

Water and Energy Consultant Association
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Presentation on
Opportunities and Challenges in Micro/Mini
Hydropower Project

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Content

Present context of
Hydropower Development

The Federal System

Licensing arrangement of
Hydropower

Financial Analysis of Mini-
Micro Hydro Power (present)

Financing prospects in the
federal Structure

Challenges and Opportunities

Energy Consumption Status

- Per Capita Energy Consumption:
- Per Capita Electricity Consumption: 150 kWh.
- Access to Electricity: 75% (60% grid(NEA), 15% renewable(AEPC)).
- Electricity as % of total energy consumed: 3%, mainly from Hydropower.

Classification of Hydropower

- Pico Hydro: <10 kW
- Micro Hydro: 10-100 kW
- Mini Hydro: 100kW- 1000 kW.
- Small Hydro: 1000- 10000 kW.
- Medium Hydro: 10000-50000 kW.
- Large Hydro > 50000 kW.

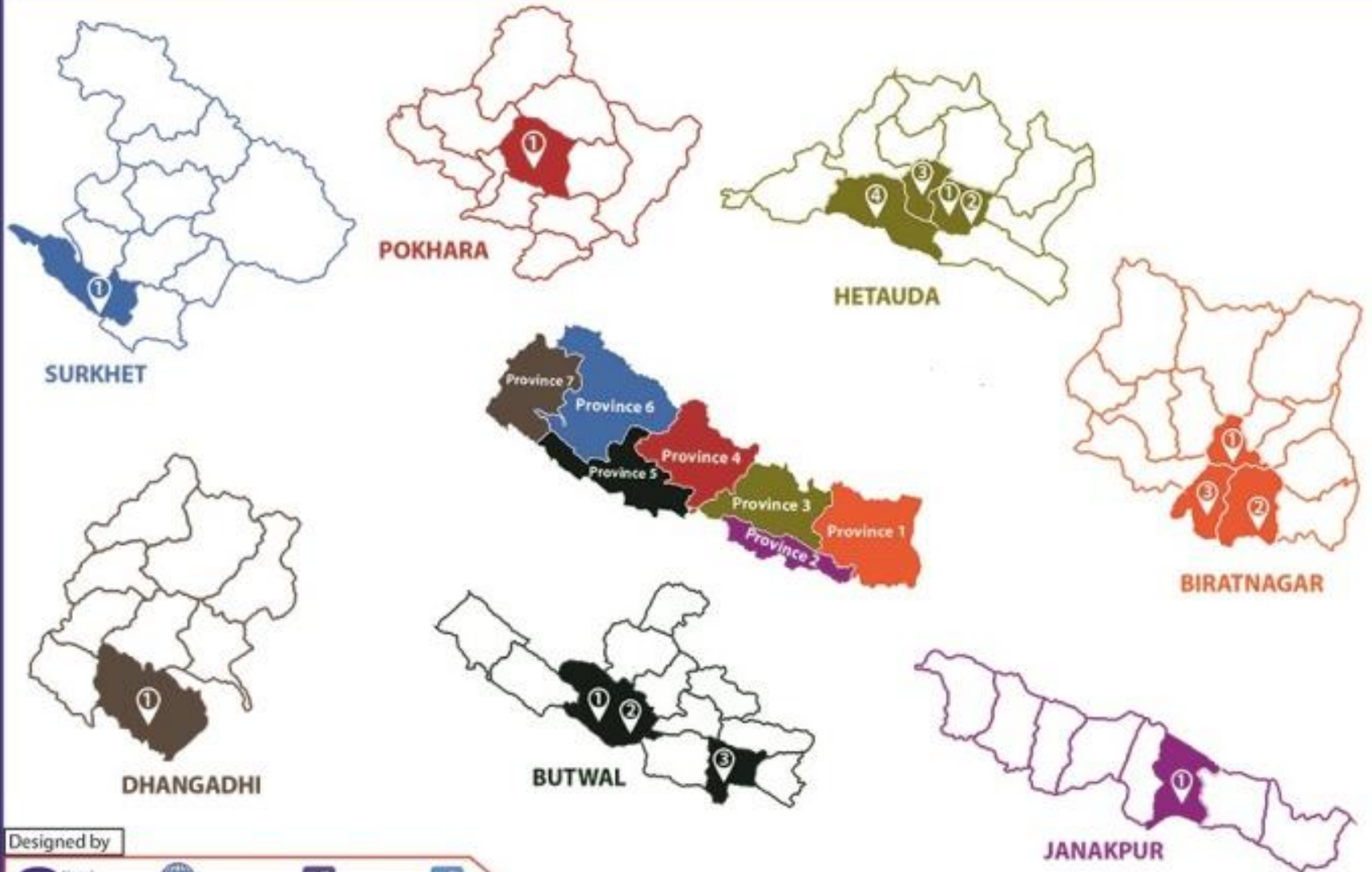
Key Agencies Involved

Ministry of Energy, Water Resource and Irrigation.	Policy/Planning and Approvals.
Department of Electricity Development	Government Interface with Private Sector.
Water and Energy Commission	Policy, Monitoring and Coordination.
Nepal Electricity Authority	Utility, Sole Power Purchaser, Grid Owner/Operator.
Tariff Fixation Commission	Fixes the tariff
Ministry of Environment	Environmental approval/clearances.
Investment Board	Promote HP Projects > 500 MW
Alternative Energy Promotion Center (AEPC)	Responsible for Off Grid RE based electrification.
Private-Sector Financers	Banks, Financial Institutions (FIs)
Private Developers	Mainly Generations

Three tier of Government in Nepal.

- Central or Federal Government based in Kathmandu, the Capital.
- 7 Provincial Government.
- 753 Local Governments which include 6 Metropolitan Cities(Mahanagarपालिका), 11 Sub Metropolitan Cities (Upa-Mahanagarपालिका), 276 Municipalities (Nagarपालिका) and 460 Rural Municipalities (Gaunपालिका).

Provincial Capital of Nepal



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Source: High-Powered Federal Administrative Restructuring Committee

Province wise summary of identified hydropower sites.

S.N	Province	No of local bodies	No of sites identified.	Power (MW)
1	Province 1	56	84	66.11
2	Province 2	-	-	-
3	Province 3	53	81	64.44
4	Province 4	29	54	45.14
5	Province 5	23	38	26.99
6	Province 6	60	102	94.75
7	Province 7	56	97	86.12
		277	456	383.56

Source: SUDIGGAA 2018

Licensing arrangement of Mini Hydropower

- Survey License
 - Desk Study report showing the project boundary and major project components in topographic map of 1:25000 or 1:50000.
