The Kick-off Meeting under "the Carbon Footprint of Renewable Energy for ASEAN Countries Project"

August 18th – 19th, 2022 Bangkok.

Energy Development in Laos

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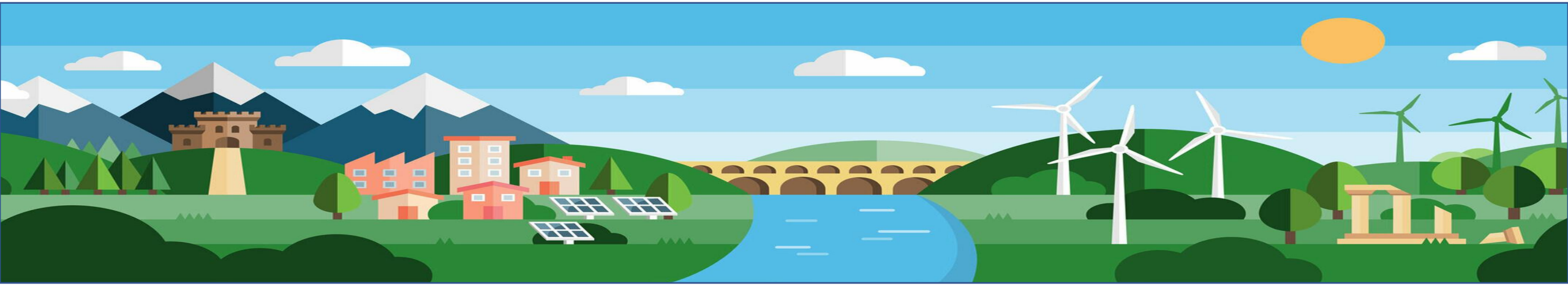
Ministry of Energy and Mine.



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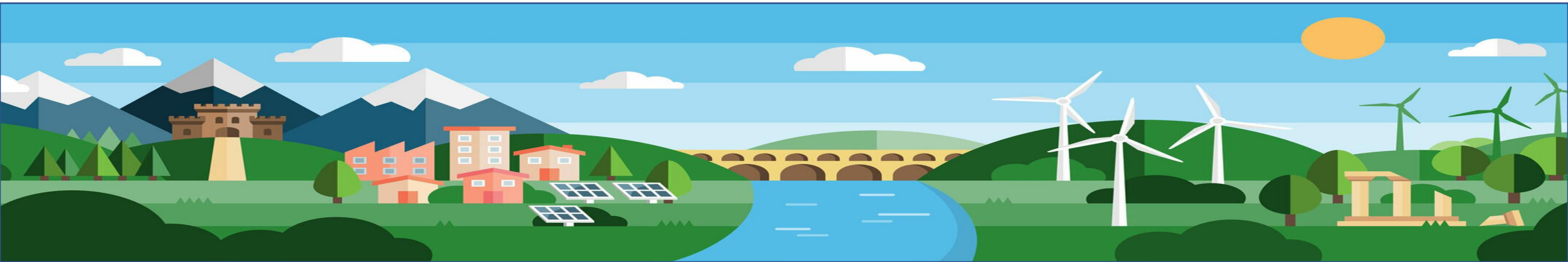
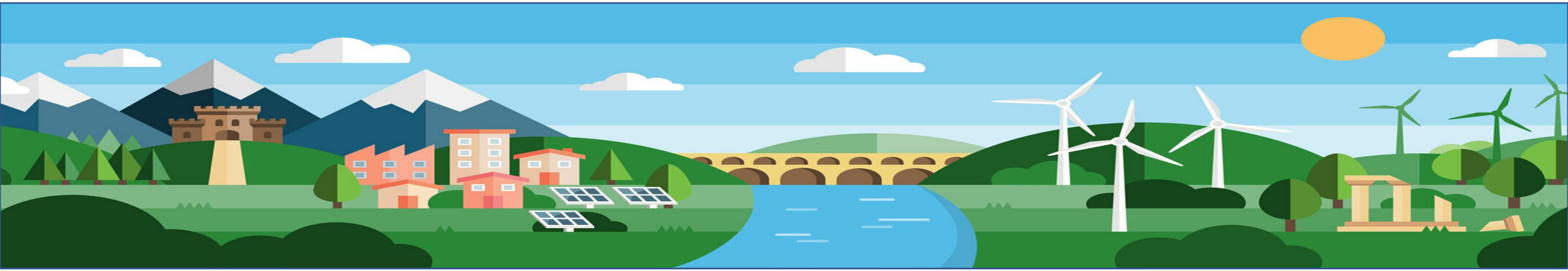


Department of Energy Business (DEB)

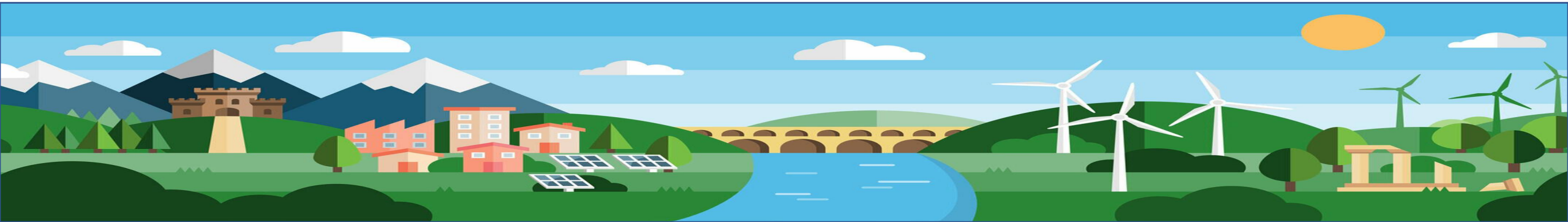
- Role and function of DEB
- The Department of Energy Business (DEB), Ministry of Energy and Mines (MEM), on behalf of Government of Laos (GOL) implementing agency of the Concession Agreement (CA) independent power producer (IPP) of hydro project in Laos, to monitoring hydro electrics projects development.
- Provide diverse academic service and consultancy to the local community in order to improve the life stye for people affected of hydro project development

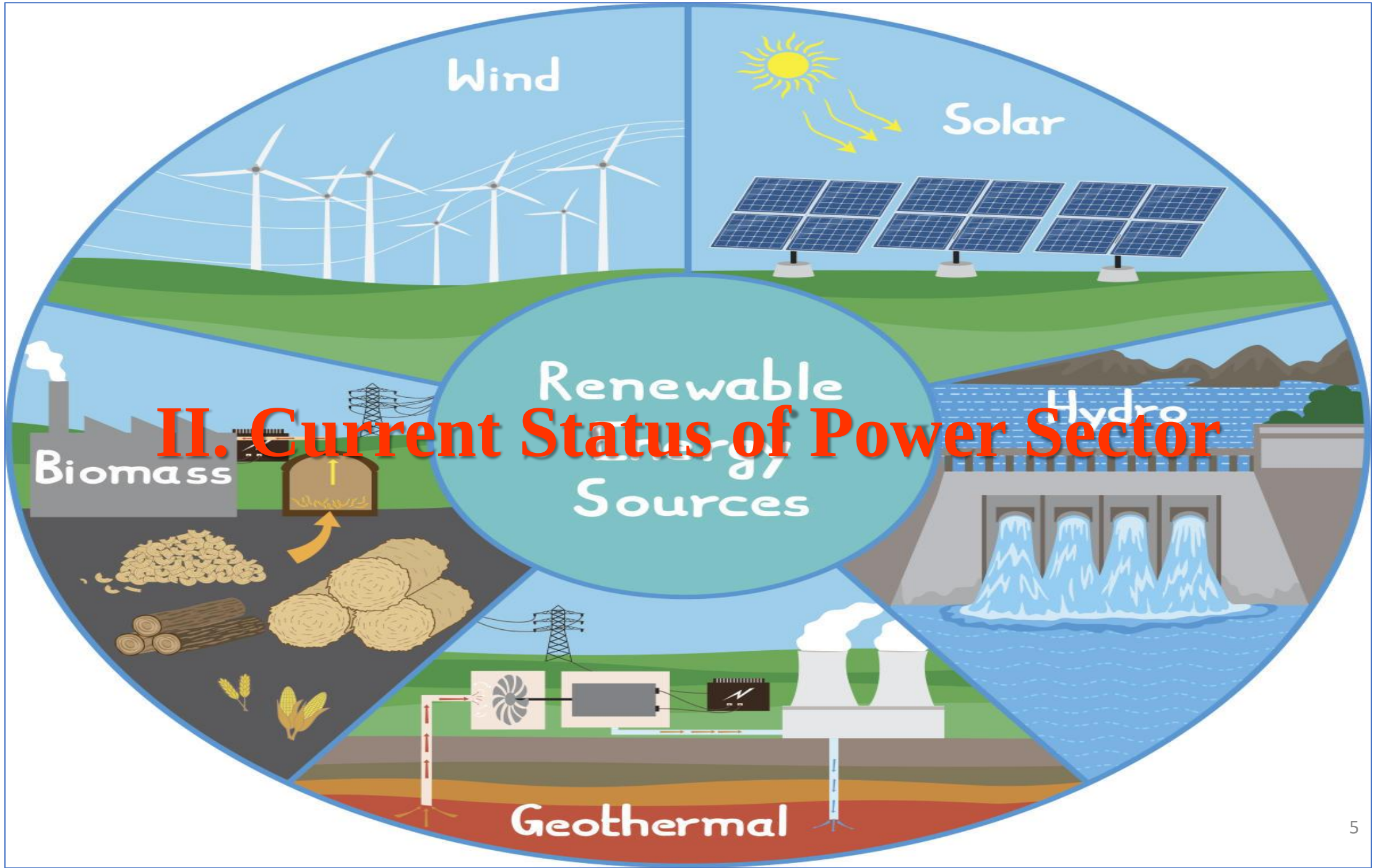


I. Energy sectors

Primary energy supply

- Fuel oil 100% import, mainly use in transportation
- Electricity mostly produced from hydropower
- Coal local product and mainly use in industrial sector (cement fact., Salt fact. Power plant,..)
- Firewood and charcoal almost from natural forest mainly use for household cooking fuel, commercial and small industry.
- LPG , 100% import and mainly use in household and commercial





