

# SMALL HYDROPOWER CONCLAVE 2025

The Road Ahead for Small Hydropower

*15<sup>th</sup> December, 2025  
India International Centre, New Delhi*

Session on Scenario & Perspective



नवीन एवं नवीकरणीय ऊर्जा मंत्रालय

**MINISTRY OF NEW AND RENEWABLE ENERGY**

सत्यमेव जयते



**DEPARTMENT OF HYDRO  
AND RENEWABLE ENERGY**  
Indian Institute of Technology  
Roorkee, Roorkee – 247667



**FEDERATION OF INDIAN  
SMALL HYDROPOWER**  
Lower GF, 1, Pocket-52, CR  
Park, New Delhi-110019

# Strategic Importance of SHP

## A. Technical importance/ advantage

- SHPs provide firm, predictable, round the clock and many of the instances peak power during non-rainy days having pondage.
- Being mostly located in remote locations, at extreme end of electricity network, help in improving electricity quality and can support the local grid.
- Stabilize the grid by supporting variable solar and wind generation.
- Helps in blackout situation and ancillary services
- With lifespans exceeding 80 years, SHPs deliver long-term value.
- Historic examples like Sidrapong (1897), Shivasamundram (1902), Galogi (1907), and Chhaba (1911) are still operational.



# Strategic Importance of SHP

## B. Driver of Rural Development

- SHPs boost local infrastructure and socio-economic conditions.
- ~40% of project investment flows into the local economy,
- Supports small and micro industries in remote areas
- Create job and reduces rural migration to urban areas.



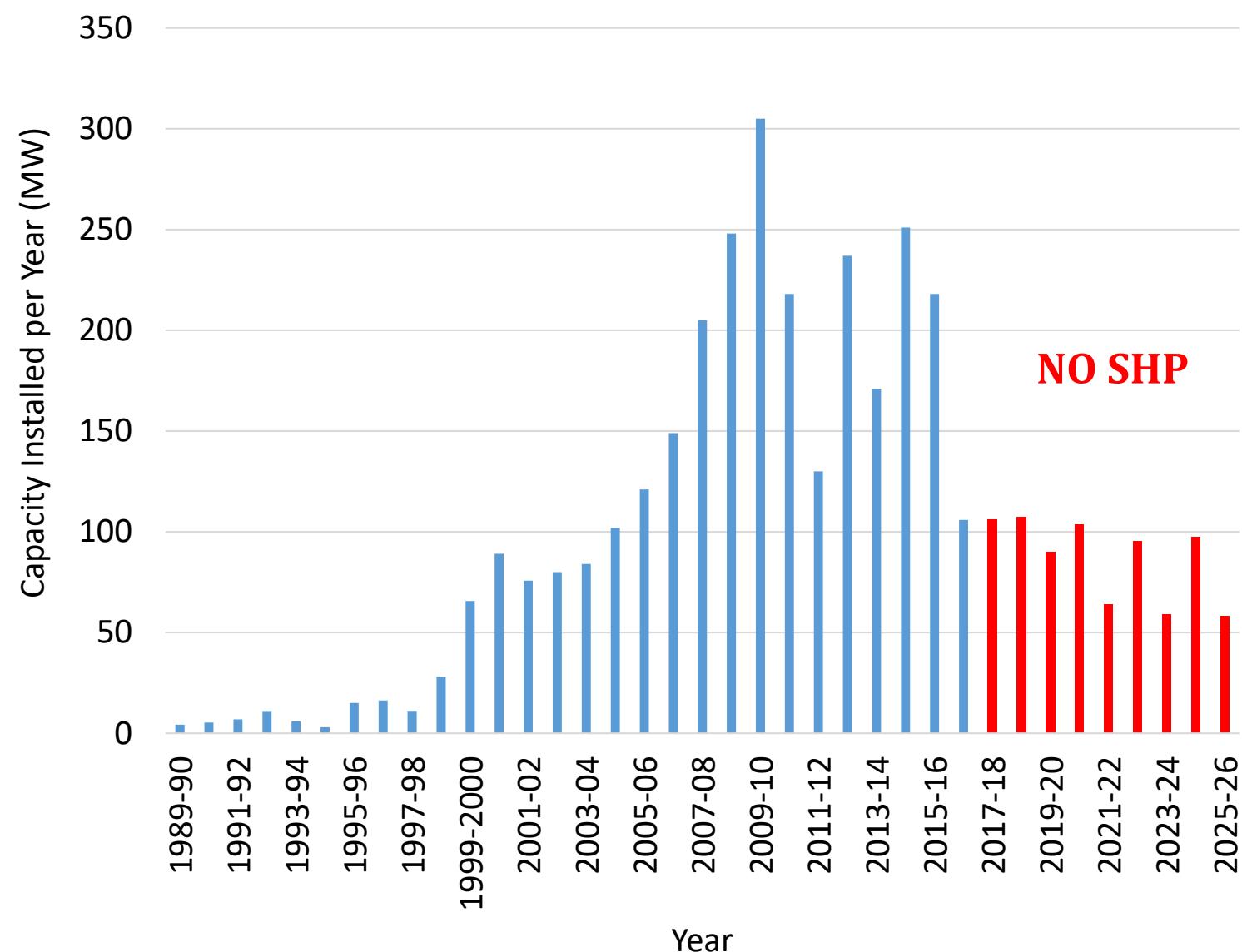
## C. Environmentally Sustainable & Nationally Strategic

