UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL CENTER
ON SMALL HYDROPOWER

World Small Hydropower Development Report 2022

Executive Summary

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Suggested citation:

UNIDO, ICSHP (2022). *World Small Hydropower Development Report 2022*. United Nations Industrial Development Organization, Vienna, Austria; International Center on Small Hydro Power, Hangzhou, China. Available at www.unido.org/WSHPDR2022.

ISSN: 2406-4580 (print)
ISSN: 2706-7599 (online)

The digital copy is available at www.unido.org/WSHPDR2022.

Design: red not 'n' cool
Cover Picture: depostihphotos

Foreword

by **Gerd Müller, UNIDO Director General** for World Small Hydropower Development Report 2022 Executive Summary

The COVID-19 pandemic caught the world unprepared for a complex, systemic challenge of such a scale. Livelihoods, economic progress, and social stability have been severely impacted worldwide. The COVID-19 pandemic has also slowed progress towards sustainable energy goals. In such a critical moment when multiple crises are coming together, we need a decisive collective effort to follow through on the goals the world community agreed on to build sustainable energy systems. We must make sure that renewable energy development is a top priority at all levels of decision-making.

In the face of this challenge, it is especially critical to continue to collect and share knowledge about the various renewable energy technologies. Small hydropower is one of such solutions. It has long played a key part in providing access to sustainable and reliable electricity around the world. Small hydropower is a simple, adaptable and low-cost technology, which makes it particularly suitable for remote and marginalized communities. When planned with environmental and socio-economic aspects in mind, it provides access to sustainable renewable energy, the basis for any development which also empowers communities, improves livelihoods and is the basis for more development opportunities. Small hydropower offers one answer to many questions posed by the pandemic, climate crisis and energy transition for achieving the commitments under the Paris Agreement.

Over 60 per cent of global small hydropower potential remains untapped. There are still vast opportunities across the globe to use it for the benefit of local communities and the planet. In order to support policy-makers, communities, potential developers and other stakeholders interested in developing small hydropower projects, the United Nations Industrial Development Organization (UNIDO) partnered with the International Center on Small Hydro Power (ICSHP) to launch the fourth edition of the World Small Hydropower Development Report. The first three editions have shown that the report is a much-needed global knowledge product on small hydropower. I am proud that that this is already the fourth edition of the report and that UNIDO and ICSHP are continuing this important work of knowledge gathering and distribution. The valuable content of the current edition is an outcome of a collective effort of more than 200 experts and contributing organizations from all over the world. The production of this comprehensive report would not have been possible without generous support and intellectual leadership from the Ministry of Water Resources of the People's Republic of China and ICSHP.

I am confident that this report will contribute to the global effort to build sustainable energy systems that will help mitigate the climate crisis and empower communities.

Acknowledgements

The World Small Hydropower Development Report 2022. was prepared under the overall guidance of Tareq Emtairah, Director of the Division of Decarbonization and Sustainable Energy, Petra Schwager-Kederst, Chief of the Division of Climate and Technology Partnerships at the United Nations Industrial Development Organization (UNIDO) and LIU Deyou, Director General of the International Center on Small Hydropower (ICSHP).

The preparation of this thematic publication was headed by LIU Heng, Senior Technical Advisor at UNIDO and consulted by HU Xiaobo, Chief of the Division of the Multilateral Development at ICSHP. The work was coordinated by Oxana Lopatina at ICSHP and Eva Krēmere at UNIDO. The publication is the result of three years of intense research work and was backed by a talented and indispensable team of researchers at ICSHP and a vast number of experts in the field of small hydropower

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Preface

Providing universal access to energy remains one of the most critical economic, environmental and development challenges facing the world today with over 700 million people, or 9.5 per cent of the global population, predominantly in rural areas, still lacking access to electricity in 2020.1 Access to reliable and affordable electricity has an immediate and transformative impact on the quality of life and is crucial to ensuring access to such basic services as healthcare and education. At the same time, in both developing and developed countries, the need for clean and sustainable sources of energy is growing more acute in the face of the climate crisis and environmental degradation. Sustainable renewable energy is, thus, a key building block towards both the broader development goals, including poverty eradication and public services provision, and climate crisis mitigation and prevention of environmental degradation.

As the lowest-cost renewable energy technology, hydropower remains integral to international efforts to fight the climate crisis and ensure a clean energy future. Small hydropower (SHP), due to its adaptability to the local needs and conditions and suitability for remote rural areas with low-density energy demand, has been at the centre of development strategies worldwide, whilst helping reduce greenhouse gas emissions and promoting greater energy independence. If effectively and sensitively planned, SHP projects can also offer opportunities for the empowerment of local communities, including the usually disadvantaged groups, such as women and youth, empowering them economically and contributing to progress towards greater equality.

In order to more effectively promote SHP as a renewable and rural energy solution and overcome existing barriers, it is essential to identify the development status of the technology across regions and engage stakeholders to share existing knowledge and experience. Prior to the first edition of the World Small Hydropower Development Report (WSHPDR) published in 2013, it was clear that a comprehensive reference publication for decision-makers, stakeholders and potential investors was needed. Today, the WSHPDR is the only global publication dedicated to the dissemination of in-depth information on SHP development.

For the fourth time, the United Nations Industrial Development Organization (UNIDO) and the International Center on Small Hydro Power (ICSHP), as the global knowledge leaders in the SHP sector, are continuing their partnership for the new edition of the report, the WSHPDR 2022. The new edition contains 20 regional chapters, 166 country chapters, 12 case studies, 3 thematic publications as well as a global database of existing and planned SHP plants. The WSHPDR 2022 is the result of an enormous collaborative effort between UNIDO, ICSHP and over 200 local and regional SHP experts from across the globe, including engineers, academics and government officials. The current edition of the Report aims not only to provide an update on the SHP status by country but also to expand on the first three editions by providing improvements in data accuracy with enhanced analysis and a more comprehensive overview of the sector by country.

What is new?

Compared to the previous editions, the *WSHPDR 2022* offers a more detailed analysis of the SHP status by country, covering such aspects as operational, planned and potential SHP projects, cost of SHP development, financial mechanisms available for SHP projects, effects of the climate crisis on SHP as well as factors favouring further SHP development. Furthermore, the new edition includes three thematic publications addressing the topics of gender equality, youth involvement and climate change from the perspective of SHP as well as the first global database of developed and planned SHP projects by country. Finally, the current edition includes a collection of new case studies illustrating successful examples of SHP implementation, focusing on the social benefits of SHP projects, as well as new technological solutions available.