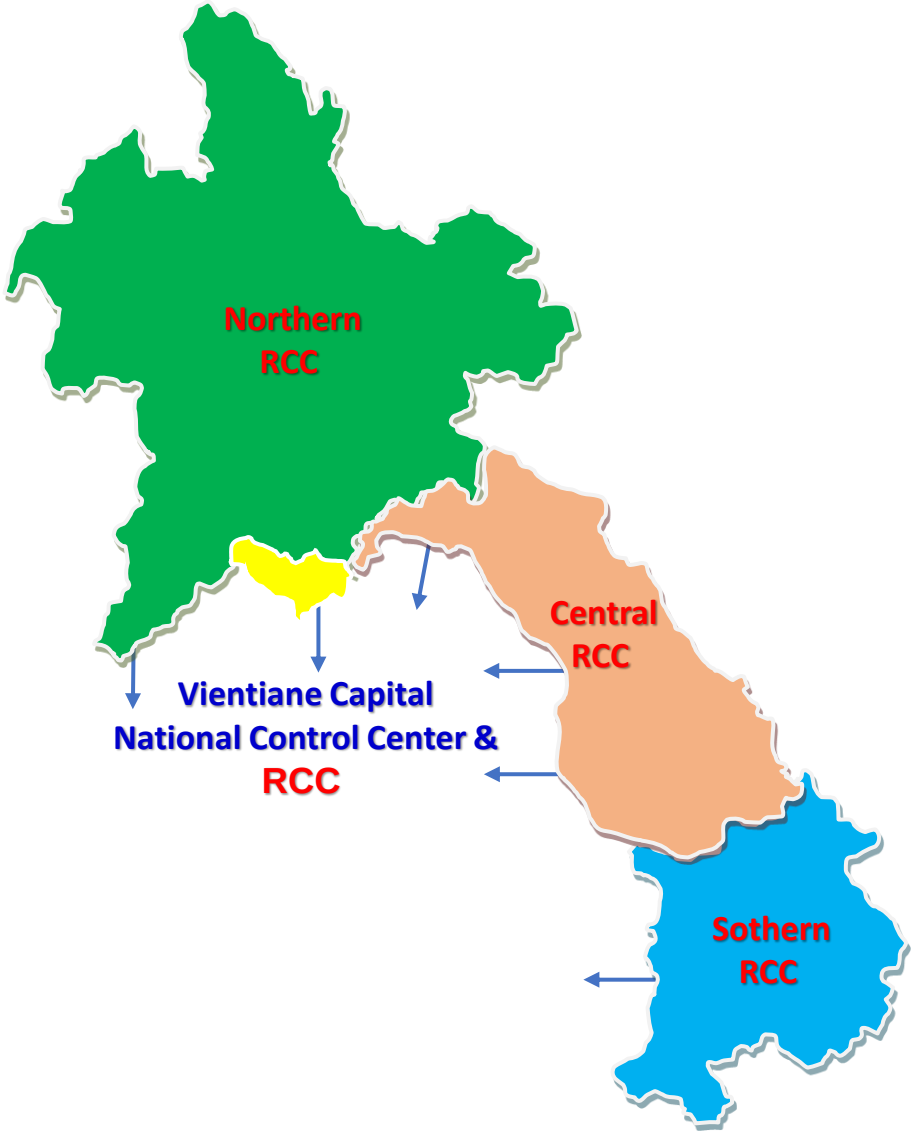
II. Current Status of Power Sector

II. Current status of power sector development

1) Grid System and Control / Admin Area

There are Four (4) control / Admin.

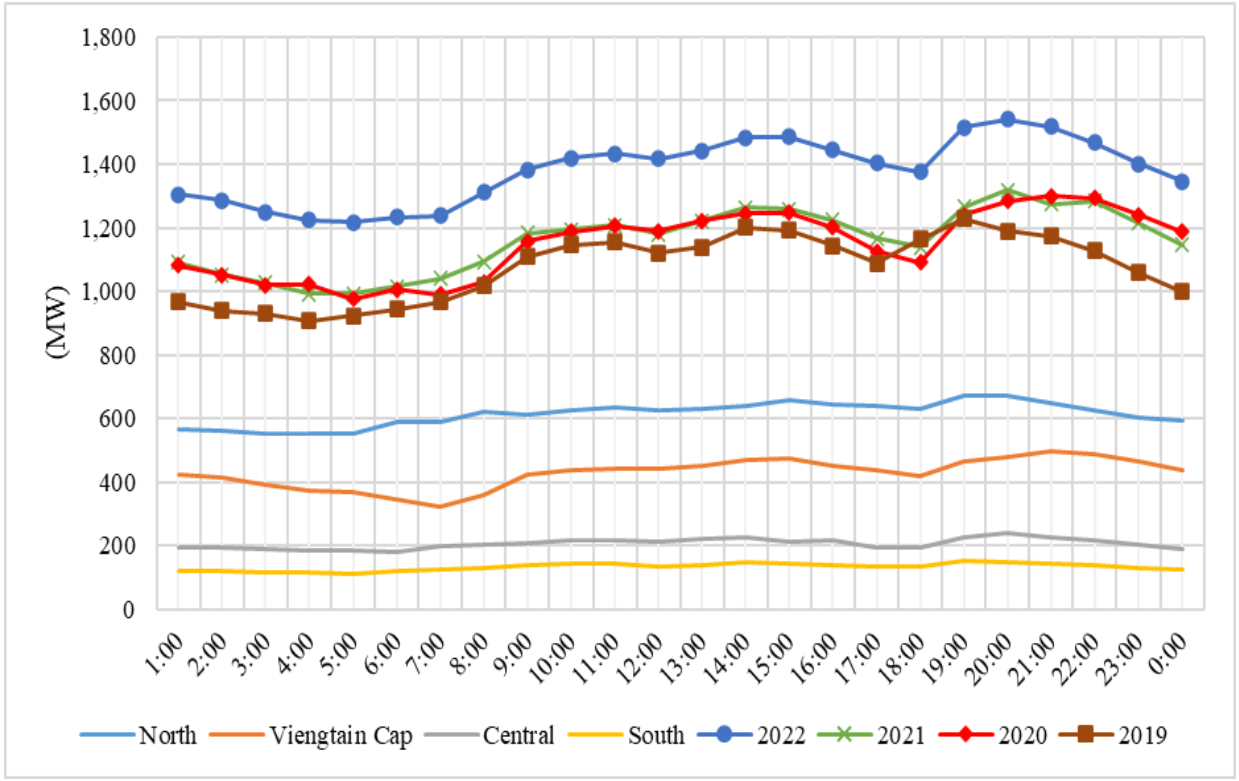
- **The north (N),**
- **Vientiane Capital (VT),**
- **The central (C) and**
- **The south (S)**