 - Hydrology: Probability of exceedence Q45% (Grid Connected) and Q80% (Off Grid).
 - License Fee Rs 5 Lakhs.
 - Issuing agency Local Body after technical clearance from DoED.
 - Duration of License 2 Years, but in case of extension requirement in the study/investigation, additional one year can be added.

- Generation/Transmission/Distribution License.
 - IEE/EIA as per condition and location of the site.
 - Power Purchase Agreement(PPA) or Connection Agreement.
 - In case of off grid projects-Details of area to be electrified.
 - Topo Sheet showing the major project components and co-ordinates.
 - Financial Closure Arrangement Documents (Equity and Loan proportion)
 - The construction has to be started within 3 years after issuing of Generation License.
 - Duration of license period is 35 years after that it has to be hand over to Government under running condition.
 - Royalty(Capacity and Energy) is decided by the local government.

Financing of Mini Hydropower.

- Assumptions
 - Financial analysis is performed for 1MW hydropower plant to get better understanding of financial indicators and the Viability Gap Funding(VGF) by federal government.
 - The selling electricity rate NRs 6/kWh (NEA PPA Rate with 8 simple escalation of 3% each.)
 - The project being grid connected, 65% PLF is taken into account.

Table : Financial Analysis of Hydropower (1000 kW) at different Costs

OUTPUT	COST#	Cost I	Cost II	Cost III	Cost IV	Cost V	Cost VI	Cost VII
		Capital Cost* [NPR/ kW] = 162,528	Capital Cost [NPR/ kW] = 200,000	Capital Cost [NPR/ kW] = 235,000	Capital Cost [NPR/ kW] = 300,000	Capital Cost [NPR/ kW] = 400,000	Capital Cost [NPR/ kW] = 500,000	Capital Cost [NPR/ kW] = 579,475
LCOE [NPR/kWh]		3.95	4.86	5.71	7.29	9.72	12.15	14.09
LBOE [NPR/kWh]		7	7	7	7	7	7	7
ROE [%]		30.85%	20.93%	15.07%	8.33%	2.30%	-1.65%	-4.11%
NPV [NPR-Million]		136.78	93.29	52.66	-22.77	-138.84	-254.91	-347.15
Cost Benefit Ratio		3.81	2.55	1.75	0.75	-0.16	-0.70	-1.00
Pay Back Period [Years]		3.75	6.15	9.56	14.70	21.02	>25	>25
VGF required** per kW [NPR/ kW]		None	None	0	79,000	201,000	323,000	420,000
First Year PPA Rate*** required [NPR/ kWh]		4.16	5.12	6.00	7.67	10.22	12.77	14.81

* O&M Costs changes as well because Yearly O&M Costs is calculated as 3% of Capital Cost

** To achieve at least 15% ROE (criteria for financial viability)

*** With 8 simple escalations of 3% each to achieve 15% ROE in case of No VGF provided

The Cost I to Cost VII models are based on increased costs in constructing hydropower plant due to site characteristics and distance from road head.
The Discount rate used is 10%.

