Hydropower in Asia Pacific

August 2015

Produced by:

EMIS™
A Euromoney Institutional Investor Company

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I. Region Overview

Region Definition

Asia Pacific

Asia Pacific economies

Country	Status as per World Bank, 2015	ASEAN Member	MRC Member
Cambodia	Low-income	x	x
China	Upper-middle-income		Upstream partner
India	Lower-middle-income		
Indonesia	Lower-middle-income	x	
Lao PDR	Lower-middle-income	x	x
Malaysia	Upper-middle-income	x	
Philippines	Lower-middle-income	x	
Thailand	Upper-middle-income	x	x
Vietnam	Lower-middle-income	x	x

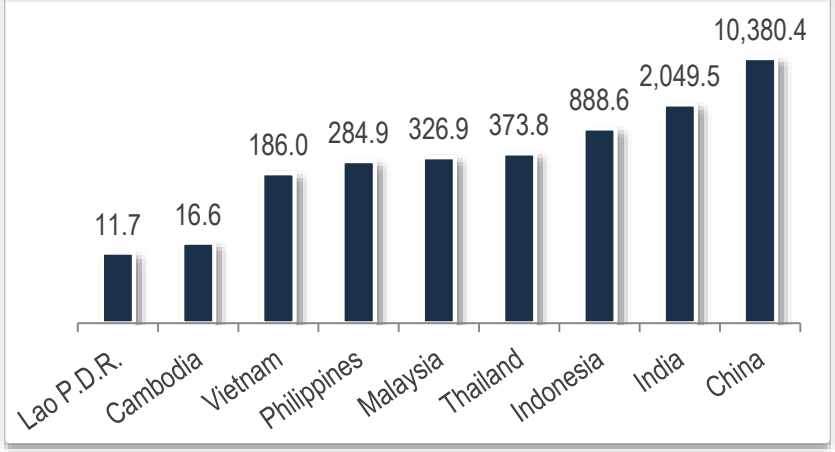
Comments

In this report, the Asia Pacific region includes Cambodia, China, India, Indonesia, Laos, Malaysia, The Philippines, Thailand, and Vietnam. Important regional unions include the Association of South East Asian Nations (ASEAN) and the The Mekong River Commission (MRC). ASEAN is a political and economic organization, set to launch a single market for goods, services, capital and labor by the end of 2015. ASEAN members expect hydropower to have the second-fastest growth rate after coal, as countries develop their vast hydropower potential for electricity trade with neighbours. MRC is the inter-governmental agency that works for joint management of shared water resources and sustainable development of the Mekong River – the most important hydropower source in the region.

Source: ASEAN, MRC, World Bank

Economic Growth

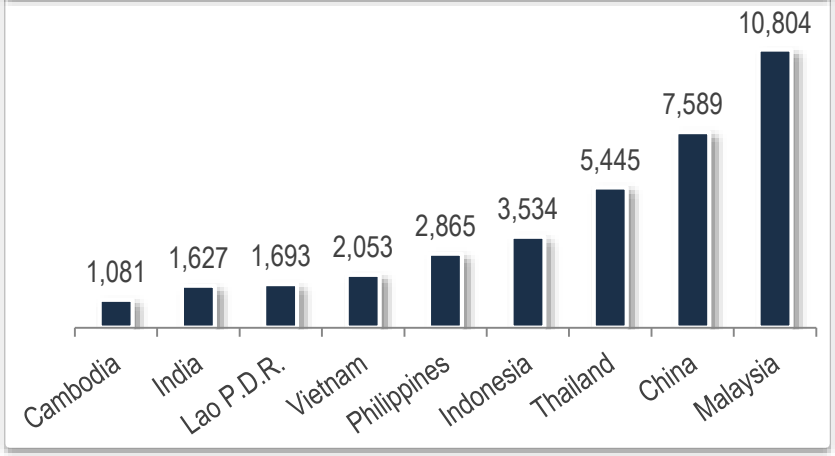
GDP 2014, current prices, USD bn



Real GDP growth, annual change, %

	2013	2014	2015f	2016f
Lao P.D.R.	7.97	**7.41**	7.31	7.85
China	7.75	**7.36**	6.76	6.30
India	6.90	**7.17**	7.46	7.47
Cambodia	7.43	**6.97**	7.20	7.19
Philippines	7.18	**6.10**	6.71	6.30
Malaysia	4.75	**6.02**	4.80	4.90
Vietnam	5.42	**5.98**	6.00	5.80
Indonesia	5.58	**5.03**	5.20	5.50
Thailand	2.89	**0.71**	3.71	3.97

GDP per capita 2014, current prices, USD



Comments

- According to the latest IMF Regional Economic Outlook for Asia and the Pacific (April 2015), growth in the region will continue to outperform the rest of the world. The regional average is expected to remain steady at 6.1% in 2015 and 2016.
- Growth rates across the region are mixed: China is gradually slowing down, whereas the forecast for India is that it will accelerate to surpass China.
- India, Laos and Cambodia are expected to be the best performers in 2015 and 2016, with economy expansion rates of over 7.0%.

Source: IMF

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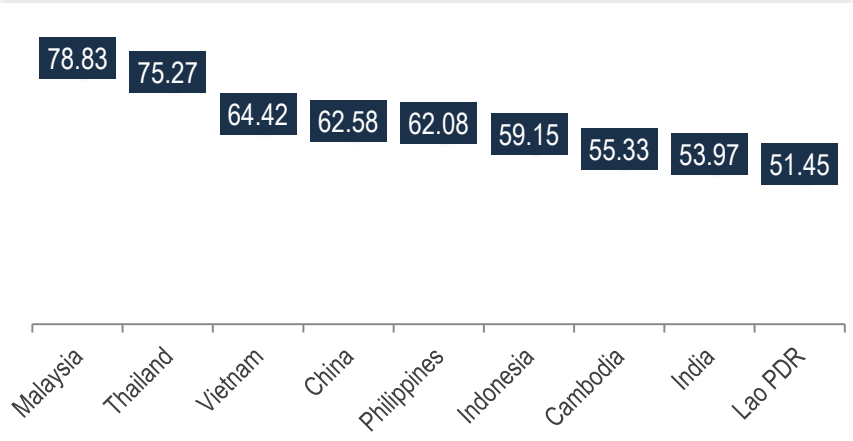
Policy Challenges

Ease of doing business 2014, distance to frontier



Global competitiveness index 2014-2015

	Global rank (out of 144)
Malaysia	20
China	28
Thailand	31
Indonesia	34
Philippines	52
Vietnam	68
India	71
Lao PDR	93
Cambodia	95

Comments

- Overall, the high growth rates in the Asia Pacific region have been driven by increasing domestic demand, low interest rates, and low international oil prices.
- Even if these trends are expected to continue in the short-term, policy issues may influence the economic environment and restrict development prospects.
- Malaysia seems to be on the right path to achieve favourable regulatory environment, but the rest of the region needs more efforts to create a supportive business climate, which in turn can boost investments and trade.

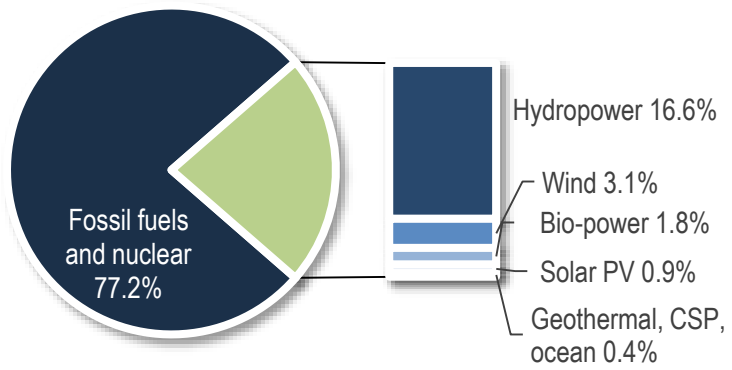
Notes:

- The World Bank's distance to frontier score assesses the regulatory environment by capturing the gap between a country's performance and a measure of best practice across 31 indicators affecting the life of a business. On a scale 0-100, 0 represents the lowest performance and 100 represents the frontier.
- The World Economic Forum competitiveness index ranks countries based on 114 macroeconomic and business aspects of competitiveness.

Source: World Bank, World Economic Forum

Hydropower – Global Overview

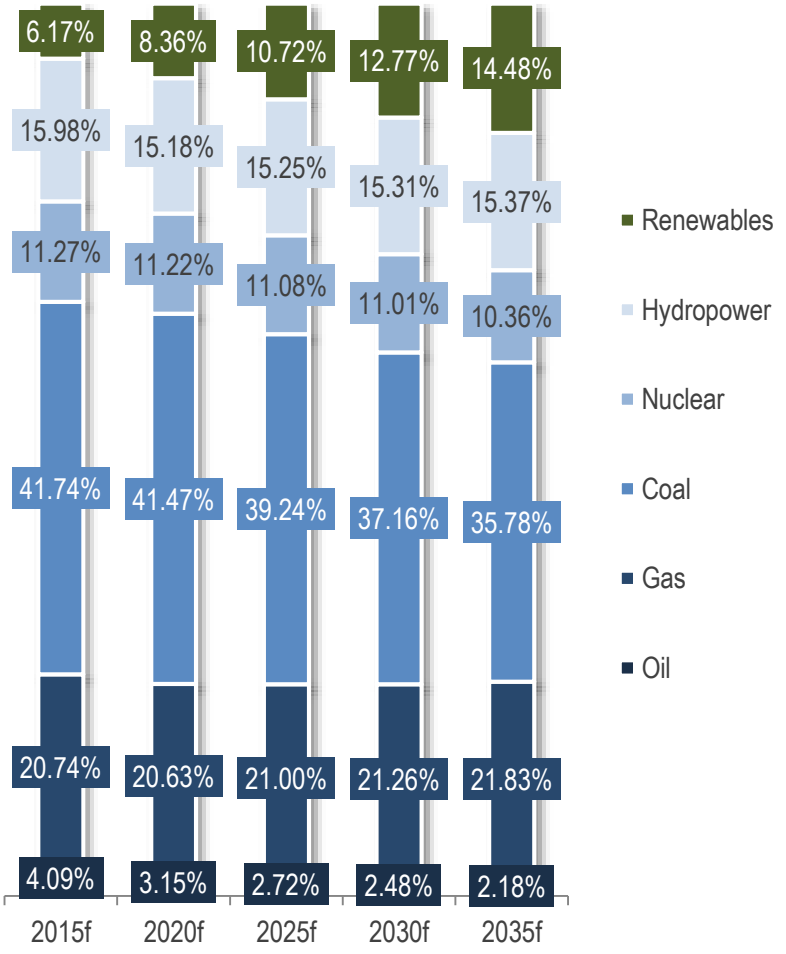
Global electricity production, 2014



Comments

- Hydropower is the leading renewable source for electricity generation. Globally, hydropower is likely to maintain a constant share in the power generation mix.
- In regional terms, Asia Pacific is the largest hydropower consumer. Its share in the period until 2035 is to gradually increase from 37% in 2015 to 40% in 2035. South and Central America ranks second, consuming half as less hydroelectricity.

Power sector inputs, outlook



Source: REN 21, BP Energy Outlook 2035

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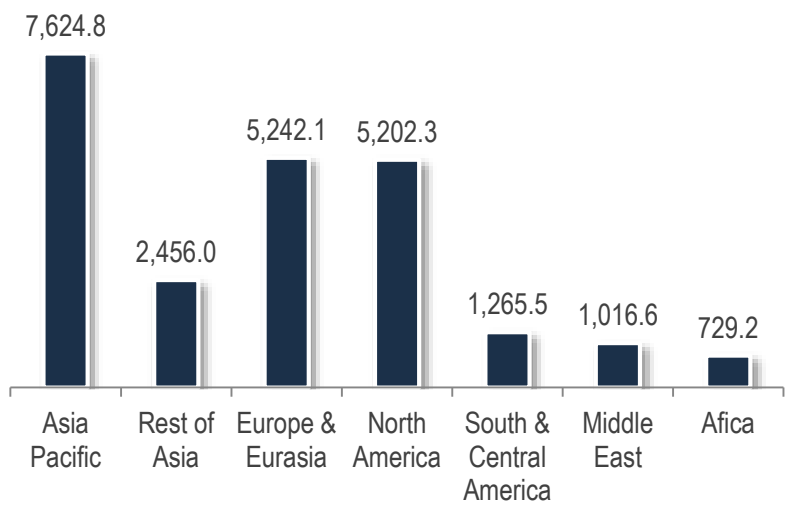
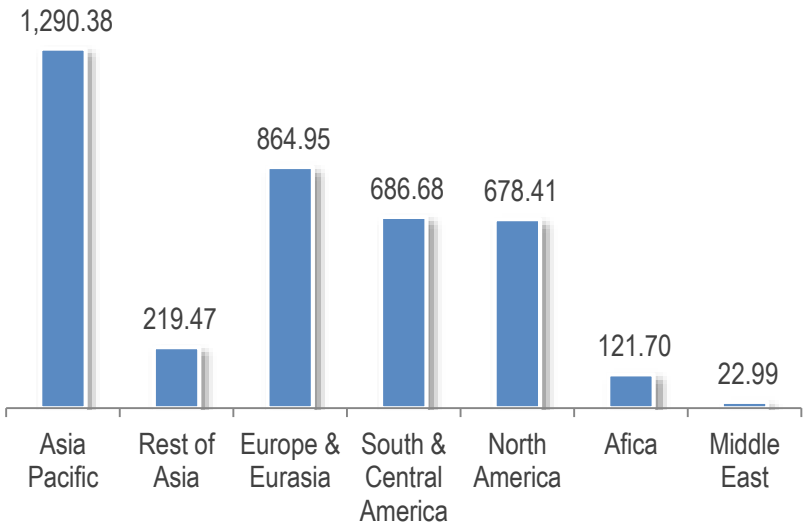
Hydropower Consumption

Electricity generation in 2014, TWh



Consumption of hydroelectricity in 2014, TWh



Comments

In 2014, total installed hydropower capacity was 1,055 GW. It generated 16.6% of the world's electricity from all sources, and more than three-quarters of all renewable electricity.

The Asia Pacific region has the largest power installed capacity in the world, generating over 7,600 TWh of electricity in 2014. The region accounts for about 40% of the global hydropower capacity.

Source: BP, IRENA

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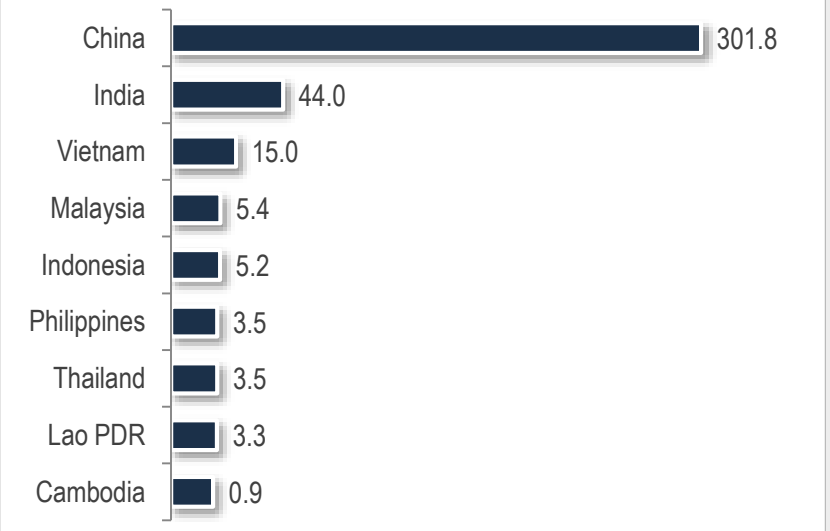
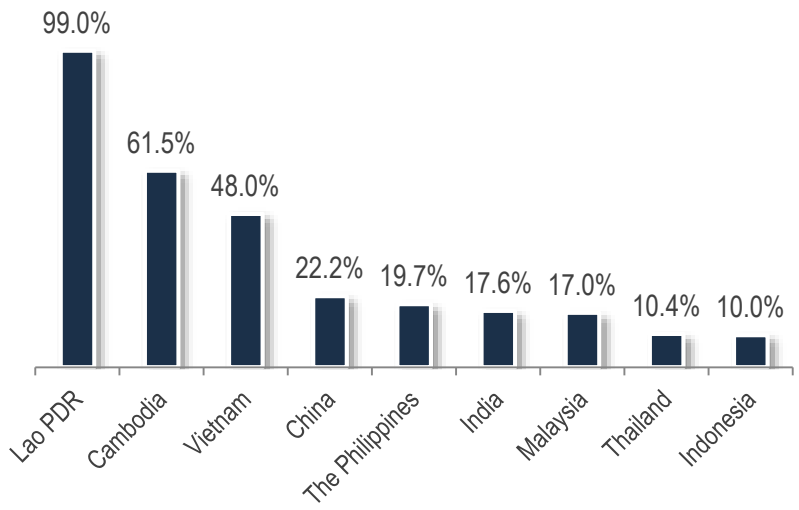
Hydropower in Asia Pacific

Hydropower installed capacity as of 2014, GW



Hydropower as % of total power capacity



Comments

The Asia-Pacific region has installed hydropower capacity of over 380 GW as of end-2014, with significant potential remaining for development. Globally, an estimated 37 GW of hydropower capacity was commissioned in 2014, of which 22 GW were added in China.