II. Current status of power sector development

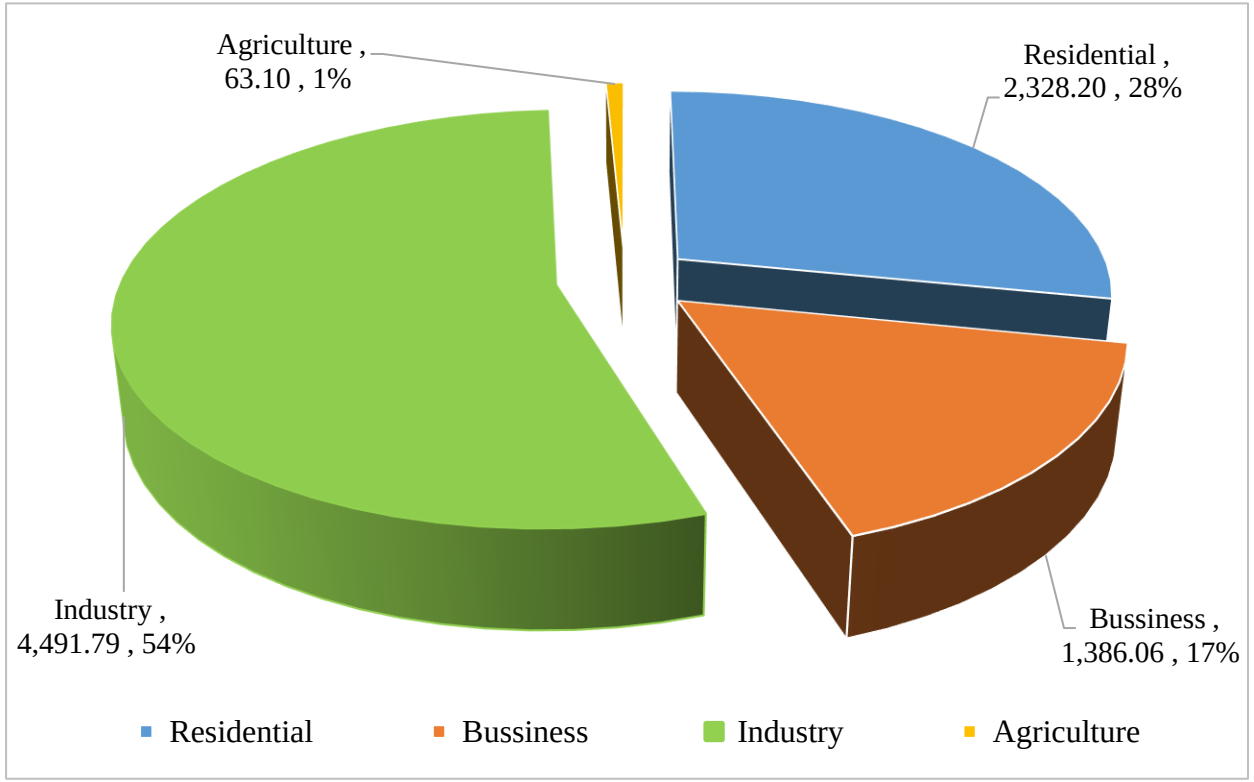
2) Daily Peak demand and Energy consumption

- **Daily Peak Demand in 4 Regions and Whole**



System Peak Demand in 4 Regions and Whole the country 1,541 MW @ 28 April 2022

- **Annual Energy Consumption, 2021 (GWh)**



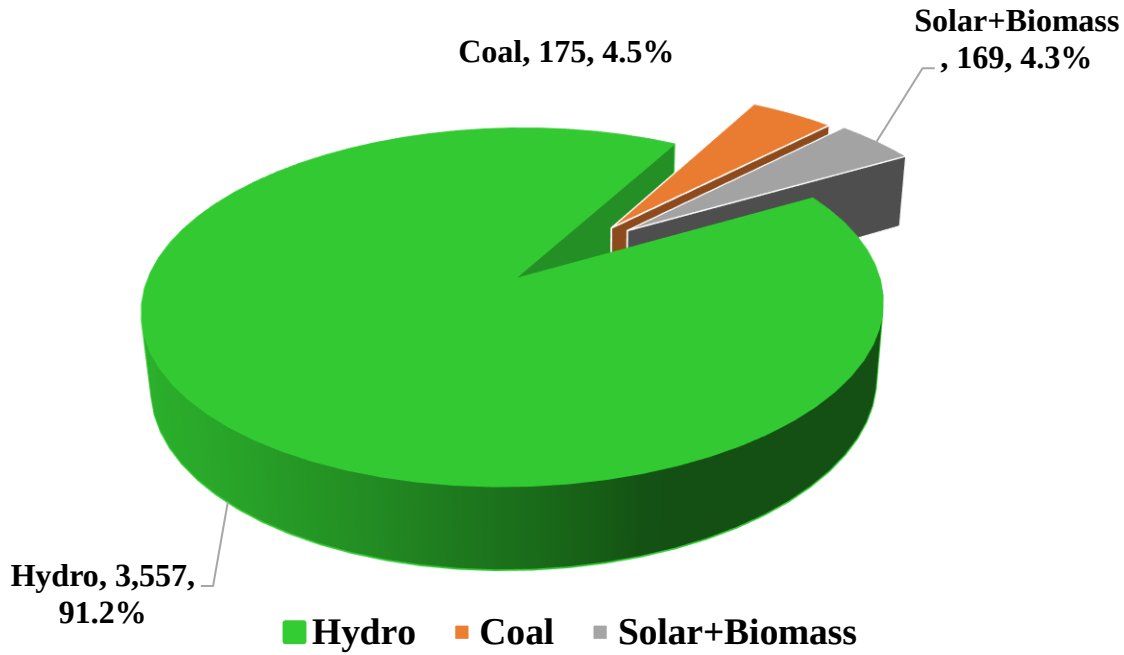
Total Energy Consumption: 8,269 GWh

II. Current status of power sector development

3) Power Generation Sources Development

Type	Year 2021			
	Amount	Install Capacity (MW)	GWh/Year	%
Hydropower	79	8,925.1	43,083.2	81.35
Coal Thermal	1	1,878	12,200	17.12
Solar	7	56.5	94.6	0.51
Biomass*	4	112	702.7	1.02
Total	**91**	**10,971.1**	**56,080.6**	**100**

*Biomass: sugar can and paper



Domestic Consumption

II. Current status of power sector development

4) Transmission System Development

a. Domestic system

Substations & Transmission Line facilities in 2021			
Voltage Level	Substation		Transmission Line Length (cct-Km)
	Number of Substation	Transformer Rated (MVA)	
230/115/22 kV	14	3,300	2,726
115/22 kV	67	2,822.5	8,133
Total	**81**	**6,112.5**	**10,915**

b. Interconnection Point

	Voltage Level	EDC	EVN	CSG	Myanmar	Thailand		Total
						EGAT	PEA	
●	22/35 kV	1	7	3	1		7	19
●	115 kV	1		1	1	6		9
●	230 kV	1	2			3		6
●	500 kV					4		4
	Total	3	9	4	2	13	7	38

II. Current status of power sector development

5) Cross-Border Interconnections

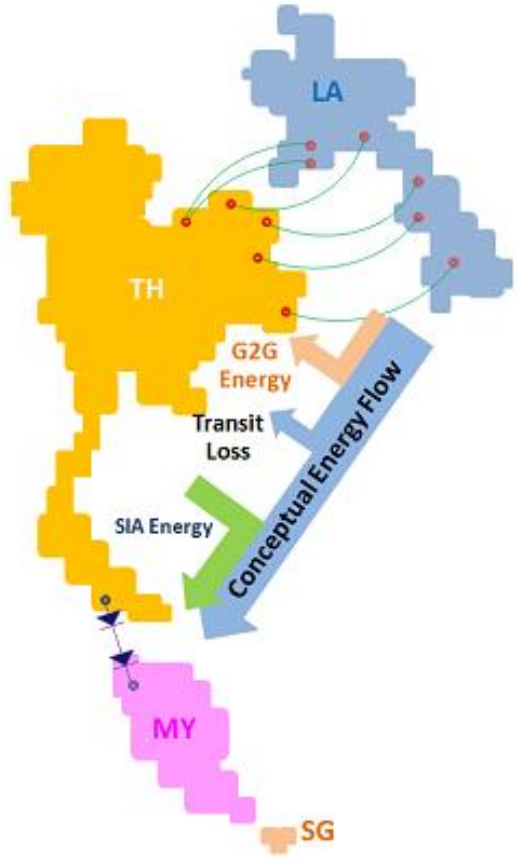
Laos – Thailand Grid to Grid Power Exchange					
No.	**Connection Point**	**Voltage**	**Circuit**	**Conductor Type**	**Conductor Size**
1	Kenthao – Thali	115	1	ACSR	1X240
2	Thanaleng – Nong Khai	115	1	ACSR	1X240
3	Phone Tong – Nong Khai	115	2	ACSR	1X240
4	Pakxan – Bung Kan	115	1	ACSR	1X240
5	Thakhek – Nakhon Phanom	115	2	ACCC	1X325
6	Pakbo – Mukdahan 2	115	1	ACSR	1X240
7	Bangyo – Sirindhorn (July 2022)	115	2	ACSR	2X410

Laos – Myanmar Grid and Load Power Export						
No.	**Connection Point**	**Capacity PPA (MW)**	**Voltage (kV)**	**Circuit**	**Conductor Type**	**Conductor Size**
1	Tonpheun –Tachileik (May 2022)	30	115	1	ACSR	1X240

Laos – China Grid to Grid Power Exchange						
No.	**Connection Point**	**Capacity PPA (MW)**	**Voltage (kV)**	**Circuit**	**Conductor Type**	**Conductor Size**
1	Namo 1 – MengLa	40-60	110	1	ACSR	1X185

Laos – Cambodia Grid to Load and Gen to Grid Export						
No.	**Connection Point**	**Capacity PPA (MW)**	**Voltage (kV)**	**Circuit**	**Conductor Type**	**Conductor Size**
1	BanHat – Preah Vihear	Up to 70	115	2	ACSR	1X240
2	Donsahong – BanHat – Strung Treng BanHat – Strung Treng	195 500	230	2	ACSR	4X500