- SHPs are clean, renewable, and require minimal land, deforestation, or displacement.
- Being entirely indigenously built, they align with Make in India and *Atmanirbhar Bharat*.
- Ongoing BIS and ISO standardization will boost global market access for Indian equipment.
- Using non-consumptive indigenous water resources, enhance national energy security.

# High SHP potential, low project development

Despite the many benefits of SHPs

- In recent years there has been a sharp fall in the development of SHPs due to various issues faced by the sector.
- Out of roughly 25 GW estimated potential of SHPs, only 5 GW has been developed so far.
- Additionally, about 10 GW on non powered dams, outfall structures and 15 GW as hydro kinetic potential remains unexploited
- High opportunity to tap the existing potential



# GHG emissions from different energy technology

Coal	820
Gas	490
Solar PV (Utility)	48
<b>Hydropower*</b>	<b>18.5</b>
Wind Offshore	12
Nuclear	12
Wind Onshore	11



**Figure 1:** Median life-cycle carbon equivalent intensity (gCO<sub>2</sub>-eq/kWh)

Source: IPCC 2014 / IHA 2018

\*IHA STUDY

**Figure 2:** Relationship between GHG emissions intensity (gCO<sub>2</sub>-eq/kWh) and the power density of projects (W/m<sup>2</sup>)

# 1. Need for policy intervention- National Policy Push

The SHP sector is experiencing a slowdown,  
Requires a stronger national-level policy intervention to revive growth.

Key challenges:

- Difficult site conditions, access, lesser hydrological data
- Limited access to affordable financing
- Delays in land acquisition, Right of Way (ROW), land use conversion permits, and clearances due to multiple authorities and absence of single-window systems
- Unpredictable regulatory changes and non-compliance with CERC/SERC tariff guidelines
- Inadequate power evacuation infrastructure
- Tariff fixation that excludes key cost components
- High insurance costs and inadequate policy coverage
- Non-signing of Power Purchase Agreements (PPAs)



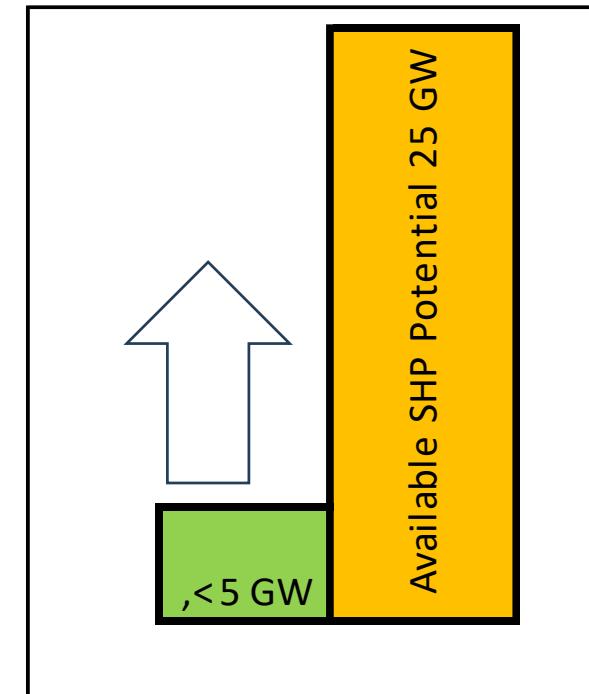
# 1. Need for policy intervention- National Policy Push

Currently, states follow varied norms for SHP development.

