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NEPAL ENGINEERING COUNCIL

LICENSE EXAMINATION PREPARATION COURSE
FOR
CIVIL ENGINEERS
on
Hydropower Engineering

-Er. Babu Ram Karki

8. Hydropower Engineering

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Fig: Dam site of Budhigandaki Hydropower project

8. Hydropower Engineering

Hydropower is defined as the source of renewable energy formed by the movement of flowing mass of water on the surface of the earth. It gives number of times energy production without change of its physical properties.

- In hydropower plant the water is utilized to move the turbines which in turn run the electric generators. The potential energy of the water stored in the dam gets converted into the kinetic energy of the moving water in the penstock.
- And this kinetic energy gets converted into the electrical energy with the help of turbine and generator combination

8. Hydropower Engineering

Advantages:

- Renewable source of energy.
- Low operation and maintenance cost
- Environmental friendly and non polluting.
- Very efficient for peaking load (Operational flexibility i.e. opening and closing can be done as desired)
- Can be use as multi-purpose project (flood control, water supply, irrigation)
- Long span of life

8. Hydropower Engineering

Disadvantages:

- Long time for construction
- Large initial investment cost
- Submergence leading to the ecological imbalance, resettlement etc
- Necessity of costly transmission and distribution network
- Sedimentation and landslide problem

8. Hydropower Engineering

8.1 Planning of hydropower projects

8.2 Power and energy potential study

8.3 Head works of storage plants

8.4 Head works of run-of-river (ROR) plants

8.5 Water conveyance structures

8.6 Hydro-electric machines and powerhouse

8. Hydropower **(ACiE08)**

8.1 Planning of hydropower projects: power potential (gross, technical, economic) of Nepal and the world; stages of hydropower development, hydropower development in Nepal (history, policy, acts & regulation.) (ACiE0801)

8.2 Power and energy potential study: power and energy potentials; methods of fixing installed capacity of a plant; types of hydropower plants on various basis; components of different types of hydropower projects; reservoirs and their regulation. (ACiE0802)

8.3 Headworks of storage plants: components of a typical storage plant; dams (types, functions, selection, design, failure modes and remedies); stability analysis of gravity dam, seepage control and foundation treatment in dams; design of intake, spillway and energy dissipaters; gates (types and locations). (ACiE0803)

8.4 Headworks of run-of-river (ROR) plants: components of a typical ROR plant; design of intake; methods of bed and suspended load handling; design of settling basin (practice and concentration approach), estimation of sediment volume in settling basin, flushing of deposited sediment, estimation of flushing frequency for sediments. (ACiE0804)

8.5 Water conveyance structures: hydraulic tunnels, x-sections, and hydraulic design (velocity and sizing); tunnel lining; design of forebay and surge tanks; design of penstocks and pressure shaft; hydraulic transients (water hammer). (ACiE0805)

8.6 Hydro-electric machines and powerhouse: hydro-mechanical equipment and their functions; types of turbines and performance characteristics; selection of turbine and their specific speed; preliminary design of Francis and Pelton turbines; scroll case and draft tubes; generators (types, rating); governs; pumps and their performance characteristics; powerhouse (types, general arrangements, dimensions). (ACiE0806)

8. HYDROPOWER

टेबल १ : १ अंकभार प्रश्नहरुको संख्या, विषय र उप-विषयहरुको लागि तालिका

Chapter/Sub-Chapter	CH01	CH02	CH03	CH04	CH05	CH06	CH07	CH08	CH09	CH10	No. of Questions	Total Marks
SCH01	1	1	1	1	1	1	1	1	1	1	10	10
SCH02	1	1	1	1	1	1	1	1	1	1	10	10
SCH03	1	1	1	1	1	1	1	1	1	1	10	10
SCH04	1	1	1	1	1	1	1	1	1	1	10	10
SCH05	1	1	1	1	1	1	1	1	1	1	10	10
SCH06	1	1	1	1	1	1	1	1	1	1	10	10
Total Questions	6	6	6	6	6	6	6	6	6	6	60	60

टेबल २ : २ अंकभार प्रश्नहरुको संख्या, विषय र उप-विषयहरुको लागि तालिका

Chapter/Sub-Chapter	CH01	CH02	CH03	CH04	CH05	CH06	CH07	CH08	CH09	CH10	No. of Questions	Total Marks
SCH01	1	1	1	1	1	1	1	1	1	1	Questions per sub-chapter: 1 (Max)	
SCH02	1	1	1	1	1	1	1	1	1	1		
SCH03	1	1	1	1	1	1	1	1	1	1		
SCH04	1	1	1	1	1	1	1	1	1	1		
SCH05	1	1	1	1	1	1	1	1	1	1		
SCH06	1	1	1	1	1	1	1	1	1	1		
Maximum Question	2	2	2	2	2	2	2	2	2	2	20	40

अनुसूची २
पूर्णाङ्क, अंकभार र परीक्षा समय सम्बन्धी व्यवस्था

- परिक्षा समय - २ घण्टा
- पूर्णांङ्क - १००
- उत्तीर्णांङ्क - ५०%
- १ अंकभार जम्मा प्रश्नहरु - ६०, अनुमानित समय १ मिनेट / प्रति प्रश्न
- २ अंकभार जम्मा प्रश्नहरु - २०, अनुमानित समय २ मिनेट / प्रति प्रश्न
- १ अंकभार प्रश्नहरु वितरण : १ प्रश्न प्रति सवचेप्टर, ६० सवचेप्टरबाट ६० प्रश्न। टेवल १ मा उल्लेख भएअनुसार ।
- २ अंकभार प्रश्नहरु वितरण : २ प्रश्नहरु (वढीमा) प्रति चेप्टर, १ प्रश्न (वढीमा) प्रति- सवचेप्टर गरि १० चेप्टरबाट २० प्रश्नहरु । टेवल २ मा उल्लेख भएअनुसार ।

टेबल १ : १ अंकभार प्रश्नहरुको संख्या, विषय र उप-विषयहरुको लागि तालिका

Chapter/Sub-Chapter	CH01	CH02	CH03	CH04	CH05	CH06	CH07	CH08	CH09	CH10	No. of Questions	Total Marks
SCH01	1	1	1	1	1	1	1	1	1	1	10	10
SCH02	1	1	1	1	1	1	1	1	1	1	10	10
SCH03	1	1	1	1	1	1	1	1	1	1	10	10
SCH04	1	1	1	1	1	1	1	1	1	1	10	10
SCH05	1	1	1	1	1	1	1	1	1	1	10	10
SCH06	1	1	1	1	1	1	1	1	1	1	10	10
Total Questions	6	6	6	6	6	6	6	6	6	6	60	60

टेबल २ : २ अंकभार प्रश्नहरुको संख्या, विषय र उप-विषयहरुको लागि तालिका

Chapter/Sub-Chapter	CH01	CH02	CH03	CH04	CH05	CH06	CH07	CH08	CH09	CH10	No. of Questions	Total Marks
SCH01	1	1	1	1	1	1	1	1	1	1	Questions per sub-chapter: 1 (Max)	
SCH02	1	1	1	1	1	1	1	1	1	1		
SCH03	1	1	1	1	1	1	1	1	1	1		
SCH04	1	1	1	1	1	1	1	1	1	1		
SCH05	1	1	1	1	1	1	1	1	1	1		
SCH06	1	1	1	1	1	1	1	1	1	1		
Maximum Question	2	2	2	2	2	2	2	2	2	2	20	40