Overall, the Asia-Pacific region has the fastest growing energy demand in the world. Developing hydropower has become a priority for most governments, as they aim to increase power supply, decrease carbon emissions, and achieve higher electrification rates even in remote areas.

Source: BP, IRENA

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Hydropower Targets

Targets as stated in countries' energy plans	
China	330 GW hydropower capacity by 2017
India	2.1 GW small hydro (<25 MW) added 2012–2017
Vietnam	19.2 GW hydropower capacity by 2020
Malaysia	500 MW small hydro by 2018
Indonesia	2 GW hydropower and 3 GW pumped storage by 2025
Philippines	5,398 MW new hydropower capacity addition by 2030
Thailand	376 MW small hydro by 2036, increase share of imported hydroelectricity from 6% to 15%
Lao PDR	10 GW hydropower capacity by 2019
Cambodia	77% of power generation capacity by 2030

Comments

- Hydropower is well-recognized as a clean, grid-friendly and inflation-free energy resource. This has prompted governments to set up medium and long-term power sector strategies, in which renewable energy, and hydropower in particular, is prioritized.
- The main driver for hydropower market development is the increased electric power demand. Annual demand growth rates in most Asian countries are well above the global average of around 3%: 5% in Malaysia and the Philippines, 7% in Indonesia, 10% in Vietnam.
- The need for carbon-free energy sources is another reason to include hydropower in power sector strategies. According to IEA's World Energy Outlook, hydropower will have the second-fastest growth rate after coal in ASEAN countries.
- Hydropower projects can also provide the benefits of energy storage and other ancillary services that contribute to improved grid management.

Source: Country energy plans, IEA

Key Development Risks

Grid infrastructure

- In most emerging Asian economies, addressing the infrastructure deficit and improving regional connectivity are obstacles to project development.
- As hydropower resources are unevenly distributed in the region, often far from centres of demand, countries have to invest significant amounts in the construction of transmission and distribution networks.
- To illustrate, IEA projects that about USD 990bn are required for ASEAN's power sector development through to 2035, of which USD 550bn are for transmission and distribution.

Environmental and social impacts

- The Mekong river is the world's largest and most productive inland fishery, sustaining a population of 60 million, mainly rural.
- The dam building programme for the Mekong mainstream and tributaries is highly controversial in terms of environmental and social impacts. Communities downstream in Laos, Cambodia and Vietnam require longer public consultations and extended impact assessment studies. Two large dam projects in Laos are currently challenged and face implementation delays.
- The oversight of regulators is increasing as well. Vietnam has a history of revoking investor licenses for mismanaging relevant issues.

Financial barriers

- Hydropower, particularly large-scale, is capital-intensive, and provision of up-front financing is critical for project development. Countries rely largely on private and/or foreign investors to overcome this barrier.
- Hydropower development requires central planning, carried out by public institutions. Investors have higher risk perceptions, linked to uncertainties in the licensing process, local acceptance, and the energy purchase agreements.
- Subsidized electricity prices is an ongoing issue in the region, leading to under-recovery of costs and insufficient revenues to support new investments in the sector.

Trade dependence

- Developing hydropower exclusively for industrial expansion (e.g. Sarawak/ Malaysia) and electricity exports (e.g. Laos) carries the risk of over-dependence on one off-taker.

Source: EIU, IEA,

II. Country Profiles

China

Overview

China has the largest hydropower sector in the world, with installed capacity over 300 GW and annual power output of 944 TWh as of 2014. The hydropower sector growth is driven by the ambition to decrease the thermal power share in total power generation, in order to lower pollution emissions. The main risks to implementing the capacity expansion plans include concerns over extended dry periods, management of environmental and social impacts, as well as inability to solve generation and transmission inefficiencies and to cope with excess capacity.

Hydropower Capacity	Hydropower makes up about 15% of the country's total power generation. As in previous years, China dominated the market for new hydro development and total installed capacity, adding 22 GW of new capacity in 2014. The country plans to raise its hydropower capacity to 350 GW by 2020. Previously, the government intended to achieve 325 GW of hydro by end-2015, however projects have been delayed due to issues related to environmental impacts and population displacement. The Xiluodu plant (13.86 GW) was fully completed in 2014 and became the third-largest HPP in the world after the Three Gorges and Brazil's Itaipu.
Sector Structure	The State Electricity Regulatory Commission (SERC) is the regulator of all power enterprises. Three departments at the e State Economic and Trade Commission (SETC) take the lead in direct support for renewable energy development. In 2015, the China Electricity Council proposed the establishment of a Commission for Hydropower Development, with the aim to coordinate planning and management of hydropower resources. One of its critical tasks will be the implementation of a rational planning of the hydropower resources in the Southwest by the end of 2015.
Small Hydropower	China is the largest market for small hydropower in the world. The defining threshold for small hydro there is the highest globally - 50 MW. SHP development in China is mainly driven by government rural electrification programs. By 2012, there were more than 45,000 SHP with a total capacity exceeding 65 GW, and annual power output of over 217,000 GWh - accounting for over a quarter of the country's total hydropower output. Risks to SHP often stem from administrative and regulatory issues, which lead to delays in project approvals.

Source: Reuters, China Electricity Council, China Society for Hydropower Engineering

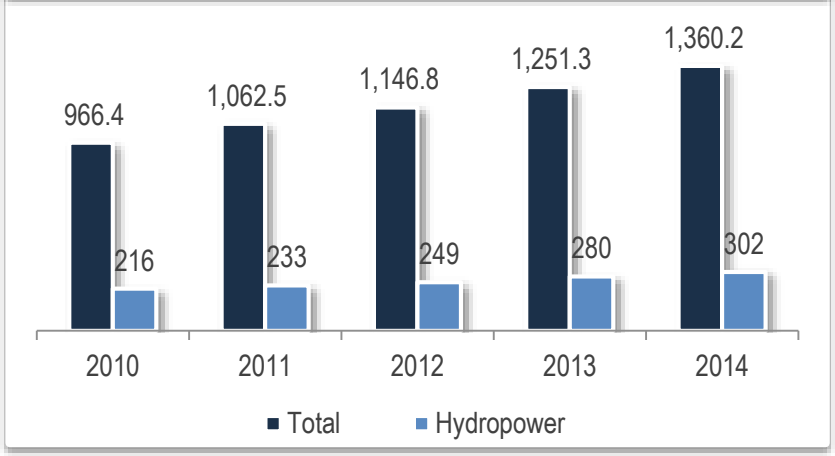
Current Trends and Outlook

Renewables Excess Capacity Rules	China's surplus hydroelectric power generation is estimated at more than 10 GWh per year, and is expected to grow with new plant installations National authorities are expected to improve coordination of local resources development and market sales, as well as to impose stricter control on capacity expansion in areas with supply surplus. Among the main government priorities for the sector in 2015 has been speeding up of inter-provincial transmission network construction, so as to avoid cancelling power production. The problem is prominent mainly in the southwestern region of China, Sichuan province in particular, where numerous hydropower plants exists (including private ones). Local producers expect approval of a new transmission grid from the Southwest to Eastern consumers. In September 2014, a direct sales pilot was initiated in Yunnan province: Huaneng Lancang River Hydropower Station is to sell surplus hydroelectric power to surrounding industrial consumers.
Support Schemes	In the beginning of 2014, China's National Development and Reform Commission announced an increase of the price grid operators pay to hydroelectric power plants. Previously, hydropower prices were based on a formula that weighted development costs against other factors, however the resulting price was generally lower than the wholesale price of conventional electricity. China is expected to promote hydropower electricity consumption by introducing price mechanisms for peak and dry seasons, as well as for peak and weak hours of electricity consumption in 2015. Hydropower stations (including pumped storage) with installed capacity over 1,000 MW can apply the VAT "Same Time Levy and Rebate" preferential policy as follows: until December 2015 – for VAT burden exceeding 8%, and from Jan. 2016 to Dec. 2017 – for VAT burden exceeding 12%.
Competitive Landscape for Suppliers	Foreign companies have been attracted to China's hydropower boom: European power generation equipment suppliers Alstom, Andritz and Voith have been steadily gaining market share (e.g. Alstom reported 20% market share of the total Chinese installed capacity of large hydropower equipment in 2014), however domestic companies are aggressively reversing this trend. Harbin Electric and Dongfang Electric have become leaders in China's hydropower generator market in terms of installed capacity, and rank among the top 3 together with Alstom. In this competitive landscape, foreign manufacturers are likely to differentiate themselves by more sophisticated quality, whereas domestic manufacturers are likely to remain more price competitive.

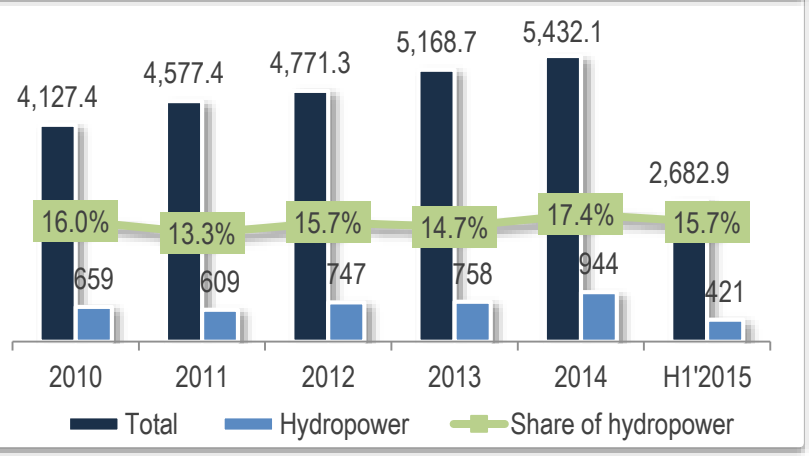
Source: EY, hydroworld.org, KPMG, The Climate Group

Capacity and Generation

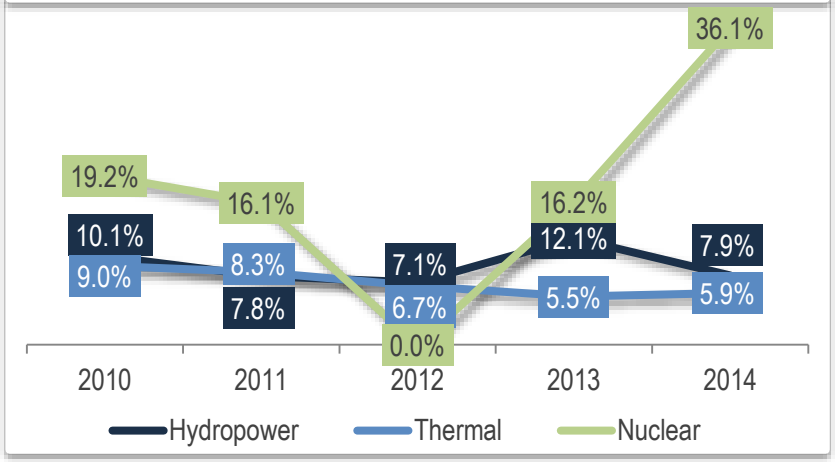
Installed power capacity, GW



Electricity generation, TWh



Annual growth rates of installed capacity, %



Comments

- The share of hydropower in the installed power generation mix has been steady at about 22% since 2010. The average annual growth rate of total installed capacity (thermal, hydro, nuclear, renewables) for 2010 - 2014 was 9.3%. It should be noted that the high wind and solar PV annual growth rates for this period are off the chart.
- Thermal power (97% of which is coal) has accounted on average for about 78.3% of the power generation since 2010. Hydropower is the second-largest electricity source in the power mix.

Source: China Electricity Council, China National Bureau of Statistics

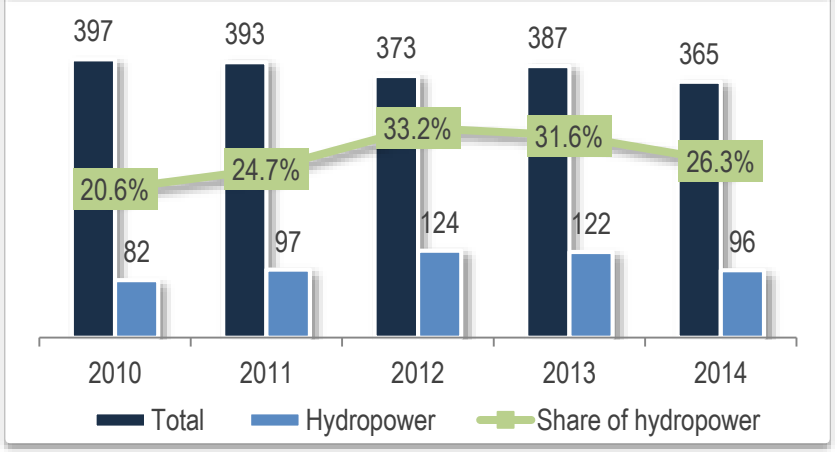
Top Listed Companies

Top five listed companies by operating revenue, RMB mn			
Company	**2014 Revenue**	**2014 Assets**	**Notes**
Power Construction Corporation of China Ltd. (Sinohydro Group Limited)	167,091	286,757	Power Construction Corporation has completed nearly 65% of China's large-scale hydropower projects or nearly 165,000 GW, including the massive Three Gorges project
China Gezhouba Group Co., Ltd.	71,605	104,900	In 2014, the company signed domestic and overseas contracts for hydropower engineering projects for RMB 33.46bn, which accounted to 24% of the company's total contracted value. The previous year, new contracted value of hydropower projects stood at RMB 68.6bn or about 57.65% of the total.
China Yangtze Power Co., Ltd.	26,898	146,994	The company operates the Three Gorges Dam. By the end of 2014 the company had an installed hydropower capacity of 25.28 GW, and was entrusted for the operation of 20.26GW.
Anhui Water Resources Development Co., Ltd.	8,409	12,340	The hydropower business achieved revenue of RMB 49mn in 2014 - an increase of 2.85% over 2013.
Guangxi Guiguan Electric Power Co., Ltd.	5,703	22,142	Total installed capacity of the company reached 5,672 MW at the end of 2014, of which hydropower capacity was 4,109 MW. Hydropower output reached 17.37 TWh in 2014, increasing by 43% over 2013, and driving the total company revenue up by 15%.