A cohesive national policy can help align state-level regulations, providing clarity and consistency for developers across the country

To shape this policy, MNRE has held several stakeholder consultations on a Draft National SHP Policy, including:

- Stakeholder consultation chaired by National-level meeting chaired by Secretary, MNRE in Shimla (July 12, 2024) with 100+ participants
- SHP session at REINVEST in Gandhinagar (Sept 18, 2024)
- “Chintan Shivir” in Bhubaneshwar (Nov 15, 2024)
- Dedicated meeting with Additional Secretary, MNRE (Dec 19, 2024)
- Meeting with Deloitte, MNRE’s policy consultant (Jan 13, 2025)



FISH actively participated in all forums and shared consolidated recommendations.

**We look forward to the release of the National SHP Policy.**

## 2. Capital Subsidy Scheme

### ***STRENGTHS & OPPORTUNITIES***

Capital Subsidy Scheme enables SHP projects by improving credibility with lenders, easing PPA signing, and facilitating financial closure.

- Projects gain stakeholder trust and better financing prospects.
- Reduces the tariff of SHP power, makes it more attractive, enhances offtake potential and competitiveness (merit order) and levels the RE field and enables harnessing of the benefits of SHPs.
- Improves the cash flow, helps in project execution and reduces risks.
- Improves Bankability and lowers long-term debt exposure.
- In tariff determination many costs remain uncovered (e.g., upfront premiums, local development, higher interest rates, free power to state, distant interconnection points, RMU needs, offsetting rising cost of SHP (land, material, labor and compliance costs)).

### 3. Streamlining permits and clearances

With initiative of MNRE, FISH held meeting with MoEFCC on 15 March 2025 and difficulties faced were discussed.

MNRE support for convincing MoEFCC officials on the following issues

- Streamline clearances: Delays in project approvals are a major bottleneck. States should establish single-window systems and proactively coordinate with GoI to fast-track clearances.
- Simplify FCA approvals: Forest clearances often take over five years. A simplified, time-bound process with a maximum two-month timeline is essential.
- Rationalize River Basin Study requirement: SHPs, being small RoR projects on tributaries, have negligible ecological impact. Yet, mandatory River Basin Studies under MoEFCC norms delay approvals. FISH has requested MNRE's support for a waiver.
- Extend CAT Plan exemption: Exempt SHPs up to 25 MW (currently applicable up to 10 MW) from CAT Plan requirements.

### 3. Streamlining permits and clearances

- Land Pool for Compensatory Afforestation: States should earmark and allocate land on a chargeable basis for SHPs to meet afforestation obligations.
- Revise ROW Guidelines for hills: CEA's ROW norms—meant for plains—don't suit hilly terrain where service roads are unfeasible and tree clearance irrelevant. Separate guidelines for hills are needed. Representation already given to CEA in May 2025 as response to Draft Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) (1st Amendment) Regulations, 2025.
- Animal Passage concerns: SHPs on rivulets/tributaries without pondage don't obstruct animal movement. Objections on this basis should be reconsidered.
- Catchment Area Treatment Plan exemption: Since SHPs involve no submergence, exemption from CAT plans should be extended up to 25 MW (currently up to 10 MW).
- Decentralized approvals: For SHPs up to 25 MW and land use below 5 hectares, all permits and clearances should be handled by state agencies without central referral.

## 4. Challenges in SHP projects

High Capital Cost	<ul style="list-style-type: none"><li>SHP projects have a high capital cost (~₹ 8 - 12 crore/MW) and limited economies of scale.</li></ul>
Infrastructure & Accessibility Constraint	<ul style="list-style-type: none"><li>Many SHP sites are in remote and hilly regions with poor Infrastructure.</li><li>Difficult terrain and short working seasons increase project timelines and costs.</li></ul>
Institutional & Technical Gaps	<ul style="list-style-type: none"><li>There is need for enhanced R&amp;D, reliable discharge data, tail end power evacuation, design optimization and modern technology adoption.</li></ul>
Financing Challenges	<ul style="list-style-type: none"><li>Lack of long-term, low-interest financing.</li><li>Small project sizes further limit investor interest.</li><li>High cost of Insurance.</li></ul>

