Team 7 Presentation

An Overview of Hydroelectricity in ASEAN Countries

Case study: Cambodia, Indonesia, Laos, Philippines and Vietnam

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Research Objective

To compare and contrast the current status of hydropower technology and policy, as well as the barriers to develop hydroelectricity in the Southeast Asian region

Scope of Analysis

1) Status of Hydroelectric Development

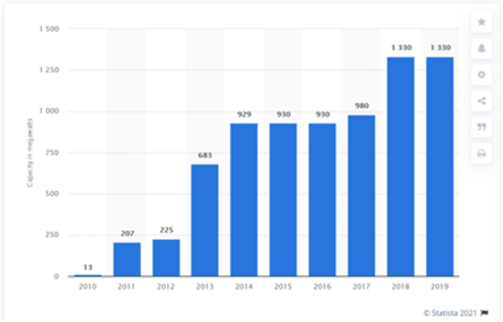
2) Policy and Regulatory Participation

3) Barriers to Development

1. An Analysis of Hydroelectric Policy - Cambodia

A. Status of Hydro Development

Total hydropower capacity in Cambodia from 2010 to 2019
(in megawatts)



Existing Hydropower Project

No.	Name of the Project	Install Capa.MW	IA/PPA/LA	Company	Country
1	Kirirom 1	12	BOT	CETIC	China
2	Kirirom 3	18	BOT	CETIC	China
3	Kamchay	194.1	BOT	Sinohydro	China
4	Stung Atay	120	BOT	CHD	China
6	Lower Stung Russei Chhrum	338	BOT	CHDPC	China
5	Stung Tatay	246	BOT	CTHL	China
7	Lower Se San 2*	400	BOT	LSS2 Co.,Ltd	Cambodia/ China/VN

Hydropower Project under MoU Study

No	Name of the Project	Install Capa.MW
1	Stung Sala Munthun	70
2	Middle Stung Russie Chhrum	70
3	Stung Veal Tmor Kombot	100
4	Prek Liang 1&2	70&50
5	St. Battambang 2	36
6	Stung Pursat 1	40
7	Stung Cheay Areng	108
8	Sambor	2600
9	Lower Se San 1/5	96
10	Stung Meteuk	100
11	Stung Treng	900
12	Lower Sekong	190
13	Lower Sre Pok 3&4	416
14	Lower Stung Toch	24
15	Upper Stung Toch	56
16	Lower Se San 3	180

Key Executive Points:

Cambodia is have water resources and huge development potential for hydropower development.

- Total hydropower potential is estimated about 10,000 MW.
- 50% in the Mekong river mainstream,
- 30% in the tributaries of Mekong river and
- 20% in the South-Western coastal area outside the Mekong basin.
- There are about 63 possible sites of small and large hydropower project in the whole country.
- Number of Possible Mini/Micro Hydropower
- Theoretical Small Hydropower Potential about: 300 MW

Source: https://www.mrcmekong.org/ 2021

1. An Analysis of Hydroelectric Policy - Cambodia

B. Policy and Regulatory Participation

1. Hydropower resources in Cambodia is huge because of relatively flat geographical features and less rainfall.
2. There is currently no law on hydropower in Cambodia, although there are a number of laws with relevance to the development and running of such projects, including the laws related to investment, electricity, land, forests, water resources and the environment.
3. Electricity has been traditionally been very expensive however with reduced reliance on diesel and imports and with the grid extension cost of supply will be stabilized.
4. All hydropower projects must be subject to an environmental impact assessment prior to approval, and environmental impact assessments (EIAs) should be conducted according to the procedures set out by the Ministry of Environment

https://opendevelopmentcambodia.net/topics/hydropower-dams/

1. An Analysis of Hydroelectric Policy - Cambodia

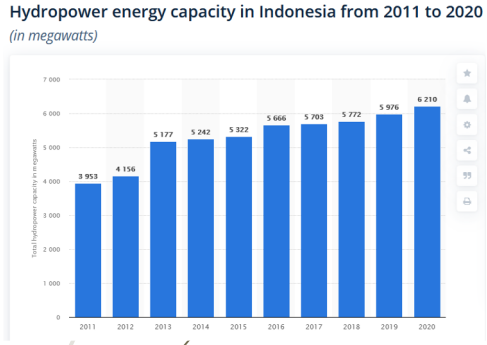
C. Barriers to Development

Flags line the Lower Russei Chrum River hydropower dam in Koh Kong province.

