Hydropower regains the lead in several key categories

IN 2013 the cumulated hydropower capacity reached 1,103 GW, with an estimated annual electricity generation of around 3,704 TWh/y. This growth positioned hydropower energy as the highest cumulated installed capacity among renewable energy sources. Intriguing, considering that over the last two years solar and wind power generation actually grew faster than hydropower.

What's even more fascinating is that more than 60% of the installed capacity in the beginning of 2013 came from China, making this market in the most active in the field during 2013. In fact, according to the report, the majority of the installed pumped storage capacity was generated in Asia — which currently has about 50 GW of cumulative installed capacity [3]. Specifically, Japan lead the pack with more than 25 GW installed capacity, followed by China with 14.3 GW.

By comparison, Europe accounted for 49 GW in pumped storage capacity. Italy, Spain, Germany and Switzerland held the greatest share, followed by the UK region. Ukraine alone added approximately 2.26 GW in 2013.

The US accounted for 22.5 GW installed pumped storage capacity in 2013, although the country did not see any "additional" installed capacity [3].

Major projects

Among the most prominent hydropower projects completed in 2013: Xiluodu, China (13,68 GW), which began impounding in May 2013; the project will be completed in 2015. Then there was the Xiangjiaba HPP plant (6,4 GW), which was fully completed in 2013. Several units of vast hydropower projects such as Guanyinyan (3 GW), Jinping I and II as well as Longkaikou were commissioned within 2013.

The Theun-Hinboun expansion project (280 MW), which was recently inaugurated, brought the total combined capacity to 500 MW. The 220 MW Sangtuda-2 hydro project officially began operation in April 2013 in Tajikistan.

In Turkey, several hydropower projects were commissioned in 2013: Köprü (145 MW) and Kandil (214 MW). In Greece there is Sykia (126 MW), Ilarion (158 MW) and Messochora (162 MW).

Elsewhere, Mexico completed the La Yesca CFRD project (750 MW). And in Canada the 200 MW Wuskwatim hydroelectric project was commissioned.

In Brazil, two new plants came into operation: Rio Madeira (626 MW) and Maua (361 MW). This on the heels of the 1GW Estreito Hydroelectric Power Plant, which came into operation at the end of 2012 under Brazil's "Program of Acceleration of Growth" programme.

In Africa, the Bujagali scheme in Uganda (250 MW) was fully commissioned.

Lastly, in Luxembourg, the Vianden plant (200 MW) is presently in the commissioning phase.

Under construction

China, which accounts for 249 GW of total installed capacity, continues its expansion. The country increased its capacity by nearly 137 GW since

Region	Cumulated installed capacity 2013		Installed capacity 2013		Estimated electricity generation 2013	
	[GW]		[GW]		[TWh]	
North American	194.1		2.2		728.4	
South American	142.7		2.4		643.9	
Europe	240.7		1.9		657.7	
Asia	484.6		32.4		1512.8	
Oceania	14.2		0.0		41.4	
Africa	27.6		1.0		120.7	
World Total	**1,103**		**39.9**		**3,704**	
Largest National Market	China	249	China	25.1	China	864

Table 2. Summary of the global hydro power market in 2013 [2].

Figure 3. The 214 MW Kandil Dam and Hydroelectric Power Plant in Turkey.

2001, and it currently has 53 GW under construction [7]. This includes work at various vast hydro projects, such as Nuozhadu (5,85 GW), where a unit is also now in operation. At least 10 other large-scale projects are under construction in China, with capacities ranging from 1500 to 4000 MW.

In Vietnam, the 1200 MW Lai Chau scheme — the country's largest — is under way on the Da River. Elsewhere, in Nepal, a very active programme of development is presently under way. In fact, the Upper Tamakoshi plant (456 MW) is now nearing completion. Other large projects include Upper Seti and Budi Bandhaki.

In the Middle East, the 969 MW Neelum Jhelum scheme in Pakistan is on schedule for completion in 2016. In addition, funding was secured for the 1400 MW Tarbela extension as well as the Diama Basha facility (4500 MW). Completion is scheduled for 2020. Other large hydropower plants such as Akhori and Munda are also planned.

One of largest hydro schemes currently under way is the Skavica project (350 MW) in Albania on Upper Drin River. Germany is upgrading the Waldeck pumped-storage scheme, with a new 300 MW plant scheduled to be built alongside the existing 440 MW facility. A big pumped-storage scheme Atdorf with 1400 MW is under construction at Black Forest Mountains.

Meanwhile, Switzerland is continuing with Nant de Drance (600 MW), Linth-Limmern (1000 MW) and Lago Bianco (1000 MW) pumped-storage plants. Austria is moving forward with the Kaunertal extension as well as the Reisseck II pumped-storage plant.

Elsewhere, Spain is upgrading the La Muela II PSP and is planning to upgrade the Aguayo PSP adding additional 360 MW to the existing capacity of 1000 MW.