## 5. Addressing revival of distressed assets

1. In India, especially in hilly regions, instances of projects suffering damages and production loss due to extreme weather events, due to climate change. Damages to power-house, water conductor system, power evacuation infrastructure or washing away of access roads.
2. Until 2018, IREDA- NCEF Refinance Scheme supported grid-connected SHPs affected by force majeure or regulatory setbacks. With extreme weather events now more frequent, reinstating such support mechanisms is essential and should be prioritized.
3. ‘IREDA-NCEF REFINANCE SCHEME’ was available from the years 2015-2018 for existing biomass power & SHP projects affected due to unforeseen circumstances (up to 10 MW for biomass and 5 MW for SHPs)
4. The scheme was powered by National Clean Energy Funds (NCEF) with 2% concessional rate of interest up to 30% of the outstanding loans of the projects
5. The scheme rescued many genuine developers who put in concerted efforts in order to commission their projects despite facing force majeure conditions.
6. Request to relaunch ‘IREDA-NCEF REFINANCE SCHEME’ at the earliest.

## 6. Rejuvenation of Poorly functional SHPs

1. Renovation, Modernization, Uprating & Life Extension (RMU&LE) is a cost-effective way to optimize existing hydro assets
2. As per MOP (2017–22), RMU&LE is planned for 9,197 MW
3. 1995 Ministry Guidelines propose three models:
  - Lease, Rehabilitate, Operate & Transfer (LROT)
  - Sale of Plant
  - Joint Ventures between state utilities and private entities
4. Many SHPs across states are underperforming or idle mainly owned by state, largely due to low priority by large state utilities, outdated technology, poor O&M due to lack of focus from utilities managing larger plants.
5. Maharashtra's LROT Policy—inspired by the successful revival of the other projects—demonstrates the potential of this model. Other states should be encouraged to adopt similar policies and implement time-bound RMU&LE programs on similar models to unlock idle SHP potential.

## 7. Way Forward

- Frequent consultation and hand holding with state government for speedy implementation of SHP projects.
- Announcement of subsidy support scheme
- Announcement of schemes for SHP
- Review of insurance terms
- Early clearance by MOEFCC
- Support of regulators and must purchase by DISCOMs as per other REs

Thank you



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Permits & Clearances



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# Scenario & Perspective: Permits & Clearances

## Background on Small Hydro Projects (SHP)

- SHP projects are environmentally friendly and use minimal land.
- No pondage, No submergence, No displacement,
- Classified as 'White Category' by CPCB, meaning minimal pollution impact.
- Require policy interventions to streamline approvals and reduce unnecessary financial burdens.
- Ensure efficient energy generation with minimal ecological disturbance.



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# Scenario & Perspective: Permits & Clearances

## Exemption of CAT Plan Charges for Projects up to 25 MW

- CAT Plan charges are not applicable to Run-of-River projects up to 10 MW.
- Further, Run-of-River hydro projects up to 25 MW are categorized as White Category projects, involving no poundage and negligible environmental impact.
- In view of the above classification and the absence of poundage, such projects should be exempted from CAT Plan charges, as levying these charges contradicts the very basis of their White Category status and also financial burden on the project.



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# Scenario & Perspective: Permits & Clearances

## **SHP: River Basin Studies & EIA Exemption**

- SHPs fall under the 'White Category,' meaning they have minimal environmental impact.
- As per regulations, SHPs are not required to conduct Environmental Impact Assessments (EIA).
- 15% environmental flow is mandatory, ensuring sustainable river ecology.
- Recommendation: No additional river basin studies should be required.



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# Scenario & Perspective: Permits & Clearances

## No Compensatory Afforestation for Tunnels

- Highway tunnels are exempted from compensatory afforestation charges (MOEFCC letter No 11-50/2020-FC dated 31-03-2023)
- SHP tunnels also do not impact forest land above the tunnel.
- Policy recommendation: Extend the same exemption to SHP tunnels.
- This will significantly reduce project costs and improve viability.



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# Scenario & Perspective: Permits & Clearances

## Right of Way (RoW) in Hilly Terrain

- Transmission lines traverse from one hill to another, with minimal land impact.
- Land below the conductor remains in forest use, making diversion notional.
- The requirement for tree-to-conductor distance is irrelevant in hilly areas.
- Policy recommendation: Modify RoW calculation methods for SHP in hills.