Total											80	100

8.1 Planning of hydropower projects

8.1.1 Power potential (gross, technical, and economic) of Nepal and the world

8.1.2 Stages of hydropower development in Nepal

8.1.3 Hydropower development in Nepal (history, policy, acts, and regulation)

Energy Sources in Nepal

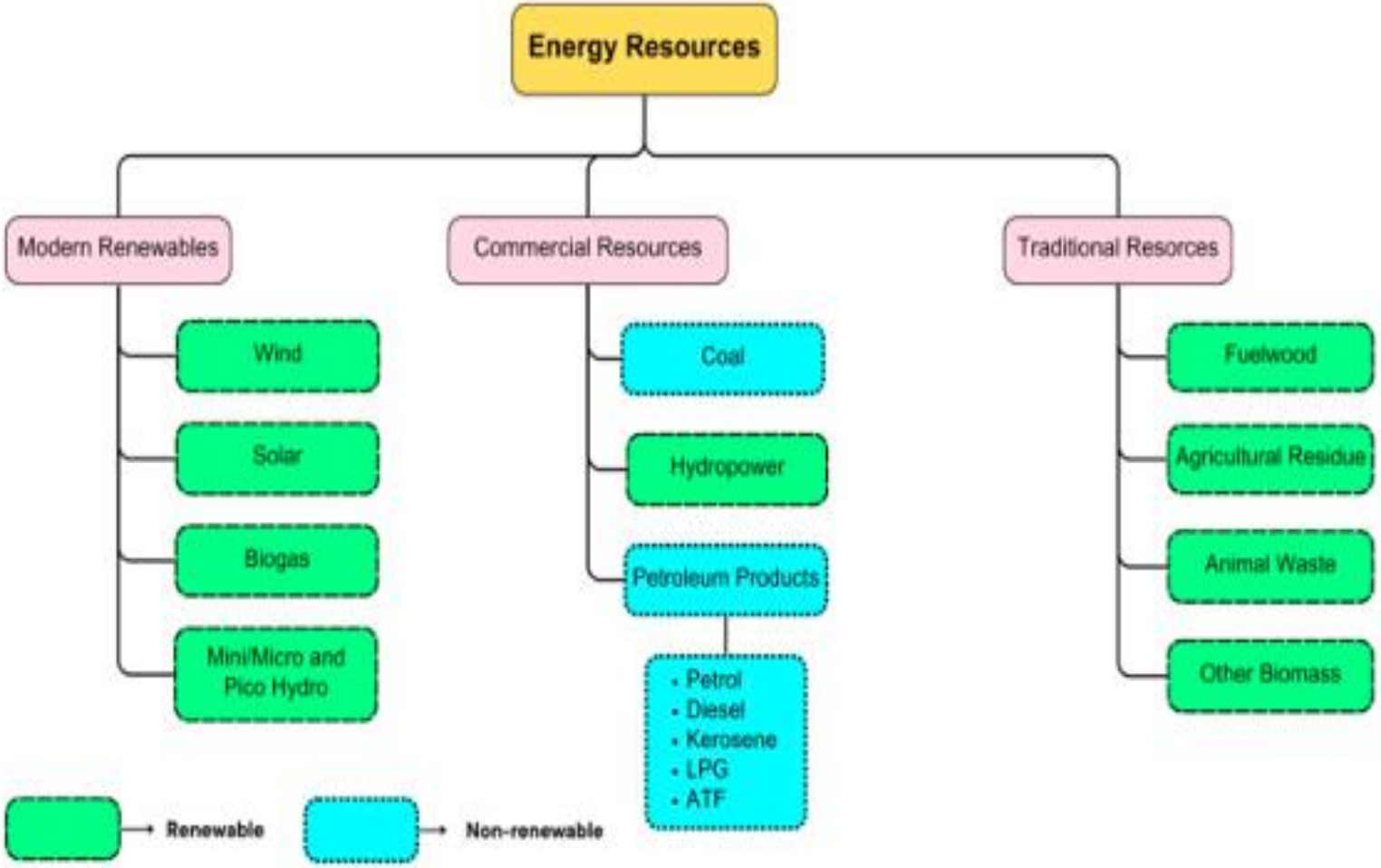

Figure 3-1: Energy Resources in Nepal

Energy Consumption in Nepal

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Table 3-15: Overall Energy Consumption in Nepal in 2022

Category	Fuel Type	FY 2078/79 Energy (000 GJ)	000 TOE	GWh	% of National Total	Growth Rate from previous FY
Traditional	Firewood	374,562.95	8,946.28	104,877.63	58.53%	-0.85%
	Agricultural Residues	17,965.50	429.10	5,030.34	2.81%	-4.35%
	Animal Waste	18,150.14	433.51	5,082.04	2.84%	1.02%
	Total	410,678.59	9,808.89	114,990.01	64.17%	-0.93%
Commercial	Coal	58,148.22	1,388.85	16,281.50	9.09%	-0.51%
	Petrol	24,653.98	588.85	6,903.11	3.85%	26.04%
	Diesel	66,079.60	1,578.28	18,502.29	10.33%	4.12%
	Kerosene	640.68	15.30	179.39	0.10%	-22.91%
	LPG	24,657.27	588.93	6,904.04	3.85%	13.09%
	ATF	5,392.72	128.80	1,509.96	0.84%	143.10%
	Furnace Oil	1,834.45	43.82	513.65	0.29%	-46.03%
	Total	**181,406.91**	**4,332.83**	**50,793.94**	**28.35%**	**6.88%**
	Grid Electricity	**31,766.40**	**758.73**	**8,894.59**	**4.96%**	**20.45%**
Renewable	Biogas	10488.72	250.52	2,936.84	1.64%	7.50%
	Wind	1.87	0.04	0.52	0.0003%	0.00%
	Micro/Pico Hydro	539.97	12.90	151.19	0.08%	4.86%
	Solar	5083.32	121.41	1,423.33	0.79%	6.80%
	Total	***16113.88***	***384.87***	***4,511.89***	***2.52%***	***7.19%***
Total		**639,965.79**	**15,285.32**	**179,190.42**	**100%**	**2.28%**