Global overview

According to the *WSHPDR 2022*, the global installed SHP capacity for plants of ≤10 MW is estimated at approximately 79.0 GW and the total known potential for SHP ≤10 MW (including developed capacities) is estimated at 221.7 GW. Thus, despite the appeal and benefits of SHP solutions, much of the world's SHP potential remains untapped (64 per cent). It should be noted that for a number of countries, including those with very developed SHP sectors (for example, India), data on SHP of ≤10 MW are not available due to the use of different local definitions. Therefore, the global installed and potential capacity can be assumed to be somewhat higher than the reported totals.

Compared to the *WSHPDR 2019*, SHP installed capacity (≤10 MW) increased by 1 per cent (Figure 1). At the same time, the estimated SHP potential decreased by 3 per cent (Figure 2) based on more accurate data obtained for a number of countries, including Norway, Turkey and the Philippines, as well as due to the lack of data on SHP of ≤10 MW for some other countries.

Figure 1.
Global Installed Capacity of Small Hydropower of ≤10 MW in the WSHPDR 2013/2016/2019/2022 (GW)

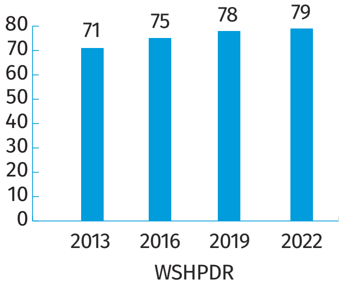
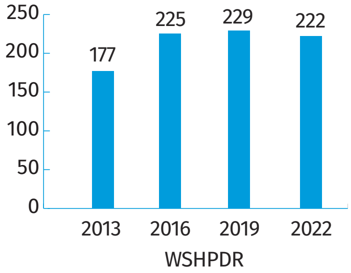
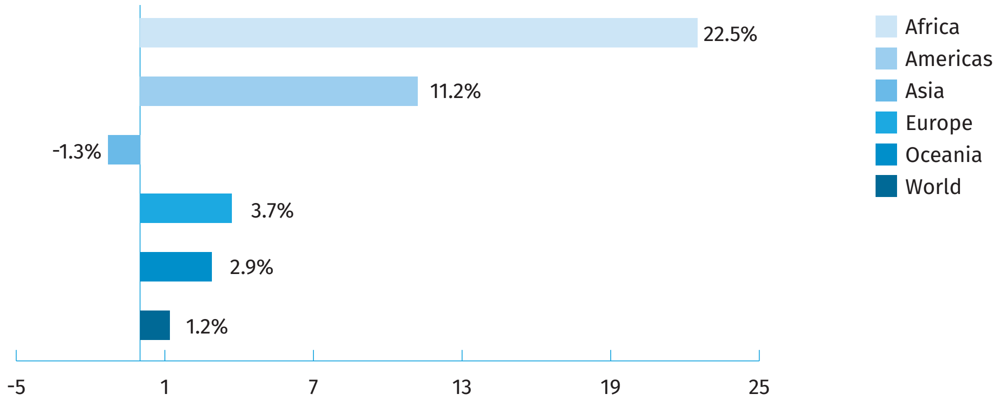


Figure 2.
Global Potential Capacity of Small Hydropower of ≤10 MW in the WSHPDR 2013/2016/2019/2022 (GW)



The greatest relative increase in installed SHP capacity compared to the *WSHPDR 2019* is reported for Africa with an increase of almost 23 per cent (Figure 3). The Americas, Europe and Oceania have also seen an increase in installed SHP capacity of approximately 11 per cent, 4 per cent and 3 per cent, respectively, compared to the previous edition of the Report. In absolute terms, the largest increase in installed capacity is reported for Europe at 734 MW, followed by the Americas with 698 MW and Africa with 134 MW of new capacity. Conversely, the reported SHP installed capacity of Asia decreased by approximately 1 per cent, as a result of an updated estimation for Turkey as well as a lack of data for the 10 MW definition for some countries.

Figure 3.
Change in Installed Small Hydropower Capacity between the WSHPDR 2019 and the WSHPDR 2022 by Continent (%)



SHP (of ≤10 MW) represents approximately 1 per cent of the total electricity installed capacity of the countries included in this Report and 6 per cent of their total installed hydropower capacity. Asia continues to have the largest installed capacity and potential for SHP of ≤10 MW, accounting 64 per cent and 63 per cent of the global total, respectively (Figures 4 and 5). Europe has the highest percentage of SHP development (52 per cent for SHP ≤10 MW), with Western Europe having 83 per cent of its known potential already developed. The largest known undeveloped SHP potentials are concentrated in Central Asia, Eastern Asia and South-Eastern Asia (Figure 6).

Figure 4.
Share of Global Installed Small Hydropower Capacity of ≤ 10 MW by Continent (%)

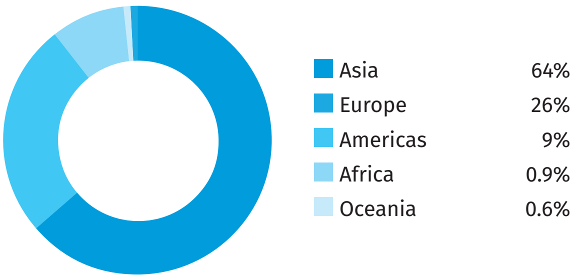


Figure 5
Share of Global Small Hydropower Potential of ≤ 10 MW by Continent (%)