- Lacking of Financial Capacity
- Limited Access and Slow Connection Times to a reliable Electricity Supply
- Limited Institutional and Human Resources Capacity for Power Sector Development
- Limitation of EMP implementation
- Multipurpose of dam is still an issue (water are used mainly for electricity)
- No clear standard of compensation, but case-by-case basis
- Regulation gives way to project to move forward
- Problem of impact scoping (upstream/downstream; direct impact/indirect impact) and the important of EIA

2. An Analysis of Hydroelectric Policy – Indonesia

A. Status of Hydro Development



Source: Statista, 2021

Table 1. Potential of micro hydro energy from river in Indonesia [9]

No	Province	Number of Location	Potential Capacity (kW)
1	Aceh	3	2,862.4
2	Sumatera Utara	11	9,329.2
3	Sumatera Barat	13	26,819.0
4	Sumatera Selatan	4	10,238.0
5	Jambi	2	1,360.0
6	Bengkulu	13	21,458.4
7	Lampung	3	3,494.0
8	Jawa Timur	1	2,486.9
9	Kalimantan Barat	3	2,079.8
10	Kalimantan Selatan	4	2,743.9
11	Kalimantan Timur	4	980.0
12	Kalimantan Tengah	6	2,838.0
13	Sulawesi Utara	5	5,059.4
14	Sulawesi Tengah	12	10,225.0
15	Sulawesi Selatan	14	14,135.3
16	Sulawesi Tenggara	2	1,154.4
17	Nusa Tenggara Barat	10	4,143.6
18	Nusa Tenggara Timur	18	14,849.8
19	Maluku	5	1,809.0
20	Papua	8	5,743.2
	Total		143,845.3

Source: Erinofiardi et.al., 2017

Jatiluhur Hydroelectric Plant, West Java

Key Points:

1. Indonesia's technical hydropower potential is estimated at around **6,200 MW**, with untapped resources concentrated on the islands of Sumatra, Java and Sulawesi.
2. It is estimated that there is currently about 1,43 GW of economically viable undeveloped hydropower potential, which would provide almost 33 TWh of electricity per year.
3. Hydropower development will be driven in part by the government's target to increase the share of renewables in the country's total energy use to 23% by 2025; the figure is around **5.87%** for 2015.
4. The largest project currently under construction is the 1,040 MW Upper Cisokan plant, a pumped storage project located in western Java.
5. Currently there are **30 hydroelectric power stations** installed all over Indonesia

2. An Analysis of Hydroelectric Policy – Indonesia

B. Policy and Regulatory Participation

Maninjau Hydroelectric Plant, West Sumatera

General

- The construction of the RE power plant is partly conducted by PT PLN and mostly handed over to the IPP
- IPP builds, operates, and sells electricity to PT PLN.

Legal

- Permen ESDM No. 50 Year 2017 About Utilization of Renewable Energy For Power Generation
- Kepmen ESDM No. 1404 Year 2017 About Power Generation Cost of PT PLN (Persero)
- Permen ESDM No. 10 Year 2017 and revision Permen ESDM No 49 Year 2017 on Principles in Power Purchase Agreement (PPA)

Pricing

- The Indonesian government uses the BPP system to determine the purchase price of electricity from IPP (the developer). BPP (Biaya Pokok Pembangkitan) is PT PLN power generation cost.
- The purchase price of electricity from IPP is calculated from PT PLN's BPP in the grid which the power plant will connect.