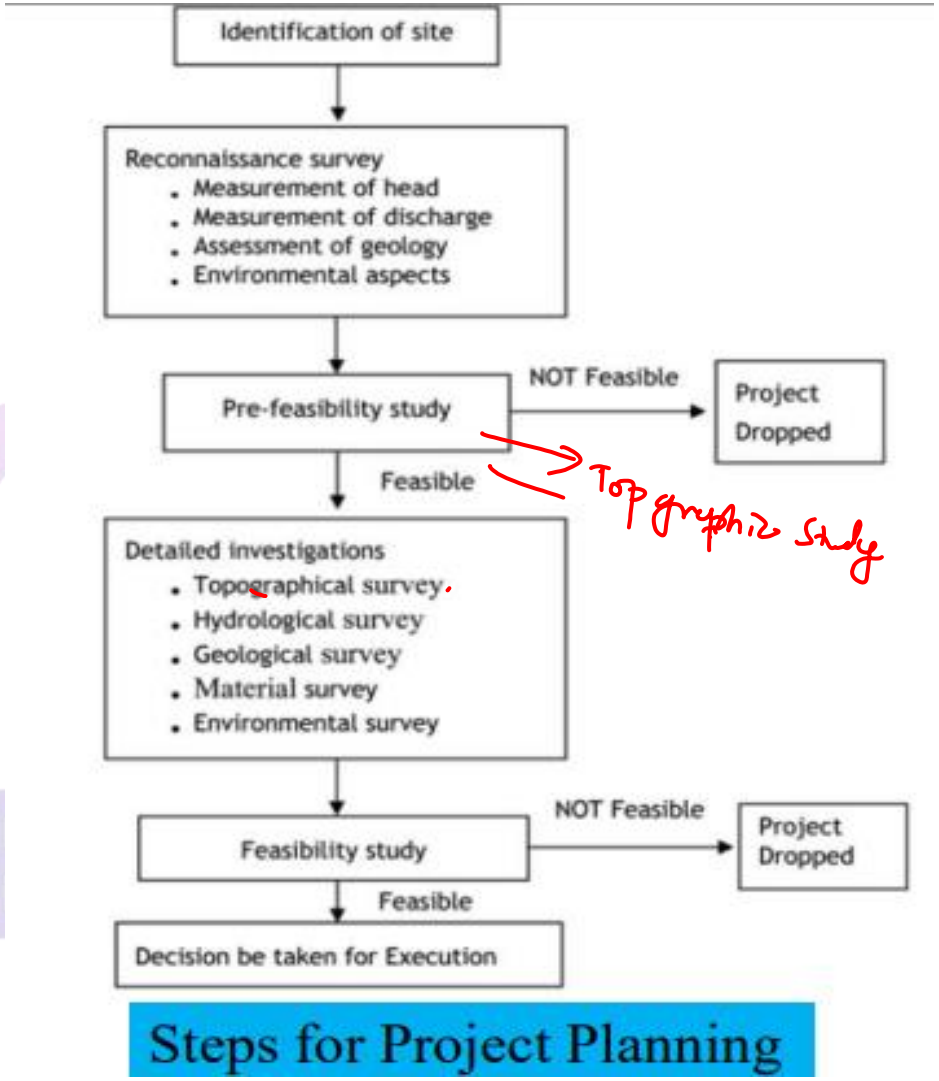
WECS Energy Synopsis Report 2023

8.1 Planning of hydropower projects

- Initial stage of work of any hydropower development

  ⇒ planning is 1st stage of HP development.

- Involves estimation of present demand, forecasting for future and generation of alternative energy source



Steps for Project Planning

8.1.1 Power Potential of Nepal

Potential Energy = m.g.h

where, m, g, h has their common notations

So, Power Potential = Rate of change of potential energy

= m.g.h/t

= V. ρ . g. h/t

= Q. γ . h

Hence, Power Potential of a River is calculated by the given equation,

P= γnQH

P = 9.81 n Q H (kW)

8.1.1 Power Potential of Nepal

Types of potential:

(i) Theoretical/ Gross potential

(ii) Technically feasible potential

(iii) Economically feasible potential

8.1.1 Power Potential of Nepal

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1. Theoretical potential (Gross potential):

It is the power potential of all sources of flow of water i.e. theoretical power possible to generate.

Power = $P = \eta \gamma Q H$

Where η γ Q H have their usual notations

Gross potential of Nepal: 83000 MW (83GW)

[By Dr. Hari Man Shrestha in 1966 AD during his research while in Moscow Plant Institute]

8.1.1 Power Potential of Nepal

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2. Technically feasible potential:

- It is that part of theoretical/gross potential which can be utilized with the help of construction of hydropower station i.e. power which is technically feasible.
- It depends on unfavorable geology, topography, climate, and accessibility.
- Technically feasible potential of Nepal: 44000 MW 44 GW.

8.1.1 Power Potential of Nepal

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3. Economically feasible potential:

- Technically feasible projects can't be implemented if they donot give a good return once the investment is made.
- IRR/BCR/MAAR (prevailing interest rate) is tools for hydropower for economic analysis. B/C > 1 IRR > MARR
- If IRR higher than prevailing interest rate OR B/C ratio greater than 1, projects are usually consider economically feasible.
- Economically feasible potential of Nepal: 42000 MW, 42 GW.

8.1.1 Power Potential of Nepal

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Hydropower potential of Nepal

- Huge potential of water resources compared to country size.
- More than 6000 rivers and streams
- Topography changes from elevation 8848m to less than 60m within short distance of 160 – 270 km from North to South
- Average annual precipitation is about 1500mm
- Annual runoff (surface) of Nepal = 0.5% of total world's surface runoff.
- Total surface runoff of Nepal including from Tibet is about = 200 B. m^3 (Billion m^3)
- Total annual surface run off inside Nepalese territory = 174 B. m^3

8.1.1 Power Potential of Nepal

Table 3-12: Theoretical Potential of Hydropower in Nepal

River Basin	Shrestha (1966) at 80% Efficiency	Bajracharya (2015)
Koshi	22,350	35,166
Narayani (Gandaki)	20,650	32,086
Karnali	32,010	25,755
Rest of Small Basin	8,171	10,334
Total ROR Potential	***83,181***	***103,341***