LTM, LTMS-PIP (Use the existing TL 115 kV Grid to Grid)						
	Connection Point	**Capacity PPA (MW)**	**Voltage**	**Circuit**	**Conductor Type**	**Conductor Size**
1	Lao–Thailand–Malaysia	100	115	9		
2	Lao–Thailand–Malaysia–Singapore	30 (100)				

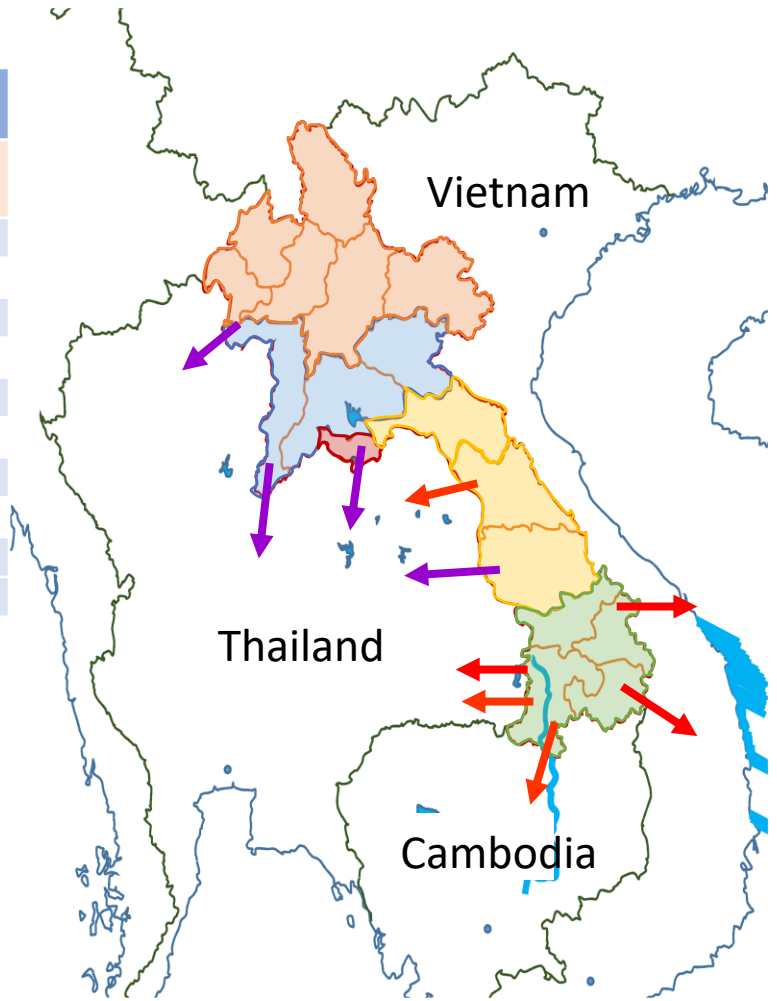


II. Current status of power sector development

5) Cross-Border Interconnections (cont.)

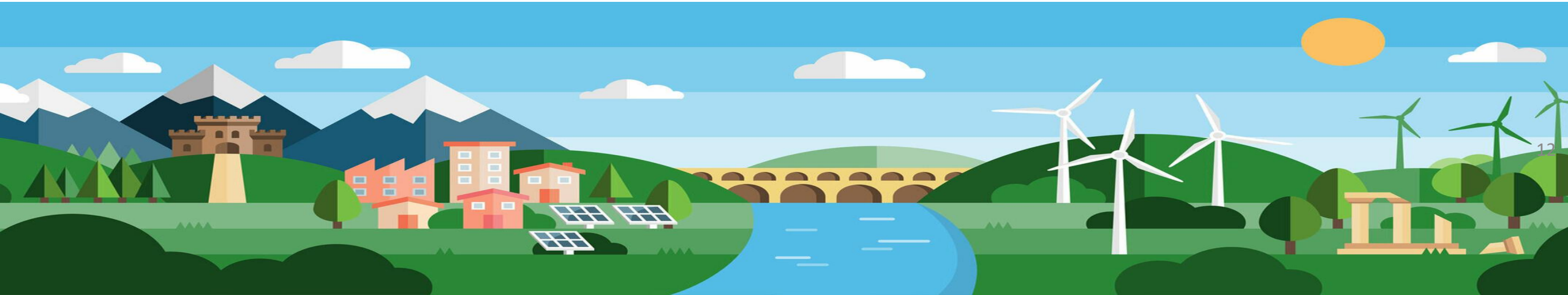
Laos – Thailand Generator to Grid							
No.	**Connection Point**	**Capacity (MW)**	**Voltage**	**Circuit**	**Conductor Type**	**Conductor Size**	**COD**
1	Theun Hinboun (HP) – Nakhon Phanom 2	434	230	2 + 2	ACSR	2X400	1998&2012
2	Houay Ho (HP) – Ubon Ratchathani 2	126	230	2	ACSR	2X400	1999
3	Nam Theun 2 (HP) – Roi Et 2	948	500	2	ACSR	4X630	2010
4	Nam Ngun 2 (HP) – Nabong S/S – Udon Thani 3	597	500	2	ACSR	4X630	2011
	Nam Ngiep 1 (HP) – Nabong S/S – (Udon Thani 3)	261	230	2	ACSR	1X630	2019
	Nam Theun 1 (HP) – Nabong S/S – (Udon Thani 3)*	290	500	2	ACSR	4X400	2022
5	Hongsa (T) – Nan	1,473	500	2	ACSR	4X410	2015-16
6	Mekong Xaiyaburi (HP) – Thali	1,220	500	2	ACSR	4X410	2019
7	Ban Lak 25 – Ubon Rachathani 3	370	230	2	ACSR	4X630	2020
	Xe-Pain Xe-Namnoy (HP) – Ban Lak 25 – (Ubon Rachathani 3)		230	2	ACSR		

Laos – Vietnam Generator to Grid							
No.	**Connection Point**	**Capacity (MW)**	**Voltage**	**Circuit**	**Conductor Type**	**Conductor Size**	**COD**
1	Xekaman 1 (HP) – BoY	290	220	2	ACSR	4X400	2018
	Xekaman Xansay (HP) – Xekaman 1	32	110	2	ACSR	1X240	2018
2	Xekaman 3 (HP) – ThanhMy	250	220	2	ACSR	2x400	2022



Hydro powerplant: HP
Thermal Powerplant: T

III. National Power Development Strategy



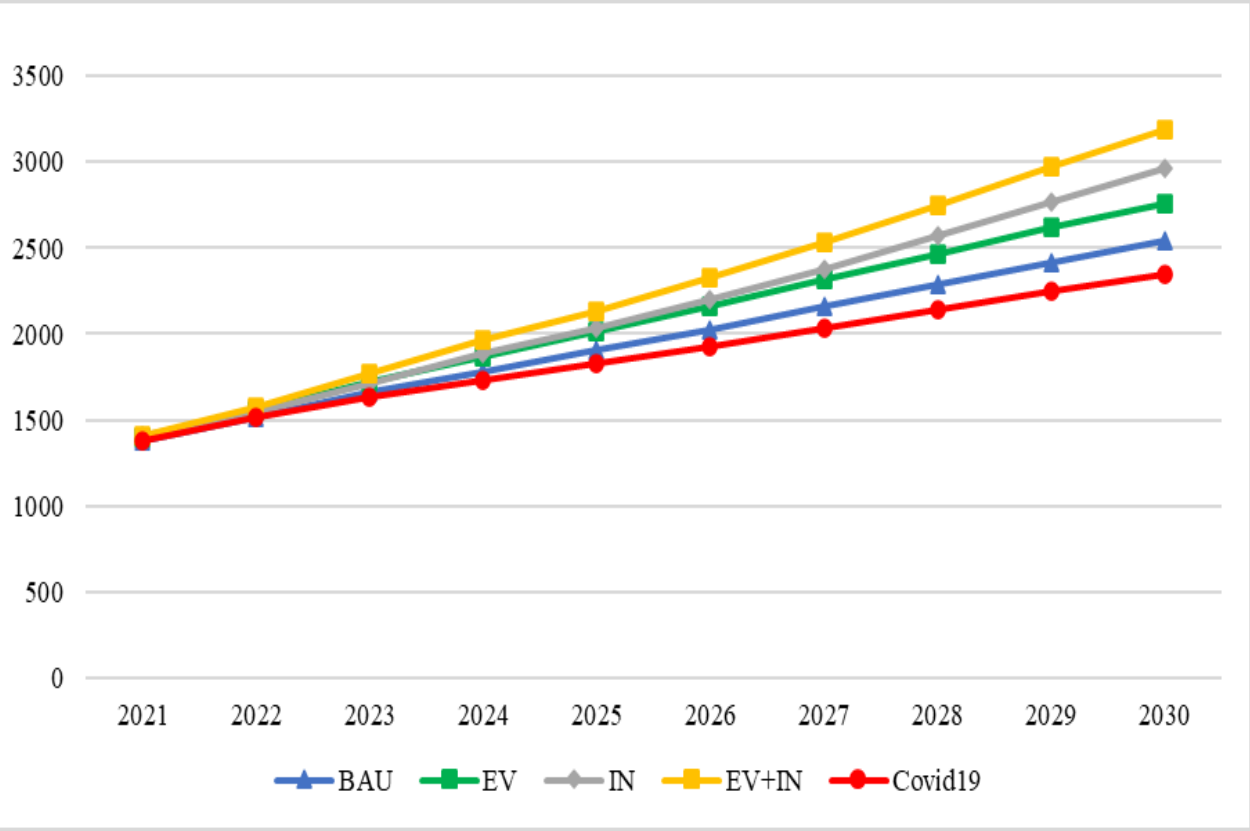
III. National Power Development Strategy

1) Energy Policy 2021-2030

- Develop all potential power sources in the country with power generation mixed for domestic use and export;
- Power generation mixed for domestic use from hydro accounts for 75%, coal based 14% and renewable energy 11%;
- Promote power generation for export and power exchange among neighboring countries.