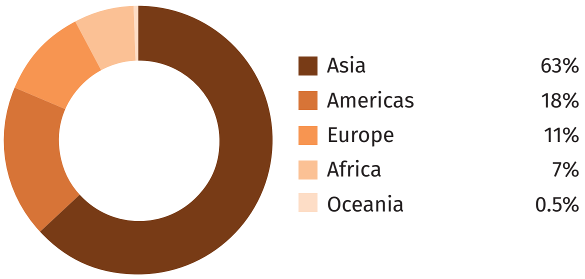
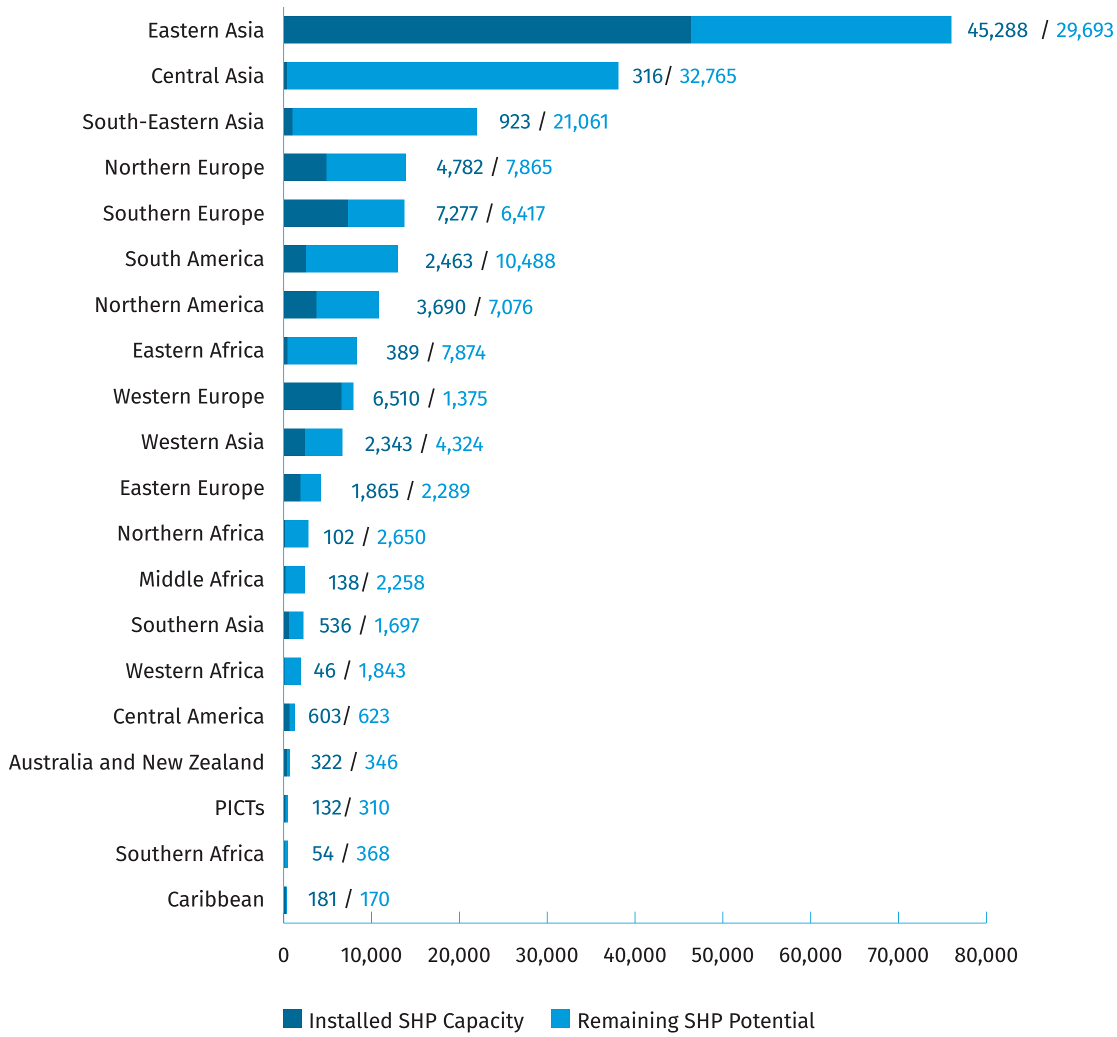
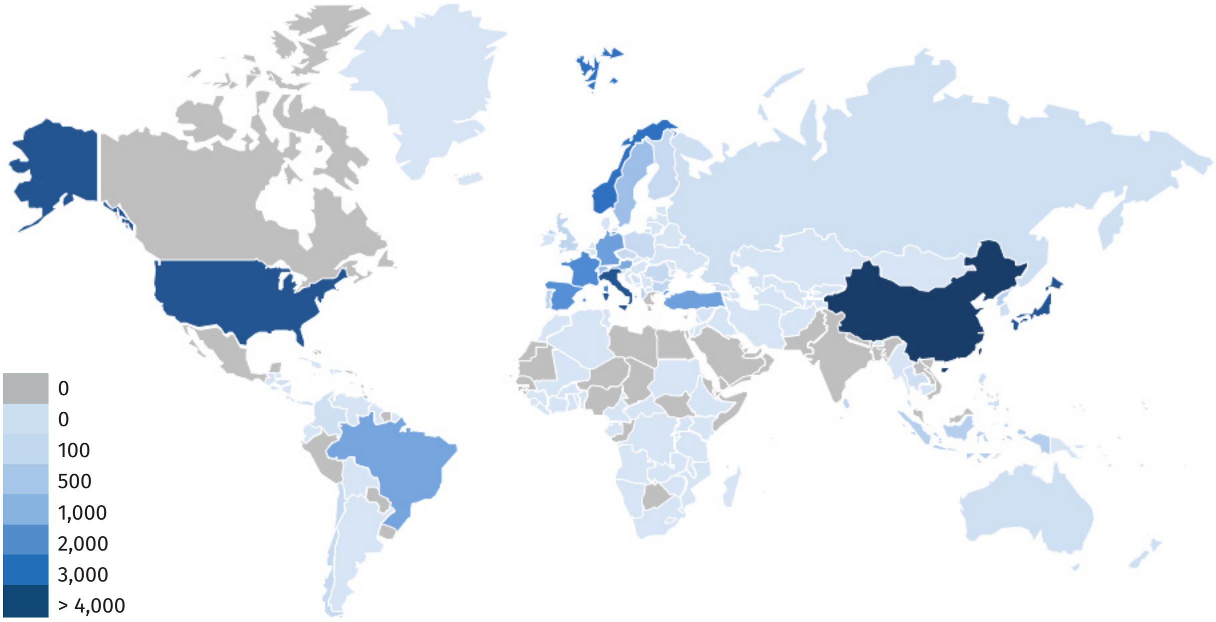