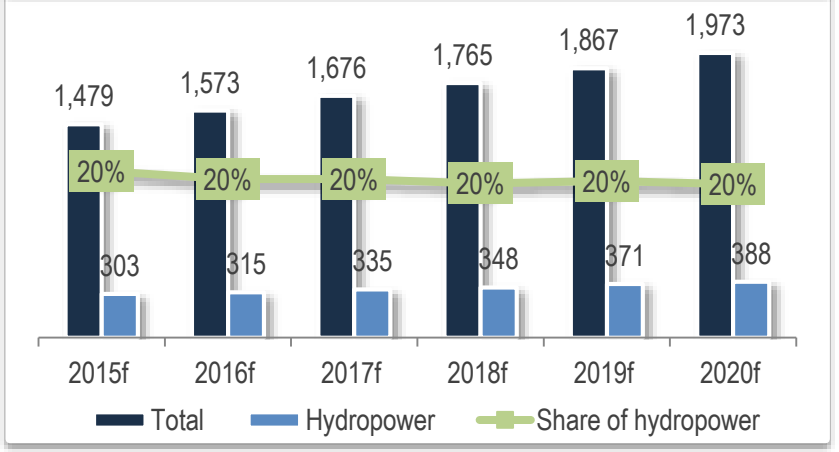
Source: EMIS, Company financial reports

Investment and Development Outlook

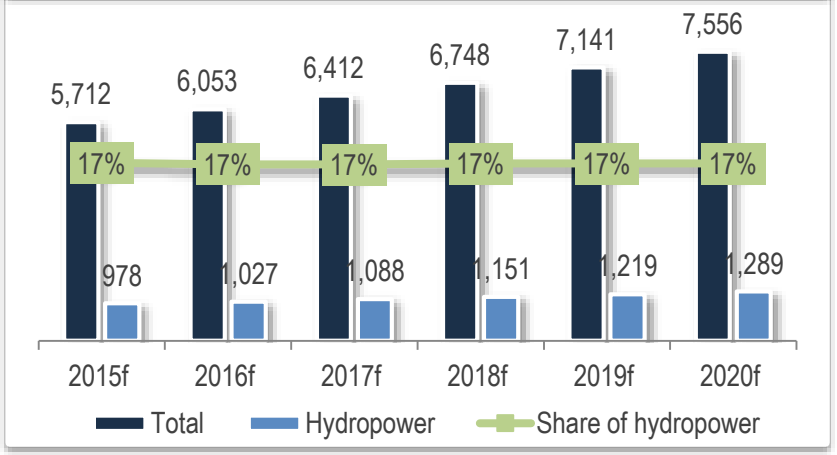
Electricity sector construction investment, RMB bn



Forecasted power generating capacity, GW



Forecasted power generation, TWh



Comments

- In 2014, investment in hydropower infrastructure of all sizes was USD 15.6 billion (CNY 96bn), down by 21% from 2013.
- Total power generation is forecasted to grow at about 5% per year on average. Hydropower is to keep a steady share in the power mix, on the back of realizing China's ambitious plans for adding new nuclear and renewables capacity.
- As much of China's untapped hydropower potential is located in remote areas, development will become more expensive. That is why the average annual growth in hydropower capacity in 2015-20 is expected to be slower than in 2009-14.

Source: BMI Research, China Electricity Council, EIU

India

Overview

In 2014, as per IRENA estimates, India ranks sixth globally in terms of installed hydropower capacity, and fifth by new capacity additions for 2014.

Hydropower is the second-largest energy source in the country after coal. It is also an important resource for electricity imports from the neighbouring Bhutan and Nepal, with whom India is developing joint hydropower projects.

Hydropower Capacity	Hydropower contributes by 17.6% to the total power generation installed capacity in India. In terms of electricity generation, it made up 12.3% in FY 2014/15 (ending March). As of end-June 2015, there are 190 hydropower stations in India. More than two-thirds of the installed capacity (excluding installations up to 25 MW) is in the Northern region (42.5%) and in the Southern region (27.2%). As of the FY 2014/15, installed small hydropower capacity (< 25 MW) is 4,055.36 MW, which accounts for 11.3% of the total renewable energy capacity.
Sector Structure	There are three types of electricity-generation companies: state-level companies, national public companies, and private companies. State utilities own the majority of the hydropower capacity, but their share has been gradually decreasing: from 69.6% in 2012 to 65.4% as of June 2015. The shares of central government and private utilities have registered increases, and now cover 27% and 7% of the installed hydropower capacity, respectively. 'Small' hydropower – per definition less than 25 MW – falls under the responsibility of India's Ministry of New and Renewable Energy. 'Large' hydropower – more than 25 MW – is administered by the Ministry of Power.
12th Five-Year Plan	As per India's 12th Five-Year Plan for 2012-2017, the projected hydropower capacity addition is 10,897 MW, of which 6,004 MW are to be provided by central government, 3,285 MW by private sector, and 1,608 by the states. Additionally, 1,200 MW import of hydropower from Bhutan is also foreseen. As of June 2015, about 27% of the hydropower target was fulfilled, with the central government leading implementation by fulfilling as much as 40% of its target. State and private utilities were at 6% and 15% of achievement, respectively.

Source: Central Electricity Authority, IRENA. *Note: India's fiscal year runs from April to March*

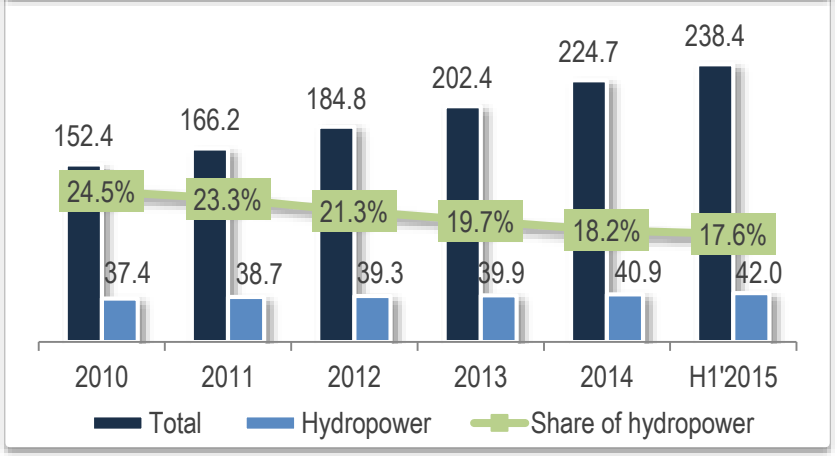
Current Trends and Outlook

Latest Project Developments	▪ Upper Siang I and II: Developed by NEEPCO and NHPC, total capacity 9.5 GW. RusHydro is designing Upper Siang II (3.75 GW) and has expressed interest in the tender for construction (yet to be announced). ▪ Dibang Multipurpose: Developed by NHPC, total capacity 3 GW. Upon completion, this could be the world tallest concrete gravity dam (288 m). The project has been marked by significant environmental concerns. The Ministry of Environment rejected the project twice before approving it in September 2014. However, in July 2015, the environmental clearance was challenged in front of India's National Green Tribunal. ▪ In February 2015, the MNRE released details of the National Mission on Small Hydro: Phase 1 of the USD 71.5mn project seeks to add 500 MW of small hydro capacity in the next two years.
Regional Cooperation	▪ Bhutan: India has cooperated successfully with Bhutan to import power from the Chukha, Kurichu, and Tala hydro projects (funded by India, total capacity 1,416 MW, average annual exports to India 5,400 GWh). Further plans to add 10,000 MW of hydropower in Bhutan by 2020, however, are likely to be delayed due to lack of funds of the Indian government. ▪ Nepal: In the past, hydropower cooperation with Nepal has been limited due to political instability, resource constraints, and regulatory issues. With emerging investor-friendly environment, a few hydro projects are being revived, including 900 MW Upper Karnali, 900 MW Arun III, and 5,600 MW Pancheshwar. In January 2015, the joint working group on sub-regional cooperation between Bangladesh, Bhutan, India and Nepal issued a statement indicating that efforts would be made to explore joint hydropower projects.
Private and International Players	Although the state and central government are the main drivers of hydropower development, private actors and international investors have a growing significance for the sector. ▪ Private sector: In 2014, Reliance Power Ltd bought Jaiprakash Power Ventures Ltd's entire hydropower business (1800 MW) and announced it had additional 5,292 MW of hydroelectric capacity under development. This is the largest privately held hydropower business. ▪ International investments: In July 2015, Russia's Direct Investment Fund signed an MoU with India's Infrastructure Development Finance Company for funding of hydropower projects. This is a continuation of a previously signed agreement for joint investment of USD 1bn in Indian infrastructure.

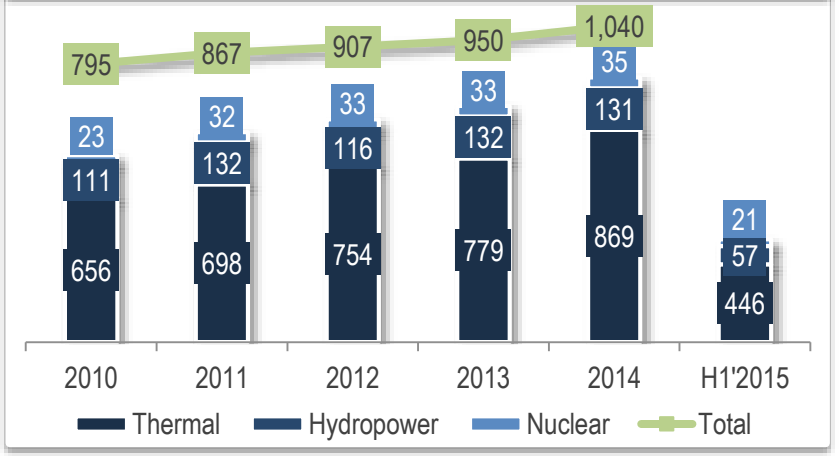
Source: Central Electricity Authority, hydroworld.com, India Ministry of External Affairs, PowerWatch India, Reliance Power Ltd., Reuters, The Bhutanese

Capacity and Generation

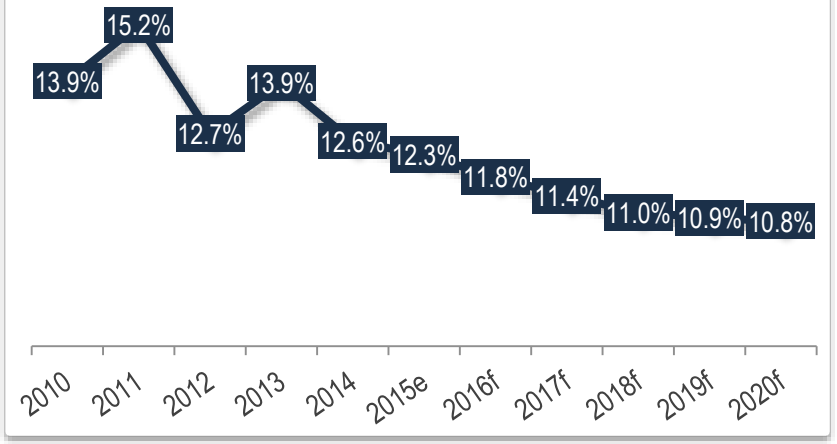
Installed power capacity, utilities, GW



Electricity generation, utilities, TWh



Share of hydropower in total power generation, %



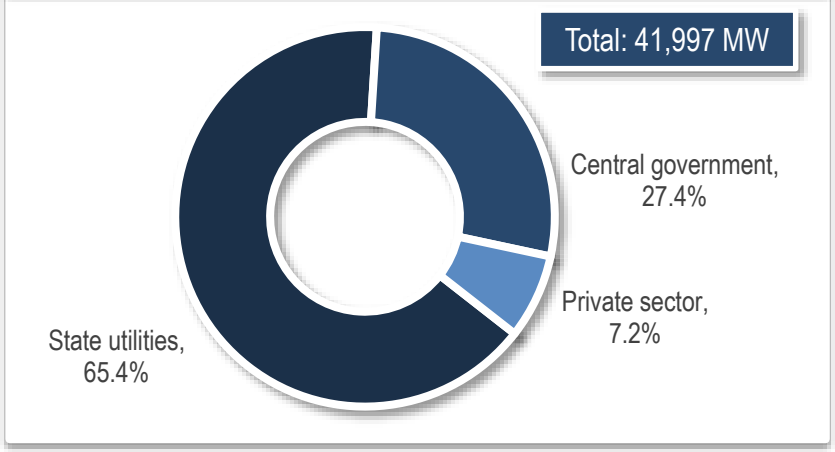
Comments

- Even though hydropower capacity has been increasing and is projected to grow further, its share in the total installed capacity is expected to continue falling, reaching 15% in 2020. The same trend applies for the share of hydro in the power generation mix, which is likely to fall to around 11% by 2020.
- This would be a result of the rising shares of solar and wind. Annual growth rate of non-hydro renewables is forecast at as high as 13% on average by 2018, whereas hydropower generation is estimated at 2%-3% growth per year.

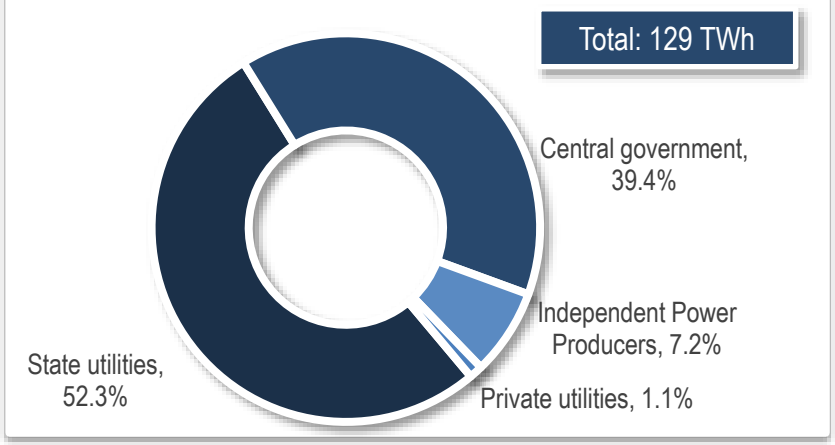
Source: BMI Research, Central Electricity Authority

Hydropower Operators

Hydropower capacity ownership, as of end-June 2015



Hydropower generation, FY 2014/15



New hydropower stations in CEA's plan for FY 2015/2016

	Capacity, MW	Expected start of operation	Operator	State
Kol Dam	800	Aug'15	Central: NTPC	Himachal Pradesh
Kashang I	65	May'15	State utility	Himachal Pradesh
Sorang	100	Jul'15	Private: HSPCL	Himachal Pradesh
Baglihar II	300	FY 2016/17	State utility	Jammu & Kashmir
Shrinagar	330	Jun'15	Private: GVK	Uttarakhand
NJ Sagar TPD	50	Apr'15	State utility	Andhra Pradesh
Lower Jurala	160	Aug'15	State utility	Telangana
Teesta Low - IV	40	FY 2016/17	Central: NHPC	West Bengal
Teesta III	600	Mar'16	Private: Teesta Urja	Sikkim
Jorethang Loop	96	Oct'16	Private: Dans Energy	Sikkim

Source: Central Electricity Authority (CEA)

Small Hydropower (SHP)

States with highest SHP potential, installed capacity, FY'14

State	Potential MW	Installed capacity, MW	Under implementation	
			Number	Capacity, MW
Karnataka	4,141	1,032	23	173.09
Himachal Pradesh	2,397	639	33	76.2
Uttarakhand	1,708	174	46	174
J&K	1,430	147	7	17.65
Arunachal Pradesh	1,341	104	44	22.23
Andhra Pradesh	978	221	13	32
Total India	**20,000**	**3,804**	**254**	**895.4**

MNRE SHP financial support scheme, 12th Plan

	< 1 MW	> 1 MW	max. per project
New sites assessment, Detailed Project Report	INR 600,000 per report	INR 1mn per report	
New projects, private sector, SC* states	INR 10.5mn per MW		INR 50mn
New projects, private sector, other states	INR 10mn per MW		INR 50mn
New projects, gov't/ state sectors, SC states	INR 75,000 per kW	INR 70.5mn per MW	INR 200mn
New projects, gov't/ state sectors, other states	INR 35,000 per kW	INR 30.5mn per MW	INR 200mn
Renovation of existing gov't/ state SHP projects	INR 10,000 per kW	INR 10mn per MW	INR 10mn

Comments

The Ministry of New and Renewable Energy (MNRE) has a target to reach 7,000 MW SHP installed capacity by the end of 12th Plan. It has a financial support scheme for public and private projects. In addition to the subsidies described in the table above, project owners are required to contribute minimum 10% (for state-owned projects) or 50% (private projects) of the total cost. For micro-projects (up to 100 kW capacity), state agencies, local NGOs, and individual entrepreneurs may get INR 100,000 per kW, and they have to contribute 10% of the project cost.