Provisions

- Geothermal and hydropower are two renewables priority. This is due to its energy stability, scale, and potential.
- If in a region there are geothermal and hydro potentials, these two potentials will be prioritized before other renewable types.

2. An Analysis of Hydroelectric Policy – Indonesia

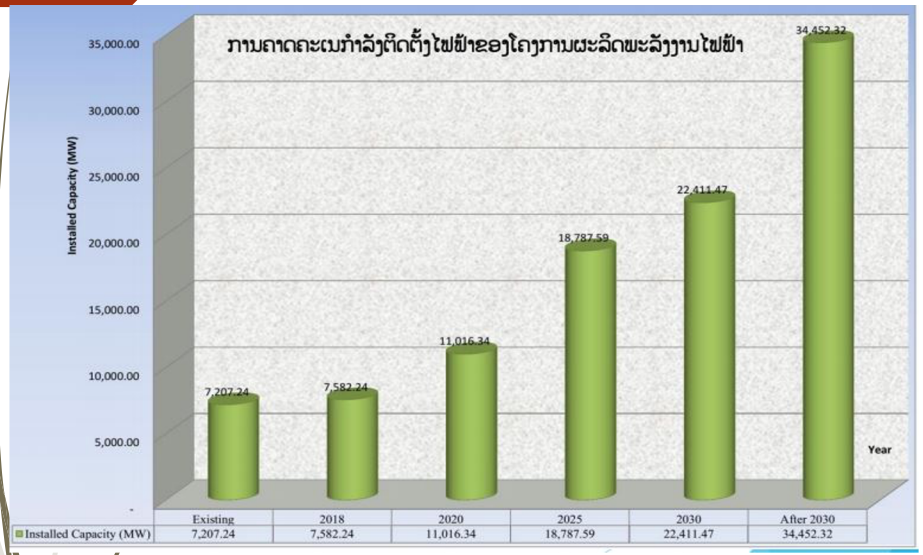
C. Barriers to Development

Bakaru Hydroelectric Plant, South Sulawesi

Barriers	Opportunities
• Project-specific issues relate to access to the project site, environmental impact and social issues, catchment area protection, as well as water rights management	• Strengthen capacity with local companies to ensure that studies are based on industry best practice and are bankable for project finance
• Historical data are often lacking at a regional level; in many locations there are no flow data or flood and groundwater data beyond the last 5-10 years	• The Indonesian Meteorological Agency (BMKG) could install additional monitoring equipment and collect information regularly. These data could be made openly available to any project developer to be used as the basis for project assessment
• Hydropower projects are planned involving different levels of government, while advantages of hydropower projects to local communities might not be optimally communicated	• Highlight the large opportunity for local employment and industry creation to local authorities to increase local interest

3. An Analysis of Hydroelectric Policy - Laos

A. Status of Hydro Development



https://www.mekongeye.com/2017/07/12/laos-expects-to-have-100-hydropower-plants-by-2020/

Key Points:

- Laos currently has 46 operational hydropower plants with combined generation capacity of 6,444 MW.
- There are 54 hydropower plants under construction across the country
- Annual power output of about 35,000 million KWh.
- Laos sells electricity mainly to Thailand, Cambodia and Vietnam. Thailand is its main export market, purchasing up to 10,000 MW, while Vietnam buys about 5,000 MW per year.
- Laos is expected to export 100MW of power to Singapore via power grids in Thailand and Malaysia and 200 MW to neighboring Myanmar by 2020