Figure 6.
Developed and Remaining Small Hydropower Potential of ≤10 MW by Region (MW)



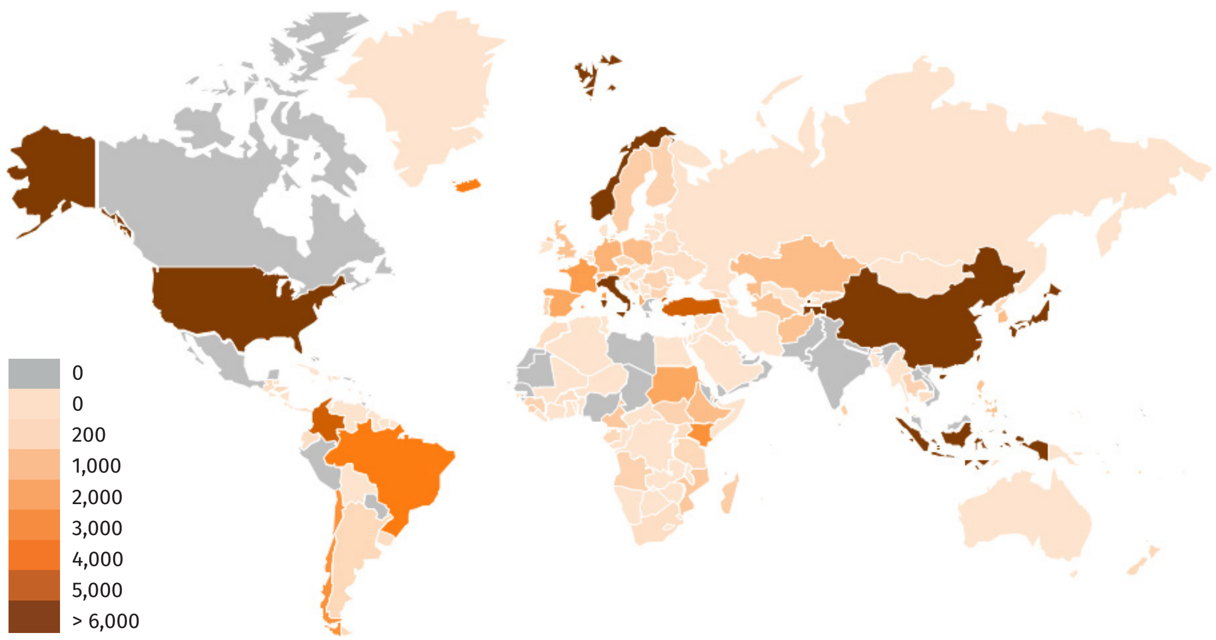
China continues to dominate the global SHP landscape, with 53 per cent of the world's total SHP installed capacity (definition of ≤10 MW) and approximately 29 per cent of the world's total known SHP potential. In terms of installed capacity, China is followed by the United States of America (USA), Italy, Japan and Norway. Together, these five countries account for almost 71 per cent of the world's total installed capacity of SHP ≤10 MW.

Figure 7.
Small Hydropower Installed Capacity of ≤10 MW by Country (MW)



Note: Highlighted in grey are countries without data on SHP of ≤10 MW or no SHP plants installed.

Figure 8.
Small Hydropower Potential Capacity of ≤10 MW by Country (MW)



Note: Highlighted in grey are countries without data on SHP of ≤10 MW.

Africa

SHP in Africa can be characterized as having a relatively low level of installed capacity but with considerable potential for development. Climatic and topographic characteristics vary tremendously across the continent, resulting in a large variance in SHP potential in the north and south as compared to the east and west. The total installed capacity of SHP ≤10 MW in Africa is 729 MW and the total estimated potential is 15,714 MW. This indicates that less than 5 per cent of the known SHP potential of ≤10 MW has been developed so far.

Eastern Africa has the highest installed capacity of SHP of ≤10 MW on the continent (53 per cent of the continental total), followed by the Middle and Northern Africa regions. The highest known SHP potential is also found in Eastern Africa (also 53 per cent of the continental total), while the lowest potential is found in Southern Africa. Of all the countries in Africa, Uganda has the highest installed capacity of SHP of ≤10 MW (108 MW), whereas Kenya has the highest estimated potential for SHP of ≤10 MW (3,000 MW).

Americas

Northern America and South America dominate the SHP landscape in all of the Americas, with Brazil and the USA being leaders in terms of installed capacity and the USA also dominating in terms of known SHP potential. Countries in the Caribbean region have significantly smaller estimated potential. However, further studies could reveal a greater potential in the region as well as in other countries in the continent.

The total SHP capacity in the Americas is 6,937 MW, while the total potential is estimated at 25,294 MW for SHP of ≤10 MW. Some countries with enormous expected SHP potential have not performed feasibility studies to determine their exact potential capacity. Mexico, for example, is a country that is suspected to have significant SHP potential but no studies have been conducted yet. At the same time, in the current edition, the continent's reported potential significantly decreased compared to the previous edition, which is primarily due to the re-estimation of the potential of Colombia. According to the available data, approximately 27 per cent of the known SHP potential capacity in the Americas has been developed.

Asia

Asia has vast SHP resources, which are, however, unevenly distributed across the continent. The total installed SHP capacity of Asia is 50,406 MW and the total estimated potential is 139,946 MW (for SHP of ≤10 MW). This indicates that approximately 36 per cent has so far been developed. The decrease in reported SHP installed capacity in comparison with the *WSHPDR 2019* is primarily due to the re-estimation of the installed capacity data for Turkey.

China dominates not only the SHP landscape in Asia but also globally, accounting for over 83 per cent of the continent's installed capacity and 45 per cent of the known potential for SHP of ≤10 MW. SHP development is one of the major priorities for countries in Asia. The key motives for SHP development on the continent are to decrease dependence on energy imports and fossil fuels and to improve access to electricity, especially in rural areas.

Europe

Europe has a long history of SHP development, which has enabled it to reach a high level of installed capacity and potential development. The overall installed capacity of SHP of ≤10 MW in the region is 20,434 MW, while the potential capacity is estimated at 39,607 MW, indicating that 52 per cent of known potential has been developed. The increase in SHP installed capacity in comparison to the *WSHPDR 2019* is mainly due to the new capacities added in Norway, Italy and Albania.