* *Special Category (SC) states are those in the Northeast region, Jammu and Kashmir, Himachal Pradesh and Uttarakhand. They have a low resource base and are not in a position to mobilize resources for their developmental needs, therefore rely heavily on central government financing.*

Source: Ministry of New and Renewable Energy

Hydropower Development Abroad

Projects in Bhutan, in the pipeline

	Capacity MW	Expected start	Project cost USD	Scheme
Indian Government Funding				
Punatsangchhu-I	1,200	2019-20	1.74bn	40% grant, 60% loan
Punatsangchhu-II	1,020	2017	600mn	30% grant, 70% loan
Mangdechu	720	2018	450mn	30% grant, 70% loan
Joint Ventures				
Chamkarchu	770	2017-18	1bn	NHPC Ltd, DGPC
Kholongchu	600	2017-18	638mn	SJVN, DGPC
Wangchu	570	2017-18	606mn	SJVN, DGPC
Bunakha	180	2017-18	240mn	THDC Ltd., DGPC

Projects in Nepal, in the pipeline

	Capacity MW	Project cost USD	Status
Upper Karnali	900	1.4bn	GMR (India) to develop the project. Project Development Agreement signed in Sept. 2014
Arun III	900	1,040mn	SJVN to develop the project, 25-year BOT scheme. 88 MW power for Nepal free of charge, remainder to be exported to India. Commissioning scheduled for 2021.
Pancheshwar Multipurpose	5,600	4.65bn	March 2015 - WAPCO awarded environmental impact assessment
Sapta Kosi High Dam	3,300	n.a.	Agreement to finalize DPR by Feb. 2017

Comments

In April 2014, Bhutan and India signed an agreement for the development of four joint venture hydropower projects with total capacity 2,120 MW. On India's side, JV partners are the National Hydroelectric Power Corporation (NHPC), THDC (joint company of the governments of India and Uttar Pradesh), and SJVN (joint venture between the governments of India and of Himachal Pradesh). The partner on Bhutan's side is Druk Green Power Corporation (DGPC). Nepal's largely untapped hydropower potential offers another important source for development and imports. The latest agreement signed between the two countries is for the development of Arun-III in November 2014. This is a controversial project, planned already in the 1990s, but without much progress since 1995 when the World Bank withdrew its financial support due to social and environmental concerns.

Source: Central Electricity Authority, hydroworld.com

Vietnam

Overview

Hydropower is the most important electricity source in Vietnam: in 2014, it supplied 42% of the electricity, followed by natural gas and coal, with a share of 37% and 27%, respectively. The country has significant untapped potential, but further development is likely to be contained with growing awareness for environmental and social issues. The oversight of regulators has increased, and there is already some history of cancelling projects due to environmental and social reasons. Vietnam lacks capacity for sustainable development of hydropower (for either planning, consultancy, or construction), and therefore international experts and funding would benefit the sector.

Hydropower Capacity	Hydropower capacity has had a steady share of around 48% of the total installed capacity since 2011 up to present day. In the future, however, hydro is likely to lose share to thermal power generation, especially to coal. The high frequency of droughts affects reliability on hydropower and increases Vietnam's vulnerability to electricity shortages. Nevertheless, hydro will remain an important power source and the government plans to add about 3 GW of hydro by 2020. As of end-2014, there are 284 operational hydropower projects with combined capacity of over 14 GW.
Master Plan for Power Development 2011 - 2020	According to the 7th National Master Plan for Power Development, development of hydropower resources is prioritized, especially for multi-purpose projects. Target hydropower capacity to be achieved by 2020 is 17.4 GW (23.2% of the target total power capacity 75 GW), and target capacity for energy storage hydropower plants is 5.7 GW. Beyond the term of the Master Plan, the government intends to achieve 19.5 GW installed hydropower capacity by 2030.
Sector Structure	The Ministry of Industry and Trade (MoIT) oversees all energy industries. EVN is the national electricity company, under MoIT's supervision. Under agreed power purchasing agreements, privately-owned power generation companies can sell power to EVN, where EVN is unable to mobilize financial resources to meet the investment capital for a power project. The participation of domestic and foreign investors in the form of independent power producers (IPPs) is likely to play a significant role in supplying power in the future.

Source: BMI Research, The Economist, International Institute for Sustainable Development (IISD), National Master Plan for Power Development

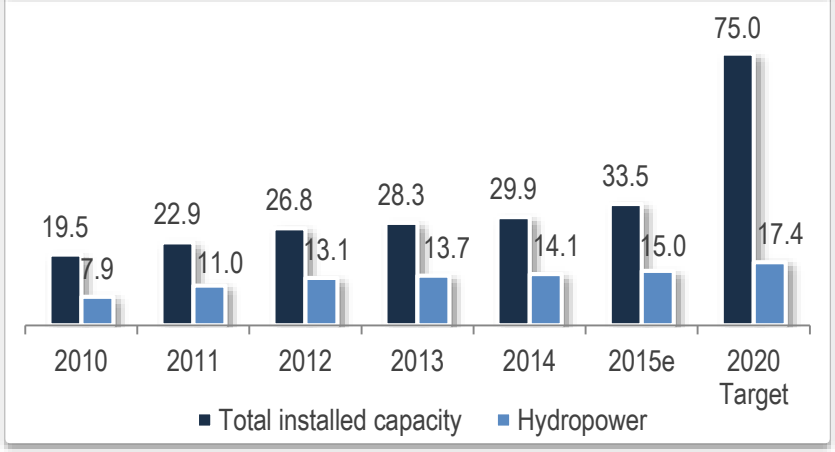
Current Trends and Outlook

Hydropower Incentives	The Avoided Cost Tariff (ACT) provides incentives for small-scale renewable energy developers. The avoided cost is defined as the production cost per 1 kWh of the most expensive power generating unit (combined cycle gas turbine) that would be avoided if the buyer purchases 1 kWh of renewable electricity. Eligible project capacity must not exceed 30 MW. For 2015, the MoIT defined the following ACT tariffs (*differ per region*): ▪ For peak hours: VND 625 (approx. USD 0.029) – 663 per kWh in the dry season, VND 598 – 632 per kWh in the rainy season; ▪ For regular hours: VND 624 – 662 per kWh in the dry season, VND 602 – 636 per kWh in the rainy season; ▪ For idle hours: VND 623 – 661 per kWh in the dry season, VND 605 – 639 per kWh in the rainy season.
Power Market	In 2012, a competitive generation market (CGM) was introduced for power plants with capacities above 30 MW. Producers that do not meet this requirement sell electricity directly to state utility EVN at a lower price, which makes the sector unattractive for foreign investors. CGM was established as Phase 1 on the way to introduce fully-functional competitive wholesale (from 2015 onward) and retail (from 2021) power markets. In March 2015, the Ministry of Trade announced that the wholesale power market would come into effect in early 2016, with the competitive retail market to follow in 2023.
Increased Oversight	Investors developing new hydropower projects face increasing oversight. In January 2015, Vietnam's Minister for Agriculture announced that the government might revoke investor licenses for projects that were mismanaged and accompanied by illegal land acquisitions. The minister recommended stopping any projects which delay the reforestation targets and livelihood compensation process. In 2014, the Ministry of Industry and Trade cancelled 167 small hydropower projects with combined capacity of 160 GW. Reported reasons for the cancelations included licensees missing deadlines, breaches of land management protocols, and unauthorized purchase of land held by ethnic minority communities. In general, there is a trend that ministerial officials have become more sensitive to environmental and social impacts of hydropower, and are willing to scale back plans for future projects.

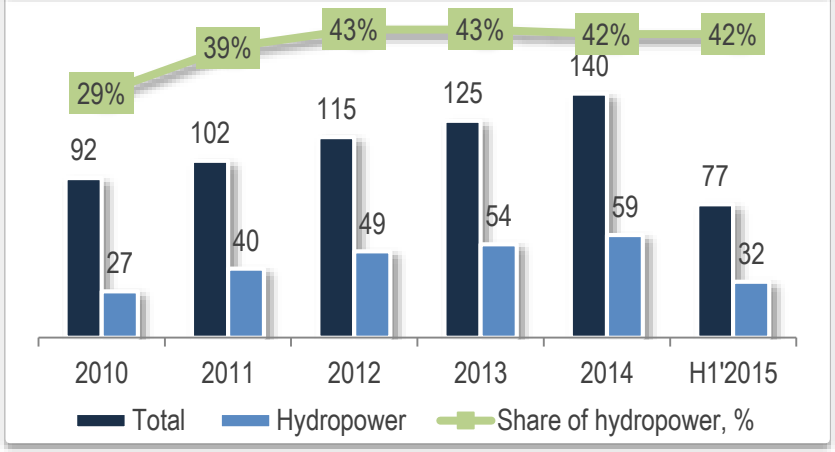
Source: hydroworld.com, MoIT's circular No. 32/2014/TT-BCT, Viet Nam News

Capacity and Generation

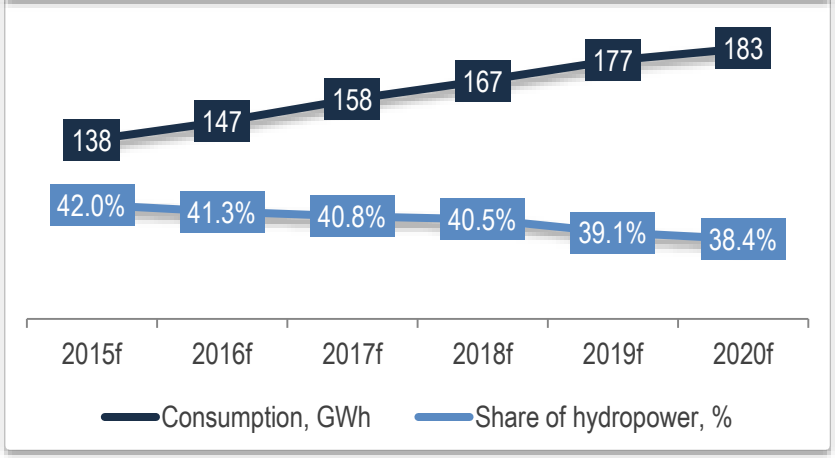
Installed power capacity, MW



Annual electricity production, TWh



Electricity generation forecast



Comments

- Electricity demand is expected to grow rapidly, at around 6% per year, driven by residential consumption (a result of a fast urbanisation rate and rising living standards), industrial development, and export market expansion. Forecasts point at reaching over 183 TWh in 2020.
- Hydropower will continue to play an important role in the electricity mix, even though its share there will be decreasing due to extended focus on thermal power development, in particular coal.

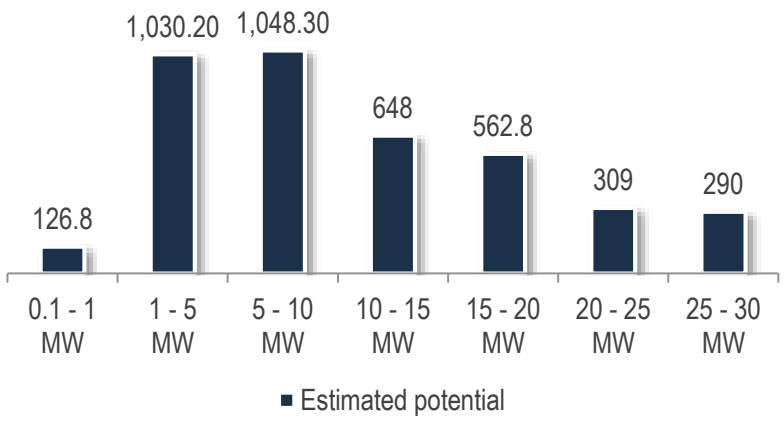
Source: BMI Research, EIU, Enerdata, General Statistics Office, Vietnam Master Plan for Power Development

Development Potential

Hydropower potential sites

River basins	Capacity, MW	Power Output, GWh
Da River	6,800	27,700
Dong Nai	3,000	12,000
Lo-Gam-Chay	1,600	6,000
Vu Gia-Thu Bon	1,500	4,500
Ma Chu	760	2,700
Srepok	730	3,300

Small hydropower potential, by plant size



Sector development risks

The following issues should be assessed when evaluating project and sector development risks:

- Resources: Over 60% of the water resources in Vietnam originate in other countries, which increases the risk of conflicts over water use. Climate change patterns that result in prolonging the dry season may cause water shortages, which affect the power output of hydropower stations.
- Regulations: In July 2015, MoIT announced a draft decree, as per which the state is to hold exclusive rights to operate multi-purpose hydropower works. Although the idea is to improve water resources management, it may slow down new investments in the sector.
- Finances: EVN is heavily in debt and has a limited ability to fund improvements to the power infrastructure.

Source: IISD, International Center on Small Hydro Power (ICSHP), Power Engineering Consulting JSC, Vietnam Institute of Energy

Indonesia

Overview

Indonesia's growing electricity demand (at 5.5% per year in the next five years) is to be covered by implementation of ambitious plans for a 35-GW power capacity expansion (or, almost double of today's levels). Renewables are to reach 15% of the power mix by 2025 (11% as of end-2014). Micro-hydro for decentralized electricity supply systems is an essential prerequisite to achieve the country's electrification rate goal of 97% by 2020.

Hydropower Capacity	Total installed hydropower capacity as of 2014 is estimated at 5.4 GW, or 10% of the total power capacity. As per Indonesia's Long-Term Electricity Plan (2013 - 2022), new hydro capacity to be added is 6.9 GW, including small and large hydro.
Sector Structure	The power sector is regulated by the Ministry of Energy and Mineral Resources (MEMR) and related agencies. MEMR develops 10-year estimates for electricity supply and demand, known as RUKN, which guide the central and regional governments, as well as investors, on expected energy contribution levels from conventional and renewable resources. Power generation is dominated by state-owned PLN and its subsidiaries. Private sector participation is allowed through independent power producer arrangements (IPP). For renewables, IPPs do not necessarily need to go through tenders, but can be appointed directly. Foreign ownership is limited to 95% for the electricity sector.
Existing Dams	In December 2014, the Indonesian Public Works and Public Housing Ministry announced plans to offer 33 hydropower projects to potential investors in 2015. The dams are to be "rented" to developers to add the power generation units. The projects could use government support through the viability gap fund (VGF) scheme, which may cover up to 40% of the total investment of an infrastructure project developed through a public-private partnership model.

Source: Energy and Mineral Resources Ministry, PLN, PwC

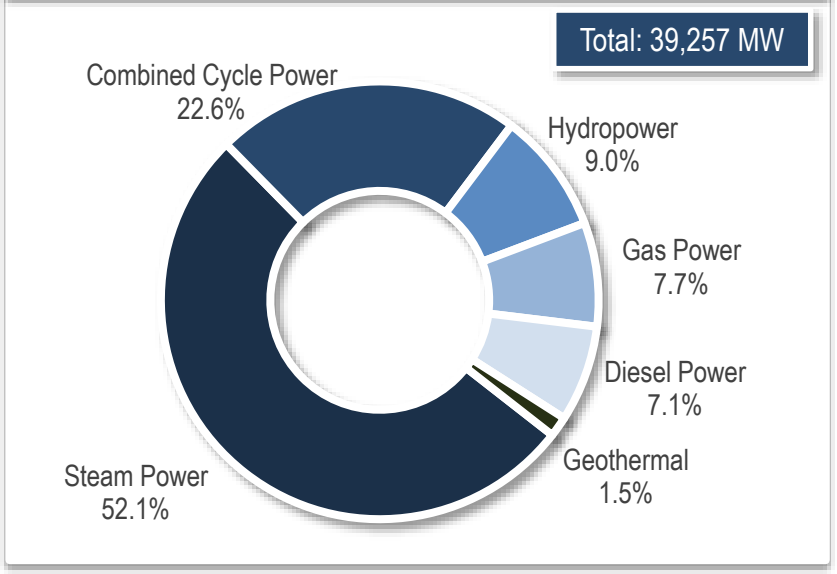
Current Trends and Outlook

Second Fast-Track Program	Phase II of the 10,000 MW Fast Track Program (2011 – 2019) aims at developing renewable energy and hydropower resources with the participation of independent power producers. For the phase II period, the total hydropower capacity addition target is around 1,800 MW, of which four large hydro projects developed by PLN would provide three-quarters of the capacity, and independent power producers would provide the rest through six more projects. Investments for the hydropower development are estimated at USD 1.4bn, or 7.5% of the total investments for FTP II.
Support Scheme	PLN does not have the ability to catalyse all of the necessary investments, which makes IPPs and private investment essential to meet the capital demand. Feed-in-tariffs for hydropower plants with capacity up to 10 MW are regulated under Regulation no.19 /2015 by MEMR as of 29 June 2015. The new feed-in tariff considers the overall cost of connection to PLN's network. It has been raised to USD 0.12 (IDR 1,655) per kWh for plants connected to a medium-voltage grid, and USD 0.144 (IDR 1,986) per kWh for plants connected to a low-voltage grid. Additionally, there are incentive factors (F) based on the region, where Maluku and Papua get the highest incentive multiplier of x1.5. Under the previous Regulation, the feed-in-tariff ranged between USD 0.05 and 0.07.
Foreign Developers – Focus on Small Hydro	▪ Mid-2014: Asian financial firm Armstrong Asset Management announced development plans for 50 MW portfolio of mini-hydro plants in Indonesia, worth USD 22.5mn. ▪ Mid-2014: Dutch consultancy Royal HaskoningDHV is developing four projects with total capacity 15.6 MW along the Merawu River. The projects are the first phase in an agreement with Indonesian energy investment company TIRASA to develop more than 100 MW of hydroelectric power by 2018 and to connect about 400,000 people to the grid. ▪ May 2015: The Iranian government finalized a deal to develop 48 small hydropower plants with capacities between 1 MW and 10 MW in Indonesia within the next five years.