Karnali + Mahakali = 36,000MW

83,000MW

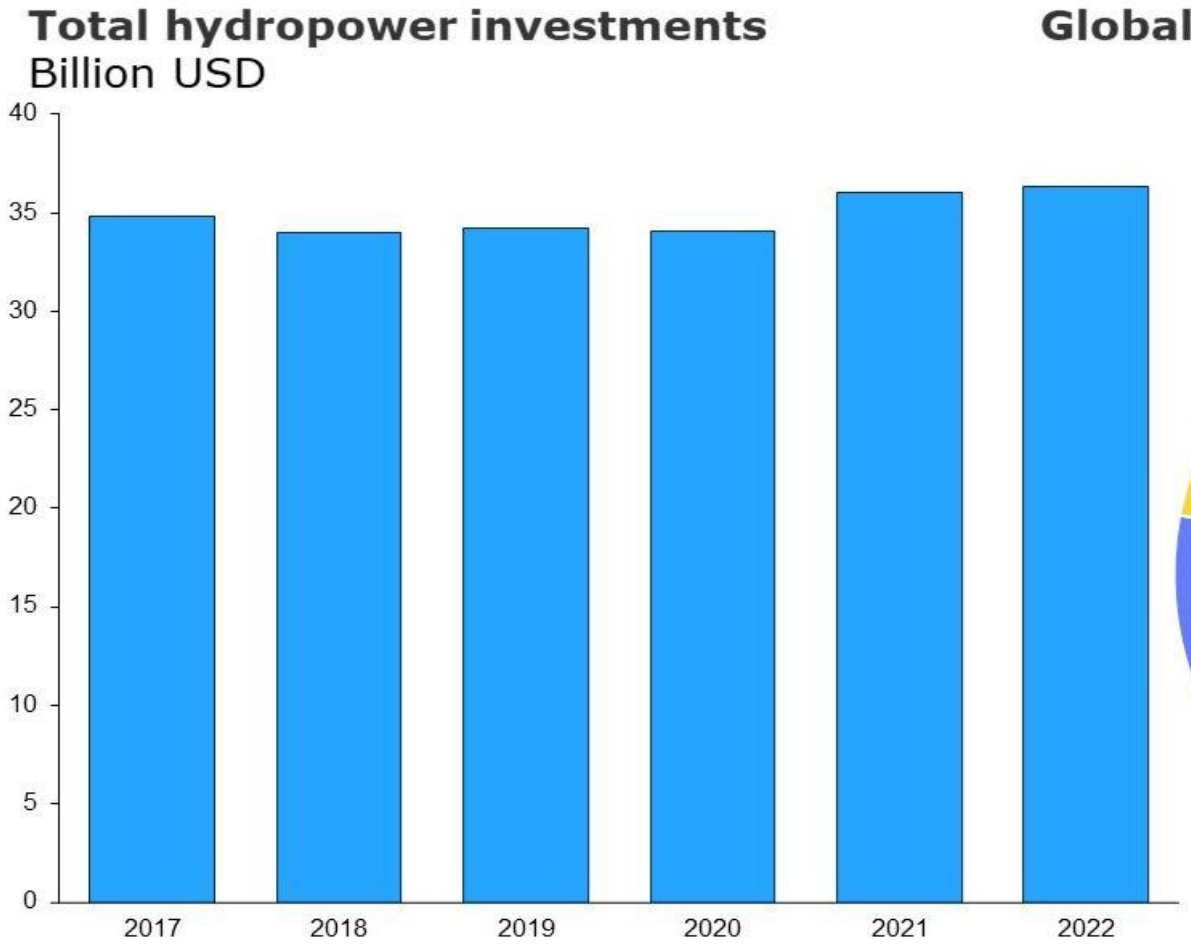
8.1.1 Power Potential of Nepal

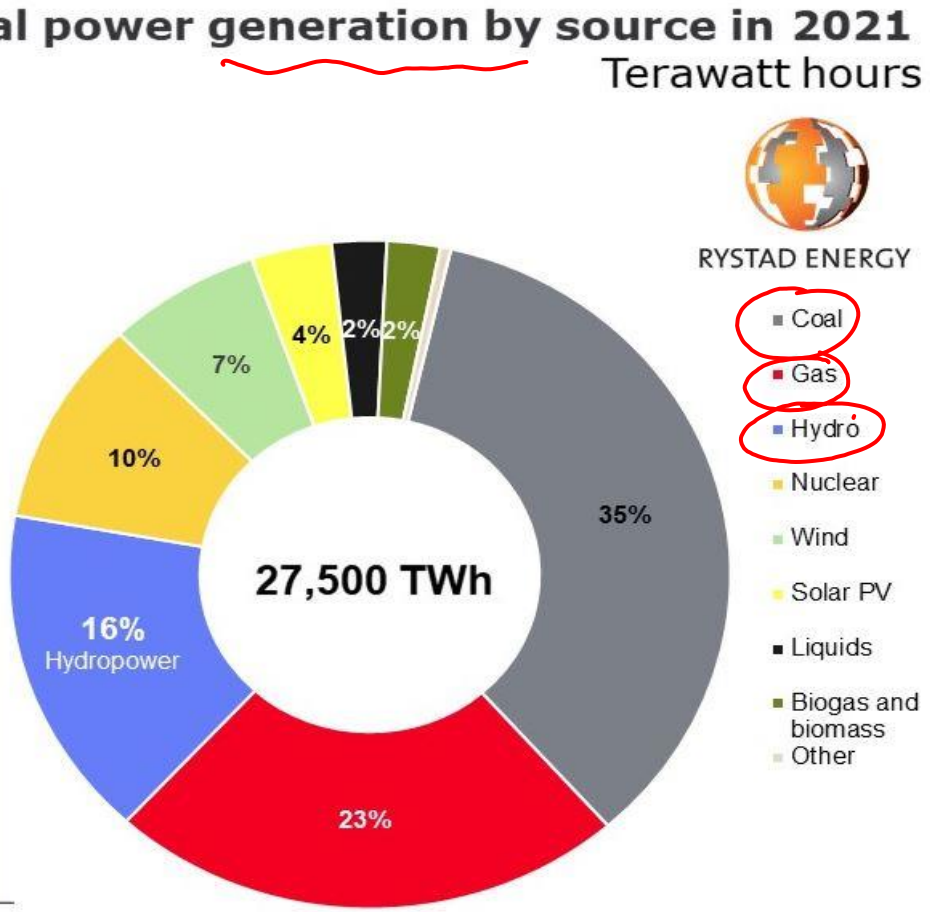
- Major river basins are Koshi, Gandaki, Karnali and Mahakali
- Karnali and Mahakali river basins have a catchment area of 48,811 km2 and 16,097 km2, with approximate hydropower potential of ***36,180 MW*** (the watershed area of the Mahakali River lies in India and Nepal)

32+4 = 36 MW

- Gandaki(Narayani) river basin has a catchment area of 36,607 km2 and approximate hydro potential of ***20,650 MW***
- Koshi river basin has a catchment area of 57,700 km2 and hydro potential of ***22,350 MW*** (the watershed area lies in Tibet/China and Nepal)
- Other river basins (i.e., southern rivers) have a catchment area of 3,070 km2 and hydro potential of ***4,110 MW***

8.1.1.1 Power Potential of the World





Source: Rystad Energy Global Power Mix dashboard, Rystad Energy research and analysis

8.1.1.1 Power Potential of the World

The Installed global hydropower capacity reached 1,397 GW in 2022, as per 2023 Hydropower status reports by IHA

The world leader in total installed hydropower capacity are:

1. China (414.8 GW),
2. Brazil (109.8 GW),
3. U.S.A (102.0 GW),
4. Canada (83.3 GW) and
5. Russia (55.8 GW)

2023 Hydropower status report

8.1.1.1 Power Potential of the World

1. Gross potential = 38,606.913 TWh/yr
2. Technically feasible potential = 14,604.209 TWh/yr [37.8%]
3. Economically feasible potential = 8,771.502 TWh/yr [22.72%]

World's biggest hydroelectric power plants:

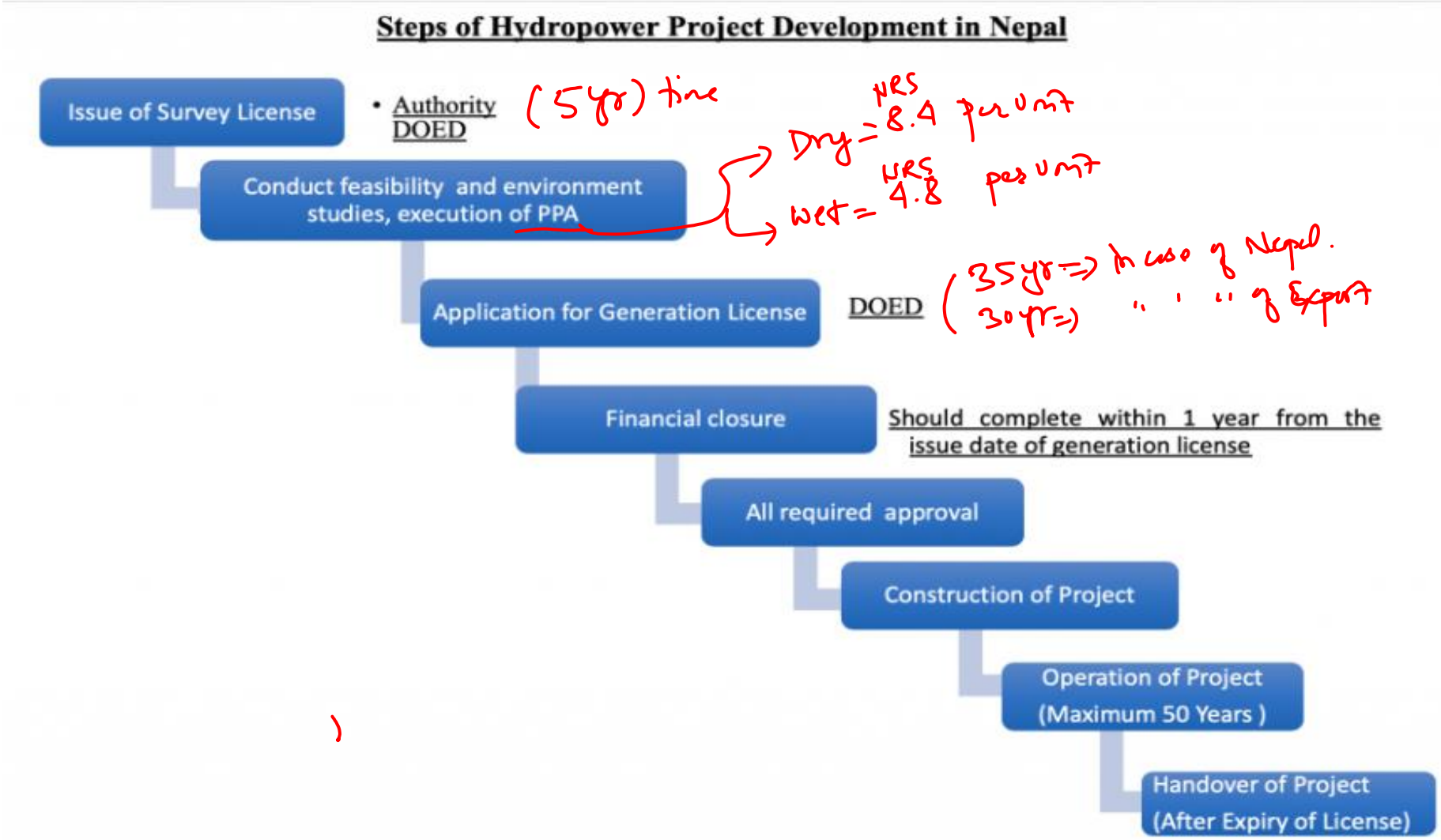
- Three Gorges Dam (Yangtze River, China)– 22.5GW (22500MW)
- Baihetan Dam (China)- 16 GW
- Itaipu, Brazil & Paraguay – 14GW