III. National Power Development Strategy

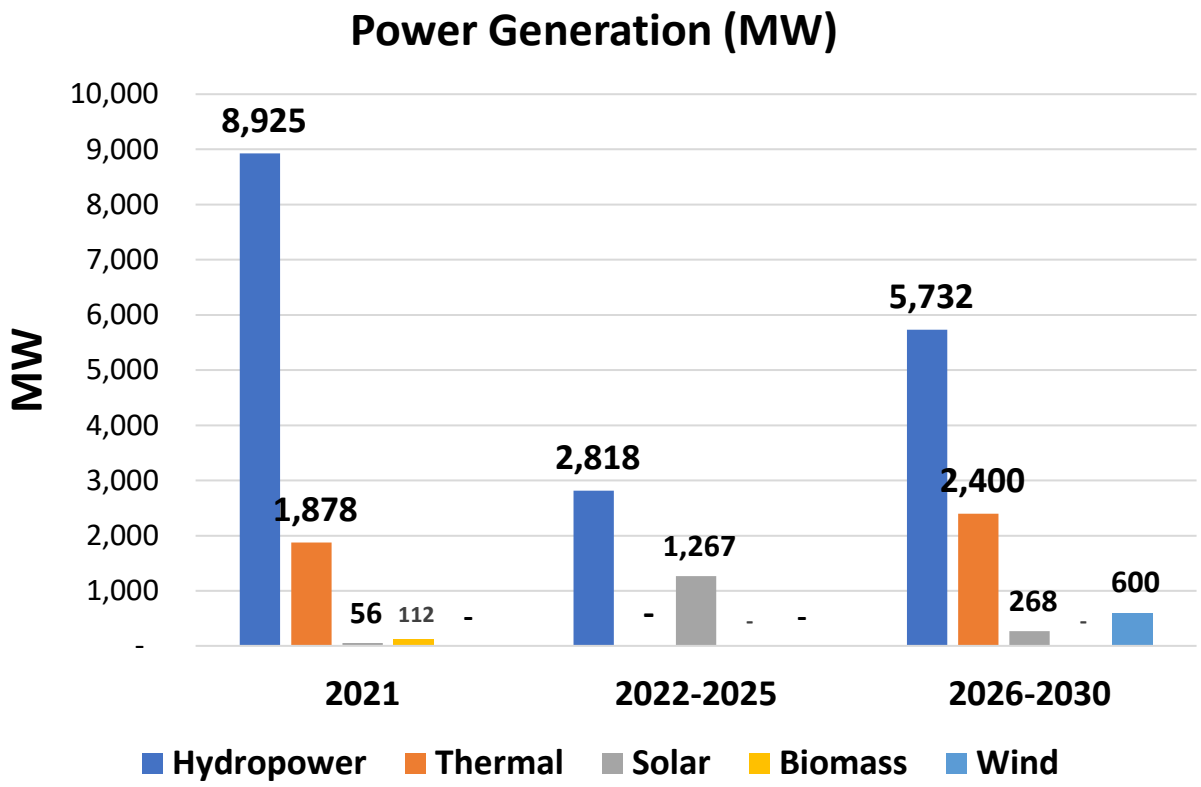
2) Power Demand Forecast 2021-2030



Year	BAU	EV	IN	EV+IN	Covid19
2021	1,380	1,396	1,403	1,406	1,375
2022	1,514	1,554	1,542	1,571	1,516
2023	1,659	1,723	1,715	1,770	1,636
2024	1,783	1,871	1,883	1,962	1,735
2025	1,902	2,012	2,030	2,134	1,829
2030	2,541	2,760	2,965	3,188	2,343
AAGR	7.0%	7.9%	8.7%	9.5%	6.1%

III. National Power Development Strategy

3) Power Generation Planning



Type	Plan (MW)			Total	%
	2021	2022-2025	2026-2030		
Hydropower	8,925	2,818	5,732	17,475	72.6
Thermal	1,878	-	2,400	4,278	17.8
Solar	56	1,267	268	1,591	6.6
Biomass	112	-	-	112	0.5
Wind	-	-	600	600	2.5
Total	10,971	4,084	9,000	24,055	100