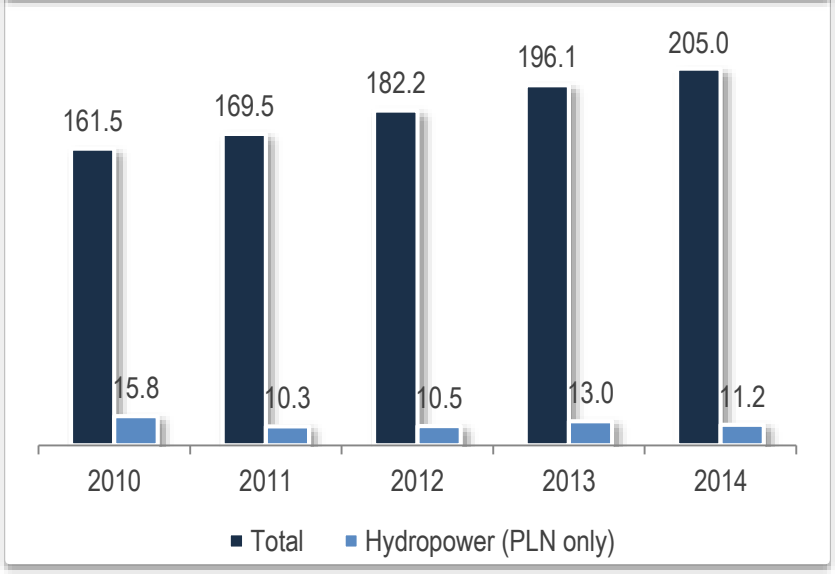
Source: Ministry of Energy and Mineral Resources of Indonesia, hydroworld.com, IPP Journal, PLN

Capacity and Generation

PLN installed capacity, 2014



Electricity production, TWh



Comments

PLN is Indonesia's government-owned corporation which controls about 80% of the electricity generation and has a monopoly on electricity distribution in the country. PLN operates 3,527 MW of hydropower, which accounts for 9% of PLN's total installed capacity. Electricity production by PLN includes own generation (152 TWh in 2014) as well as purchases from private parties (53 TWh in 2014).

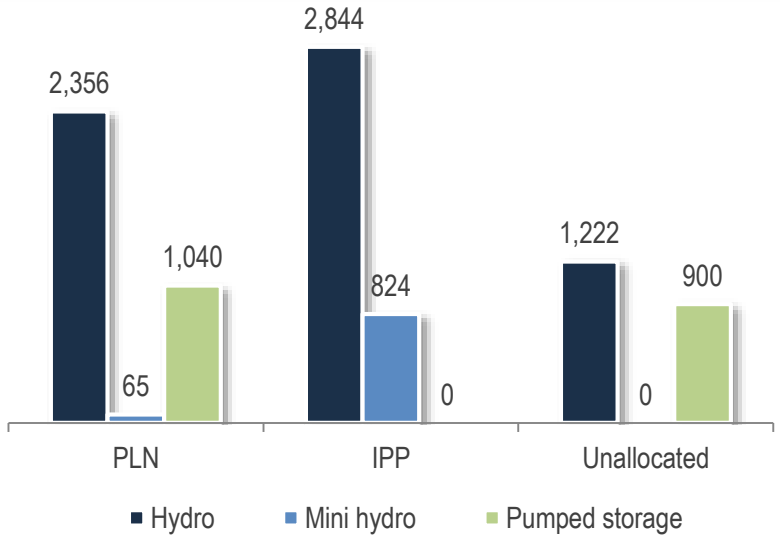
Source: PLN

Development Plans

Hydropower in Fast Track Program II

Owner	Project	Capacity, MW	Expected COD	Province
PLN	Upper Cisokan PS	1040	2019	West Java
	Jatigede	110	2019	West Java
	Masang 2	55	2020	West Sumatera
	Asahan 3	174	2018	North Sumatera
		Total: 1379		
IPP	Hasang	40	2018	North Sumatera
	Wampu	45	2015	North Sumatera
	Semangka	56	2018	Lampung
	Bonto Batu	110	2024	South Sulawesi
	Malea	90	2020	South Sulawesi
	Peusangan 4	83	2020	Aceh
		Total: 424		

Hydropower in PLN's General Business Plan 2015-2024, MW



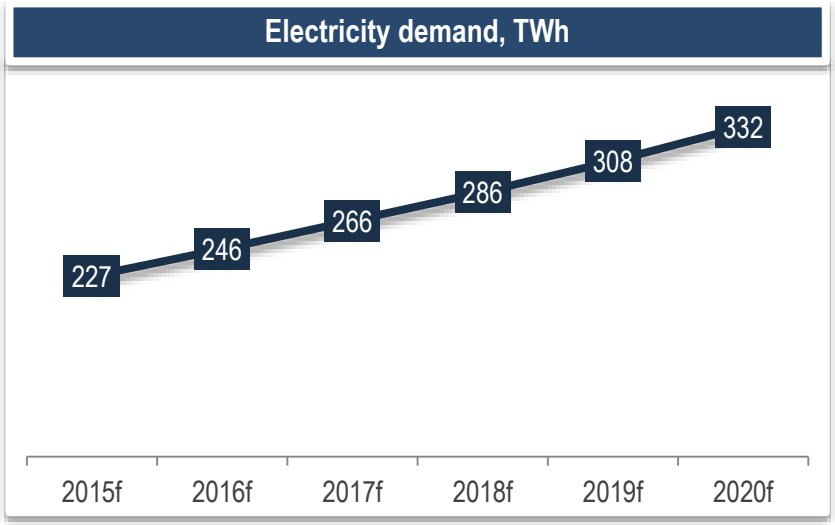
Comments

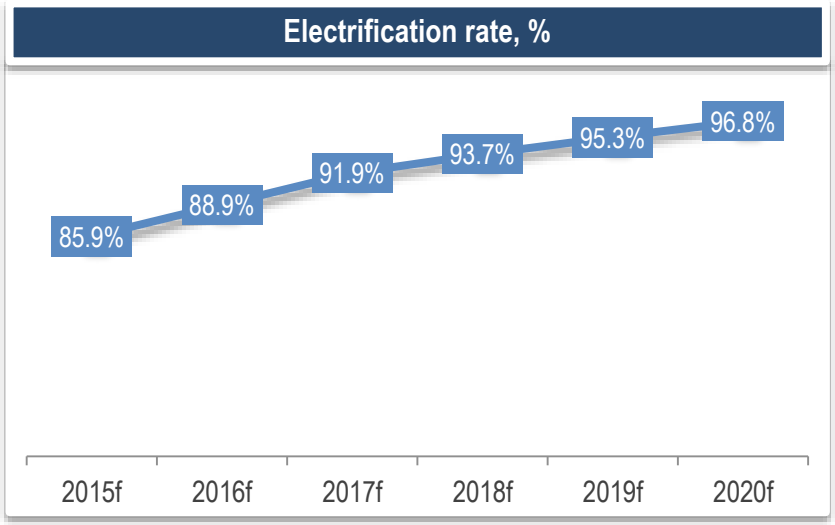
The projects earmarked under the Fast Track Programme are only a fraction of Indonesia's hydropower development plans, as envisaged in PLN's General Business Plan for the period 2015 – 2024. Overall, there is an obvious tendency to allow more independent power producers in the market.

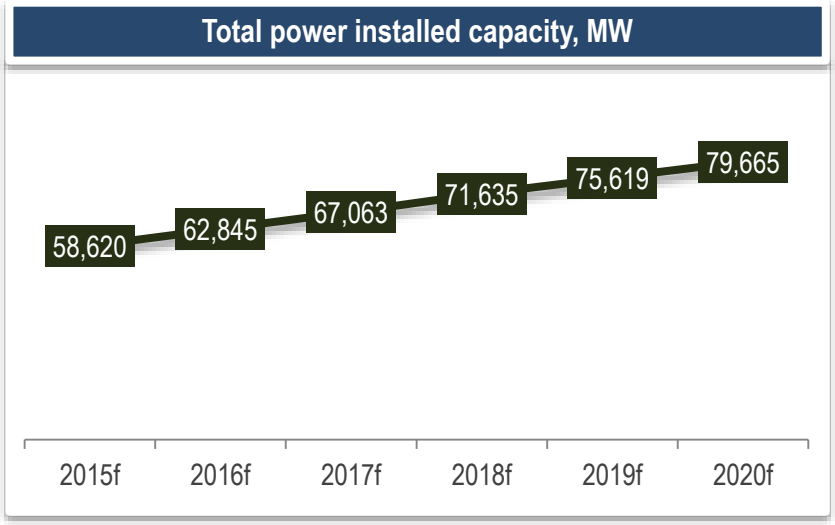
Risks for project implementation may arise in cases when the hydropower potential is located in remote areas with poor transmission and distribution network, far from the large demand centres. Economic viability may be challenged due to seasonal factors. Land acquisition is another challenging issue.

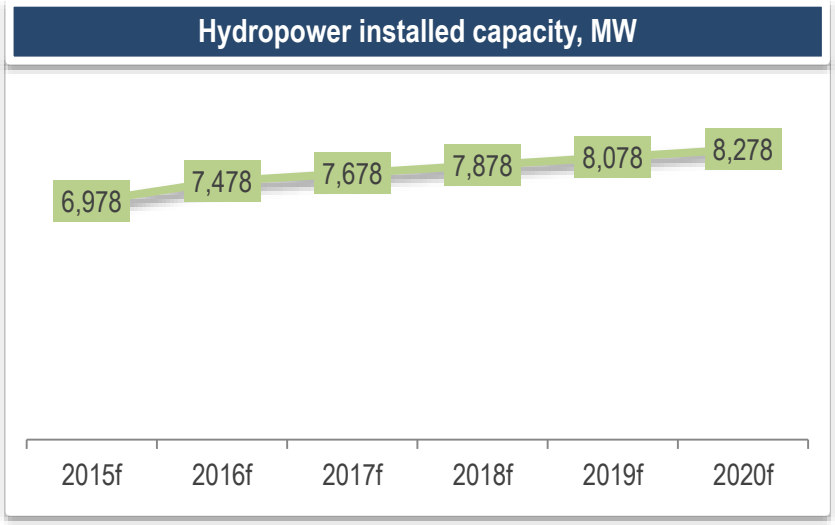
Source: PLN

Energy Sector Forecasts









Source: Indonesia Ministry of Energy and Mineral Resources, BMI Research, EIU

Malaysia

Overview

Malaysia is moving fast towards developed nation status, both in terms of economic power and electricity consumption. The country's electricity demand is expected to reach the OECD average by 2030. Even though natural gas will remain the main fuel for electricity generation, Malaysia will continue to expand its hydropower capacity, with both small and large installations. However, government targets for hydropower development face implementation risks due to public opposition of particular large dam projects, particularly in Sarawak.

Hydropower Capacity	As of mid-2015, installed hydropower capacity in Malaysia is estimated at 5.4 GW, or about 17% of the total installed power capacity. Just in 2014, Malaysia added 3.3 GW of hydropower capacity. Two hydropower plants are planned to come online by the end of 2015 or beginning of 2016, adding more than 500 MW to the grid. In general, estimates for Malaysia's hydropower potential range between 20 and 30 GW.
Sector Structure	The country's three geographical areas are served by three electricity utilities: Tenaga National Berhad (TNB) on Peninsular Malaysia, Sarawak Energy, and Sabah Electricity (SESB). In all three regions, there are also independent power producers (IPPs), which supply around 40% of the electricity in the country. They hold 21-year concessions that are due to expire in 2015. PPAs were extended for five IPPs already in March 2015. Since 2011, foreign ownership in IPPs can be as much as 49%, after the government increased the previous threshold of 30%.
11th Development Plan (2016 – 2020)	Under the Tenth Plan (2011 – 2015), the share of renewable electricity was set to increase from <1% in 2009 to 5.5%, and total RE capacity was to reach the ambitious 985 MW. As much as 30% of it, or 290 MW, were to be contributed by mini-hydro. As of end-2014, total RE installed capacity increased fivefold to 243 MW, with mini-hydro accounting for 6% of it. The Eleventh Plan sets a target of 2,080 MW RE capacity by 2020, contributing to 7.8% of total installed capacity in Peninsular Malaysia and Sabah. The share of mini-hydro is to increase to 24% in the renewables mix.

Source: EIU, Eleventh Malaysia Plan, International Hydropower Association

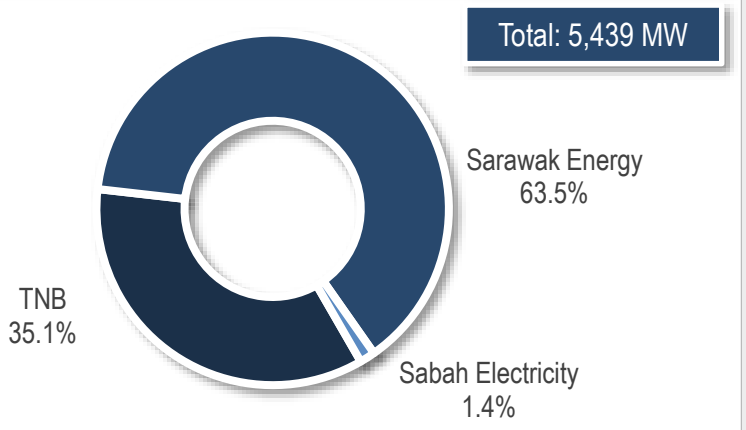
Current Trends and Outlook

Peninsular Malaysia	▪ As of May 2015, TNB's shareholders include the Malaysian sovereign wealth fund (29.7%), Employees Provident Fund (15.3%), Permodalan Nasional Berhad (biggest fund management company in the country, 13.8%), government agencies (9.4%), Malaysian public (6.1%), and foreign shareholders (25.7%). ▪ New HPPs expected online: Hulu Terengganu - its two units are expected to start commercial operation in September and December 2015; the two units of Ulu Jelai are to start in December 2015 and March 2016.
Sarawak	▪ The Sarawak Corridor Renewable Energy (SCORE) is the second-largest of Malaysia's economic corridors. The core of the Corridor is its energy resources. Hydropower provides the energy backbone to supply clean and cheap electricity and thus attract a number of priority industries, such as glass, steel and aluminum, to settle in the state. ▪ At least 12 large hydropower stations are scheduled to be built by 2030. The Murum dam (944 MW) should be fully commissioned in 2015. Plans for the 1,200 MW Baram project are currently on hold due to local community protests. ▪ Over the long term, SCORE involves building 20 GW of hydroelectric capacity in Sarawak at as many as 50 sites. Estimated investments amount to MYR 20bn, which are expected to be funded by the private sector.
Sabah	▪ Sabah Electricity Sdn. Bhd. is owned 80% by TNB and 20% by the State Government of Sabah. ▪ Upper Padas Hydroelectric Project (180 MW) will boost the installed hydro capacity from 81 MW to 260 MW in 2023. Thus, the share of hydropower in the energy mix would increase from 7% (2013) to 14% in 2023. Project construction is expected to begin in 2016. ▪ A SESB review of the technical, economic and financial merits of potential hydropower sites resulted in the identification of 12 as economically viable sites, yielding an IRR greater than 10%. These 12 sites have a total capacity of 782 MW. ▪ SESB and Sarawak Energy are currently exploring the possibility of interconnection between Sabah and northern Sarawak, so that 700 MW potential hydroelectric capacity can be realised.