3. An Analysis of Hydroelectric Policy - Laos

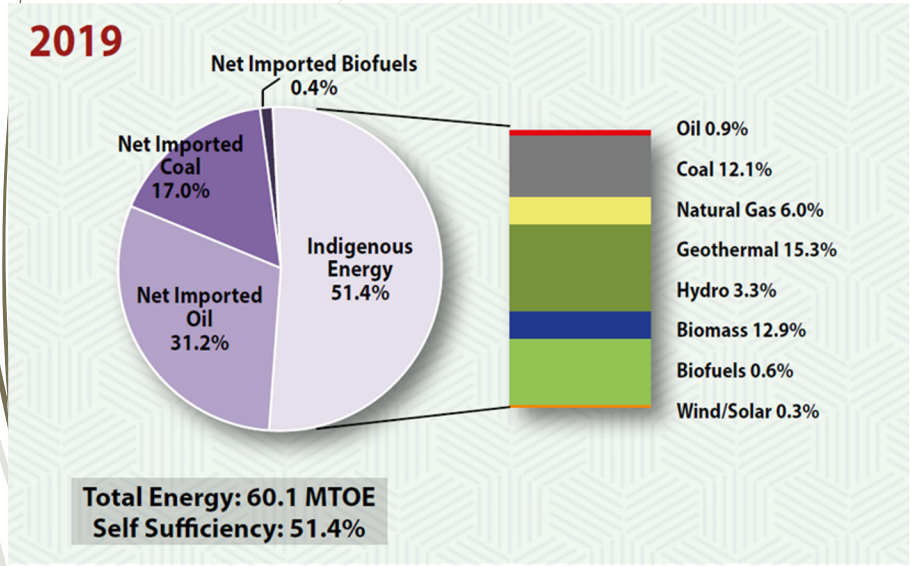
B. Policy and regulatory participation

https://silo.tips/download/lao-hydropower-potential-and-policy-in-the-gms-context#modalsh
https://www.mrcmekong.org/assets/RSF8/RSF8-Overview-of-LPBHPP-v2.pdf
https://www.mrcmekong.org/assets/Publications/Council-Study/PPT-on-Lao-hydropower-development.pdf

- End poverty in all its form everywhere
- Ensure availability and sustainable management of water and sanitation
- Increase access to electricity by grid extensions and off-grid rural electrification;
- Maintain an affordable tariff to promote economic and social development;
- Protect, restore and promote sustainable use of terrestrial ecosystems,
- Conserve and sustainably use marine resources for sustainable development
- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work

4. An Analysis of Hydroelectric Policy - Philippines

A. Status of Hydro Development



In KTOE

	2015	2016	2017	2018	2019	AAGR*
Indigenous Energy	**26,881**	**29,405**	**29,515**	**29,977**	**30,876**	**2.3%**
Oil	715	702	622	594	523	-5.9%
Natural Gas	2,854	3,270	3,226	3,601	3,626	1.2%
Coal	3,894	5,917	6,298	6,204	7,258	11.4%
Hydro	2,157	2,019	2,393	2,336	1,998	-2.0%
Geothermal	9,496	9,519	8,831	8,973	9,192	0.3%
Biomass	7,431	7,494	7,651	7,725	7,736	1.8%
Wind/Solar	76	178	197	207	197	42.6%
Biofuels	258	305	298	338	347	10.8%
Net Imported Energy	**24,393**	**25,185**	**28,443**	**29,739**	**29,222**	**6.7%**
Oil	16,496	17,844	19,048	19,400	18,778	4.9%
Coal	7,721	7,169	9,177	10,145	10,224	11.0%
Biofuels	176	172	219	194	220	20.8%
Total Energy	**51,274**	**54,590**	**57,958**	**59,717**	**60,098**	**4.2%**
Renewable Energy	19,594	19,687	19,588	19,772	19,690	0.9%
Clean Energy (RE + Natural Gas)	22,448	22,957	22,814	23,373	23,316	1.0%
Self Sufficiency (%)	**52.4**	**53.9**	**50.9**	**50.2**	**51.4**	