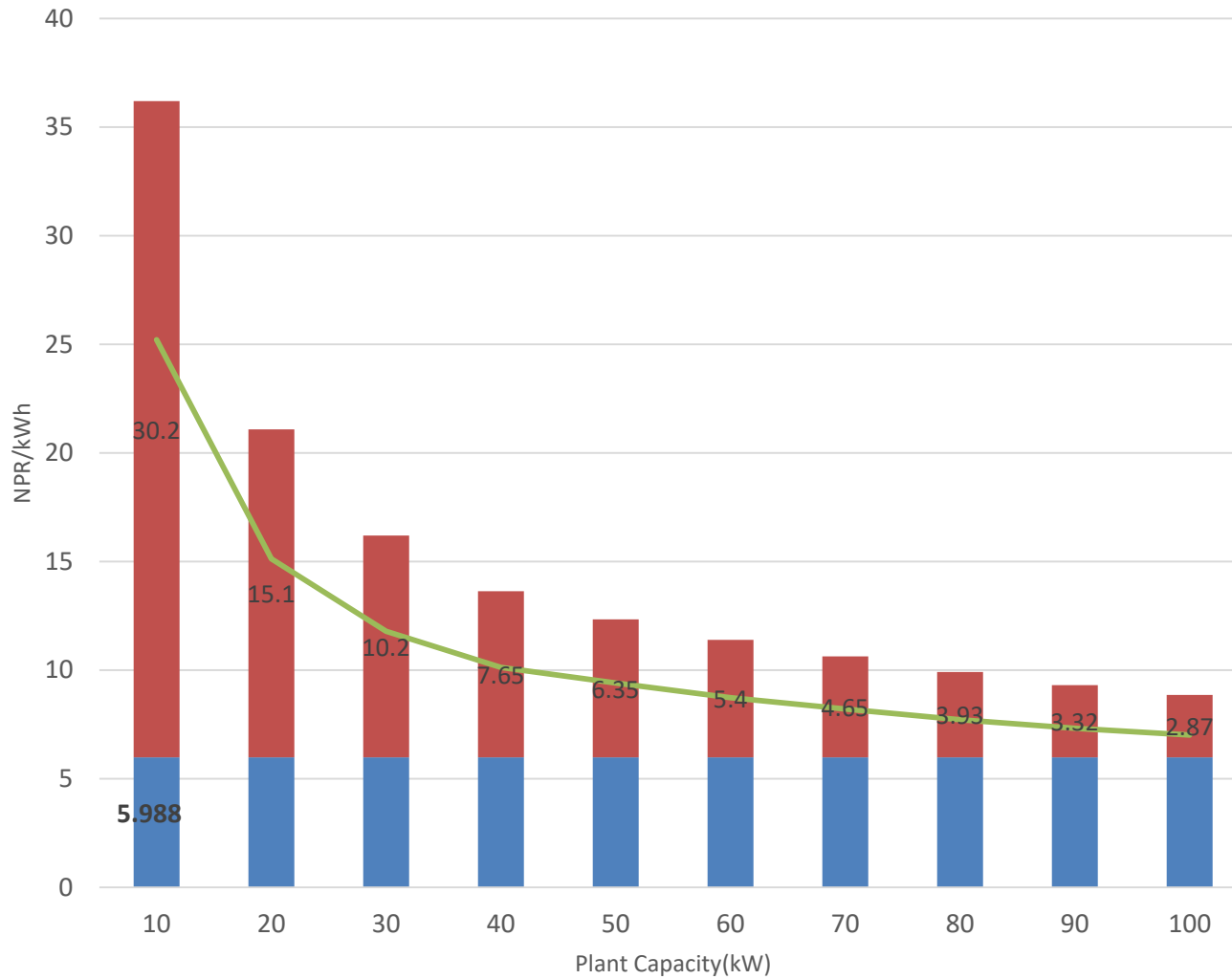
Source: SUDIGGAA 2018

Financing of Micro Hydropower.