With a wide variety of climates and landscapes in the continent, SHP potential varies across the regions. The greatest remaining potential is concentrated in Northern Europe, primarily in Norway. Italy is the leader in the continent in terms of installed capacity of SHP of ≤10 MW, followed by Norway and France.

Oceania

Oceania is the smallest region in terms of the number of countries included in this Report as well as in terms of installed and potential SHP capacity. The total installed capacity of SHP of ≤10 MW amounts to 454 MW, indicating an increase of 3 per cent in comparison to the *WSHPDR 2019*. The total estimated potential is 1,106 MW, thus, approximately 36 per cent has so far been developed.

The Oceania region is very diverse in terms of SHP potential. While all the countries receive enough rainfall to merit constant SHP production, only a few of the islands have mountainous terrain, which is usually a key factor for SHP potential. The Australia and New Zealand region is the richest area regarding SHP potential in Oceania, however, further SHP development is not foreseen in the region. On the other hand, the Pacific Island Countries and Territories (PICTs) are mostly flat islands and have little or no SHP potential, thus, making topography the key barrier.

Thematic publications

Compared to the previous editions, the *WSHPDR 2022* has been expanded with three thematic publications exploring three important aspects of SHP development: gender empowerment, youth involvement and climate change. The social and environmental aspects of SHP development often do not receive the needed attention and the particularities of the SHP technology can be lost in more general analyses devoted to renewable energy technologies or hydropower. These three publications aim to address this gap in the understanding of the SHP sector by exploring the specificity of the SHP technology in terms of how it both impacts and is impacted by gender dynamics, youth representation and climate change. The information gathered in these publications is based on literature reviews and expert and stakeholder interviews and is intended to highlight key themes within each topic as well as outline some of the most important directions for further research and analysis.

"How SHP empowers women and closes gender gaps and can do more"

Empowering women and girls and closing gender gaps are critical to realizing sustainable development goals (SDG) and ensuring a good quality of life for all. The energy sector, and in particular, decentralized systems such as SHP can facilitate the achievement of these targets. SHP can provide not only sustainable energy but also a steady baseload, which can facilitate positive changes to women's lives in the communities in which SHP plants are constructed and also beyond these communities.

In countries with low levels of access to electricity, benefits of access to electricity from SHP plants for women can include reduced time poverty and drudgery due to the use of electric appliances for household chores and economic activities. This immediately improves women's welfare but can also have knock-on benefits when such time is invested in studying, income generation and other life-enhancing activities. SHP development can also create direct and indirect jobs, provide power for productive uses and income generation and improve the delivery of critical social services including education and health services. Making the gender approach part of project design and implementation is critical to ensuring that SHP projects help empower women and girls across the globe, and close gender gaps. This publication discusses some of the ways in which SHP development is empowering women and girls and closing gender gaps between women and men. Further, it discusses the barriers to women's participation in the SHP sector and makes some key recommendations for addressing these barriers.

"Prospects for youth in the small hydropower sector"

Young people around the world can play a key role in creating the change required for the transformation of the global energy system, thus, contributing to regional and international development aims, while at the same time finding and creating opportunities for their own professional and personal development. While much of the world's SHP potential remains untapped, the SHP sector offers great opportunities for young professionals and entrepreneurs to get involved in providing clean energy to communities across the world. The active participation of youth in SHP can play a vital role in achieving a sustainable energy system because young people can bring the creative and forward-oriented thinking that is needed for a rapid energy transition. At the same time, young people continue to face multiple barriers in accessing the required skills to get involved in the sector as well often do not receive the needed policy, institutional and financial support.

This publication explores different opportunities that exist for youth in the SHP sector, with examples from around the world. It also analyzes the main barriers that young professionals considering joining or transitioning to the sector face as well as existing challenges faced by young energy professionals, including young women, already involved in the SHP sector. The report also provides a list of recommendations on how to overcome the existing barriers.

"Small hydropower and climate change"

Hydropower has a dual relationship with the climate crisis — it helps mitigate the impacts of changing climate but is also subject to vulnerability because of its dependence on the hydrological regime, which is affected by climatic conditions. Hydropower projects help displace fossil fuel energy sources (particularly, oil, coal and biomass in the case of SHP) and limit global warming. At the same time, changes in runoff due to climate change can have an effect in the short term (days, months) and the long run with significant implications for the productive uses of SHP plants. Climate change also induces effects in other sectors that can cascade to SHP plant operations, with competing water uses and different requirements from the grid also affecting the operations of SHP plants. However, climate change will impact hydropower generation in different ways depending on the region. Moreover, size influences the project's role in mitigation and adaptation to climate change. Due to limited capacity to store water and control floods, run-of-river SHP plants are particularly vulnerable to changing hydrological patterns.

The current publication offers a synopsis of projected climate change impacts on SHP by region as well as makes recommendations on climate change adaptation measures to be considered for climate change-resilient SHP and indicates the key directions for further research on the topic.

Global SHP Database

As part of the new edition of the *WSHPDR* and in collaboration with local experts, UNIDO and ICSHP have created the first Global SHP Database, which aims to gather in one place and make easily accessible detailed information on SHP projects worldwide. The database consists of two sections: (a) existing SHP plants and (b) planned and potential SHP projects. Currently, it includes data from 129 countries and territories across five continents, listing 6,249 existing SHP plants and 8,860 potential and planned plants. The database is intended to serve as a source of information on the current status of SHP development by country as well as on projects that are under development or are available for investment.

The database is based on the most accurate data available, however, the completeness of data varies from country to country. Moreover, some countries have legal restrictions on sharing data on power plants publicly and, hence, these countries were not included in the database. This indicates that further efforts are required both on a local and international level, where this is possible, to compile detailed information on SHP projects to have a more complete understanding of the sector. It is hoped that the database can be further expanded in future editions.

Case studies

The case study section of the *WSHPDR 2022* comprises 12 case studies. The case studies share the best practices and experiences from a range of countries, highlighting the potential of SHP for productive use and community development. They demonstrate that SHP plants, when carefully planned and developed respecting the needs of communities and with regard to local capacities, infrastructure and environment, can provide a reliable and affordable source of electricity, revolutionizing the daily lives of communities, in particular in rural areas.