**average annual growth rate*

Philippines Energy Plan 2018-2040, Department of Energy

Hydropower

	2007	2008	2009	2010	2011	2012
Installed Generating Capacity (MW)	3,293	3,291	3,291	3,400	3,491	3,521
Dependable Generating Capacity (MW)	2,962	2,950	2,914	3,021	2,963	2,983
Electricity Generation (GWh)	8,563	9,843	9,788	7,803	9,698	10,252

	2013	2014	2015	2016	2017	2018	2019
Installed Generating Capacity (MW)	3,521	3,543	3,600	3,618	3,627	3,701	3,760
Dependable Generating Capacity (MW)	2,983	2,982	3,073	3,181	3,269	3,473	3,508
Electricity Generation (GWh)	10,019	9,137	8,665	8,111	9,611	9,384	8,025

Philippines Energy Plan 2018-2040, Department of Energy

Supply Outlook

REFERENCE vs. CLEAN ENERGY: TOTAL INSTALLED CAPACITIES AND TOTAL CAPACITY ADDITIONS by 2040, By Fuel (MW) for Milestone Years

Fuel Type	Installed Capacities					Total Capacity Additions by 2040	
	2018	2030		2040			
	Actual	REF	CES	REF	CES	REF	CES
Coal	**8,844**	**18,900**	**17,850**	**31,470**	**18,150**	**22,626**	**10,506**
Oil-Based	**4,292**	**1,993**	**1,993**	**1,993**	**1,993**	**115**	**75**
Natural Gas	**3,453**	**4,760**	**4,620**	**18,240**	**21,660**	**14,787**	**18,207**
Renewable	**7,226**	**25,266**	**26,259**	**38,881**	**50,479**	**34,289**	**45,337**
Geothermal	1,944	1,890	1,890	1,770	2,770	697	1,597
Hydro	3,701	9,247	9,920	9,629	12,302	7,659	9,882
Biomass	258	660	660	660	1,550	402	1,292
Solar	896	11,393	11,393	22,050	24,960	21,154	24,064
Wind	427	2,076	2,396	4,772	8,897	4,378	8,503
Other Technology	**-**	**-**	**-**	**-**	**1,200**	**-**	**1,200**
Total	**23,815**	**50,919**	**50,722**	**90,584**	**93,482**	**71,817**	**75,325**

Philippines Energy Plan 2018-2040, Department of Energy

4. An Analysis of Hydroelectric Policy - Philippines

B. Policy and regulatory participation

1. Lowering of investment costs

Fiscal Incentives

- Income Tax Holiday and Low Income Tax Rate
- Reduced Government Share
- Duty-free Importation of Equipment and VAT-zero Rating
- Tax Credit on Domestic Capital Equipment
- Special Realty Tax Rate on Equipment and Machinery
- Cash Incentive for Missionary Electrification
- Exemption from Universal Charge
- Payment of Transmission Charges
- vax Exemption on Carbon Credits

National Renewable Energy Program

- Increase RE-based capacity by 200% within the next 20 years (2011- 2030)
- Double hydro capacity (additional 5,400 MW)

2. Enhanced Competitiveness

Mandatory Utilization of RE Resources

- **Feed-in-Tariff (FIT)**
  - Priority connection to the grid
  - 250MW allocation for Hydro
  - Priority purchase and transmission of and payment for by grid system operators
  - Fixed tariff for 20 years
- **Renewable Portfolio Standard (RPS)**
  - Mandatory (percentage) utilization of RE generation system in on-grid systems

Market Options

- **Net-Metering Rules and Interconnection Standards**
  - Connection / sale of customers' RE generation to the grid
- **Green Energy Option Program**
  - End-users' option to purchase electricity from RE facilities (open access)

4. An Analysis of Hydroelectric Policy - Philippines

C. Barriers to development

The capital-intensive nature, long gestation period (average of seven years) and accompanying issues of social acceptability of large hydropower projects remain to be the sector's biggest challenges. On the other hand, micro-hydro development for off-grid electrification is hindered by high upfront costs and the need for government intervention and subsidy.