The Russian Federation this year plans to re-commission the Sayano Shushensk power plant (6400 MW) in Siberia and jump-start the 3000 MW Boguchany plant; 6 of 9 units are already commissioned.

In Africa, the Grand Renaissance (5250 MW) and the 1870 MW Gibe III schemes are progressing in Ethiopia, with the first unit due to come online in 2014. Other projects currently under way: Lauca (2000 MW) and Cambembe II; the 1500 MW Mphanda Nkuwa scheme in Mozambique. In

addition, the Governments of Zambia and Zimbabwe are firmly committed to the Batoka Gorge scheme (with its target capacity of 1600 MW). The Mambilla HPP with about 2600 MW in Nigeria is still moving forward.

In Latin America, the 3750 MW Jirau scheme in Brazil is on schedule for commissioning in 2015. Ten large-scale schemes are under way, including preliminary work at Belo Monte (11 GW), after many setbacks and suspensions of work at this major project [8].Chile has more than 6000 MW at the design stage, the most significant scheme being the HidroAysen complex, which would comprise five plants totaling 2750 MW. Peru has 1500 MW under construction, including the 406 MW Chaglla schme on the Huallaga River. In Ecuador, the Paute-Sopladora plant has a capacity of 487 MW, with development of the 253 MW Toachi-Pilaton complex under way.

Lastly, in Venezuela there are the Tacoma CFRD and 2160 MW Manual Pilar power plants, which are near completion. In Colombia major projects like Sogamoso (820 MW) and Quimbo (400 MW) are under way.

Small Hydropower market

Even the small hydropower market is dominated by China, primarily due to rural electrification programs promoted by the Chinese government. A small hydro potential in China is equivalent to about 128 GW [9]. Currently, more than 30 % of China's counties depend on small hydro. This number is continuously increasing year by year, growing to around 65 GW in 2013. By 2014, we estimate that around 90 GW will have been installed around the globe.

Pump storage plants

In recent decades the solar and wind energy sectors received a lot of incentives and favorable policies — which partially explains why the installed capacity has grown tremendously. But these two renewable energy technologies are not capable of storing energy, and the intermittency of its variable energy makes essential to have PSP plants for grid flexibility, which is nowadays still by far the most commercially proven technology available for grid-scale energy storage. Modern pump storage plants can achieve around 80% efficiency in energy conversion. Improvements can be seen in modern reversible pump-turbines, adjustable-speed pumped turbines, new equipment controls such as static frequency converters and generator insulation systems [10].

Currently there are approximately 132 GW of power capacity of pump storage plants in operation throughout the world, representing 12% of the total. In 2013 Europe had around 49 GW of PSP installed capacity. Plans are in place to grow, over the next ten years, overall capacity in the Alpine regions (Switzerland, Austria, Germany). China is planning a 3.6 GW pump storage plants in Hebei Province, which would be the world's largest, and Indonesia is building the 1040 MW Upper Cisokan PSP. At the Ingula PSP in South Africa, an installed capacity of 1332 MW is planned for 2014. In Spain and Portugal, capacity has decreased.

In Africa, there is considerable potential for further development of hydropower. Technically feasible potential is estimated at 400 GW, but the installed capacity is only 25 GW.

Untapped hydropower in Africa

Hydropower as a secure and cost-effective way of energy generation represents an increasingly attractive option to emerging countries seeking further extension and stabilisation of their power supply.

In Africa, for instance, there is considerable potential for further hydropower development: The technically feasible hydropower potential on the continent amounts to an estimated 400 GW while the installed capacity amounts to no more than about 25 GW. Thus, the highest percentage of untapped hydropower potential in the world is in Africa.

In Angola, the hydropower potential is estimated to be around 18 GW, with only four percent of that amount under development so far. Industry watchers say the country intends to significantly invest in its energy sector in the coming years. As part of this, a considerable share of the enhanced electricity generation is supposed to originate from hydropower.

Many other countries in Africa also focus on hydropower when approaching the necessary expansion of the local energy supply. These countries are aiming to provide a reliable and stable electricity supply to the dynamically growing population as well as the increasingly developing local economy.

Source: Voith

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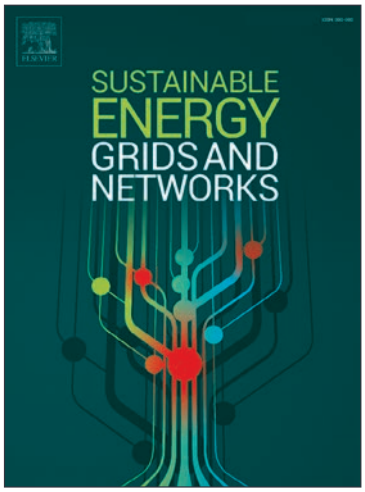

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