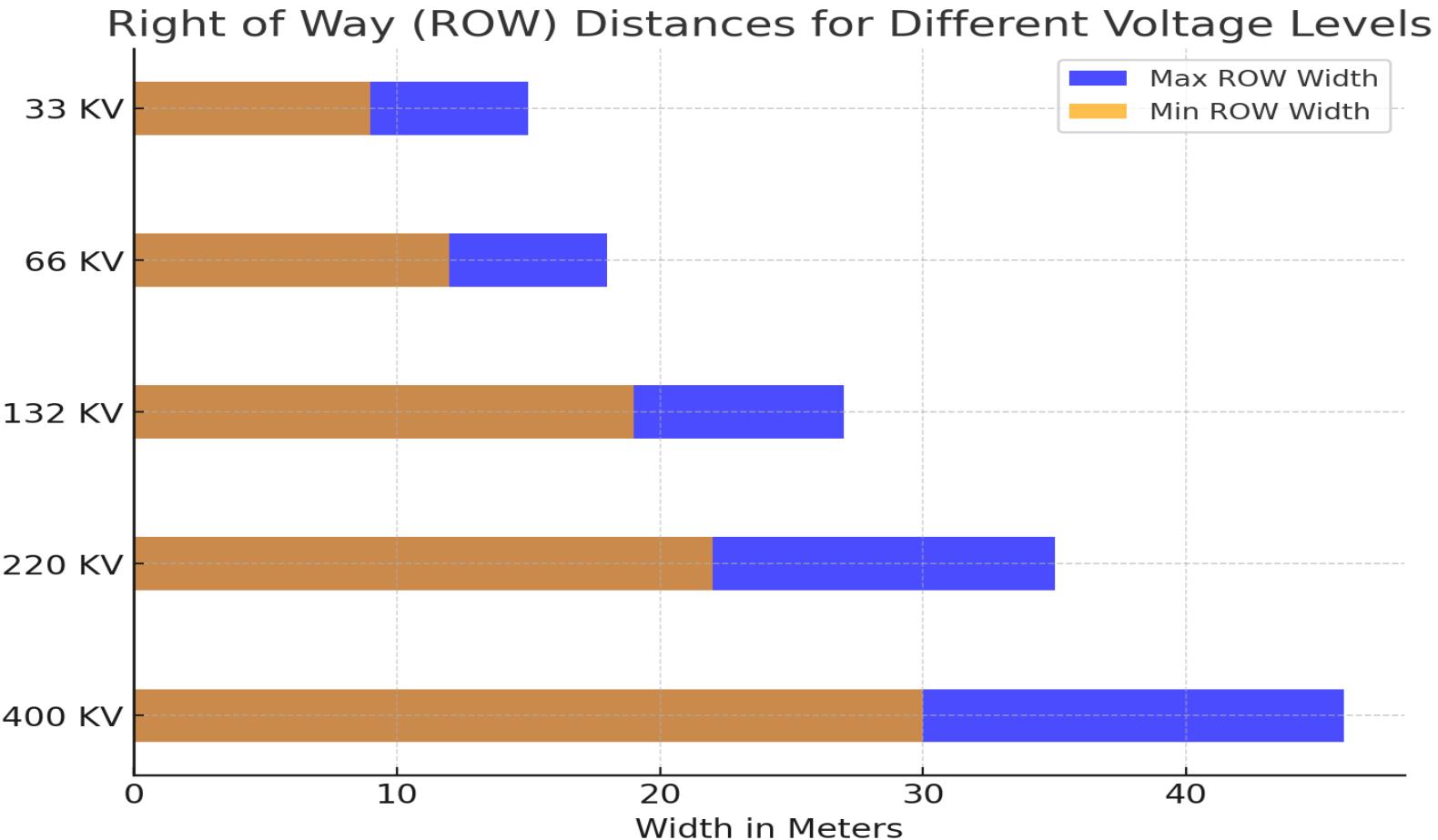


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# Scenario & Perspective: Permits & Clearances