↳ on the basis of Annual Energy
↳ 3 gorges
↳ Itaipu

Power = kW/MW/GW.

Energy = power * time
= kWhr/MWhr/GWhr

8.1.2 Stage of Hydropower Development

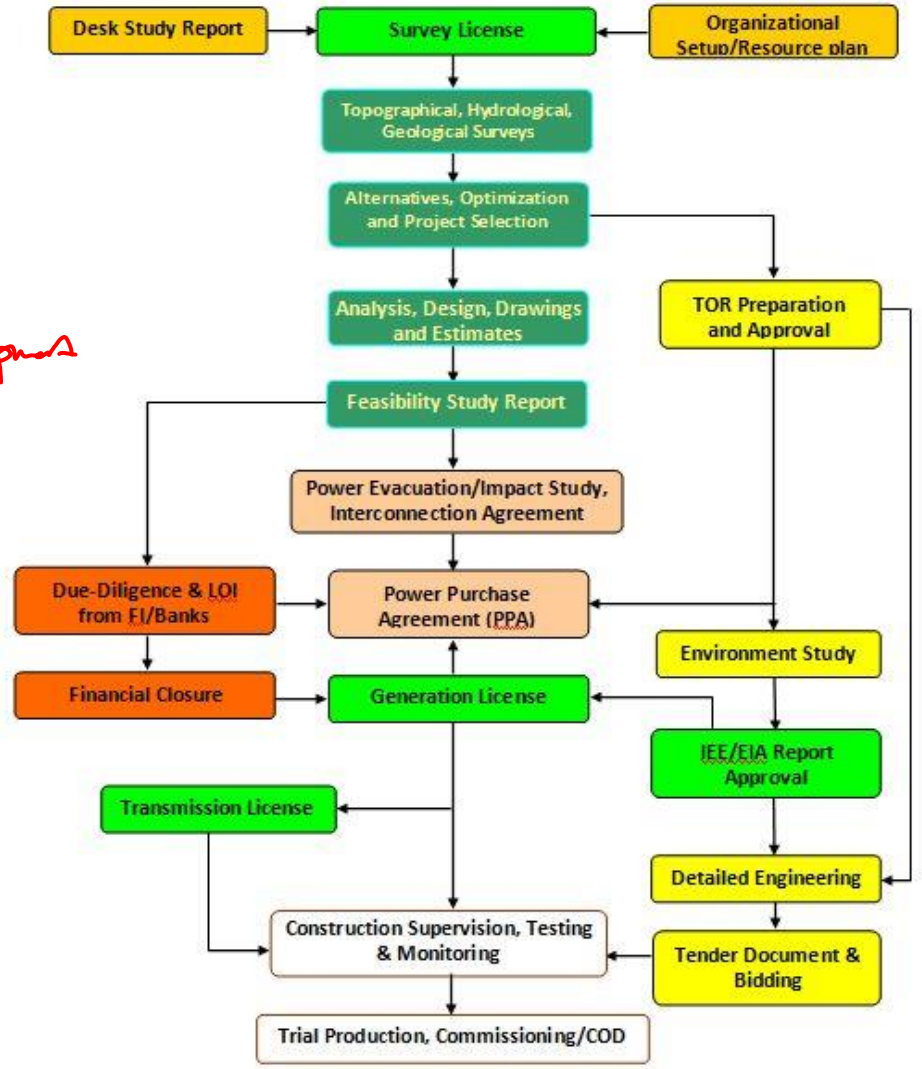


8.1.2 Stage of Hydropower Development

A. Preconstruction phase (3 – 5 yrs)
- Planning phase
- Reconnaissance studies
- Pre-feasibility study
- Feasibility study
- Detailed Engineering Design

B. Construction/Implementation phase(4 – 6 yrs)
- Tendering, contracting and construction phase

C. Operation and Maintenance phase (40 – 60 yrs)



8.1.2 Stage of Hydropower Development

Exploration and Identification of potential sites:

- The first stage of hydropower development in Nepal involves identifying potential sites for the construction of hydropower projects. The government, along with private developers, carries out surveys and studies to identify sites with suitable hydrological and topographical conditions.

Feasibility study and site selection:

- Once potential sites are identified, the feasibility of constructing a hydropower project at the site is studied. This includes conducting geotechnical surveys, environmental impact assessments, and financial viability studies. Based on the results of these studies, the most suitable site is selected for further development.

8.1.2 Stage of Hydropower Development

Design and engineering:

- After site selection, the project design and engineering is carried out, which includes detailed designs of the dam, intake, penstock, turbine, and other components. The design also takes into account the environmental and social impact of the project, as well as the safety and reliability of the infrastructure.

Construction and installation:

- The construction and installation stage involves building the infrastructure and installing equipment at the site. This includes building the dam, intake, powerhouse, and transmission lines, as well as installing the turbines, generators, and other equipment

8.1.2 Stage of Hydropower Development

Commissioning and testing:

- Once the construction is completed, the hydropower project is commissioned, and the equipment is tested to ensure that it operates as per the design specifications. This includes testing the turbines, generators, and other equipment under different operating conditions.

Operation and maintenance:

- After successful commissioning, the hydropower project is put into operation, and electricity is generated. The project requires regular maintenance and operation to ensure that it operates safely and efficiently.

8.1.2 Stage of Hydropower Development

Upgrading and modernization:

- Hydropower projects in Nepal also require upgrading and modernization from time to time to improve their efficiency and extend their life. This includes upgrading the equipment, modernizing the control systems, and implementing new technologies to optimize the performance of the project.

