Hydropower Solutions

HYPOSO

Hydropower solutions for developing and emerging countries

D6.3
Political recommendation papers
CAMEROON

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1 Introduction

HYPOSO is a multi-approach project to tackle several objectives; identification and mapping of the European hydropower industry, hydropower stakeholders in the HYPOSO target countries, education of new hydropower experts through capacity building activities and bringing together relevant actors from the EU hydropower sector with stakeholders in the target countries. Interaction with stakeholders is therefore an integral part of the activities, as workshops, capacity building activities and interviews with national/local stakeholders are envisaged in all target countries which are outside the European Union, namely workshops in Bolivia, Colombia and Ecuador in Latin America, and in Cameroon and Uganda in Africa. Additionally, capacity building courses will be carried out in Bolivia and Ecuador, and in Cameroon and Uganda.

2 Information about Deliverable

The policy recommendation papers developed within HYPOSO shall be seen as a perspective from the European side on the small hydropower sector in the HYPOSO target countries Bolivia, Colombia and Ecuador in Latin America, and in Cameroon and Uganda in Africa. The following recommendations are composed of findings during the HYPOSO project (reports on the framework conditions, discussions during HYPOSO events), as well as of trends that have developed in the recent years and should be considered when a sustainable development of the sector is planned. The following recommendations do not claim to be comprehensive or to propose any concrete legislative changes. This must always be done at national level.

3 General information about the electricity sector in Cameroon

The MINEE (Ministere de l'Eau et de l'Energie) and the Electricity Development Corporation (EDC) are responsible for the energy sector in Cameroon. The utility company ENEO is in charge of the generation and distribution of electricity. The National Company for Electricity Transmission Network (SONATREL) is the TSO (voltage above 30 kV). ENEO, Kribi Development Corporation (KPDC), Dibanba Development Corporation (DPDC) and the Emergency Thermal Programme (PTU) supply all electricity to the national grid.

The Rural Electrification Agency (AER) is in charge of promoting rural electrification and managing the Rural Energy Fund.

The Electricity Sector Regulation Agency (ARSEL) approves electricity tariffs and determines electrical standards. The Agency also monitors the sector’s activity and financial equilibrium, examines concession license applications, authorizes electricity generation and distribution in rural areas, protects consumers, promotes competition and facilitates private sector involvement. The Electricity Development Corporation (EDC) is a state-owned company that is in charge of the development of the electricity sector including all hydropower projects.

A development plan for the electricity sector, known as PDSE 2030 (Plan de Developpement du Secteur de l'Electricite Horizon 2030) was established in 2006 and updated in 2014 to meet the 2035 energy target. This Electricity Sector Development Plan presents estimates of the rate of energy consumption within the country up to 2035. Cameroon also intends (since cop21 in Paris, France) to increase the share of renewable energy in energy mix from 1 % to 25 % by 2035. It recommends development of hydropower plants, interconnection between the south grid and the north grid, and also interconnection with neighbouring countries. Along with it, the government points out that hydropower sources are vulnerable to drought, thus threatening the country's energy security. Therefore, there is a need to diversify Cameroon's energy mix to ensure energy security[1].

The total installed capacity of all powerplants (as of 2021) is 1,547 MW, of which 950 MW is hydro. Total production in 2019 (latest available data) was 7,006 GWh, of which 5,254 GWh were contributed by hydro (75 %). The remaining 25 % are provided by natural gas (almost 19 %), heavy fuel oil (HFO, 4 %), and light fuel oil (LFO, almost 3 %)[2].

In 2021, the total electrification rate was 65.4 %, 94.6 % for urban areas and 24.8 % for rural areas[3]. The Government of Cameroon (GoC) is well aware of that situation and has, together with the African Development Bank (AfDB), set up the Cameroon Country Priority Plan (CPP) in 2021, including the establishment of a new planning & coordination unit, and, amongst others, the addition of 3,500 MW hydropower (which shall mostly be developed by private partners) contributing to the 5,000 MW of generation capacity that shall be reached until 2030[4].

Being aware that such plans naturally mainly focus on large hydropower projects, the following recommendations like to bring the focus also to small hydropower plants (SHP), and the chances which go along with the implementation of more of such SHP.