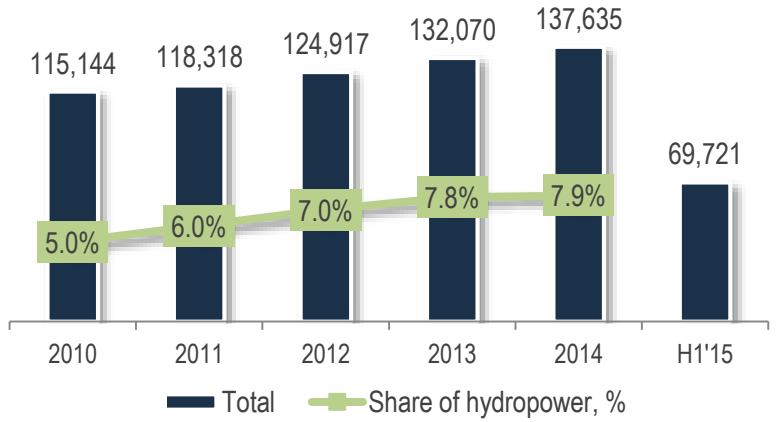
Source: Energy Commission of Malaysia, Sarawak Energy, SESB, TNB

Capacity and Generation

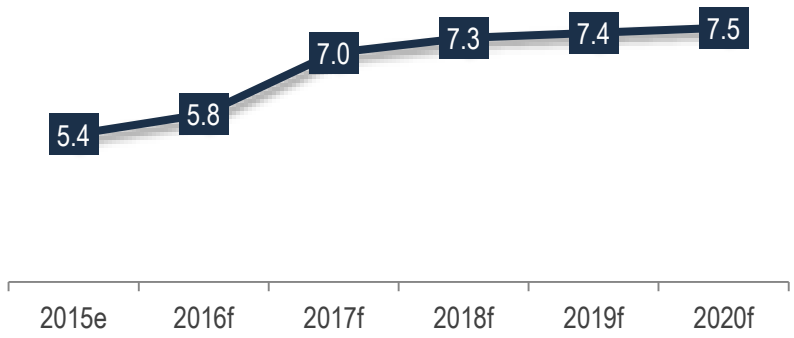
Installed hydropower capacity, mid-2015, MW



Electricity generation, GWh



Hydropower capacity forecast, GW



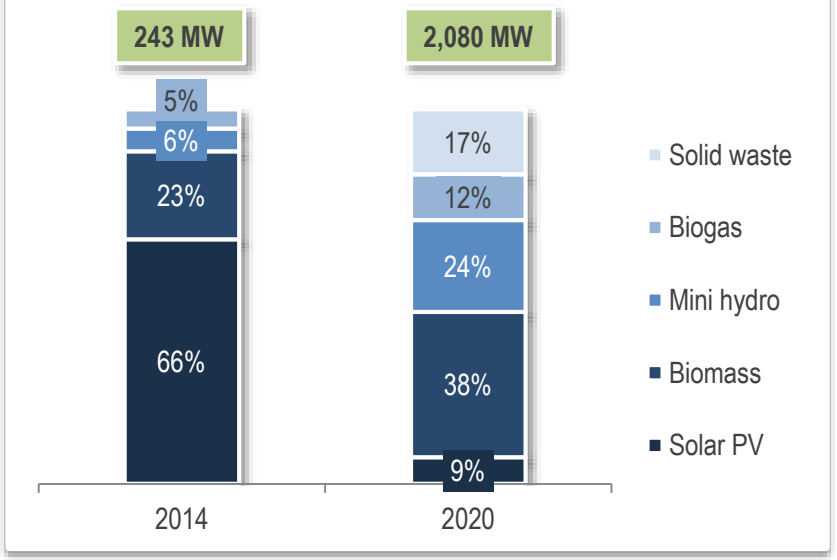
Comments

- For the period Sept'14 – May'15 (first three quarters of FY'15), TNB generated 3,850 GWh from hydropower, which represented 4.6% of the total electricity generation.
- Installed hydropower capacity is expected to increase by almost 40% in five years. This growth rate is twice as high compared to the growth estimate for the total electricity generation capacity expansion by 2020, forecasted to increase by 18%.

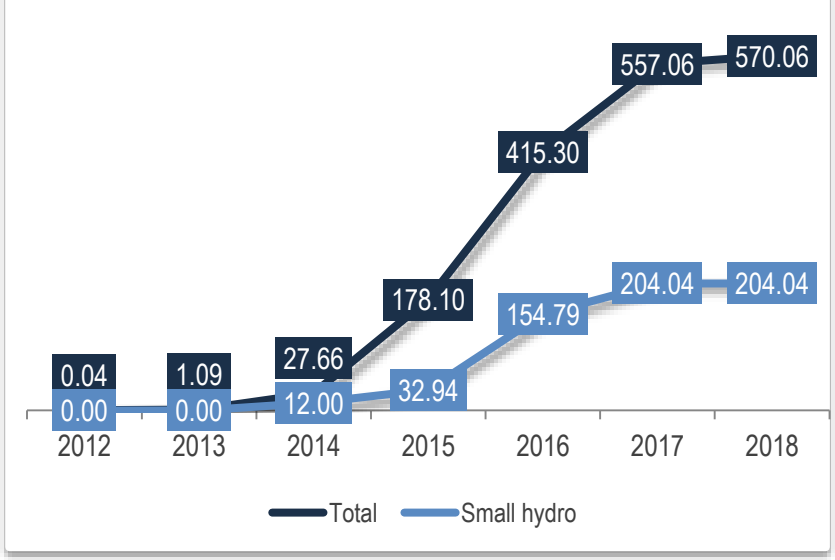
Source: Department of Statistics Malaysia, EIU, Sabah Electricity, Sarawak Energy, TNB

Small Hydropower

RE capacity expansion, Eleventh Malaysia Plan



RE capacity with granted FiT approvals, MW



Comments

Fiscal incentives for small hydropower include:

- Green Technology Financial Scheme: A soft loan mechanism - includes a government guarantee of 60% on the loan amount from selected participating financial institutions (FI). The government bears 2% of the interest rate charged by the FI. GTFS is available until the end of 2015.
- Feed-in-Tariff: The feed-in-tariff (introduced with the Renewable Energy Act in 2011) for small hydro is MYR 0.24 (approx. USD 0.059) per kWh for installations with capacity up to 10 MW, and MYR 0.23 for installations with capacity > 10 MW up to 30 MW.

Source: Energy Commission of Malaysia, GTFS, Sustainable Development Authority Malaysia, Malaysia Federal Government Gazette

Large Hydro Development

Energy Commission's electricity supply outlook			
	Name	**Capacity, MW**	**Status as of 2015**
Peninsular Malaysia	Hulu Terengganu	250 + 15	Start of commercial operation in 2015 and 2016
	Ulu Jelai	372	Start of commercial operation in 2015 and 2016
	Chenderoh Unit 5	12, upgrade	Start of commercial operation in 2018
	Nenggiri	450	Public acceptance survey ongoing; tender for engineering and EIA consultants in preparation; commercial operation in 2024
	Tekai	155.8	Tenders for civil and electrical works in preparation; commercial operation in 2020
	Telom	132	Feasibility study
Sarawak	Baleh	1,285	Construction timeline 2016 - 2024
	Pelagus	465	Feasibility study
	Linau	182	Start of construction after 2022
	Belaga	260	
	Limbang	130 + 45	Start of construction after 2022
	Belepeh	114	Start of construction after 2022
	Lawas	47	Start of construction after 2022
Sabah	Upper Padas Hydroelectric Project	180	Start of commercial operation in 2023

Source: Energy Commission

The Philippines

Overview

Currently, hydropower is a booming sector, with hundreds of new projects expected to come online in the short- and mid-term. Hydropower provides about 12% of the total power generation, and is likely to maintain its share in view of the overall energy sector development. The Philippines are undergoing a privatization process in the power sector, which includes selling hydropower assets to independent power producers.

Hydropower Capacity	As of end-2014, installed hydropower capacity in the Philippines is 3,543 MW, almost 20% of the total capacity. On average, hydropower supplies 12% of the power demand, but there are significant regional differences. In Mindanao, half of the electricity produced is from hydropower, whereas the share of hydro in Luzon and Visayas in the power mix is 7.7% and 0.3%, respectively.
Sector Structure	The Department of Energy (DOE) is the government body in charge of planning and licensing activities in the energy sector. The National Power Corporation (NPC) is the government-owned electricity provider. In 2014, it generated 6.6% of the total power, whereby less than 1% was in off-grid areas. The remaining 93% of the power generation capacity is by independent power producers (IPPs), which either have a contract with NPC or sell electricity directly to other consumers. The main IPPs that own hydropower are First Gen Corporation and EDC.
Foreign Investment	Under the Philippine Constitution, foreign equity of up to 40% is permissible for activities related to exploration, development and utilization of natural resources. Some of the foreign players currently in the hydropower market include Statkraft (Norway) and Korea Water Resources Corp.

Source: Department of Energy

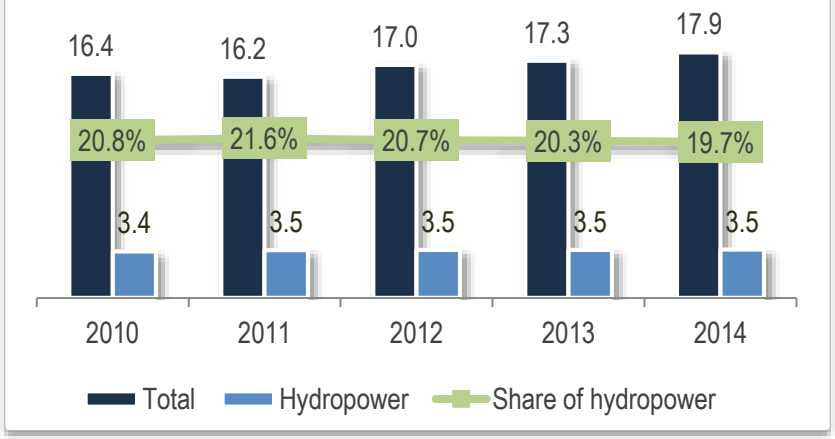
Current Trends and Outlook

Hydropower Incentives	The Renewable Energy Act in the Philippines refers to run-of-river hydropower, without defining capacity constraints, as eligible for incentive schemes: The applicable feed-in tariff is PHP 5.9 per kWh (approx. USD 0.13) as of 2014. The RE Act also allows for priority connection to the grid, and for priority dispatch. The latter is a benefit for intermittent resources. Tax incentives include, among others: ▪ Income tax holiday for the first seven years of commercial operations; ▪ Duty-free importation of RE machinery, equipment and materials; ▪ Tax exemption of carbon credits.
Recent Development	▪ In January 2015, the DOE awarded pre-development and development contracts to nine organizations for the construction of 22 new hydroelectric projects on Mindano Island. The combined capacity of the projects is estimated at 256.35 MW. The 140 MW Davao project is the largest one in terms of capacity. ▪ In April 2015, the National Irrigation Administration announced plans to bid 150 - 200 micro hydropower plants with the aim to increase the country's hydro generating capacity by a cumulative 50 MW. The bidding process is reported to take place in May, allowing construction to start later this year. ▪ In May 2015, construction of the 68.8-MW Manolo Fortich hydropower cascade began. The USD 280mn project is developed by a subsidiary of Aboitiz Power Corp. The company will also build a 380 MW hydropower complex in Ifugao.
Privatization	The government corporation tasked to privatize state-owned power assets is PSALM. As of mid-2015, there are about 982 MW of hydropower capacity remaining for privatization, originally scheduled for bids in 2017. These are the six Agus HPPs and Pulangi HPP, which supply more than 50% of the total electricity requirements of Mindanao. At the same time, in June 2015, DOE announced an intention to put off the privatization of the Casecnan (150 MW) and Caliraya (728 MW) hydropower plants, and pass it on to the next administration. They are scheduled for privatization in the beginning of 2017, but the government argues that these are the only power assets left to potentially defend rates in times of uncertainty or power shortages.

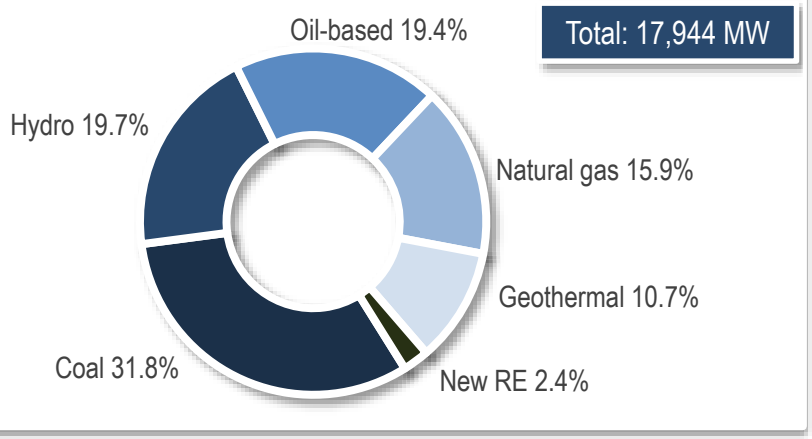
Source: Department of Energy, hydroworld.com, PSALM, The Philippine Star

Capacity and Generation

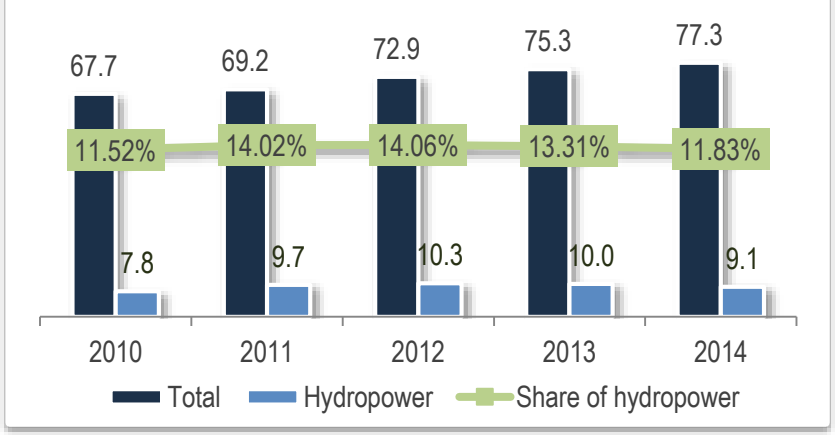
Installed capacity, GW



Total installed capacity in 2014, MW



Power generation, TWh



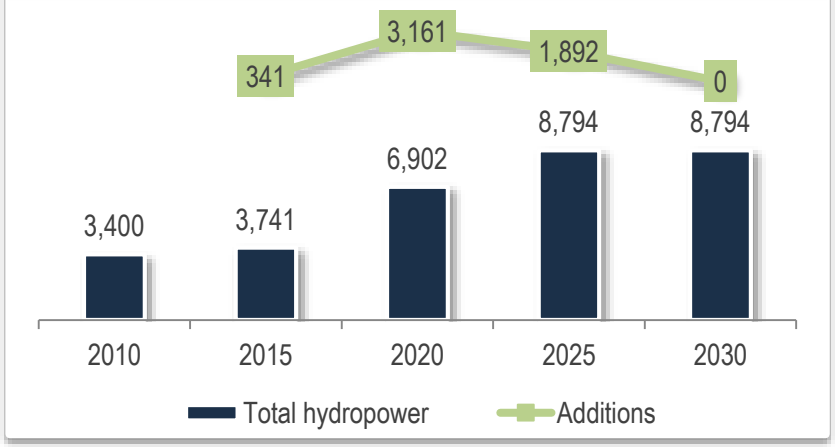
Comments

- Since 2009, hydropower is the second-most important power source after coal. Previously, oil-fired power generation had a higher share of the installed capacity.
- In 2014, hydropower generated 9,137 GWh electricity, accounting for 11.8% of the total generated electricity.
- According to five-year forecasts, the expected annual growth rate of electricity generation is about 5%. Natural gas and coal will continue to dominate the mix, supplying on average 33% and 29%, respectively. The share of hydro is expected to remain the same.

Source: BMI Research, Philippine Department of Energy

Development Plans

Hydropower additions as per National Renewable Energy Plan



Awarded hydropower projects under RE Law, end-June 2015

	Potential capacity of projects undergoing studies and permitting, MW	Installed capacity of operational projects, MW
Luzon	5,618.93	101.80
Visayas	715.24	4.50
Mindanao	1,550.37	30.43
Total	***7,884.54***	***136.73***

Comments

- The NREP seeks to increase the renewable energy capacity to about 15,300 MW by 2030, which is more than 2.5-times the current RE capacity. Hydropower would comprise 57% of the RE installed capacity by then.
- As of end-2014, hydropower installed capacity is 3,543 MW, which indicates that the plan implementation is currently
- In addition to the traditional hydropower development, the plan foresees construction of a sea water pumped-storage demo facility by 2030.