Solar Pilot auction from 2023-24

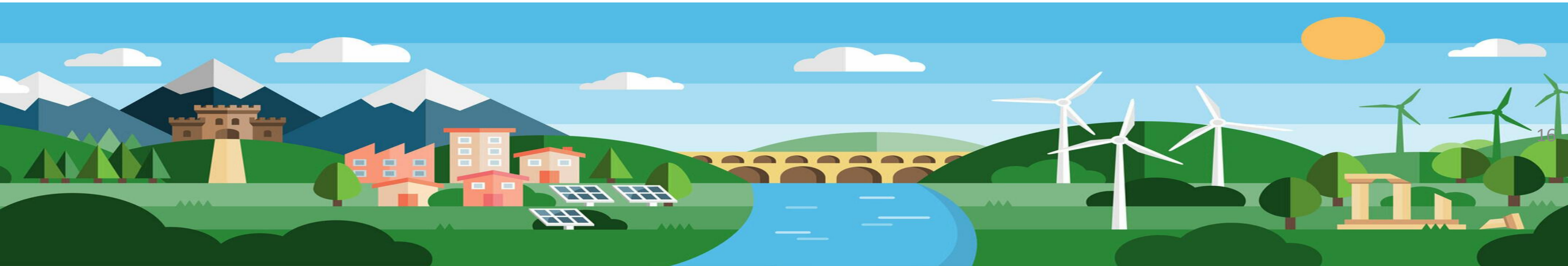
Connect to Distribution

- Central area: Capacity 61 MW
- Southern area: Capacity 45.5 MW

Connect to 115 kV

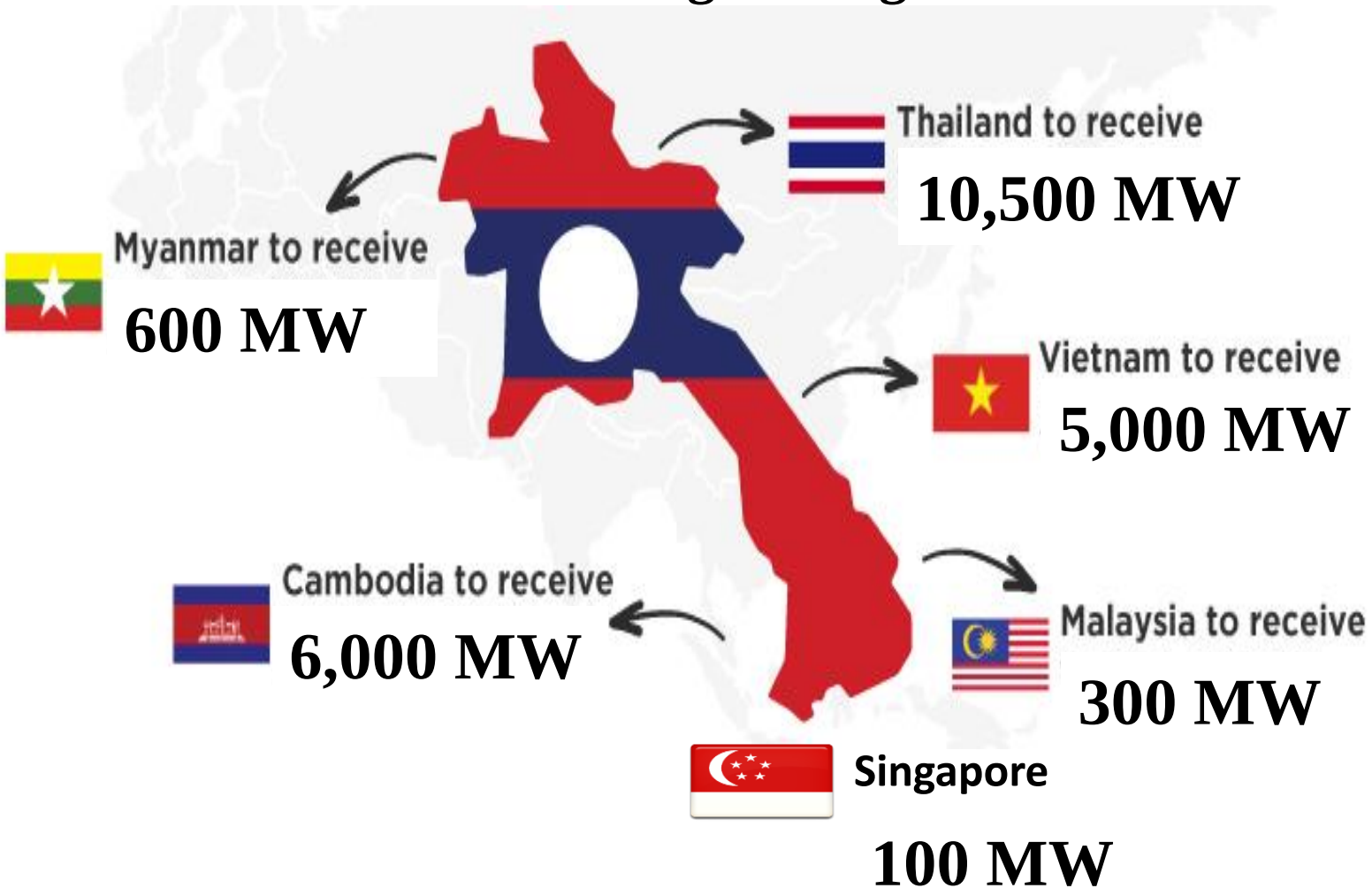
- Target 90 MW

IV. Cross Border Power Trade



IV. Cross-Border Power Trade

1) Cross-Border Power Trade with neighboring



IV. Cross-Border Power Trade

2) Power Export Planning

Export to	Target	Achieved	Plan
Thailand	10,500 MW	• 8 projects exported with 5,418 MW	• In 2022 will export one more project with 514 MW • In 2026-2033 will export 7 more projects with 4,557 MW.
Vietnam	5,000 MW	• 3 projects exported with 572 MW	22 under-construction projects with 1,608 MW expects to be exported in the period of 2022-2025
Cambodia	6,000 MW	• 2 project exported with 445 MW	• In 2025 expects to export from EDL's grid with 250 MW. • In 2026-2029 expects to export from 2 Coal Thermal Power Plants with 2,400 MW
Myanmar	600 MW	Phase 1: exported through 115 kV with 30 MW from Tonpheung-Tachileik.	Phase 2: export through 230 kV with 300 MW from Meuang Long-Kaeng Lard which expect to be exported during 2025-2026 based on Myanmar's power plan

IV. Strategy on Power Development Plant

2) Power Export Planning (cont.)

Export to	Plan	Achieved	Plan
China	• In 2017, Laos and China signed the MOU on establishment of strategic partnership on power cooperation. To strengthen the interconnection of power grid and promote power exchange between 2 countries. • In March 2022, MEM and NEA convened the Second Meeting of China-Laos Energy Cooperation Working Group to support the China-Laos 500 kV Power Interconnection Project.		
Malaysia (LTM-PIP)	300 MW	• Phase 1: exported 100 MW • Phase 1: exported 300 MW	
Singapore (LTMS-PIP)	100 MW	PPA signed on 17 June 2022 and EWA will be effective date on 22 June 22 and Energy Flow on 23 June 2022	

V. Roles of Renewable Energy

V. Roles of Renewable Energy

1. RE Strategy

The Government considers the promotion and development of renewable energy as a priority in order to stabilize power supply and to support the national socio-economic development:

- Encourage the domestic and foreign business sectors to invest in the development of renewable energy for domestic consumption and export;
- The promotion of power generation from renewable energy is focused on the areas where the demand existed in EDL's system to ensure adequate power supply and stability, reduce power loss in the system and supply power in remote areas, both on-grid and off-grid;
- Promote power generation from renewable energy as a self-sufficient particularly in agriculture, industry and others sector to ensure sufficient power, especially in the dry season, on the basis of regulatory obligations in accordance with the law and being able to exchange power with the utility under the terms of the PPA;
- Encourage local and foreign businesses to invest in the development of biofuels (biofuels and solid biomass);
- The government encourages local and foreign businesses to invest in the development of hydrogen power to generate electricity for domestic use, using in the transport sector and export as appropriate;
- Public awareness on climate change integration program by consuming more renew energy in order to shift fossil fuels consumption.

V. Roles of Renewable Energy

2. RE Target Achievement

Target	Year 2022			
increase RE Consumption to 30 % of national demand by 2025 (bio-fuel production accounts for 10 %)	**Technologies**	**MW**	**million Litter**	**Remark**
	Small hydropower<5 MW	400		
	Solar	56		
	Wind			3162 MW, Under FS
	Biomass	112		
	Biofuel		42	
Total		**568**		

National Demand in 2025 is around **1,902 MW**. RE consumption already achieved 30% by 2022.

V. Roles of Renewable Energy

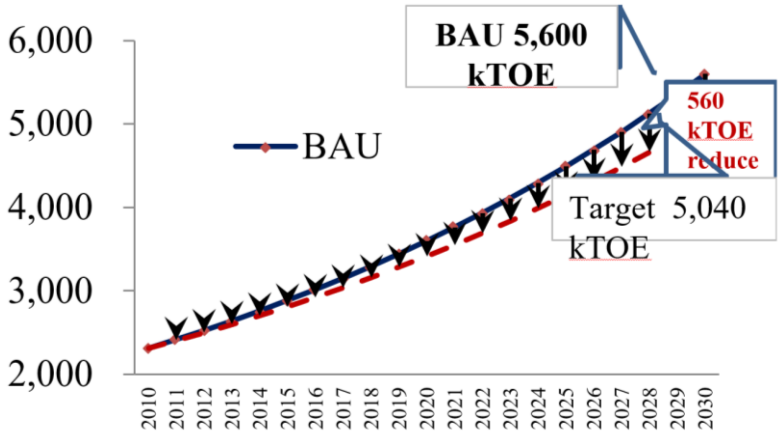
3. EE & C Legislation

1) Roadmap and Master Plan (**EE&C Implementation plan)**
2) National EE&C Policy (Implementation plan of EE&C Policy)
3) Prime minister degree (EE&C promotion plan)
4) Standard and labeling for Air conditioner
5) Energy Management system
6) Building energy code (GB, EnvB, ZeB..)
7) Strategy on clean energy use in transportation sector 2030, development plan 2025, vision 2050

V. Roles of Renewable Energy

2) Energy Efficiency and Conservation Policy

- The National EE&C Policy towards 2030, aiming to achieve the following goal:
  - Reduction of national energy demand by 10% (year 2030)
  - Reduce energy consumption level by around 1% per year on average (BAU)
  - GHG reduction (2.6 Mil.tco2 in 2030)
- 4 areas of focus:
  - Industry
  - Residential
  - Building & office
  - Transportation