- Assumptions
 - Financial analysis is performed for Micro hydropower plant(≤ 100 kW) to get better understanding of financial indicators and the Viability Gap Funding(VGF) by federal government.
 - The selling electricity rate NRs 5.988/kWh (NEA PPA Rate with 8 simple escalation of 3% each.)
 - The project being grid connected, ideal case PLF of 90% is taken into account.

Source:

Micro Hydro Power Sites (<100 kW)



- Grid Connected
- Considering Optimum PLF of 80 %
- Off-grid operation: Not Allowed
- PPA Duration 30 years

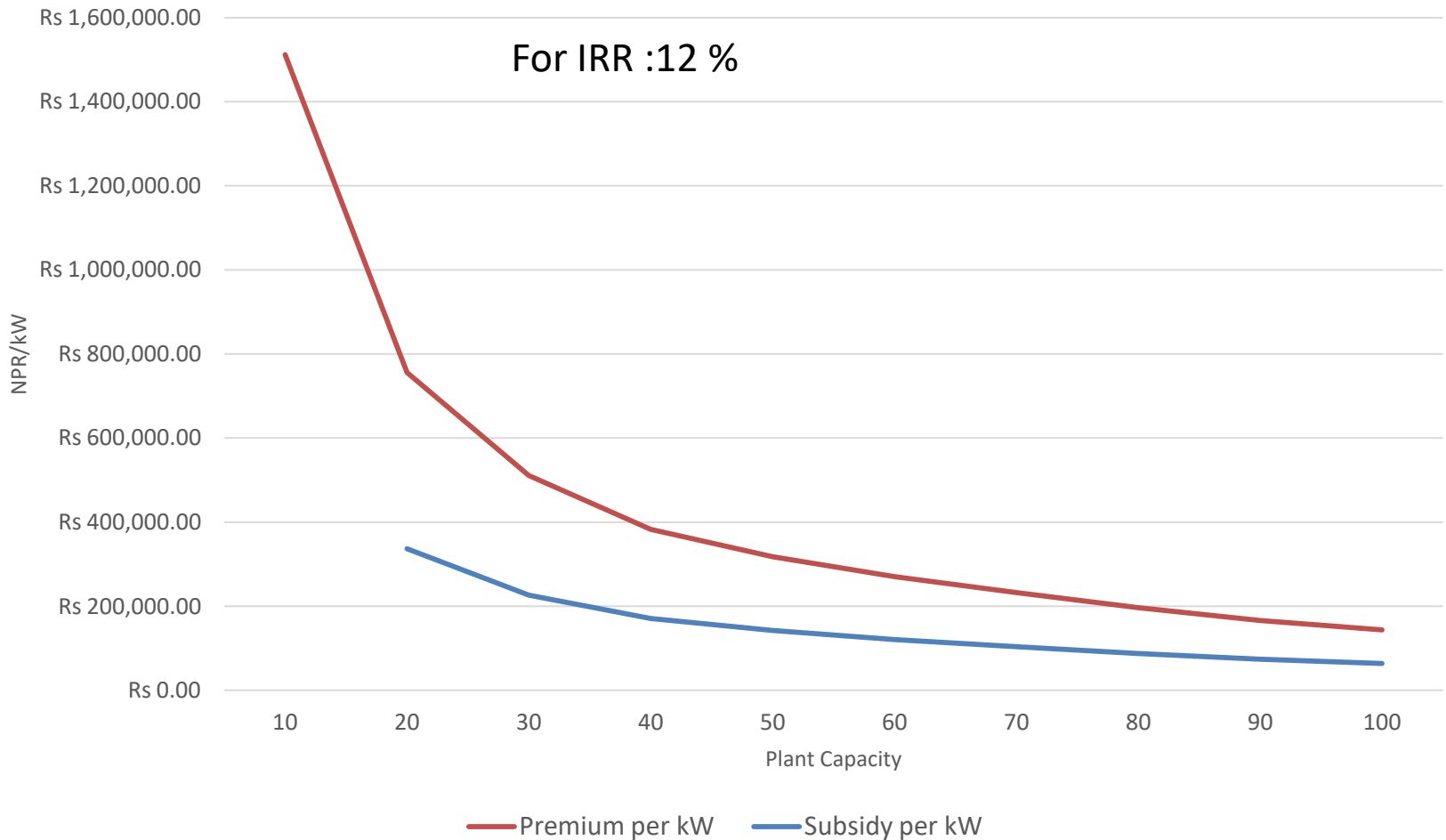
■ NEA Tariff ■ premium required — LCOE

Feed In Tariff

- Policy mechanism designed to accelerate investment in renewable energy technologies.
- Long-term contracts to renewable energy producers, typically based on the cost of generation (LCOE) of each technology