8.1.3 Hydropower Development in Nepal

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(pharping Hydro power) (1911)

Chandra Jyoti Electric power station is one of the oldest hydropower plants of Asia and the first hydropower plant of Nepal which was established in the year 1911AD (1968 BS) while the first hydropower plant in china was established in 1912AD. Ironically, we lagged behind in hydropower generation ever since.

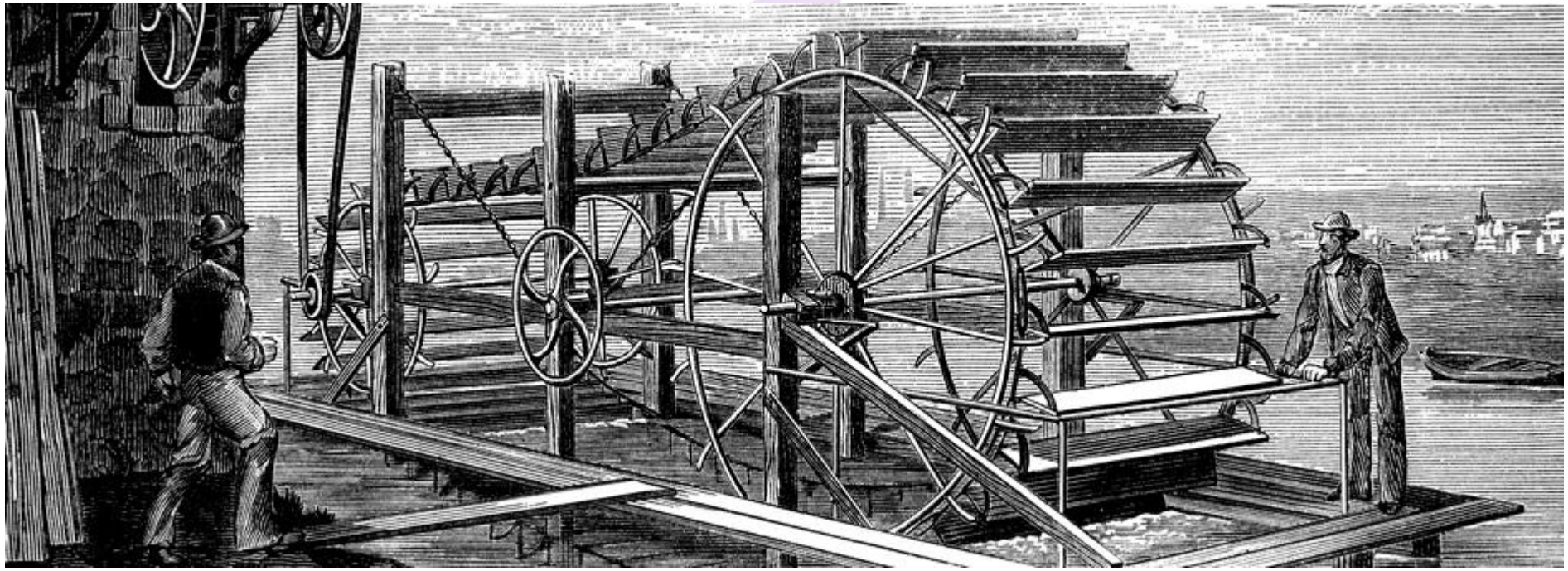

Fig: Typical historical Hydropower development

8.1.3 Hydropower Development in Nepal

Some facts about Chandra Jyoti Electric power station: (Pharping Hydropower 500KW)

- Construction : 1907-1911AD
- Inaugurated : King Pritivi Bir Bikram Shah on May 22, 1911
- Cost: NRs 713,273.82
- Source: Spring water from Satmule & Shesh Narayan area
- Second Hydropower of South Asia (1st- 1898 in Sidrapong hydel, Darjeeling)
- Declared a Living Museum by government of Nepal in 2010 AD
- Built only 30 yrs after the installation of world's first hydropower plant, Vulcan Street Plant on Fox River in Appleton, Wisconsin in 1882 AD, USA

8.1.3 Hydropower Development in Nepal

Historical Development of Hydropower in Nepal:

1911 A.D: Pharping Hydropower plant, install capacity = 500 kw

1936 A.D: Sundarijal power station - install capacity = 640 kw

1942 A.D: Sikarbas Hydropower at Chisang Khola, 677 kW, fully destroyed by landslide in the 1960s.

[Letang Hydropower 1800 KW in 1943AD by Morang Hydro under public-private partnership]

1965 A.D: Panauti(Khopasi) hydropower, 2.4 MW

1967 A.D: Trishuli hydropower, 12MW and upgraded later to 21 MW (Nuwakot) [37MW]

1969 A.D: Phewa hydropower, 1MW

1972 A.D: Sunkoshi hydropower, 10.05 mw

1979 A.D: Gandaki hydropower, 15 mw, Kaplan (Propeller type turbine)

1982 A.D: Kulekhani Ist Capacity, 60 mw, Makawanpur (1st storage)

1984 A.D: Devighat hydel, 14.1 mw

8.1.3 Hydropower Development in Nepal

1985 A.D : Seti hydro-project, 15 MW

1986 A.D: Kulekhani II, 32 MW

1989 A.D: Marsangdi hydropower, 69 MW, (Tanahu)

1996 A.D: Chatara hydropower, 3.2 Mw.

1996 A.D:Tinu river butwal (1st tunneling project)-500kw

1999 A.D: Illam hydro project - 62 Mw,

2000 A.D: Madikhola hydroproject (Parbat), 14.8 Mw

2000 A.D : Khimti 60 MW (2000 AD)

2002 A.D: Kaligandaki A Hydropower, 144 Mw, (Syangja, Beltar)

2008 A.D: Mid. Marsyandi hydropower, 70 Mw

2019 AD : Upper Trishuli 3A , 60 MW

2021 A.D: Upper tamakoshi hydropower, 456 MW(biggest hpp in Nepal)

8.1.3 Hydropower Development in Nepal

Power Plant Status in Nepal (Source- DoED until 28 Feb 2024)

- Hydropower < 1MW- 14.22 MW
- Hydropower > 1MW – 2625.263 MW
- Thermal 53.41 MW
- Solar 63.38 MW

Visit website- www.doed.gov.np

8.1.3 Hydropower Development in Nepal

Fig: First Hydropower powerhouse of Nepal

Fig: Largest Hydropower head works of Nepal

8.1.3 Hydropower Development in Nepal

- The majority of hydropower projects in Nepal are **run-of-river projects**, which generate electricity by diverting water from rivers and returning it downstream.

- **The Nepal Electricity Authority (NEA)** is the state-owned utility responsible for distributing electricity in Nepal.

- The government of Nepal has recently launched the Nepal Power System Master Plan, which aims to increase the country's installed capacity to 17,000 MW by 2040, with hydropower contributing over 80% of the total.

- In 1992, the government of Nepal has decided to open its door to private in order to fulfill the growing electricity demand.

- Department of Electricity Development (DOED) under the Ministry of Energy (MOE) has the authority of issuing licenses under one window policy.