The section aims to provide real-life examples of benefits that communities can receive from SHP as well as the challenges encountered and solutions found during the implementation of SHP projects. Each case study includes a list of lessons learnt summarizing the factors that should be kept in mind while planning, developing and implementing SHP projects in order to ensure their success. This information might be particularly useful for decision-makers, students, engineers and company managers.

The case studies are gathered under the following three themes.

SHP for social and community development: Many people in the world still live without access to affordable, reliable and clean electricity. Lack of electricity is a significant barrier to human, social and community development, specifically impacting vulnerable groups, including women and young people. The case studies presented in this group (Brazil, Ghana, Japan, Kenya, Tanzania and Zambia) demonstrate the benefits that SHP can offer target communities. In particular, the discussed projects created employment opportunities, increased the standard of public service provision, improved security and education conditions. In these cases, SHP helped communities become more autonomous, stimulated local business and entrepreneurship and considerably improved life quality.

Technological solutions for SHP: SHP development and operation can be influenced by different factors, such as market, weather, site location and strict environmental regulations. A range of technical solutions exist that can help adapt the SHP technology to the local conditions and improve the control over different factors, making the SHP management more efficient and predictable. These include retrofitting of existing civil structures (Italy case), developing a compact run-of-river low-head hydropower concept (Hydroshaft), using innovative software solutions such as HYDROGRID's automated data-driven optimization for SHP cascades, intelligent operation control and dispatching systems for complementary power plants (China case), or Fichtner's Hybrid Configurator that helps design hybrid power plants and analyze their technical and financial impact.

Green SHP: Lack of appropriate regulation and control over SHP development can result in significant ecological impact including river dehydration, changed river ecology, reduced river connectivity and affected migratory fish and other aquatic species. Lack of sustainable practices, can also increase the risk of socio-environmental conflicts. To maintain the ecological safety of the sector, the future of SHP development should be in the form of green SHP, supported by regulations, guidelines, incentive policies and practices. The Ukraine case study outlines the importance of SHP construction and operation in line with the principles of ecological sustainability.

Conclusions & Recommendations

SHP is a mature and versatile technology, effective for providing access to clean and sustainable electricity both in the developing and developed world, particularly in rural areas. Through developing SHP, many countries have already taken steps — or are beginning to take steps — to alleviate poverty and increase access to electricity. SHP also helps developed nations achieve targets for advancing renewable energy and reducing greenhouse gas emissions.

The purpose of this edition of the *WSHPDR* is to illustrate the improvements achieved in the SHP sector across regions and the great positive impacts linked to SHP development. Since the publication of the first edition of the Report in 2013, the combined installed capacity of SHP in the world increased by 12 per cent reaching 79 GW. At the same time, known SHP potential is estimated at 221.7 GW. Thus, the data collected in the Report demonstrate that there is still room for improvement in the SHP sector in many parts of the world. Overall, despite the progress made in SHP development in the last few years, many of the barriers and, hence, recommendations for the further development of the sector remain similar to those listed in the previous editions of the Report.

The following recommendations for addressing the barriers to SHP development are provided as general recommendations and should not be considered comprehensive.

(a) Undertake detailed resource assessments

Developing countries should undertake detailed analyses of their SHP potential to lower development costs and encourage private investment. Developed countries would similarly benefit from undertaking detailed re-assessments of their SHP potential, accounting for new technologies, ecological conditions, regulations as well as the potential arising from the conversion of existing infrastructure and the rehabilitation of old sites.

(b) Develop appropriate policies and regulations

Policies and financial incentives already established for other sources of renewable energy should be extended to cover SHP, particularly emphasizing green technology, and clear targets for SHP development should be set. Such policies and incentives should be properly designed to account for the local conditions and draw on collaboration among agencies responsible for water resources, environment and electricity. Government agencies should also streamline the licensing process by creating a one-stop shop for standardized permits and contracts.

(c) Facilitate access to sustainable sources of financing

An overall strategy aiming to reduce the financial risks for investors should be developed. High initial costs need to be overcome with easier and improved access for project developers to be able to successfully provide finance. One measure that can mitigate this is creating awareness of SHP among local banking institutions or microfinance institutions to improve the risk assessment and provide conducive loan conditions.

(d) Facilitate access of the SHP industry to equipment and technology

The building or improvement of industries that serve as components of SHP will aid in the overall development of the SHP sector. In countries with insufficient local technology, access to imports can be aided through the establishment of concessionary duties and reduced import taxes.

(e) Provide reliable infrastructure

Developing robust grids with suitable capacity and coverage to accommodate new connections facilitates connecting SHP plants and is critical for attracting private investment. In countries with high distribution losses, investments in distribution systems should match those in the generation, to raise the overall efficiency of SHP projects. Establishing microgrids with SHP providing base-load power can also offer a short to medium-term—or even permanent—solution for electrifying remote and inaccessible communities.

(f) Improve local skills and expertise

By increasing local capacities in conducting feasibility studies, construction, operation and maintenance of SHP plants, the whole SHP sector can become more self-sufficient and long-lasting for countries.

(g) Strengthen international and regional cooperation

The promotion of SHP by international and regional institutions is essential for mainstreaming SHP as a positive renewable energy solution. On a more specific level, more information is needed on such topics as new SHP technologies, sustainable models for financing and ownership of SHP projects, the effectiveness of financial incentives for SHP development and the impact of the climate crisis on SHP. By developing South-South cooperation and triangular cooperation among developing countries, developed countries and international organizations, international and regional agencies can facilitate the transition of individual pilot SHP projects towards the successful implementation of full-scale SHP programmes.