FiT Vs Capital Subsidy (Nepalese Context)

Capital Subsidy vs FiT in Nepalese MHP context

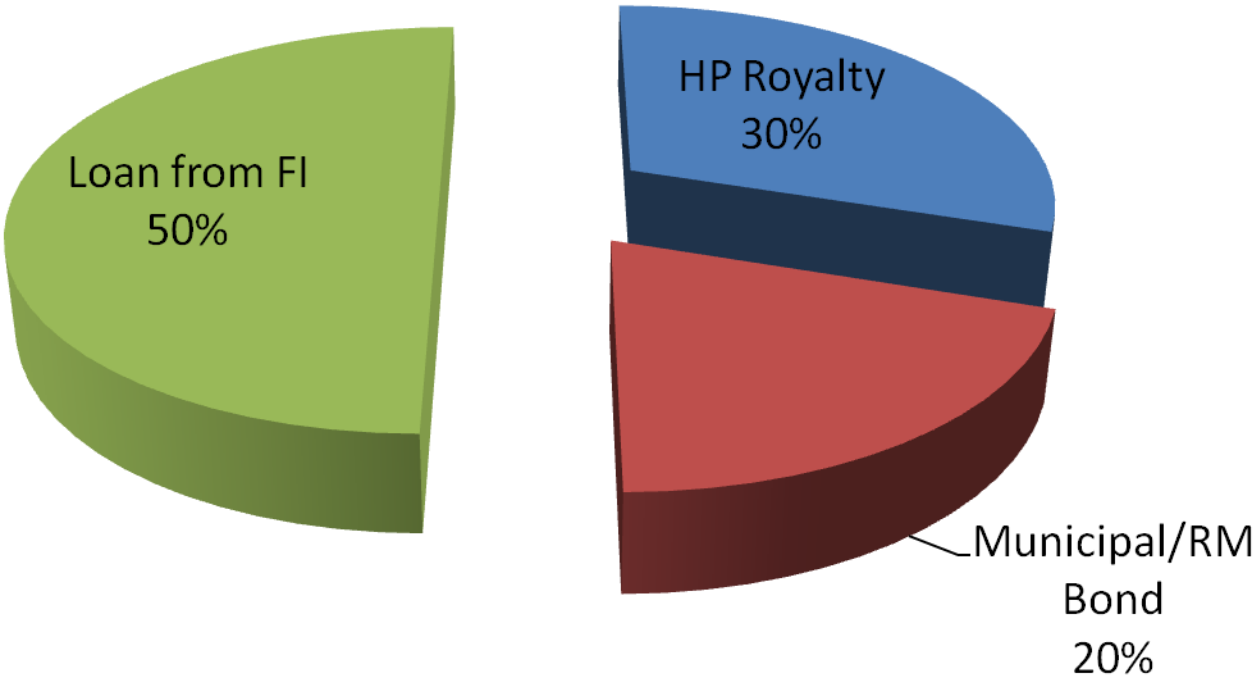


Royalty Allocation from different Hydropower Plants.

S.N1	Fiscal Year	Amount	Remarks
1	066/67	768,844,215.40	
2	067/68	527,507,500.50	
3	068/69	2,539,490,616.17	
4	069/70	1,254,029,198.81	
5	070/71	1,056,683,826.56	
6	071/72	1,137,961,160.99	The Generation was around 600MW.
	Total	7,284,516,518.43	
7	074/75		The generation is around 1000 MW.

List of Issued Generation License : 4641.57 MW (172 Projects), (Source: Doed, April 2018)

Proposed Financing Mini Hydropower under Federal Structure Local Bodies



Background on Bonds.

- Bonds: Long-term debt securities issued by government agencies or corporations.
- Par Value: for a bond, its face value, or the amount returned to the investor at the maturity date when a bond is due.
- Most bonds have maturities between 10-30 years.
- Issuers required to make interest payment and repay par value.

Type of Bonds

- Municipal Bonds: Long-term debt securities issued by state and local government agencies.
 - Low risk, Interest exempt from federal income tax.
- Federal agency bonds: long-term debt securities issued by federal agencies.
 - Low default risk, Interest is taxable.
- Corporate bonds: long-term debt securities issued by large firms.
 - Subject to default risk .