8.1.3 Hydropower Development in Nepal

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Some Important Notes:

- First Hydropower – Pharping Hydropower (1911 AD) 500 KW
- First Hydropower from private sector – Khimti 60 MW (2000 AD)
- Largest hydropower – Upper Tamakoshi 456 MW [5th July 2021 AD, inaugurated by formal PM KP Oli]
- Largest hydropower before Upper Tamakoshi – Kaligandaki A 144 MW (2002)
- Storage type hydropower – Kulekhani 1st 60 MW (1982); 2nd 32 MW and 3rd 14 MW
- Largest proposed hydropower – Karnali Chisapani Multipurpose Project (10800 MW)

8.1.3 Hydropower Development in Nepal

Government Agencies in the power sector

i. Ministry of Water Resources (MoWR)

ii. Water and Energy Commission Secretariat (WECS) - planning and policy research.

iii. Department of Electricity Development (DoED) - licensing, facilitation, promotion, compliance monitoring and project study (regulating body under Ministry of Water Resources).

iv. Nepal Electricity Authority (NEA)- public utility for transmission and distribution of electricity (Government of Nepal undertaking company under Ministry of Water Resources, Formed on August 16, 1985 under Electricity Authority Act 1984).

8.1.3 Hydropower Development in Nepal

v. Electricity Tariff Fixation Commission (ETFC) - tariff setting Legal and Policy Environment

Moreover, for the promotion of hydropower projects, the DoED has been designated as 'One Window' under the MoWR, with following responsibilities:

- Issuance of survey and Project (generation) licenses.
- Providing concessions and incentives.
- Facilitating the import of the plant, equipments and goods required for the project.
- Facilitating in the acquisition of government land required for the project.
- Facilitating in obtaining various permits and approvals.

Policy(नीति), Acts(ऐन) and Regulations(नियमावली)

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- वातावरण संरक्षण नियमावली, २०७७
- वातावरण संरक्षण ऐन, २०७६
- Hydropower Development Policy 2049(1992AD)-open to private sector,
- Hydropower Development Policy(New) 2058 (2001AD)-export of electricity, promotion of foreign investment in hydropower development, environmental conservation.
- Electricity Act, 2049 (1992)- Management and development of electricity (Energy production and distribution)
- Electricity Rules, 2050 (1993)
- Water Resource Act-2049- license, priority order for utilizing water resources: Drinking water; Irrigation; Agricultural; Hydroelectricity; Industry, Navigation; Recreational uses; Other uses.

8.1.3 .2 Hydropower Development Policy

Government has adopted the Hydropower Development Policy of 2001 and encourages both local as well as foreign investment, especially for the development of Small Hydropower Plants.

The Hydropower Development Policy 2001 (HDP) addresses issues including

- Private sector demand,
- Need for reasonable pricing,
- Rural electrification,
- Need to raise the level of employment,
- Hydro power exports and
- Investor friendly practices.

8.1.3 .2 Hydropower Development Policy

Objectives:

- To Utilize the existing water resources of country and to generate electricity at low cost.
- To extend reliable and quantitative electric service throughout the country at reasonable price.
- To tie up electrification with economic activities.
- To render the support to the development of rural economy by extending rural electrification.
- To develop hydropower as an exportable commodity.

8.1.3 .2 Hydropower Development Policy

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Commitments of Government of Nepal:

- Survey license: term of 5 years
- Generation license term: 35 years for domestic supply and 30 years for export oriented projects
- Additional maximum five years for hydrological risks
- Projects turned over free of cost on good operating condition at the end
- Water rights guaranteed
- Foreign exchange and repatriation facility

8.1.3 .2 Hydropower Development Policy

Procedure:

- Projects to be developed by way of competitive bidding
- BOOT (build-own-operate-transfer) model for private investment
- Respect for high standards for environment protection
- GoN to assist in land acquisition
- Royalty structure fix rate up to 1000 MW, export projects negotiable rate above 1000 MW
- Separate agreement for developers and GoN

Lets move to Multiple Choice Questions

8.1 Multiple Choice Questions

1. Among the hydropower plants given below, ……. is not a peaking-ROR type.

a) Kaligandaki A — 144 MW (PROR)

b) Marsyangdi (PROR) → 69 MW

c) Kulekhani-1 ⇒ Storage (60 MW)

d) Upper Tamakoshi ⇒ PROR - 456 MW

2. What is the economically feasible power potential of Nepal?

a) 83 GW ⇒ Gross.

b) 44 GW — Technical

c) 42 GW (42,000 MW)