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Attachments

Africa

Country	*Local SHP definition*	*Installed capacity (local def.)*	*Potential capacity (local def.)*	*Installed (≤10 MW)*	*Potential (≤10 MW)*
Algeria	≤10 MW	47.1	N/A	47.1	N/A
Angola	≤10 MW	46.1	600.0	46.1	600.0
Benin	≤30 MW	0.5	95.0	0.5	N/A
Botswana	N/A	0.0	N/A	0.0	1.0
Burkina Faso	N/A	N/A	N/A	5.0	246.0
Burundi	≤1 MW	2.2	30.5	17.4	61.0
Cameroon	≤5 MW	1.5	N/A	1.5	970.0
Central Africa Republic	≤10 MW	18.8	41.0	18.8	41.0
Congo	N/A	N/A	N/A	0.0	70.5
Côte d'Ivoire	≤10 MW	5.0	45.7	5.0	45.7
Democratic Republic of the Congo	≤10 MW	56.0	101.0	56.0	101.0
Egypt	N/A	N/A	N/A	0.0	120.0
Equatorial Guinea	N/A	N/A	N/A	7.5	31.9
Eswatini	N/A	8.2	16.2	8.2	16.2
Ethiopia	≤10 MW	12.9	1,500.0	12.9	1,500.0
Gabon	N/A	N/A	N/A	6.0	518.1
Gambia	≤30 MW	0.0	N/A	0.0	19.5
Ghana	≤1 MW	0.1	9.9	0.1	17.4
Guinea	≤1.5 MW	N/A	N/A	11.2	751.8
Kenya	≤3 MW	N/A	N/A	66.3	3,000.0
Lesotho	≤10 MW	3.8	38.2	3.8	38.2
Liberia	≤30 MW	4.9	592.0	4.9	N/A
Madagascar	N/A	N/A	N/A	37.0	836.0
Malawi	≤5 MW	4.7	150.0	12.9	N/A
Mali	≤30 MW	5.7	154.7	5.7	N/A
Mauritania	N/A	0.0	N/A	0.0	N/A
Mauritius	N/A	N/A	N/A	19.7	19.7
Morocco	≤10 MW	30.5	300.0	30.5	300.0
Mozambique	≤10 MW	4.8	1,000.0	4.8	1,000.0
Namibia	N/A	0.1	120.0	0.1	120.0
Niger	N/A	0.0	N/A	0.0	8.0
Nigeria	≤30 MW	57.2	734.3	N/A	N/A
Réunion	≤10 MW	10.6	16.6	10.6	16.6
Rwanda	≤5 MW	34.4	111.1	N/A	N/A
Sao Tome and Principe	≤10 MW	1.9	63.8	1.9	63.8
Senegal	≤10 MW	0.0	0.0	0.0	0.0
Sierra Leone	≤30 MW	12.2	N/A	12.2	639.0
Somalia	N/A	N/A	N/A	0.0	4.6
South Africa	≤40 MW	N/A	N/A	42.0	247.0
South Sudan	N/A	N/A	N/A	0.0	688.1
Sudan	≤5 MW	N/A	N/A	7.2	2,228.6

Country	Local SHP definition	Installed capacity (local def.)	Potential capacity (local def.)	Installed (≤10 MW)	Potential (≤10 MW)
Tanzania	≤10 MW	30.5	480.0	30.5	480.0
Togo	N/A	N/A	N/A	1.6	137.0
Tunisia	N/A	N/A	N/A	17.0	56.0
Uganda	≤20 MW	186.0	400.0	107.9	214.1
Zambia	≤20 MW	N/A	N/A	18.7	62.0
Zimbabwe	≤30 MW	31.4	N/A	16.1	120.0

Americas

Country	Local SHP definition	Installed capacity (local def.)	Potential capacity (local def.)	Installed (≤10 MW)	Potential (≤10 MW)
Argentina	≤50 MW	510.0	N/A	97.0	430.0
Belize	N/A	N/A	N/A	10.3	21.7
Bolivia	≤5 MW	N/A	N/A	99.1	N/A
Brazil	≤30 MW	6,324.6	35,765.0	1,608.2	3,737.8
Canada	≤50 MW	4,504.0	15,000.0	N/A	N/A
Chile	≤20 MW	618.0	5,145.0	304.0	2,995.0
Colombia	≤20 MW	900.8	N/A	234.6	4,946.0
Costa Rica	N/A	N/A	N/A	126.5	N/A
Cuba	N/A	N/A	N/A	21.0	77.0
Dominica	≤10 MW	6.6	N/A	6.6	N/A
Dominican Republic	≤10 MW	59.7	N/A	59.7	N/A
Ecuador	≤10 MW	112.7	356.3	112.7	356.3
El Salvador	≤5 MW	21.7	N/A	21.7	119.6
French Guiana	≤10 MW	5.5	34.5	5.5	34.5
Greenland	≤5 MW	N/A	N/A	9.0	183.1
Grenada	N/A	N/A	N/A	0.0	7.0
Guadeloupe	≤10 MW	11.6	33.0	11.6	33.0
Guatemala	≤5 MW	123.0	204.9	N/A	N/A
Guyana	≤5 MW	0.02	24.2	0.02	92.0
Haiti	N/A	N/A	N/A	6.8	37.6
Honduras	≤30 MW	288.6	N/A	148.0	385.0
Jamaica	N/A	N/A	N/A	30.6	76.2
Mexico	≤30 MW	699.3	N/A	N/A	N/A
Nicaragua	≤10 MW	26.6	104.7	26.6	104.7
Panama	N/A	N/A	N/A	147.2	263.5
Paraguay	≤50 MW	0.0	116.3	0.0	N/A
Peru	≤20 MW	503.8	3,500.0	N/A	N/A
Puerto Rico	N/A	N/A	N/A	39.3	43.9
Saint Lucia	N/A	N/A	N/A	0.0	2.7
Saint Vincent and the Grenadines	≤10 MW	5.7	7.5	5.7	7.5
Suriname	N/A	N/A	N/A	0.0	2.7
USA	N/A	N/A	N/A	3,681.0	10,583.0
Uruguay	≤50 MW	0.0	231.5	0.0	208.0
Venezuela	N/A	N/A	N/A	1.4	49.7