Comments

- As of June 2015, there are 407 hydroelectric power projects awarded to developers under the Renewable Energy Act. Of them, 136.7 MW installed capacity is already in operation, and 7,888.5 MW is undergoing studies or permitting.
- Overall, there are 679 RE projects awarded as of June 2015.
- In addition, 193 hydropower projects with total combined capacity 1,846.22 MW are pending review.

Source: Department of Energy

Lao PDR

Overview

Hydropower development is a national priority for Laos. It is the driving force behind the fact that the country is the only net power exporter in the Mekong Region and has earned the status "The Battery of Asia". Foreign investors are actively engaging in the sector, providing much needed funding and expertise in return of reliable electricity supply contracts. Sustainable long-term management of the 23,000 MW exploitable hydropower potential is critical to meet the country's development goals, and to graduate out of the "least developed country" status by 2020.

Hydropower Capacity	Hydropower capacity in 2014 reached 3,300 MW, installed at 29 power generation plants. Large hydro, defined in Laos with capacity more than 25 MW, makes up over 97% of the total power generation in Laos. The government has a goal of completing new 45 hydropower projects by the end of 2019. As a result, Laos would have in total 74 hydropower projects with combined capacity of about 10 GW, and expected generation of as much as 50,000 GWh.
Sector Structure	Electricité de Laos (EDL) is the national power company. It is vertically-integrated and involved in the production, transport, distribution and export of electricity. In 2010, EDL-GEN was incorporated (75% EDL, 25% private investors) and has been operating seven hydropower assets since then. As of Q1'2015, their combined installed capacity is 389 MW. The rest of the installed capacity belongs to IPPs, and they will play a leading role in the future hydropower expansion. That is why, in July 2015, the Ministry of Energy invited consultants to help develop an institutional framework to improve the IPP process for management, monitoring and implementation of sustainable hydropower development.
Foreign Investors	The government of Laos provides a range of tax and non-tax incentives to foreign investors. Some important prerequisites that facilitate foreign entry in the Laotian market are: permission to bring in foreign nationals to undertake investment feasibility studies; permission to lease land for up to 20 years from a Lao national and up to 50 years from the government; permission to own all improvements and structures on the leased land.

Source: Department of Energy Business, EDL, Lao News Agency

Current Trends and Outlook

Plans and Potential Constraints

As of 2015, feasibility studies on social and environmental impacts are being conducted on more than 300 other hydropower projects. Results of studies have so far shown that Laos could generate about 28 – 30 GW of electricity.

Many of the ongoing and proposed projects in Laos, however, are located on the Mekong River mainstream. This creates environmental and social risks that may turn into serious barriers for timely project implementation. Current cases include:

- Xayaburi – In October 2014, Thai communities filed an injunction with the Thai Supreme Administrative Court to halt contruction of the dam. In July 2015, the court accepted final submissions of evidence by the plaintiffs. The timeline for the court's decision is not known.
- Dong Sahong - In October 2014, local communities from Thailand and Cambodia filed a complaint to the Malaysian Human Rights Commission against the Malaysian developer of the dam. In January 2015, the governments of Cambodia, Thailand and Vietnam requested extension of the consultation process and additional data to clarify better the potential impacts of the dam. As of this moment, the MRC does not have an official opinion on the project progress.

Foreign Investment and Export Agreements

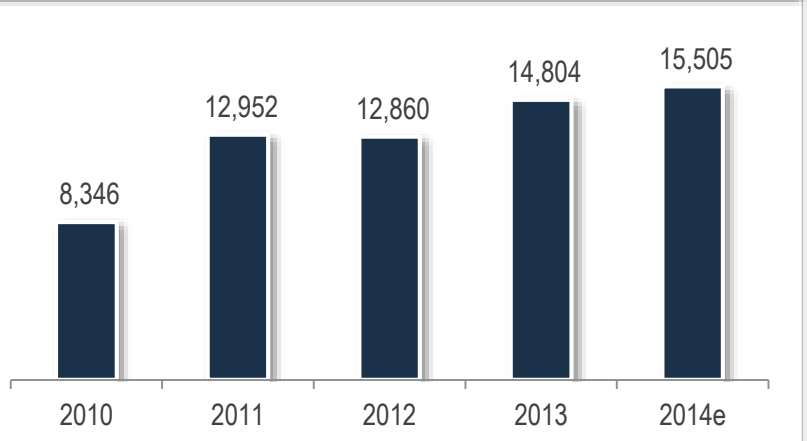
Most of the hydropower development in Laos is driven by foreign investors, most of whom are eager to supply their own power markets, such as Thailand, Vietnam and Cambodia. Hydropower is either sold, or traded for power during the dry season.

- China: Over the last decade, Chinese companies have invested about USD 2.8bn in Laos, of which 32% went in the hydropower sector.
- Thailand: At the 19th meeting of the Laos-Thailand Cooperation Committee in 2015, the Thai government confirmed a power purchase contract for 7,000 MW for 25 years, beginning in 2016. Among the projects financed by Thai banks is the disputed USD 3.5bn Xayaburi dam.
- Vietnam: As per the current MoU between the countries, in force until 2020, Laos sells 3,000 MW to Vietnam. Vietnam has invested about USD 3.45bn in Laos, with a high share going into hydropower. Vietnamese companies are involved in the planning and construction of several hydroelectric dams in Laos, with most of the electricity that will be generated by these projects already earmarked for export to Vietnam.
- Cambodia: Reportedly, the countries have an agreement for 1,500 MW, however, according to the Lao Department of Energy Business, to-date there is no MoU to officially certify the terms of the sale.

Source: Department of Energy Business, Lao News Agency

Capacity and Generation

Total electricity production, GWh p.a.



Hydropower development status as of 2014

Status	Number	Capacity, MW
Existing capacity	22	3,300
Of which 100% EDL-owned	9	389.5
Under construction, planned to come online in 2016-2020	20	3,083
Planned		
Of which with MoU signed	33	8,208
Of which with PDA signed	20	4,524

EDL-GEN hydropower generation and revenue, Q1'2015

	Generation, GWh	Plan Accomplished, %	Revenue, LAK mn
Nam Ngum 1	218.6	106.91%	99,725
Nam Leuk	37.0	118.27%	18,201
Xe Set 1	32.0	106.53%	14,416
Xe Set 2	13.44	108.56%	6,141
Nam Mang-3	3.48	152.98%	2,133
Nam Song	2.45	92.81%	936
Se Labum	1.71	102.76%	731

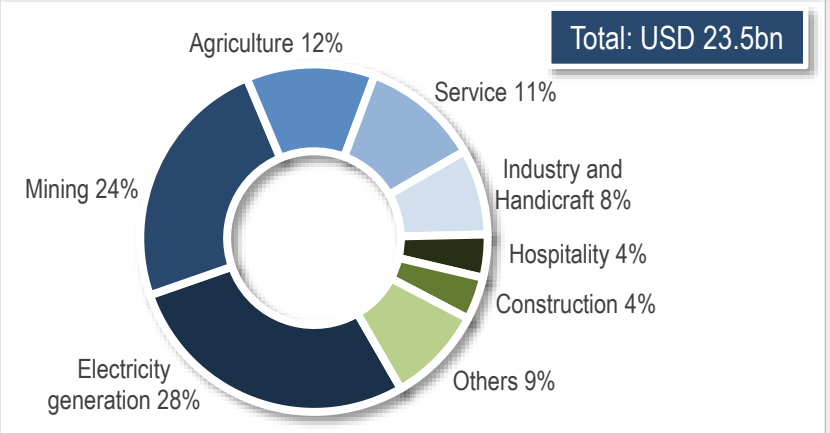
Comments

- Historically, about 80% of the generated hydropower is exported. The remaining share supplies 99% of the electricity in Laos.
- Electricity consumption and the electrification rate are increasing rapidly: about 85% of the households are connected to the grid, and consumption rates have grown by an average of 29% per year in the period 2000 – 2014.
- In Q1'2015, EDL-GEN reported over-accomplishment of the power generation targets, due to favourable weather. Total revenue for Q1 was LAK 142,283mn (around USD 17.15mn).

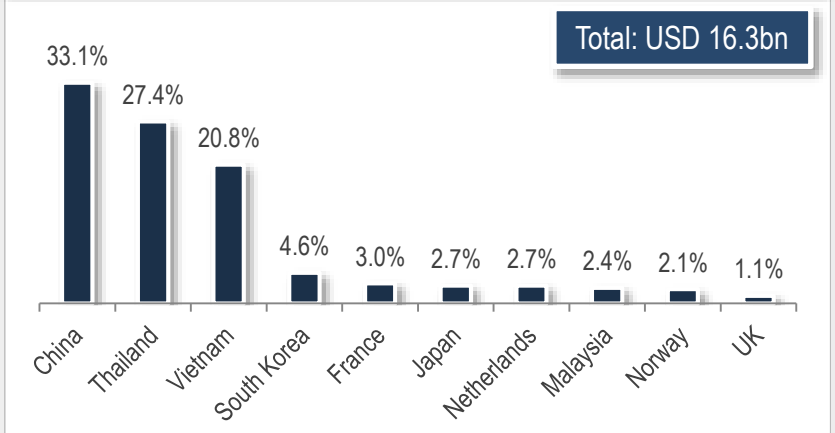
Source: Department of Energy Business, EDL-GEN, Enerdata, Lao Statistics Bureau

Foreign Investments

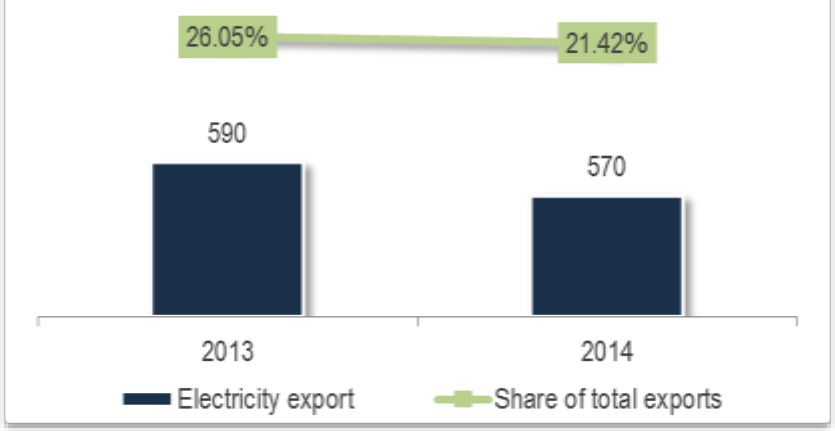
FDI by sector, 1989-2014



FDI by country, top 10, 1989-2014



Electricity export revenues, USD mn



Comments

- Laos is an attractive destination for foreign investors. Electricity generation (hydropower), along mining, has been the leading sector for foreign investments for 25 years.
- Investments in generation capacity and transmission are usually linked to long-term power supply agreements.
- The three major FDI players are China, Thailand, and Vietnam. Thailand and Vietnam are the main power markets for the forthcoming hydropower capacity.

Source: Bank of the Lao PDR, Ministry of Planning and Investment

Hydropower for Export

Development plan for markets abroad, as of mid-2015				
	Investors	**Capacity**	**Off-takers**	**Status**
Under construction				
Xe-Pian Xe-Namnoy	Korean: SKEC - 26%, KOWEPO - 25%; Thailand: RATCH - 25%; Lao Holding State Enterprise - 24%	410	EGAT 90% EDL 10%	Commercial operation 2019
Nam Ngiep 1	KPIC Netherlands - 45%; Thailand: EGAT - 30%; LHSE - 25%	272	EGAT 100%	Commercial operation 2019
Xayaburi	Laos: EDL 20%; Thialand: Ch.kanchang - 30%, EGCO 12.5 %, Bangkok Expressway 7.5%, PT 5%	1285	Thailand 95%	Commercial operation 2019
Don Sahong	Government of Laos - 20%; Malaysia: Mega Frist - 80%	240 - 360	Thailand, Cambodia	Ongoing public consultations
Planned				
Phou Ngoy	Charoen Energy and Water Asia Co.,Ltd	651	Laos, Thailand	PDA signed 2010
Se Kong 5	n.a.	400	Laos, Vietnam, Thailand	PDA signed 2009
Xekong 3	Song Da Corporation Company	105 + 100	Laos, Vietnam	PDA signed
Nam Sum	Saigon Investment	112 + 196	Laos, Vietnam	PDA signed 2011
Nam Seuang 1	Bru Thai International	56	Laos, Thailand	PDA signed 2010
Feasibilty Stage				
Nam Ngum 4A and 4B	Saigon Investment Group	255	Laos, Vietnam	MoU signed 2008
Nam Ma Cascade	Linh Linh JFC Electrical Construction Investment Co	175	Laos, Vietnam	MoU signed 2005
Nam Et Cascade	EVN InternationalJoint Stock Co	420	Laos, Vietnam	MoU signed 2008
Pak Lay	SINOHYDRO	1320	Laos, Thailand	MoU signed 2007

Source: Department of Energy Business

Thailand

Overview

Thailand is committed to develop alternative energy in order to reduce its dependence on natural gas for power generation and to focus on clean energy sources. Hydropower will remain a steady supply source, but future capacity expansion is planned only for small hydro. At the same time, as a net electricity importer, Thailand will increase the share of imported hydroelectricity. In order to ensure reliable deliveries, the country is looking to participate in developing larger hydro projects across the border, and signing long-term purchase agreements.

Hydropower Capacity	As of July 2015, Thailand's installed hydropower capacity is 3,444 MW. In total, about 3% of the energy generation is provided by domestic hydropower, and another 6% by imported hydropower from Laos. Thailand has more than 4,000 existing dams, managed by the Royal Irrigation Department. The country's total hydropower potential has been estimated at 15,155 MW. In particular, according to the Power Policy Bureau's development plan to 2022, Thailand has a total potential for small hydropower of about 328 MW. Hydropower stations with installed capacity < 12 MW are considered small, or mini, and those with capacity < 200 kW - micro.
Sector Structure	The Electricity Generating Authority of Thailand (EGAT) that is the government-owned electricity generation company, operating under the Ministry of Energy and Ministry of Finance. At present, it is the largest electricity producer in the country and owns 15,492 MW of capacity, of which 22% is hydropower. The latest hydropower addition was Naresuan Hydropower Plant (8 MW), whose commercial operation started in September 2014. In addition, there are about twelve independent power producers (IPPs) and many small power producers (SPPs).
Energy Development Plan	According to Thailand's new Power Development Plan 2015-2036, renewables (including small hydro) are to contribute 18% of the total power production, and domestic large hydro 2%. New hydropower capacity to be added includes 324 MW small hydro and 2,101 MW pumped-storage. The strategy to achieve the targets involves developing small hydropower downstream of irrigation dams, and mini hydropower systems. EGAT should commission units 3 and 4 (500 MW) of the Lam Takong pumped-storage project, and the Chulabhorn Dam with capacity of 784 MW.

Source: EIU, Electricity Generating Authority of Thailand, International Center on Small Hydro Power (ICSHP), Thailand Ministry of Energy

Current Trends and Outlook

New Incentives for Small Hydro

A new feed-in tariff (FiT) developed by Ministry of Energy has replaced the former adder rates since end-2014. The scheme is for Very Small Power Producers (VSPP). For hydropower, FiT is to be be granted for 20 years, and rates vary by power plant size and location. The new FiT is calculated as follows: *FiT = FiT(F) + FiT(V) + FiT Premium*

FiT(F) is a fixed portion of the remuneration for the whole support period: FiT(V) varies according to inflation rate if the feedstock price is volatile (hence, not applicable to hydro). For small hydro (< 200 kW), the fixed FiT is THB 4.90 per kWh, and there is a premium of THB 0.50 per kWh for projects located in the Southern Provinces.

Selection of applications for projects will change from "first-come, first-serve" to a competitive bidding system. Therefore, the suggested FiTs actually serve as a ceiling for competitive offers by the power producers.