4 Small hydropower in Cameroon

To our knowledge, up to date there is no official definition how SHP would be regarded in Cameroon. For rural electrification, a specific regulation for power plants of up to 5 MW does exist. The current installed capacity of SHP up to 10 MW is 1.5 MW (10 MW is a limit used in UNIDO's current World Small Hydropower Development Report – WSHDR 2022 - to make the developments in different countries comparable), which is provided by one single SHP. One other SHP project with an installed capacity of 2.9 MW is under development, but its commissioning was stopped due to the civil war.

The country's SHP potential is estimated at 970 MW, indicating that less than 1 % has been developed. According to WSHDR 2022, no detailed assessment of existing sites is available. However, within the HYPOSO project, the so-called HYPOSO Map was developed, and with this online tool, more than 475 potential sites for new hydropower plants have been identified.

[1] https://www.hyposo.eu/pdf/HYPOSO_Framework_Conditions_Cameroon.pdf
[2] www.unido.org/WSHPDR2022
[3] https://www.cia.gov/the-world-factbook/countries/cameroon/#energy
[4] https://www.afdb.org/sites/default/files/2021/11/22/cameroon.pdf

4.1 Why (small) hydropower at all?

To deliver on the UN Sustainable Development Goals[5], hydropower is crucial. For example, hydropower ensures availability and sustainable management of water and sanitation for all (SDG6), and it ensures access to affordable, reliable, sustainable and modern energy for all (SDG7). The implementation of hydropower plants contributes to SDG8, sustainable economic growth and jobs, and hydropower represents like few other technologies SDG9, to build resilient infrastructure, to promote inclusive and sustainable industrialisation, and to foster innovation. In addition, hydropower is a key solution for taking the urgent action to combat climate change and its impacts (SDG13).

4.2 Facts about small hydropower that are not known everywhere.

With the National Development Strategy 2020-2030, Cameroon has set itself goals to use solar energy and/or mini hydroelectric power stations for electrifying remote localities, which makes absolutely sense given the opportunities Cameroon has for these RES. It is however often overlooked, that the volatile production of solar energy can be a problem for the electricity grids which needs to be stable and has limited capacity for intermittent sources.

The French study “Hydropower and the challenge of flexibility” (“L’hydroélectricité au défi de la flexibilité”[6]) has addressed the issue of flexibility services and has shown that hydroelectricity is essential for balancing the electricity system, especially in the low voltage system. According to the French study, a small hydropower plant is equivalent to ten domestic batteries (of each 10 kW), and can increase the capacity of a high-voltage line by 20 % to accommodate photovoltaics.

According to the German study ”Contribution of small hydropower plants hydropower plants to secure and cost-effective electricity supply in Germany” (“Netztechnischer Beitrag von kleinen Wasserkraftwerken zu einer sicheren und kostengünstigen Stromversorgung in Deutschland”), small hydropower plants have the capacity to considerably decrease the costs of electricity grid adaption if considerably more PV and wind energy are fed in. Small hydropower plants achieve high values of up to 5,500 full-load hours, and are also highly available and thus operate for an average of more than 8,000 hours per year and feed continuously into the grids. Hydropower plants are therefore reliable electricity producers and guarantee a steady supply of electricity.

If required, hydropower plants can also be operated as reliable control power plants: On the one hand, negative control power can be provided by reducing the very constant feed-in power on demand; on the other hand, additional feed-in power can also be provided by slightly throttling hydropower plants during normal operation. Especially with the use of dynamic reservoir management and associated storage capacities in the potential energy of the water, the control potential can be fully exploited.

[5] https://sdgs.un.org/es/goals

[6] https://www.france-hydro-electricite.fr/actualites/energie/etude-hydroelectricite-et-flexibilite-modeles-economiques/