Socio-environmental concerns

- There is considerable resistance to the further development of large hydropower projects
- This is due to the potential for upstream flooding, destruction of agricultural areas and animal habitat and disruption of communities in the affected areas.

Shift in type of development

- Given the many issues plaguing large hydropower projects, the logical next step would be to focus on smaller, more manageable run-of-river projects.
- Challenges include decrease in new capacity given the smaller scale of the projects, intermittent supply of power and considerable decrease in power generation during the summer months

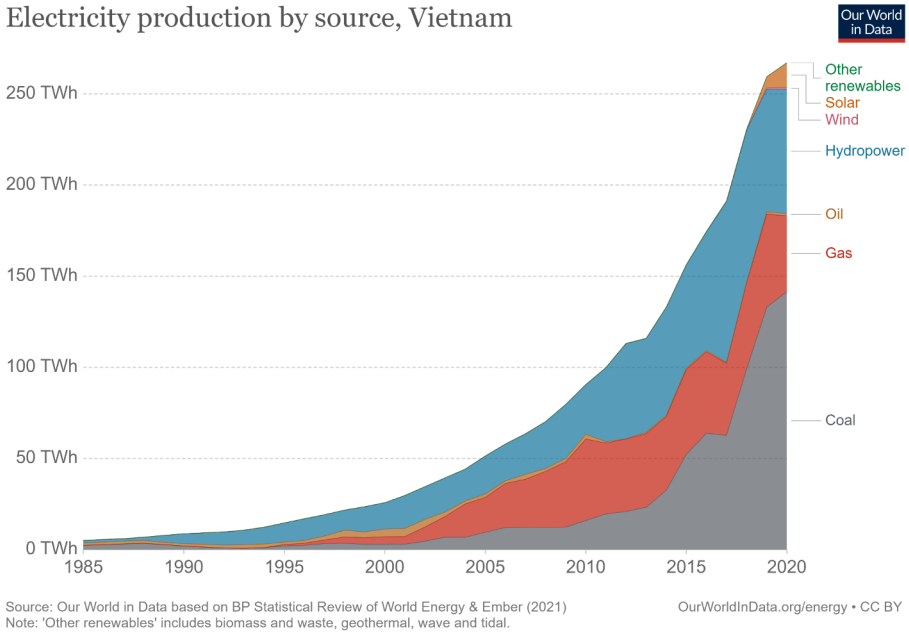
Commercialization of local micro-hydropower

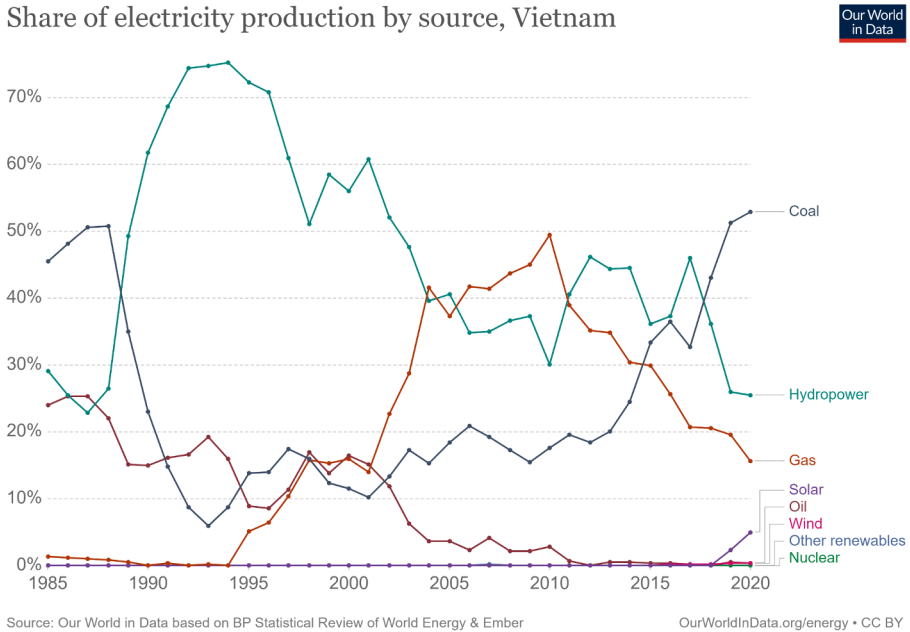
- There is also a need to develop and commercialize suitable micro-hydro technology in the Philippines
- The Philippines remains to be dependent on imported electro-mechanical equipment for micro-hydro projects.
- The costs of these equipment vary based on kilowatt capacity.