Supply Voltage (kV)	No of circuits	Conductor to Conductor distance		Effect of conductor swing and sag	Distance on either side of the extreme end conductor (To be only Considered in areas under valleys)	D	Clearance from conductor to tree. As per Indian Electricity Rules [1]	Minimum ROW under conductor in valleys C	Minimum ROW (As per the calculation from IER 1956)	Maximum ROW as per guidelines [4]
		A	B							
66	Double	3.78	0.56		1.50		3.40	7.0	15.0	18.0
33	Double	2.60	0.40		1.50		2.80	6.0	12.0	15.0

# Scenario & Perspective: Permits & Clearances



# Scenario & Perspective: Permits & Clearances

## Need for Faster Clearances for SHP

- Current approval process is slow, delaying clean energy projects.
- Objects are raised in peace meal and some time very irrelevant, like .kml file of upstream and downstream projects, interference with animal passes, conversion of dimension from Karam to meter .kml file of Eco sensitive Zone.
- Infrastructure projects up to 40 hectares are cleared at the regional level.
- Recommendation: Allow SHP projects up to 40 hectares to receive approvals from regional offices.
- This will ensure timely implementation and better investment confidence.



# Scenario & Perspective: Permits & Clearances

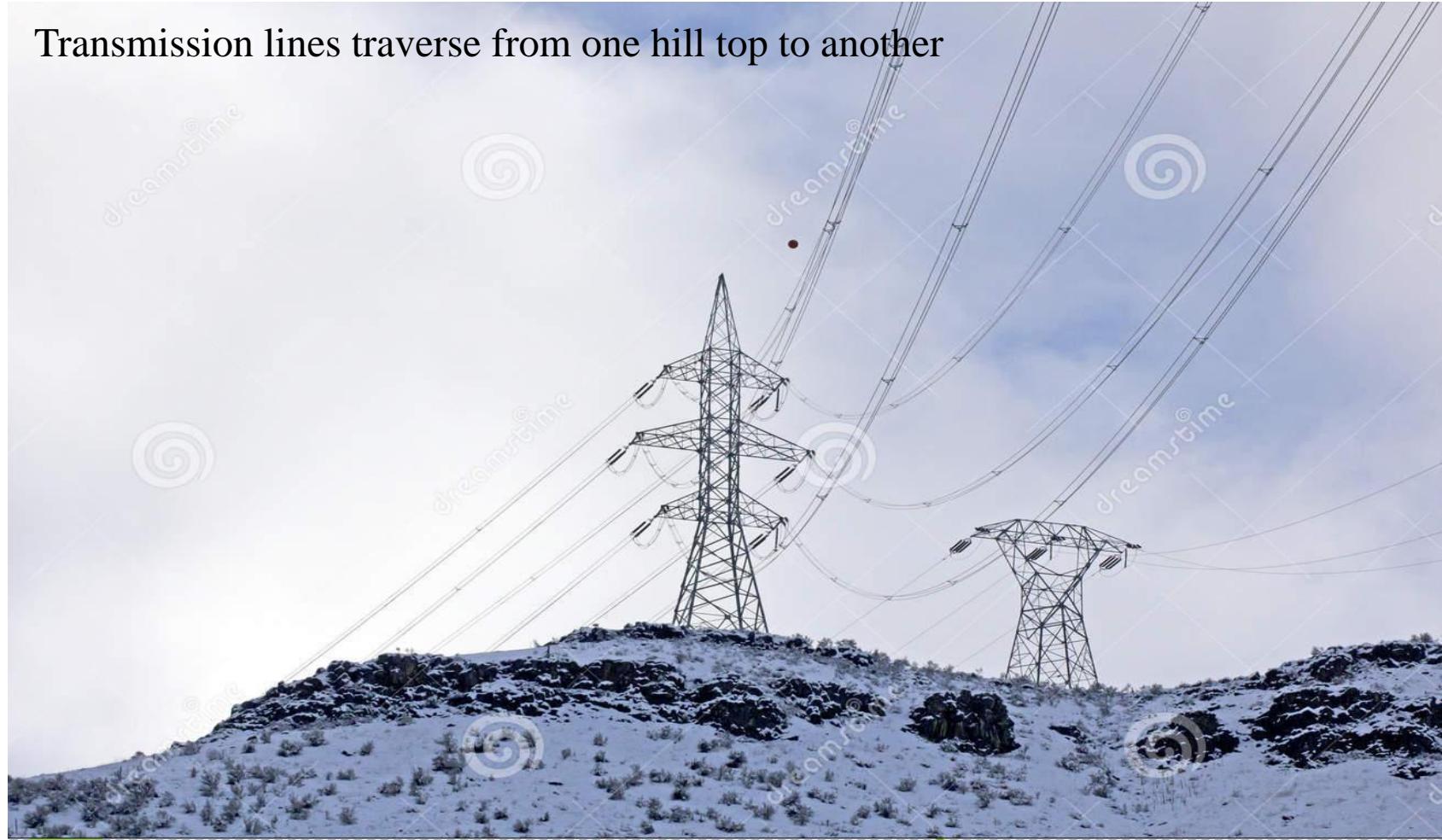
## Conclusion & Policy Recommendations

- SHP projects are crucial for clean energy and rural electrification.
- Proposed amendments will streamline approvals and reduce financial burdens.
- Key recommendations:
  - -Exemption of AT Plan charges upto 25 MW
  - - Exempt tunnels from compensatory afforestation charges.
  - - No river basin studies for SHP.
  - - Modify RoW policies to reflect actual land use.
  - - Enable regional office clearances for projects up to 40 hectares.
- Implementing these measures will boost SHP development and investment.