These services bring a financial benefit with them. For example, in Germany, the country where the study was carried out, a total of about 7,300 to 7,600 hydropower plants produce electricity. A distinction is made between large hydropower plants with an installed (electrical nominal) capacity of > 1 MW and small ones with an installed capacity of ≤ 1 MW. The large capacity class includes about 400 hydropower plants, whereas about 7,000 small hydropower plants are in operation. The share of large hydropower plants in the total amount of electricity is about 85 %, while small hydropower plants generate about 15 %. Although in Germany only about 4.1 GW of the 103 GW of installed renewable capacity is accounted for by hydropower (approx. 4%), they account for about 12% of electricity generation from renewable energy sources. This means that small hydropower plants are of great importance for the German electricity supply due to their grid-serving behaviour, as they feed in their output steadily and with high full-load utilisation hours without causing grid overloads, which significantly reduces the need for grid expansion in the distribution grids. This is another reason why it is important to maintain the existing capacities of small hydropower as well as to ensure their economic operation. If this were not successful, in Germany, the amount of energy provided by small hydropower plants (< 1 MW) would have to be substituted by wind power and photovoltaic plants, which would increase the additional grid expansion costs in the medium and low voltage grid alone in Germany to an amount of about 750 million € [7]. For Cameroon, given the considerably lower number of plants, the financial savings might be currently less but the information about the benefits of decentralised SHP should be considered for the future, taking whatever financial savings as a welcome benefit. In addition, special tariffs can be made for small hydropower to ensure its cost effectiveness.

5 Recommendations for the small hydropower sector in Cameroon

As general recommendation it must be advised to use available tools and technologies that can bring the national hydropower sector forward. In the **HYPOSO** project for example, different tools that might be helpful for the Cameroonian small hydropower sector have been developed; namely the **HYPOSO Map**, which is a useful online GIS tool to start the search for new hydropower sites from the desktop, providing more than 20 different layers with useful information for hydropower (this could be used as starting point for the assessment of Cameroon's potential; an exchange with the providers of the HYPOSO Map is highly recommended therefore), the HYPOSO Business Cases (a replicable pre-feasibility study model and a financing model are publicly available via https://www.hyposo.eu/en/sector-information/), the HYPOSO **Meeting Platform** (an online meeting forum, free of cost, see more at https://www.hyposo.eu/en/hyposo-platform/), and the HYPOSO OCW Platform (the online platform of the HYPOSO **capacity building courses**, see more at HYPOSO (un-ihe.org)).
Furthermore, the **International Hydropower Association** (IHA) has developed some very useful material which should also be considered (see more under 5.3).

[7] https://www.wasserkraft.org/wp-content/uploads/2021/12/Gutachten_Netztechnischer_Beitrag_Kleinwasserkraftwerke_Endversion.pdf

As seen above in chapter 3, mainly rural areas in Cameroon still need to be fully electrified (electrification rate of 24.8 % as of 2021). This should be done best with renewable energy sources (RES). Some electrified remote areas with long distance power lines experience high voltage drop and frequent power cut, leading to poor energy security.

Moreover, off-grid power generation in Cameroon could empower local communities, allowing them to take charge of their energy supply. Rather than relying solely on large, centralized utilities, these communities actively participate in the management and operation of these decentralized systems, ensuring increased energy resilience and fostering economic growth through the creation of local jobs in installation, maintenance, and operation.

Given the specific consumption of the population of rural areas, connecting a small hydro to the grid will increase the cost effectiveness of the project. Some electrified areas can also benefit from small hydro to mitigate the power shortage and increase the voltage level.

Although such off-grid approach presents challenges, such as the need for innovative management solutions and technical support, the benefits far outweigh the obstacles. The significant gains in energy access, reduced environmental impact, and community empowerment are just a few of them to mention. It is thus highly recommended that Cameroon will continue this approach. As there are several European providers of the needed solutions which can be found via the HYPOSO website, we also recommend to visit the HYPOSO database of European providers.

Within HYPOSO, three different hydropower sites have been assessed by Cameroonian and European experts. Although from the financial assessment, these sites need dedicated negotiated conditions to be implemented, it is recommended that these sites will be further considered as they would contribute to the development and empowerment of municipalities of which the whole state of Cameroon will benefit in the end.

As mentioned, to our knowledge, there is no dedicated legislation for small hydropower established in Cameroon. It is therefore recommended that the policy makers start a process to **set up a sustainable legislation for small hydropower in Cameroon**, in best case together with national practitioners and making use of the exchange established during the HYPOSO project with stakeholders from Uganda, but also from the Latin American countries Bolivia, Colombia, and Ecuador.