d) 44000 GW

8.1 Multiple Choice Questions

3. How does a hydroelectric dam generate electricity?

a) By harnessing the energy of falling water

b) By harnessing the energy of waves

c) By harnessing the energy of the sun

d) By harnessing the energy of wind

4. What is the right sequential order for Power development nowadays in case of Nepal?

a) PPA-survey license- Testing and commissioning -financial closure

b) Survey license -PPA-financial closure-Testing and commissioning

c) Financial closure-survey license-PPA-Testing and commission

d) PPA-financial closure -Survey license-Testing and commissioning

8.1 Multiple Choice Questions

5. Largest hydropower plant of Nepal is

(a) Kaligandaki A Hydroelectric Project

(b) Trishuli Hydroelectric Project

(c) Upper Tamor Hydroelectric Project

(d) Upper Tamakoshi Hydroelectric Project

6. Largest hydropower plant of Nepal before 2020 AD is

(a) Kaligandaki A Hydroelectric Project

(b) Trishuli Hydroelectric Project

(c) Upper Tamor Hydroelectric Project

(d) Upper Tamakoshi Hydroelectric Project

8.1 Multiple Choice Questions

7. Largest upcomming hydropower plant of Nepal is

(a) Budhigandaki Hydroelectric Project ⇒ 1200 MW

(b) Arun III Hydroelectric Project ⇒ 900 MW

(c) Upper Karnali Hydroelectric Project = 900MW

(d) Tila I Hydroelectric Project ⇒

8. The hydropower plant capacity of Bheri Babai Diversion Multipurpose Project is

(a) 60 MW

(b) 90 MW

(c) 46 MW

(d) 27 MW

8.1 Multiple Choice Questions

9. The Largest hydropower project of the world is

(a) Karnali Chisapani hydropower project

(b) Upper Tamakoshi hydropower project

(c) Three George Dam hydropower project 22.5GW

(d) Itaipu Dam hydropower Project ⇒ 14GW

10. The second largest hydropower project of the world is

(a) Baihetan Dam hydropower project

(b) Wudongde Dam hydropower project

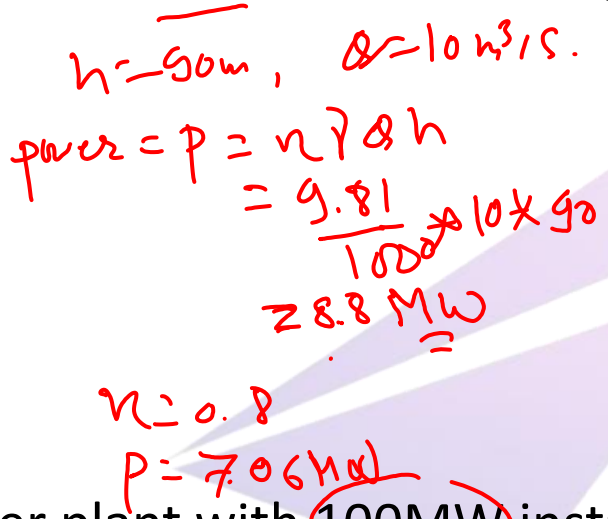
(c) Three George Dam hydropower project

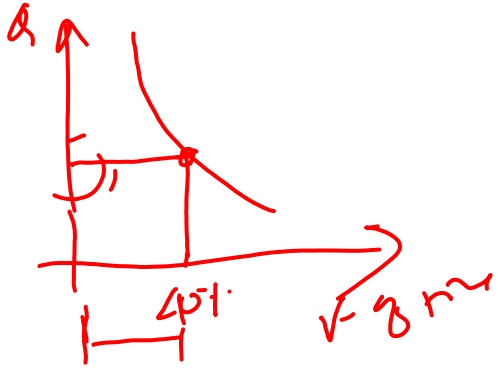
(d) Itaipu Dam hydropower Project

8.1 Multiple Choice Questions

11. A hydro-turbine with net head 90m and discharge 10 m3/s will have the power output of

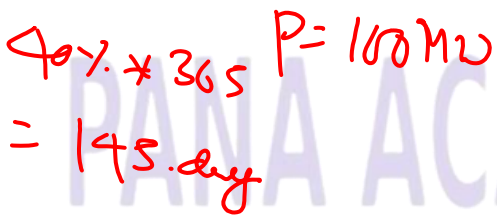
a) 6 MW
b) 8 MW
c) 10 MW
d) 11 MW





12. A ROR type hydropower plant with 100MW installed capacity and with Q40% design flow can generate the full capacity at least for…….. days of a year.

a) 145 days
b) 245 days
c) 300 days
d) 365 days



8.1 Multiple Choice Questions

13. The Upper Tamakoshi hydro project has capacity of 456MW. It has head of 822 m and design discharge of 66 m3/s. Find the overall efficiency of the project.

a) 83.5 %
b) 85.7 %
c) 87.5 %
d) 89.5 %

$P = \eta \gamma * Q * h$

$\eta =$

$456\,MW = \eta * \frac{9.81}{1000} * 66 * 822$

$\therefore \eta = 85.7\%$

14. Electricity act was formulated in year …… BS

a) 2055
b) 2049
c) 2056
d) 2050

8.1 Multiple Choice Questions

15. 400 cumecs of water are being released from dam storage to meet the downstream demand through the turbines of the connected hydro plant. The effective head of water acting on the turbines is 50 m. The efficiency of the hydro plant is 0.8. The electrical power generated from this plant is

a) 1,56,800 MW
b) 156.8 M kW
c) 156.8 MW
d) 156.8 kW

$Q = 400$ cumecs (m^3/s)
$h = 50$ m.
$\eta = 0.8$

16. PPA rate for the RoR project for the wet season is……..

a) 4.80 Nrs per unit
b) 8.40 Nrs per unit
c) 12.4 Nrs per unit
d) 7.1 Nrs per unit

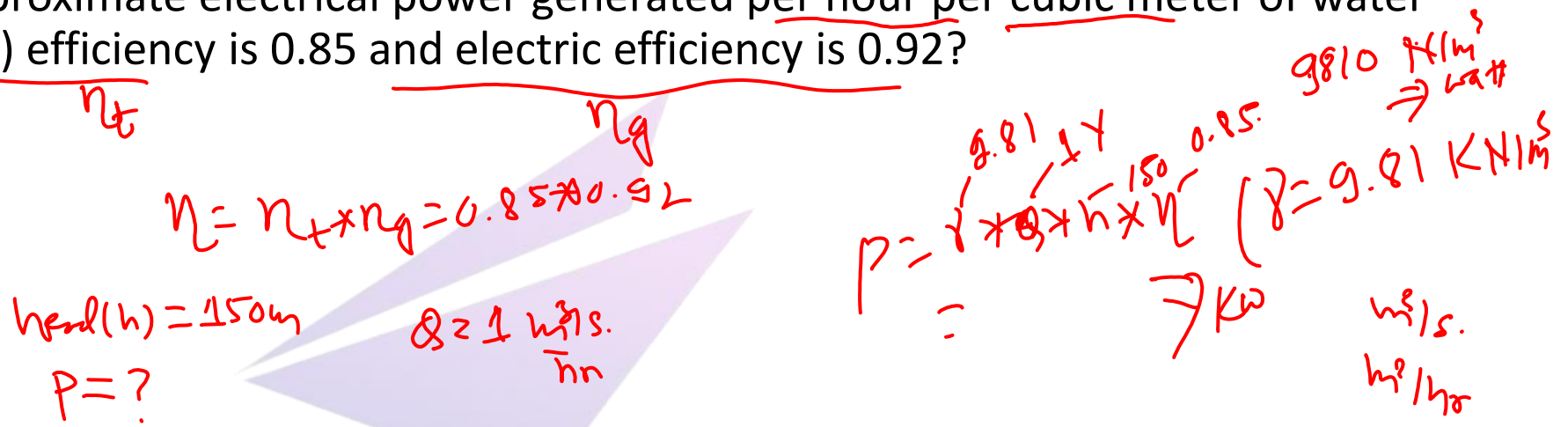
(Wet) (Dry)

PPA =

8.1 Multiple Choice Questions

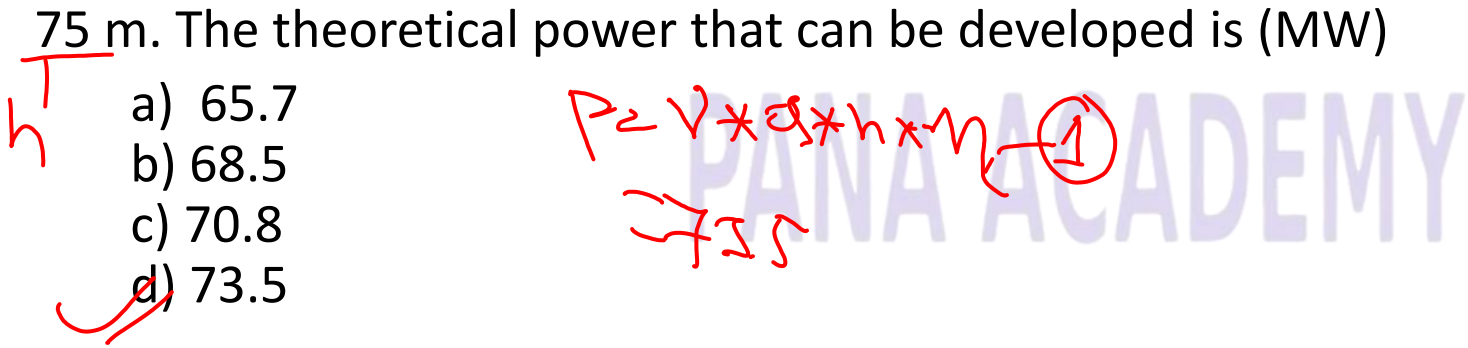
17. Water for a hydroelectric power station is obtained from a reservoir with a head of 150 m. What will be the approximate electrical power generated per hour per cubic meter of water if mechanical (hydro) efficiency is 0.85 and electric efficiency is 0.92?

a) 1149.5 kWh
b) 1470.0 kWh
c) 945.7 kWh
d) 1350.0 kWh



18. A hydroelectric reservoir can supply water continuously at a rate of 100 m^3/s. The head is 75 m. The theoretical power that can be developed is (MW)

a) 65.7
b) 68.5
c) 70.8
d) 73.5



8.1 Multiple Choice Questions

19. Which is not the objective of the hydropower development policy 2058 B.S.

A) Utilize the existing water resource
B) To tie up electrification with economic activities
C) To extend rural electrification to support rural economic activities
D) Collect the 5% royalty to use in the other development activities

20. Hydropower energy is ……. Source of energy

A) Conventional
B) Commercial
C) Conventional Renewable
D) All of the above

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Thank you!

Any Questions?