Asia

Country	*Local SHP definition*	*Installed capacity (local def.)*	*Potential capacity (local def.)*	*Installed (≤10 MW)*	*Potential (≤10 MW)*
Afghanistan	≤25 MW	N/A	N/A	83.2	1,200.0
Armenia	≤30 MW	382.0	431.0	340.0	N/A
Azerbaijan	≤10 MW	49.5	520.0	49.5	520.0
Bangladesh	N/A	N/A	N/A	0.0	60
Bhutan	≤25 MW	32.4	23,296.0	8.4	8.9
Cambodia	≤10 MW	1.7	300.0	1.7	300
China	≤50 MW	81,300.0	128,000.0	41,985.0	63,500.0
DPRK	N/A	N/A	N/A	522.1	N/A
Georgia	≤15 MW	263.0	723.9	212.2	491.8
India	≤25 MW	4,787.0	21,134.0	N/A	N/A
Indonesia	≤10 MW	543.0	19,385.0	543.0	19,385.0
Iran	≤10 MW	19.5	90.8	19.5	90.8
Iraq	N/A	N/A	N/A	6.0	62.4
Israel	N/A	N/A	N/A	7.0	N/A
Japan	≤10 MW	3,577.0	10,330.0	3,577.0	10,330.0
Jordan	≤10 MW	12.0	N/A	12.0	N/A
Kazakhstan	≤35 MW	255.0	2,354.4	118.0	1,380.9
Kyrgyzstan	≤30 MW	53.8	N/A	53.8	311.8
Lao PDR	≤15 MW	162.0	2,287.0	N/A	N/A
Lebanon	≤10 MW	31.2	144.8	31.2	144.8
Malaysia	≤30 MW	296.0	1,500.0	N/A	N/A
Mongolia	≤10 MW	4.7	129.5	4.7	129.5
Myanmar	≤10 MW	42.9	114.0	42.9	114.0
Nepal	≤25 MW	662.5	4,000.0	N/A	N/A
Pakistan	≤50 MW	445.0	3,190.0	N/A	N/A
Philippines	≤10 MW	145.0	1,265.0	145.0	1,265.0
Republic of Korea	≤5 MW	N/A	N/A	199.5	1,500.0
Saudi Arabia	N/A	N/A	N/A	0.0	130.0
Sri Lanka	≤10 MW	425.0	873.0	425.0	873.0
Syria	≤10 MW	23.0	67.6	23.0	67.6
Tajikistan	≤30 MW	142.1	N/A	54.7	30,000.0
Thailand	≤6 MW	190.4	700.0	N/A	N/A
Timor-Leste	≤50 MW	0.4	N/A	0.4	219.8
Turkey	≤10 MW	1,662.2	4,891.5	1,662.2	4,891.5
Turkmenistan	N/A	N/A	N/A	1.2	1,300.0
Uzbekistan	≤30 MW	303.6	1,392.0	87.8	N/A
Viet Nam	≤30 MW	3,600.0	7,200.0	N/A	N/A

Europe

Country	*Local SHP definition*	*Installed capacity (local def.)*	*Potential capacity (local def.)*	*Installed (≤10 MW)*	*Potential (≤10 MW)*
Austria	≤10 MW	1,521.6	1,780.0	1,521.6	1,780.0
Albania	≤15 MW	482.0	N/A	432.0	1,963.0
Belarus	≤10 MW	17.3	250.0	17.3	250.0
Belgium	≤10 MW	76.0	103.4	76.0	103.4
Bosnia & Herzegovina	≤10 MW	172.2	1,005.0	172.2	1,005.0

Country	*Local SHP definition*	*Installed capacity (local def.)*	*Potential capacity (local def.)*	*Installed (≤10 MW)*	*Potential (≤10 MW)*
Bulgaria	N/A	N/A	N/A	494.7	580.7
Croatia	≤10 MW	45.7	100.0	45.7	100.0
Czech Republic	≤10 MW	353.0	465.0	353.0	465.0
Denmark	≤10 MW	7.0	9.8	7.0	9.8
Estonia	≤10 MW	8.0	10.0	8.0	10.0
Finland	≤10 MW	297.5	585.5	297.5	585.5
France	≤10 MW	2,200.0	2,615.0	2,200.0	2,615.0
Germany	N/A	N/A	N/A	1,674.0	1,830.0
Greece	≤15 MW	247.2	2,000.0	N/A	N/A
Hungary	≤5 MW	17.1	28.0	N/A	N/A
Iceland	≤10 MW	66.1	3,742.0	66.1	3,742.0
Ireland	≤10 MW	58.5	70.7	58.5	70.7
Italy	≤10 MW	3,648.4	7,073.0	3,648.4	7,073.0
Latvia	≤10 MW	28.0	96.0	28.0	96.0
Lithuania	≤10 MW	26.9	57.9	26.9	57.9
Luxembourg	≤10 MW	25.3	44.0	25.3	44.0
Moldova	N/A	N/A	N/A	0.3	7.2
Montenegro	≤10 MW	34.7	97.5	34.7	97.5
Netherlands	≤10 MW	13.0	N/A	13.0	N/A
North Macedonia	≤10 MW	111.4	258.0	111.4	258.0
Norway	≤10 MW	2,924.0	7,162.0	2,924.0	7,162.0
Poland	N/A	N/A	N/A	291.7	1,500.0
Portugal	≤10 MW	415.0	750.0	415.0	750.0
Romania	≤10 MW	321.0	730.0	321.0	730.0
Russia	≤30 MW	852.9	825,844.6	168.4	N/A
Serbia	≤30 MW	N/A	N/A	109.0	N/A
Slovakia	≤10 MW	81.6	145.0	81.6	145.0
Slovenia	≤1 MW	N/A	N/A	164.0	180.0
Spain	≤10 MW	2,145.0	2,158.0	2,145.0	2,158.0
Sweden	≤10 MW	961.0	N/A	961.0	N/A
Switzerland	≤10 MW	1,000.0	1,500.0	1,000.0	1,500.0
Ukraine	≤10 MW	119.6	280.0	119.6	280.0
United Kingdom	≤10 MW	405.0	1,179.0	405.0	1,179.0

Oceania

Country	*Local SHP definition*	*Installed capacity (local def.)*	*Potential capacity (local def.)*	*Installed (<10 MW)*	*Potential (≤10 MW)*
Australia	≤10 MW	175.0	N/A	175.0	N/A
Federated States of Micro-nesia	N/A	N/A	N/A	0.7	9.0
Fiji	≤10 MW	11.3	43.2	11.3	43.2
French Polynesia	≤10 MW	48.6	98.0	48.6	98.0
New Caledonia	≤10 MW	13.0	100.0	13.0	100.0
New Zealand	≤50 MW	475.0	N/A	146.8	489.8
Papua New Guinea	≤10 MW	41.0	153.0	41.0	153.0
Samoa	N/A	N/A	N/A	15.5	22.0
Solomon Islands	N/A	N/A	N/A	0.4	11.0
Vanuatu	N/A	N/A	N/A	1.3	5.4

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