5.1 Accelerate the development of renewables through streamlined permitting and licensing

Cameroon has set up the ambitious National Development Strategy 2020-2030. This is very good. As could be shown under 4.1 and 4.2, we would recommend that a meaningful mix is considered. Small hydropower should not play only a small role, we would recommend that it will be considered more to achieve the goals together with other renewable energy sources.

To facilitate permitting and licensing, a **one-stop-shop** should be considered (i.e., all necessary steps needed for permissions and licenses can be found under one roof), which would allow a lot faster processes.

5.2 Install strict measures to ensure that only "good" hydropower projects are implemented

Regarding hydropower projects, we recommend that only "good" hydropower projects are provided with licenses and permissions.

Hydropower projects that are sited, planned and executed **in accordance with international good practice** in sustainability can have positive wider non-power impacts on local communities, including but not limited to water supply, social investment, economic growth, livelihoods, irrigation, and flood and drought protection.

5.3 Embed hydropower sustainability practices in government regulation.

As mentioned, hydropower, be it large or small, will only be largely accepted if the realised plants will be really sustainable plants, taking care of people already living in and/or using the area, and of course taking care of the environment. The International Hydropower Association (IHA) has developed **sustainability guidelines** that should be embedded in national regulation. All different guidelines can be accessed via:

https://www.hydrosustainability.org/hydropower-sustainability-guidelines

It is also worthy, checking the European approach on water related issues that shall lead to a more healthy status of the water environment, with the main element being the **Water Framework Directive** (WFD), which has the overall objective to achieve good environmental status for all waters, and which led to the request to EU Member States to draw up so-called river basin management plans based on natural geographical river basins, as well as specific programmes of measures to achieve the objectives. The WFD is supported by more targeted directives, i.e. the Groundwater Directive, the Drinking Water Directive, the Bathing Water Directive, the Nitrates Directive, the Urban Waste Water Treatment Directive, the Environmental Quality Standards Directive and the Floods Directive. These typical EU Directives might be interesting for political deciders, who could check, whether the topics that are dealt within the EU are already an actual national topic to be addressed. If so, of course the contact to European representatives is recommended to start discussions with experts from the EU.[8]

5.4 Enable the national hydropower sector to grow for the better of the country

It is essential that the Cameroonian hydropower sector will be able to grow and thrive. It is recommended therefore that hydropower stakeholders, especially political deciders, get familiar with the latest updates about hydropower. As mentioned before, interested stakeholders from Cameroon are invited to enroll themselves in the **HYPOSO capacity building courses** (HYPOSO (un-ihe.org)). In addition, hydropower stakeholders from Cameroon are invited to **make contacts with European stakeholders**, on the one hand via the HYPOSO Platform, on the other hand via ETIP Hydropower (ETIP HYDROPOWER (etip-hydropower.eu)), currently a project funded by the European Commission, but already now and in future aiming

[8] https://www.europarl.europa.eu/factsheets/en/sheet/74/water-protection-and-management

to be a recognised interlocutor for the European Commission, Member States and Associated Countries about the hydropower's sector specific R&I needs, also open for making contacts to hydropower stakeholders from Africa. It is further recommended that the stakeholders from Cameroon will continue the exchanges and contacts made with colleagues from Uganda during the HYPOSO project.

The set-up of a **national open table** for all actors involved in the Cameroonian hydropower sector is recommended further, as such exchange of positions and ideas can benefit the sector and lead to an improved situation for more hydropower in Cameroon.

It needs to be mentioned finally, that a **lack of gauging stations** is not only impeding good decision making for future hydropower opportunities, but also causing an unneeded risk for downstream communities (flood forecasts) and should therefore be **addressed wherever needed**.

5.5 Enable public involvement in SHP projects, making them Social hydropower projects

We recommend, if possible, that **public involvement** is facilitated, encouraged, and supported by regulative means to be taken by political deciders. Research[9] has shown that, based on the degree of citizens' involvement in small hydropower projects, inclusive relationships between their involvement and awareness were revealed. The acceptance of future plants could be improved if such involvement would see support.