5. An Analysis of Hydroelectric Policy - Vietnam

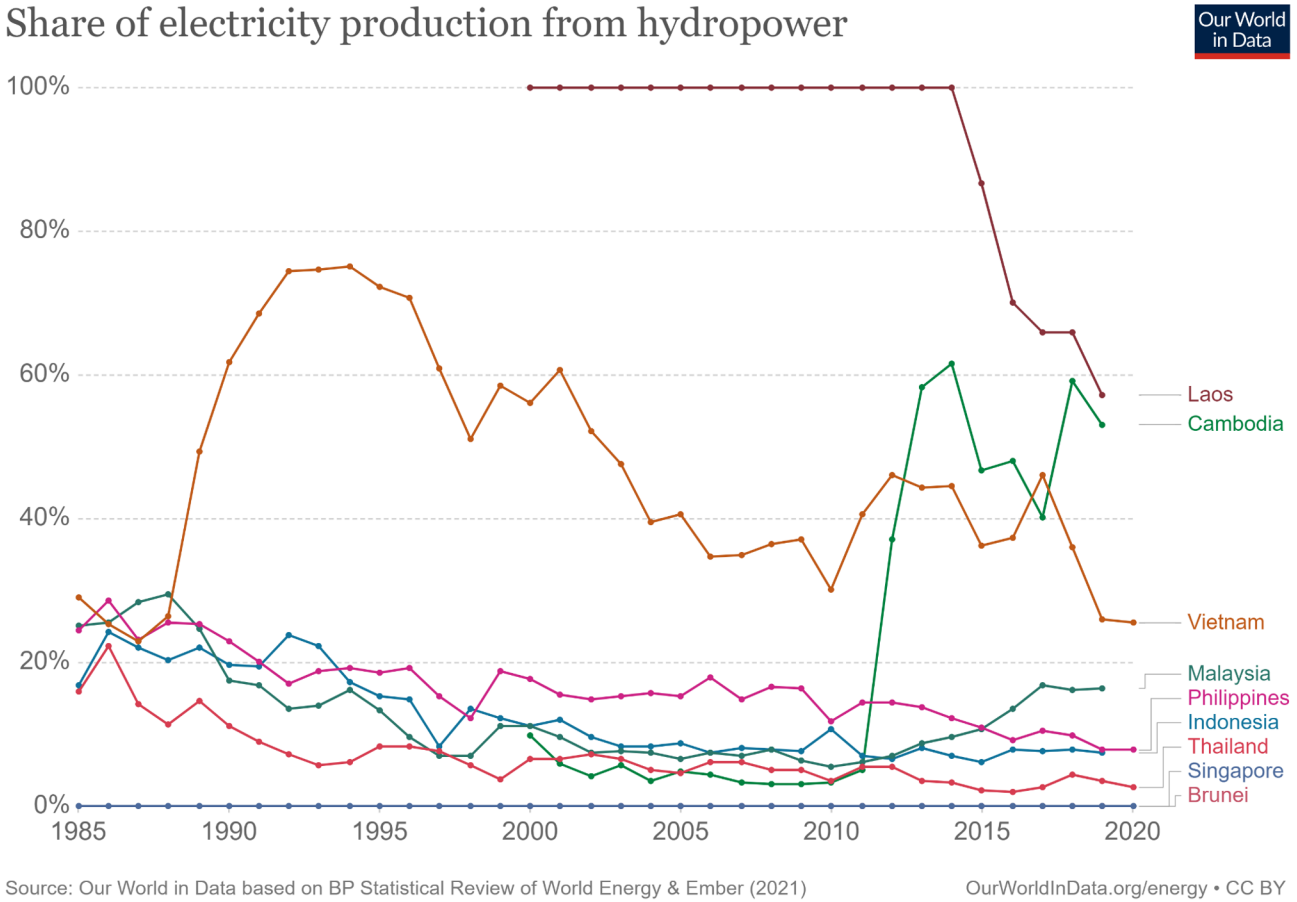
A. Status of Hydro Development

- Coal-fired power plants have been used to meet the rapidly increasing electricity demand, accounting for the highest share of electricity production in 2020.
- Hydropower is the second biggest share (68.22 TWh, 25.53 %) of the total energy mix (267.18 TWh) in 2020.





5. An Analysis of Hydroelectric Policy - Vietnam



5. An Analysis of Hydroelectric Policy - Vietnam

B. Policy and regulatory participation

In February 2021, The Ministry of Industry and Trade of Vietnam (MOIT) released a draft proposal, Power Development Plan 8 (DPD 8), for the nation's latest power development plan for the period of 2021 to 2030 with a vision to 2045.

For the period from 2021 to 2030:

- Hydroelectric power accounts for 18% of the total generation mix.
- Pumped-storage hydroelectricity and other forms of storage comprise 1% of the total generation mix.

For the period from 2031 to 2045:

- The proportion of hydropower will be reduced to 9% of the total energy mix.
- Pumped-storage hydroelectricity and other forms of storage will increase to about 3% of the total generation mix.

Table III: Scale of power sources in the PDP8 and the amended PDP7

Source	2020	Draft PDP8		Amended PDP7 (approved in 2016)	
		2025	2030	2025	2030
Coal-fired thermal power	20,431	29,523	37,323	47,877	55,477