Hydropower Imports

The lower costs of importing hydropower compared to importing LNG justifies the Thai government's strategy to increase hydropower imports from neighbouring countries. Myanmar and Laos will remain Thailand's main suppliers of electricity, with Myanmar eventually becoming the dominant supplier as new hydropower plants come on stream. Thailand currently imports over 2,000 MW of electricity from Laos at about THB 2.3 per kWh (USD 0.07/kWh), and capacity is set to increase with commissioning of several projects in 2019:

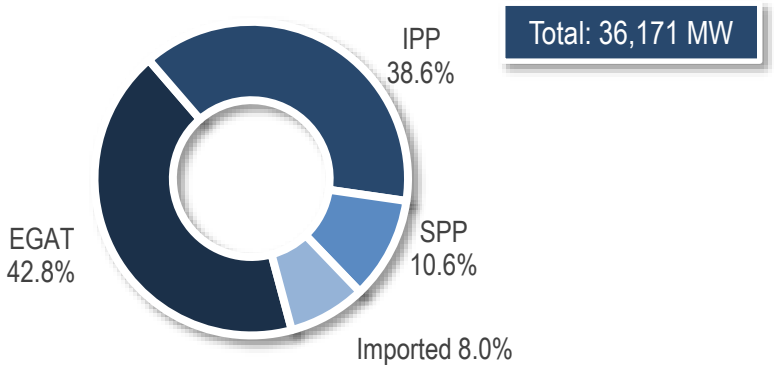
- Xe-Pian Xe-Namnoy: Thai IPP RATCH (where EGAT owns 45.01%) holds 25% in PNPC – the company developing Xe-Pian Xe-Namnoy in Laos. Of the 410 MW produced, 370 MW are to be sold to EGAT under a 27-year PPA signed in November 2012.
- Nam Ngiep 1: EGAT also holds 30% in Nam Ngiep 1 Power Company. All of the electricity produced by the 272 MW project will be exported to Thailand.
- Thailand also funds the controversial Xayaburi dam. The power purchase agreement for 95% of the electricity, signed in 2011, is now disputed in Thai court by local communities. In July 2015, the court accepted final submissions of evidence by the plaintiffs.

Furthermore, Thailand and Myanmar signed a Memorandum of Understanding in June 2015 to increase Thailand's import of electricity from Myanmar by up to 10,000 MW, including through investment in a cascade of hydro-power projects on the Salween River.

Source: EIU, Enerdata, Nam Ngiep 1 Power Co., RATCH (shareholder structure as of March 2015), Thailand Ministry of Energy

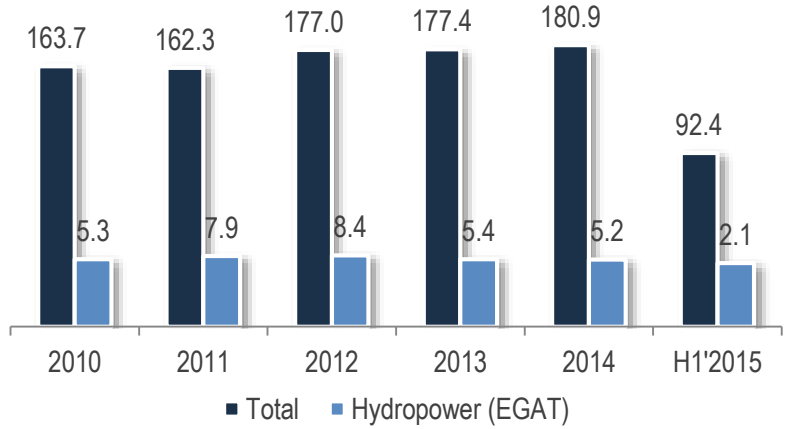
Capacity and Generation

Sector overview: power capacity, as of June-2015

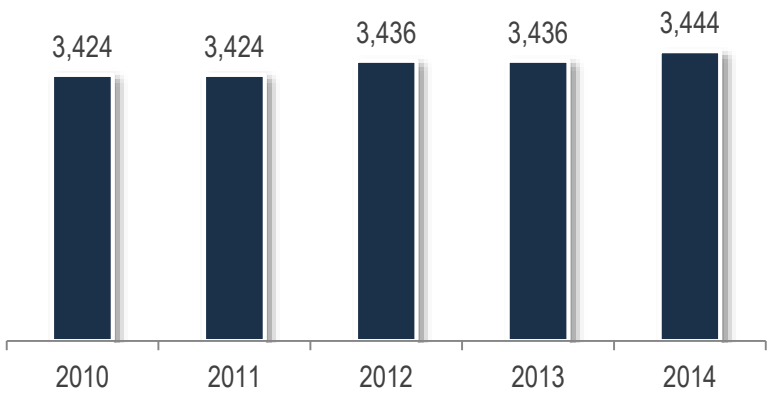


Note: EGAT's share presented in the chart excludes its stakes in the IPPs.

Power generation, TWh



Installed hydropower capacity, MW



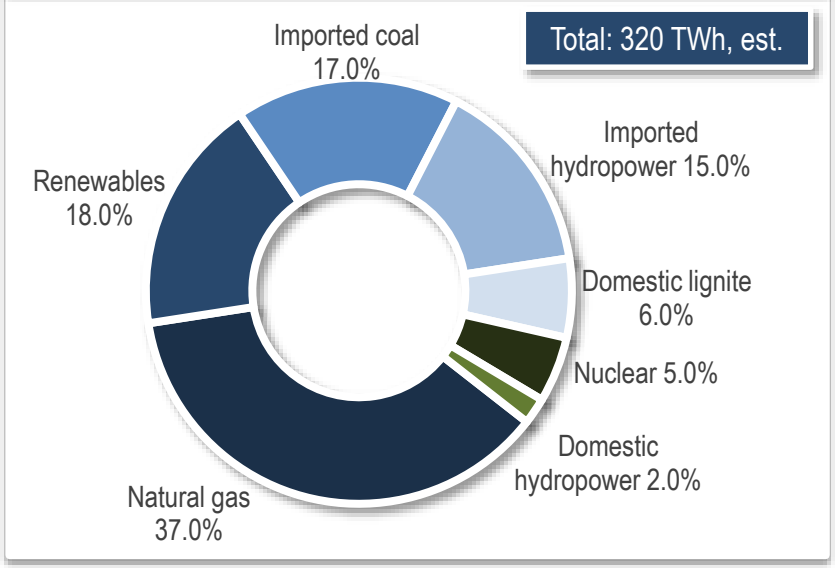
Comments

- EGAT owns 23 hydropower plants, comprising 22% of its installed power capacity.
- In 2014, EGAT hydropower supplied about 5,200mn kWh, and hydropower SPPs supplied 23 mn kWh to the grid. At this time, no IPPs own hydropower stations.

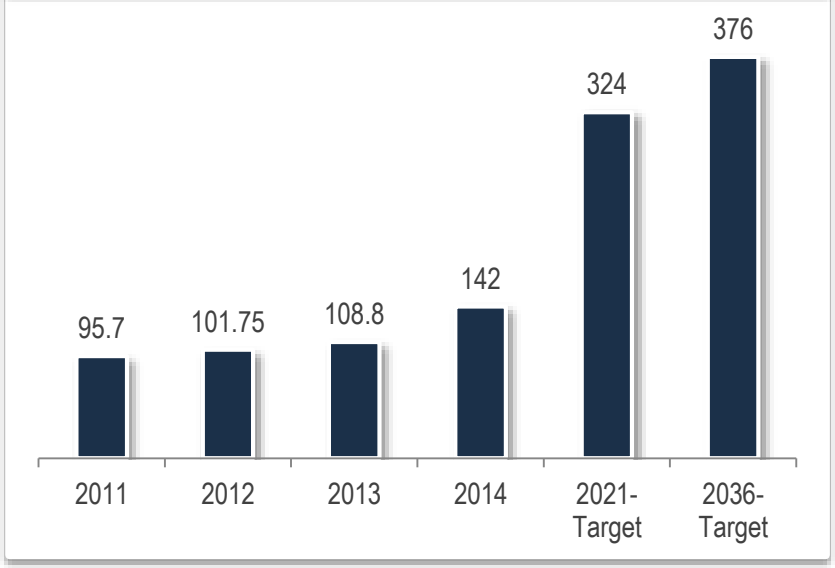
Source: Enerdata, Electricity Generating Authority of Thailand, Energy Policy and Planning Office

Development Plans

Power Development Plan 2015, Targets for 2036



Small hydro targets, MW



Comments

In 2015, four hydro projects with total capacity 59 MW are scheduled to begin commercial operation. In addition, EGAT's Lam Takhong pumped-storage hydropower plant (520 MW) is expected to be commissioned in 2017.

In the period 2015-2019, the total capacity of foreign power purchase to be added to the power system will be 3,316 MW from five power projects, of which three are hydro: Xe-Pian Xe-Namnoy (354 MW contractual capacity), Nam Ngiep 1 (269 MW), and possibly Xayaburi (1,220 MW).

Source: Electricity Generating Authority of Thailand, Enerdata, Thailand Ministry of Energy

Cambodia

Overview

Cambodia is among the fastest growing economies in the world, with an average annual growth rate around 7% in the past two decades. The electricity sector is characterized by high costs for end-consumers and poor access to infrastructure, which may pose significant constraints to further growth of the country's manufacturing sector. Hydropower development is an important pillar to strengthen the domestic power sector. Large hydropower projects also have strong regional backing from power-hungry China, Vietnam, and Thailand. A surge in hydropower-based supply is expected from 2016 onward.

Hydropower Capacity

In 2013, Cambodia witnessed a significant increase in the installed electricity capacity: in total 570 MW were commissioned, including 457 MW hydropower through the projects Stung Atay (Province Pursat) and Lower Stung Russei Chrum (Province Koh Kong). Thus, estimated total hydropower capacity in Cambodia is about 1 GW as of mid-2015. Furthermore, 13 projects are on the government's list of priority mini hydro (<10 MW) projects, and additional 8 projects are being studied.

Hydropower is expected to comprise 77% of the power generation capacity in Cambodia by 2030.

Sector Structure

The Electricity Authority of Cambodia is the power sector regulator, responsible for granting generation licenses. The national electricity company Electricite du Cambodge (EDC) produces only about 3% of the electricity, and the remaining generation comes from IPPs. Still, Cambodia imports about half of its total electricity supply.

Cambodia lacks a specific legal framework for development of hydropower projects, but relevant legislation regulates investments, land management, water resources and environmental protection.

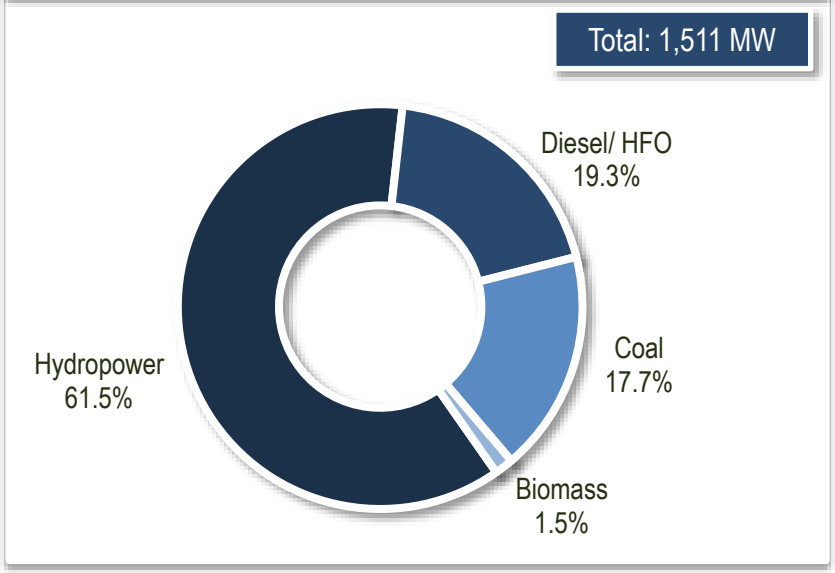
Challenges and Opportunities

- Pricing: Electricity prices in Cambodia are among the highest in the region, ranging from KHR 600 (USD 0.15) per kWh in Phnom Penh to over KHR 1,000 in rural areas. This is due to the fragmented power supply systems and the high cost of imported fuels, and including more hydropower in the mix is likely to alleviate the situation.
- Access: The low rates of access to electricity is a key constraint for economic growth and investment. Hydropower projects offer opportunities for both local electrification and connection to the grid through associated infrastructure expansion.

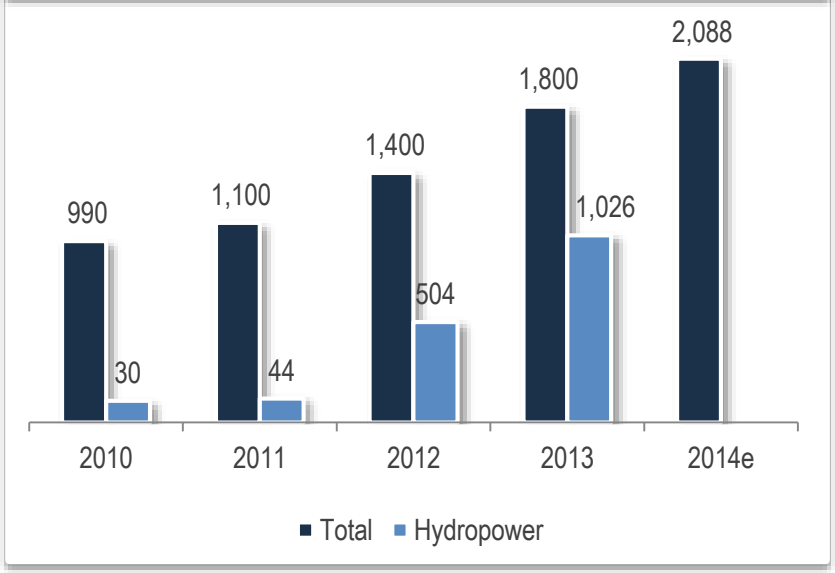
Source: BMI Research, Electricite de Cambodia, smallhydroworld.org

Capacity and Generation

Installed power capacity, as of 2014



Electricity generation, GWh



Comments

China, Vietnam and other major players in the Asian power market are increasingly looking for opportunities to invest in Cambodia.
Cambodia's two largest hydropower plants were developed by Chinese firms: In January 2015, the 338 MW Russei Chrum Krom was fully commissioned. It was built by Huadian Corporation and operates under a 35-year build-operate-transfer (BOT) contract. Project costs are estimated at USD 500mn. Due to lack of transmission infrastructure, the plant's power output has been way below capacity. The 246 MW Stung Tatay project started generating electricity in August 2014. China National Heavy Machinery Corp. invested USD 540mn and received a 40-year BOT concession.

Source: Electricity Authority of Cambodia, Enerdata, powermag.com, The Phnom Penh Post

Development Plans

Hydropower projects in the pipeline

Project	Capacity, MW	Status	Expected Start	Developer
Lower Sesan II	400	Under construction	2018	JV Lower Sesan 2 Co.
Da Dai	246	Under construction	2021	China
Chey Areng	180	On hold, as of June 2015	-	China
Sambor	2,600 / 400	Planning stage	2019	China
Srepok 3,4	400	Feasibility study	2019	China
Stung Treng	900	n.a.	2020	

Lower Sesan II

- The project is developed by Lower Se San 2 Company Ltd – a JV between Royal Group of Cambodia and China's Hydrolancang International Energy Co. The contract form is a 40-year Build-Operate-Transfer concession.
- Total costs are estimated at USD 781mn, financed by the Chinese Development Bank.
- The dam is highly controversial due to the environmental and social impacts of the large flooding area (30,000 ha). In January 2015, Cambodian and international groups issued a complaint to the UN Special Rapporteur on Human Rights in the country.
- As of mid-2015, sources report the project is 30% - 40% complete.

Comments

- **Hydropower potential:** According to a national review for hydropower development, prepared by the Ministry for Industry, Mines and Energy (MIME) and the Cambodian National Mekong Committee (CNMC) in 2003, there are 60 potential sites, and an estimated total generation potential of 10,000 MW. Half of it is on the mainstream Mekong, 40% on its tributaries, and 10% outside the Mekong basin.
- **Grid connection:** According to MIME estimates, by 2020 electricity generated from hydropower is expected to contribute to more than 50% of the total electricity supply. Over 2,100 km of transmission lines are to be built to assist distribution of this new generation capacity.
- **Small hydro:** Cambodia has a vast potential to address the low levels of rural electrification through hydropower. Estimated potential for small hydro development is about 300 MW, with installed capacity at present of only 1.87 MW.

Source: Cambodia National Sector Review 2003: Hydropower, International Journal on Hydropower and Dams

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