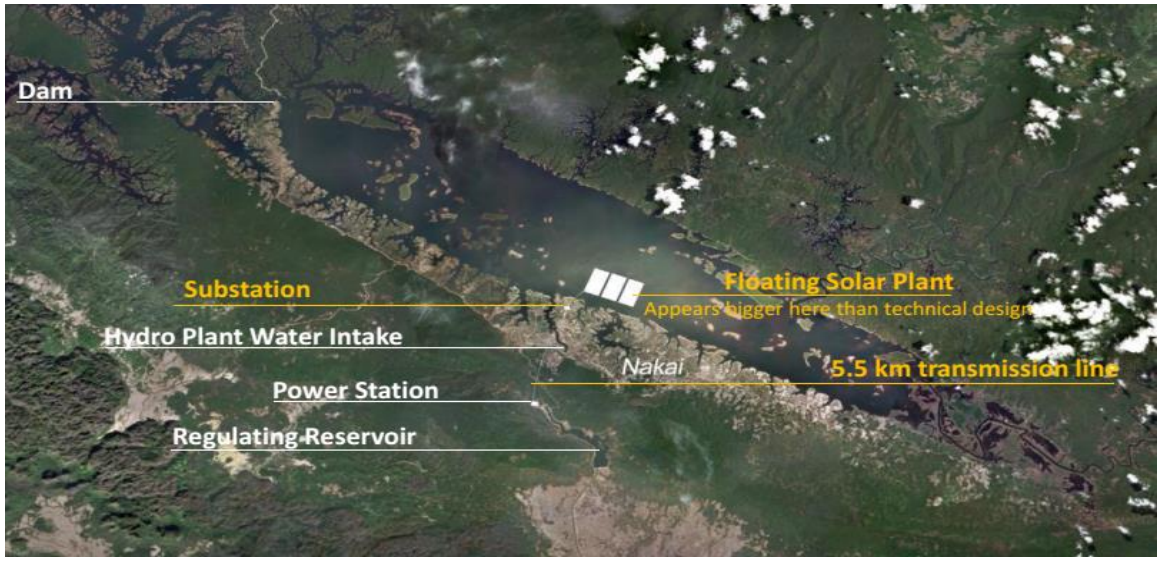
V. Roles of Renewable Energy

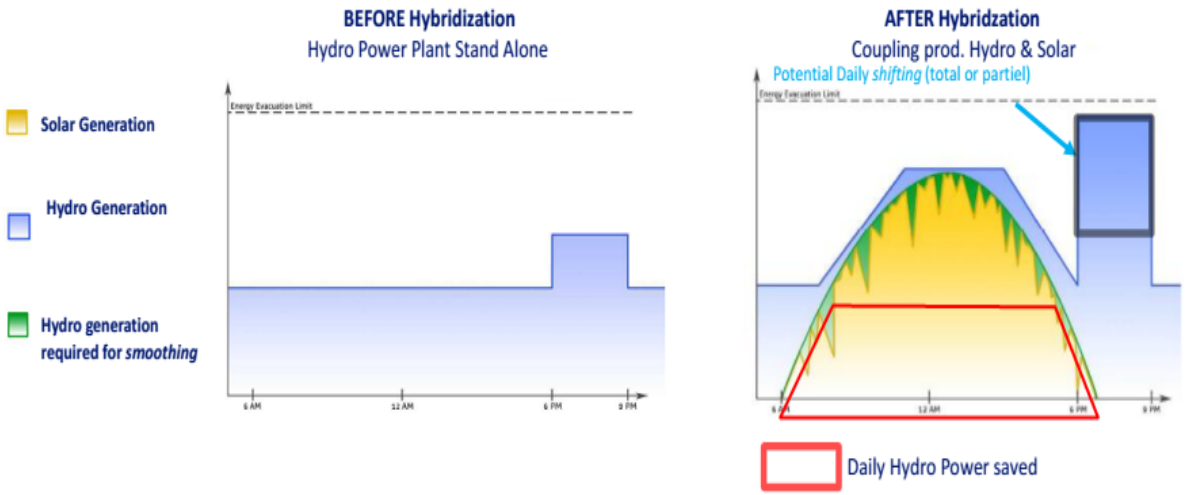
7) Strategy on Clean Energy Promotion in Transportation Sector

- Promote EV and railroad in transportation sector
- Development plan up to 2025
  - Promote EV up to 1% of total vehicles based year 2017
- Strategy 2030 increase to 30% and 2050 to 50% of EV including fuel cell vehicle in the market
- Promote transportation industry and technology transfer
- Promote infrastructure development of transportation using clean energy

V. Roles of Renewable Energy

4. Energy Storage System





1) On-Grid Hybridization hydro & Floating Solar Project

Nam Theun 2 floating Solar Project

- Capacity: 240 MWp+80 MWp
- First phase: 50-100 MWp, energy 76-151 GWh
- Area of floating panels: 0.3-0.6 km2, 30-60 ha
- COD 2025
- Hybridization capabilities with:
  - Francis turbines (4x250 MW),
  - Pelton turbines (2x75 MW)
- Hybridization simulations NT2 hydro Francis turbines can adapt to solar generation to:
  - Deliver an energy as stable as hydro → smoothing
  - Save solar for later usage in the form of water → Shifting

Nam Ngum 1 floating Solar Project.

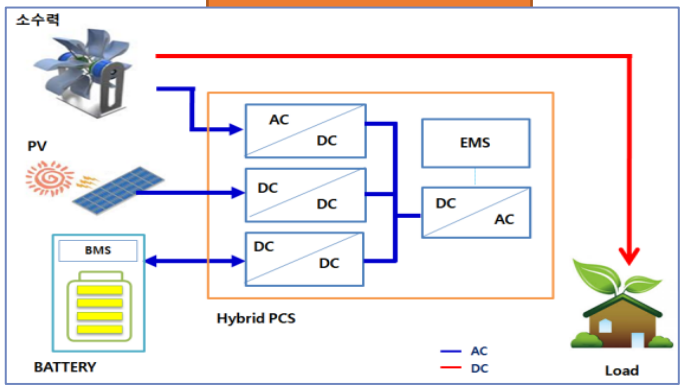
- Install Capacity: 1,200 MWp, 1,673 GWh,
- the annual full load operation 1,261 hour,
- Reduce CO2 emission 1,190,700 tongs
- First phase: 300 MWp, energy 378.53 GWh
- COD 2024~2025

III. Roles of Renewable Energy

4. Energy Storage System (Cont.)

2) Off-grid Solar Panel (Solar + Generator + Battery)

Nahao village

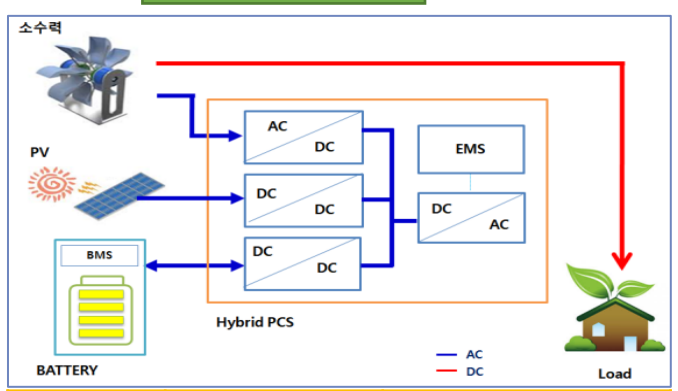


Item	Product	Capacity
Power Source	PV	120kWp
	Pb Battery	680kWh
	Generator	100kW
PCS	Hybrid	75kW*2module

Parallel Operation of PV// Battery

- **Rainy Season : Emergency Generator**
- **EMS : Battery SOC, Control Load**

Navang village



Item	Product	Capacity
Power Source	PV	140kWp
	Pb Battery	780kWh
	Generator	100kWp
PCS	Hybrid	75kW*2module

Parallel Operation of PV// Battery

- **Rainy Season : Emergency Generator**
- **EMS : Battery SOC, Control Load**

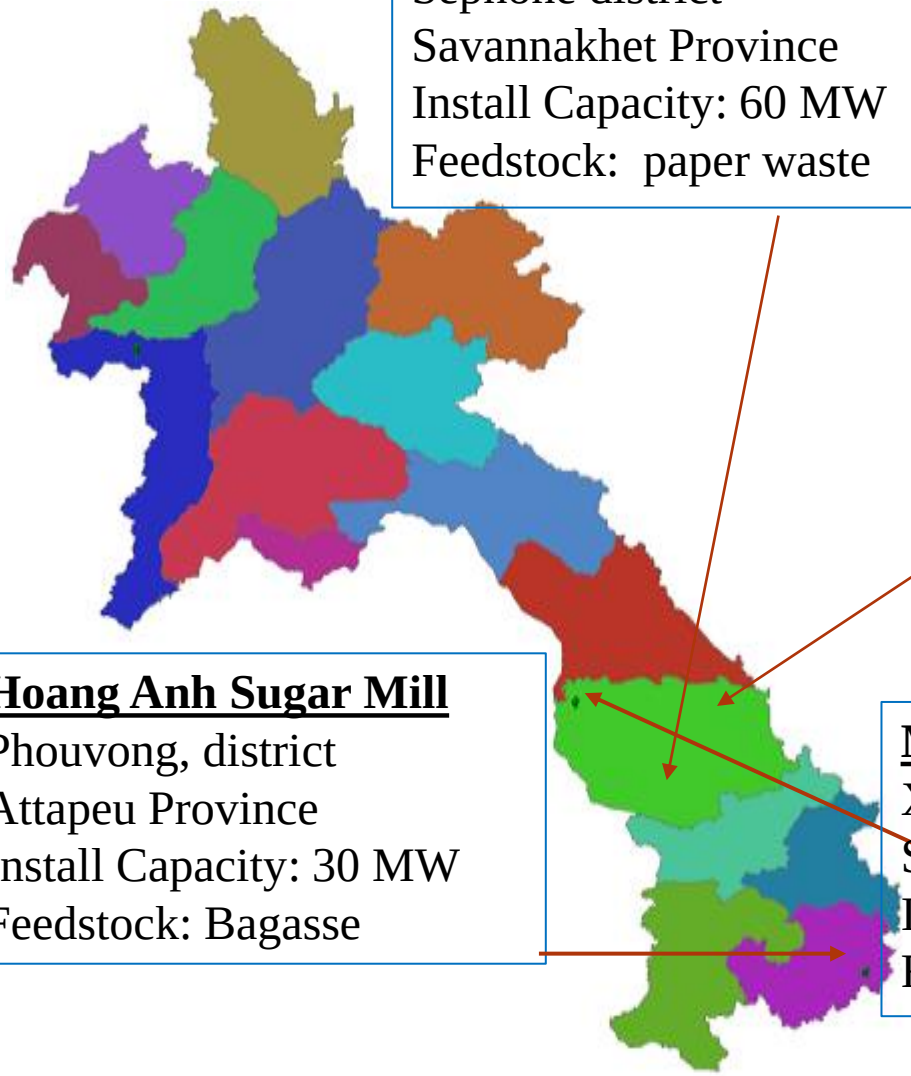
These projects can provide electricity in totally about 630 households