5.6 Use available finance sources

Regarding finance for hydropower projects, national stakeholders like project developers are often lacking enough money and are not well informed where to get access to finance possibilities. Especially the observed lack of finance for project developers in Cameroon needs to be addressed. We recommend that a dedicated office (in best case part of the one-stop-shop, see under 5.1), ideally with representations from the EU Delegation for Cameroon, the AfDB etc., will be established and promoted in the national hydropower sector, to act as information hub for local developers who are seeking financial support and have no information where that could be done best. Surely, a recommendation on making the equity available in order to raise the debt for the private sector will be welcome. The Government of Cameroon can be the one doing it via several mechanisms. As first source of information a look into **report D5.4 of the HYPOSO** project is advised, in which it was revealed that if the needed finance for a project would be in the context of medium-term debt (i.e., 10 years including grace period), funding from commercial banks or crowdfunding sources (HYPOSO project partner and finance expert 1to3 Capital is linked to crowdfunding site 'CrowdPartners') is possible. In case a project would not be pre-feasible within that context the assessment was performed (i.e., to yield a minimum DSCR (debt service coverage ratio) of 1.3x), it is recommended to take long-term

9 https://www.researchgate.net/publication/343234722_Effect_of_Residents'_Involvement_with_Small_Hydropower_Projects_on_Environmental_Awareness

finance (20 years including grace period) into account to come from covered debt - for political and commercial risks - from commercial banks plus an export credit agency coverage or from development banks who often also need governmental guarantees (in future for example through coverage from the EFSD+[10]).

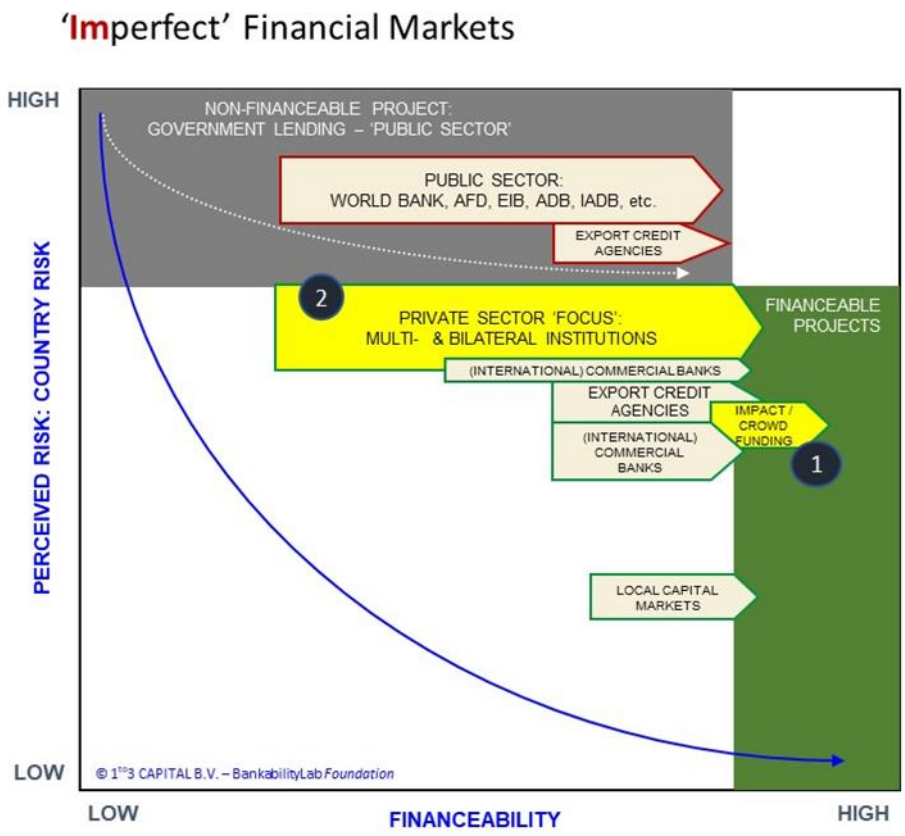

Figure 1: Financeability Matrix and Imperfect Financial Markets (Source: Marc J.M. Buiting)

In addition, it is recommended that available offers for financial capacity development are used. Prospective developers could apply for these courses. Most development banks have capacity development facilities.