Gas-to-power and oil/diesel-fired thermal power	9,030	14,055	28,871	15,016	19,016
Hydropower + pumped-storage hydropower (including small-scale hydropower)	20,685	24,497	25,992	24,611	27,871
Wind power	630	11,320	18,010	2,030	5,990
Solar power	16,640	17,240	18,640	3,935	11,765
Biomass and other renewable power	570	2,050	3,150	1,844	3,444
Power import	1,272	3,508	5,677	1,436	1,508
Nuclear power				0	4,600
Total capacity	**69,258**	**102,193**	**137,663**	**96,749**	**129,671**
Pmax (MW)	**38,706**	**59,389**	**86,493**	**63,471**	**90,651**

Unit: MW *Source: Draft PDP8, MOIT, 22 February 2021*

Source:https://insightplus.bakermckenzie.com/bm/attachment_dw.action?attkey=FRbANEucS95NMLRN47z%2BeeOgEFCt8EGQJsWJiCH2WAXW59W9rh3JQVhTTX6lUEPU&nav=FRbANEucS95NMLRN47z%2BeeOgEFCt8EGQbuwypnpZjc4%3D&attdocparam=pB7HEsg%2FZ312Bk8OIuOIH1c%2BY4beLEAeMutoVCLInEs%3D&fromContentView=1

5. An Analysis of Hydroelectric Policy - Vietnam

C. Challenges

Roles of hydropower: Hydroelectricity power plays vital important role in balancing the grid, especially covering peak demand due to intermittence of wind and solar power.

Environmental and social issues:

- Floods during raining seasons
- Heavy deforestation
- Erosion of the riverbank because of changing the flow of water
- Degrading water quality in the downstream areas
- Not enough water for agricultural activities
- Adverse impacts on fisheries resources
- Displaced people almost face difficulties after resettlement

Thank you – GROUP 7