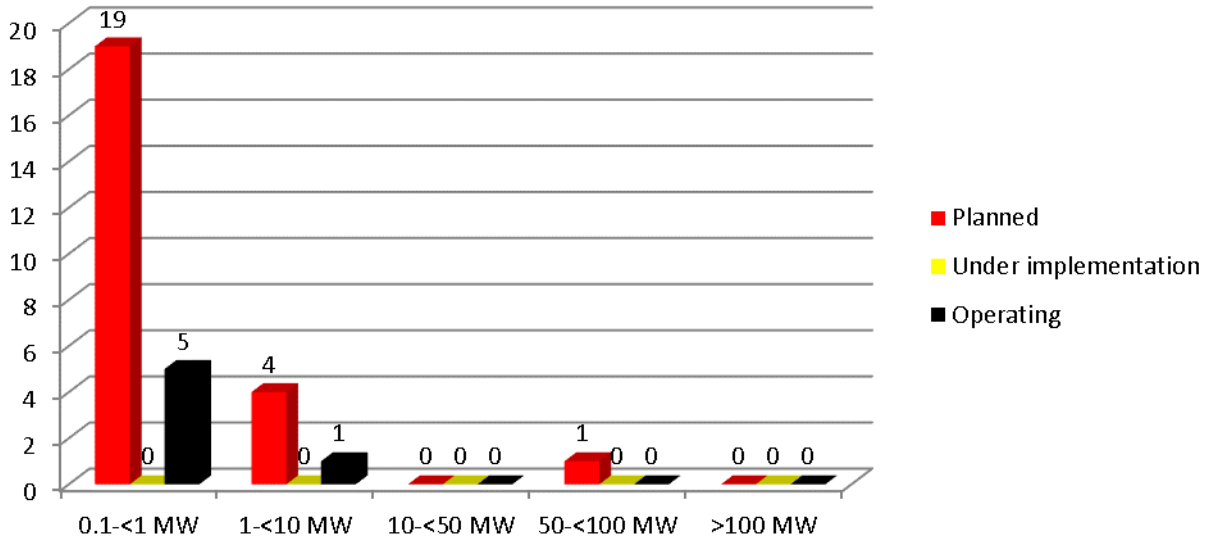

Figure 43: Distribution of HPPs in the European part of Türkiye.

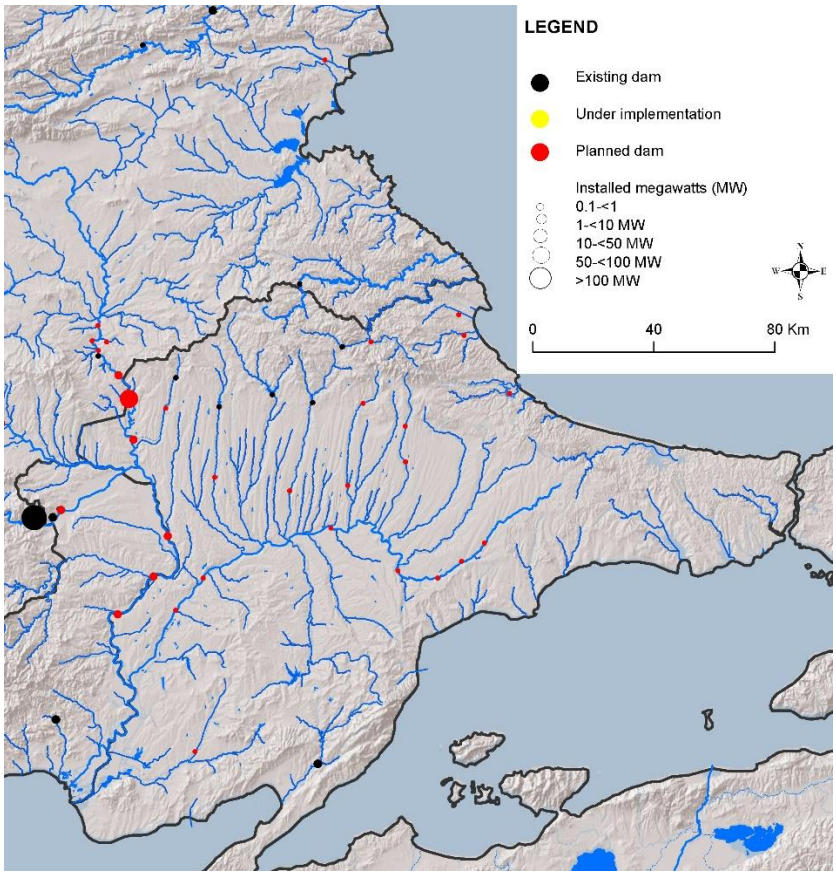

Figure 44: Distribution map of HPPs in the European part of Türkiye.

5. Conclusions

Since 2012, a rapid development of hydropower plans across the Balkan Peninsula increased the pressure on rivers of all sizes. Aside of booming countries like Albania (also for larger HPPs) and later Bosnia & Herzegovina (for small and medium-sized HPPs), Serbia, Kosovo and North Macedonia have taken on lead roles. In most EU countries (Slovenia, Croatia, Bulgaria) development of additional capacities is slow, but some larger projects such as those on Sava in Slovenia or Iskar in Bulgaria were realized in recent years. In Greece, however, much like in the other aforementioned countries, the increase of SHPs has been considerable.

Apart from traditional storage dams, the establishment of water abstraction HPPs is frequent and booming, especially on smaller rivers and even creeks. Considering the fact that in most cases almost all river water is abstracted over dozens, in total even hundreds of kilometres, the ecological damage is and will be extensive, while energy production is marginal.

The protected area network, and primarily the planned network in non-EU countries (Emerald) is impacted by numerous hydropower constructions and plans. The analysis – even at the European level – indicates a large number of HPPs in protected areas.

In many Balkan countries the booming hydropower sector defies the EU's political ambitions of improving the state of rivers in line with the Water Framework Directive, and to reconnect 25,000 km of rivers and floodplains by removing dams and water abstraction systems as a major goal for the EU Biodiversity Strategy until 2030.

The pressure of climate change argumentation and renewable energy policies encourages the ongoing development. Since hydropower still falls under the "transition" energy forms as defined by the EU Commission, it continues to receive disproportionate attention and subsidies as compared to other renewables, like wind and solar. This status quo may change pending the ongoing revision of the EU Renewable Energy Directive. Also, a stringent protected area policy could slow further developments

Some positive signals have recently come from Bosnia & Hercegovina with restrictions placed on further development of SHPs, and from Albania, which has finally committed to establishing the Wild River Vjosa National Park. Hopefully, the start of official accession negotiations between the EU, Albania and North Macedonia could further strengthen this positive trend in river protection.

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