5.7 Start today with planning future scenarios

As predictions of precipitation patterns for Cameroon give reason to expect an increase in heavy precipitation (see IEA, 2020, as well as below the result from the HYPOSO Map, available via https://www.hyposo.eu/en/hyposo-platform/), it is recommended to **think already now how to best address these forecasts** (i.e., to prevent floodings). Multipurpose hydropower plants with reservoirs might be an answer for such precipitation scenarios in the future.

[10] https://international-partnerships.ec.europa.eu/funding-and-technical-assistance/funding-instruments/european-fund-sustainable-development-plus-efsd_es

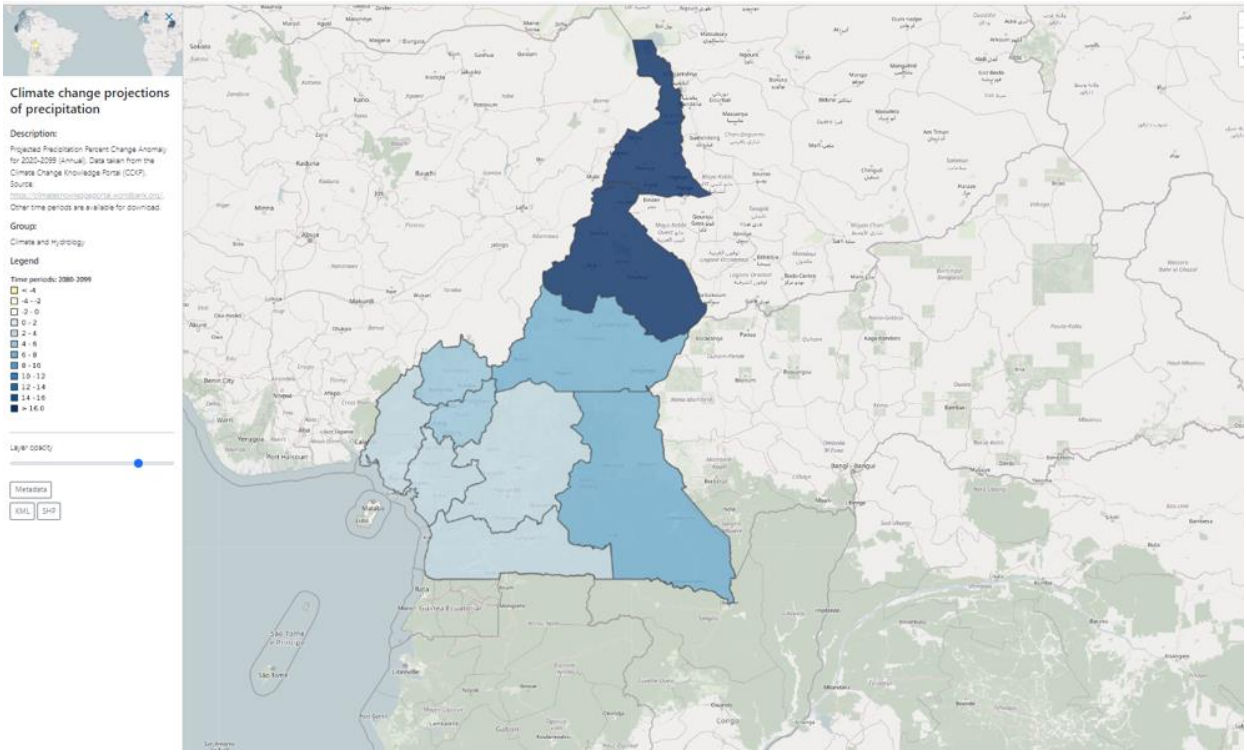

Figure 2: Screenshot of the HYPOSO Map, showing an increase of precipitation in some regions in Cameroon

An interesting work carried out by the Australian National University (ANU) and published in 2022 has shown that in Cameroon, there is also a considerable potential to implement **Pumped Storage Hydropower** (PSH or PSP). We recommend that the PSH/PSP is considered for accelerating even more the expansion of renewable energies in Uganda. There is no other proven renewable technology that matches its long lifetime and its ability to support reliable grids.

For Cameroon, the Global Greenfield Pumped Hydro Energy Storage Atlas, developed by the Australian National University (ANU), might be a perfect tool to start the journey for PSH/PSP development in Cameroon. The atlas can be accessed via: https://re100.anu.edu.au/ .