Solar Energy (REMI)

Demonstration of SHS, BCS, Street light, Solar Pumping, Grid connect

CURRENT STATUS OF BIOMASS DEVELOPMENT

Sun Paper Holding Company
Sephone district
Savannakhet Province
Install Capacity: 60 MW
Feedstock: paper waste



Savannakhet Sugar Mill
Atsaphangthong District
Savannakhet Province
Install Capacity : 5 MW
Feedstock: Bagasse

Hoang Anh Sugar Mill
Phouvong, district
Attapeu Province
Install Capacity: 30 MW
Feedstock: Bagasse

Mit Lao Sugar Mill
Xaibury, district
Savannakhet Province
Install Capacity: 9.7 MW
Feedstock: Bagasse

Biomass development (REMI)

Wood/charcoal stove development: efficiency test, production process, training and promotion

GEF project: (UNIDO/CPC-L & REMI) Promote production and use pellet in Salt factory, Energy audit in industry sector, biomass resource assessment, and set up Biomass information and Learning center at REMI,

Productions from Banana Fiber

BIOFUEL DEVELOPMENT

Plantation-Area	Harvest-Area
Palm oil	
300+800 ha	60 ha (2016)
FFB	173,640 kg
CPO	33,000 L
B100	20,000 L
Biodiesel Plant: 20,000 L/day	
Extraction Plant: 20 tons/day	
Vernicia Montana	
12,350	3,000 ha
Fruit collection	75,000 kg
B100	18,000 L
Biodiesel Plant: 1,000 L/day	
Extraction Plant: 2 tons/day In 2017 new Plant 2 units; Each unit 15 t/day	
B100	18,000 L

Biodiesel-Makao Oil Lao Co., Ltd
Luangprabang, district
Luangprabang Province

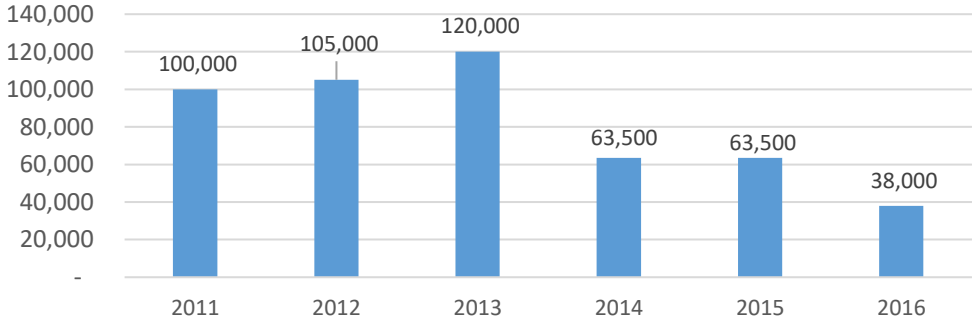
Lao-Agrotech Co., Ltd
Naxaythong, district
Vientiane Capital

LAO AGRO TECH CO., LTD
OIL PALM BUSINESS CONVERGENCE

Bio ethanol: June 2014

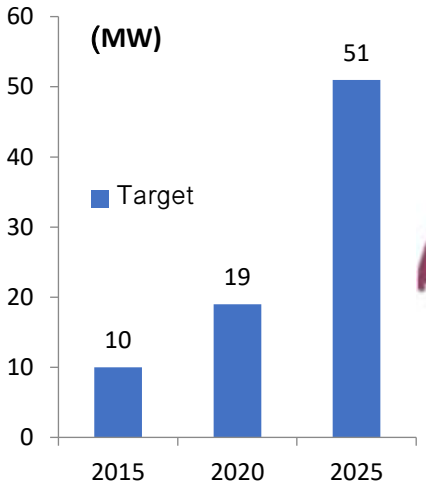
The GOL signed MOU with 2 local private company to conduct feasibility study of bio ethanol production from cassava (each 200,000 L/day)

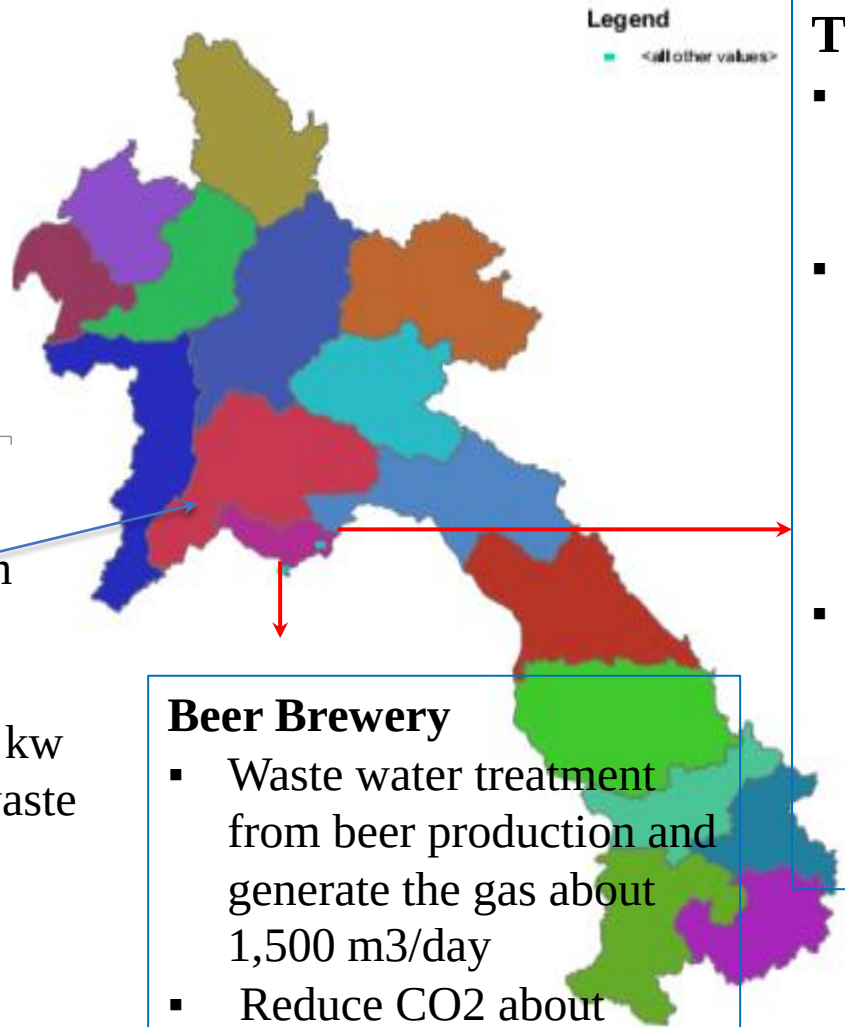
Current Statute Bio-Diesel Production B100 (liter)



Biodiesel researches (REMI)

CURRENT STATUS OF BIOGAS DEVELOPMENT





➢Viravong pig farm
Keooudome district
Vientiane Province
Install Capacity: 30 kw
Feedstock: paper waste

Beer Brewery

- Waste water treatment from beer production and generate the gas about 1,500 m3/day
- Reduce CO2 about 3,338 ton/y

TBEC (Lao) Sole Co. Ltd

- Waste water treatment from Cassava and produce biogas 7 million m3/y
- Production of biogas 90 Million (Nm3) or million normal cubic meters (Nm3), approximately at 175 million liters, of heavy fuel oil (HFO)
- reducing as much as 300,000 tones of greenhouse gas per year and 60,000 tones of CO2 on an annual basis.

Biogas (REMI)

Long experience in fix dome biogas digester (4-16 m^3 size)

Laboratory for biogas research (Lao-china joint lab)

Fertilizers Development (REMI)

Social and Community Promotion

Challenges

- ***Awareness barriers among policy makers, consumers, suppliers etc***
  - ✓ Lack of knowledge concerning opportunities, reliability and lifetime of technologies;
  - ✓ Lack of knowledge concerning impacts on environment from renewable energy production;
  - ✓ Lack of information on resources available and sustainability, in particular with regard to biomass
- **Financial challenges:**
  - ✓ The high investment cost and scare resources support
  - ✓ Renewable energy is hardly variable economically unattractive to provide investor
  - ✓ Lack of financial institutional support and absence of appropriate financing

Challenges

- **Socio-cultural challenge**
  - ✓ Lack of renewable energy specialist among the decision makers meaning that policy makers are not be fully aware of characteristics and benefits of renewable energy
  - ✓ Limited public awareness of renewable energy advantage in daily life
- **Technical challenge**
  - ✓ Some of renewable energy has low energy generation compare to other energy
  - ✓ Lack of local standards for renewable energy equipment and systems as renewable energy technologies are relatively new to the market Environmental and social impacts

Limited Domestic Market and Market Constrain for Export

- ✓ Domestic Power Demand is limited
- ✓ None Hydro Renewable Energy Trading among SEAN

Thank You for Your Attentions