The screenshot below of this tool is giving an impression of the potential that Cameroon is having.

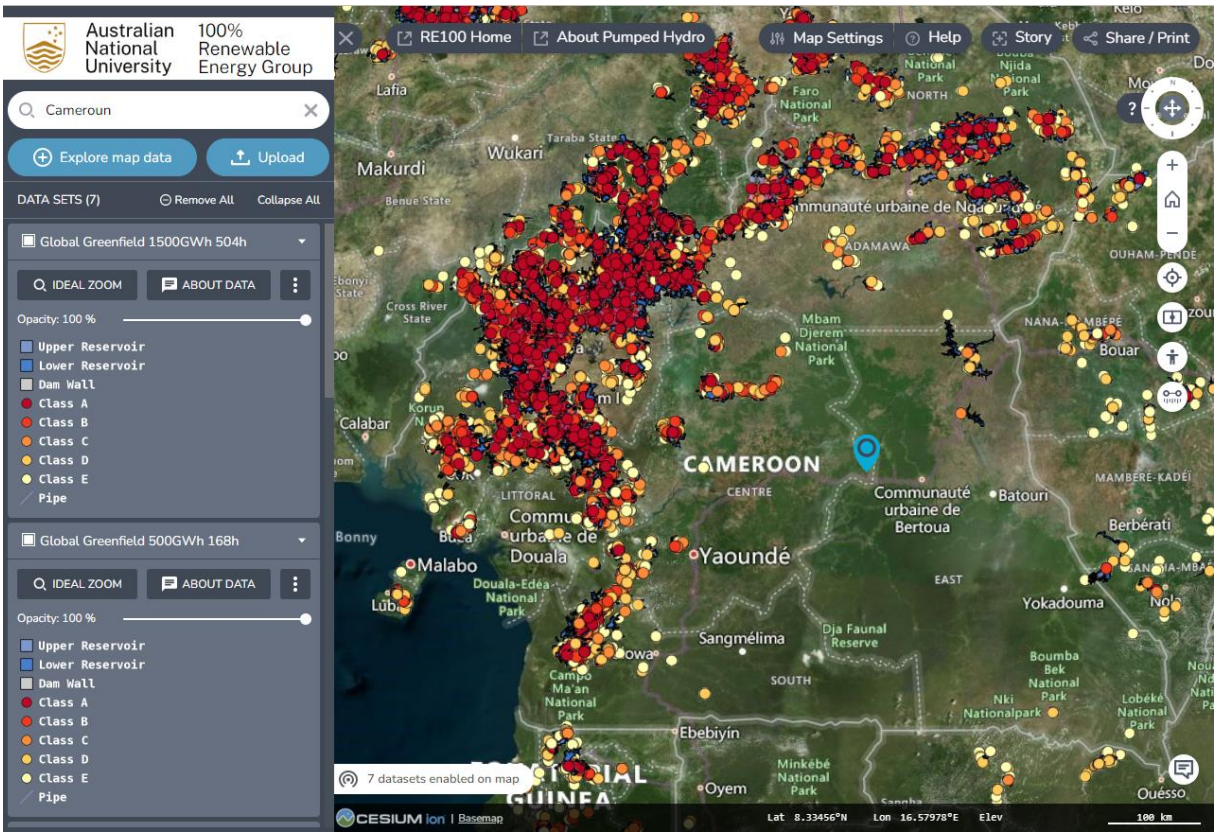

Figure 3: Screenshot of the Global Greenfield Pumped Hydro Energy Storage Atlas, showing parts of the PSP potential in Cameroon

6 Conclusion

The HYPOSO consortium is convinced that small hydropower plants (SHP) are a viable solution as a contribution to achieving the decarbonisation of the energy sector, which, if implemented well, will enable the further expansion of other renewable energies. At the same time, the value of small hydropower plants for a stable electricity grid cannot be underestimated, especially in the mid– and low-voltage grid. In our view, measures should therefore be taken that will lead to more SHP projects being implemented in the near future in Cameroon. It can be a key to meeting the 2030 target given the relative short development time.

Cameroon should not only look into more sustainable and sensibly located SHP, but should also make use of the favourable geographical characteristics which it has, and explore the potential of PSH/PSP in the country.