# Scenario & Perspective: Permits & Clearances

Transmission lines traverse from one hill top to another



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03-09-2014

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# Small Hydropower Conclave 2025

## The Road Ahead for Small Hydropower

Presentation on

# **Sediment Management in Hydropower Plants**

by

Prof Sunil Kumar Singal

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*December 15, 2025*

# DESILTING ARRANGEMENTS

- **Preventive** : The entry of sediment checked before its entry into the head regulation. These are constructed in the streams.
- **Curative** : The sediment is excluded from the channel after its entry with the channel. These are constructed in the channel.
- **Desilting Devices are**
  - Settling basin,
  - Vortex tube
  - Sediment ejector
  - Vortex settling basin



**Desilting tank in himanchal pradesh 3MW SHP project**

**Desilting tank in Uttrakhand 5MW SHP project**



# INTRODUCTION

- ▶ Silt Size to be removed:
  - i. High head scheme:0.1-0.2 mm
  - ii. Medium head scheme-0.2 mm
  - iii. Low head scheme-0.2-0.5 mm

# Performance of Settling Basins

The performance of settling basins are guided by;

- The ability to trap suspended sediments
  - Size of the basin related to the flow (surface area)
  - The geometry of the basins i.e. poor or favorable hydraulics, turbulence level
  - The characteristics of the suspended sediments
- The ability to remove trapped sediments
  - The qualities and efficiency of the adopted flushing system
- The use of the facilities
  - The skills of the operators
  - The management regime of the plant

# Vortex Settling Basin

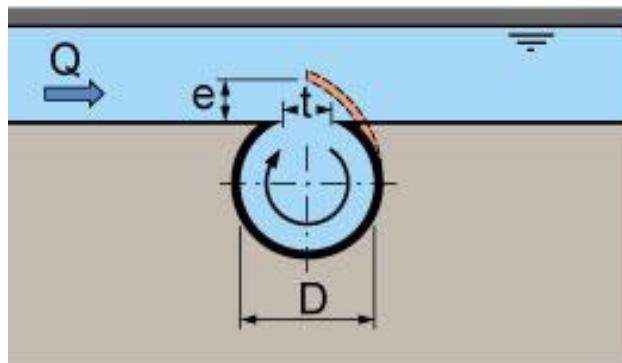


D-tank Khaulihp station(2x6 MW)

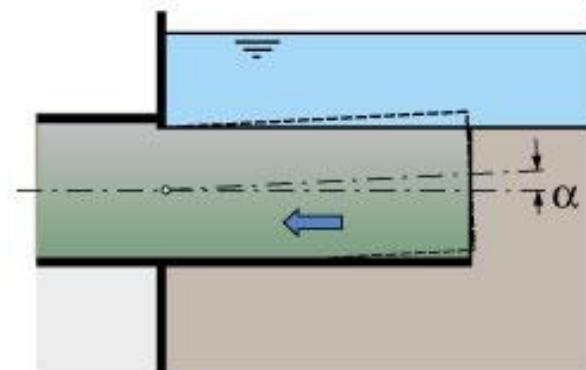


# Vortex Tube type Ejector

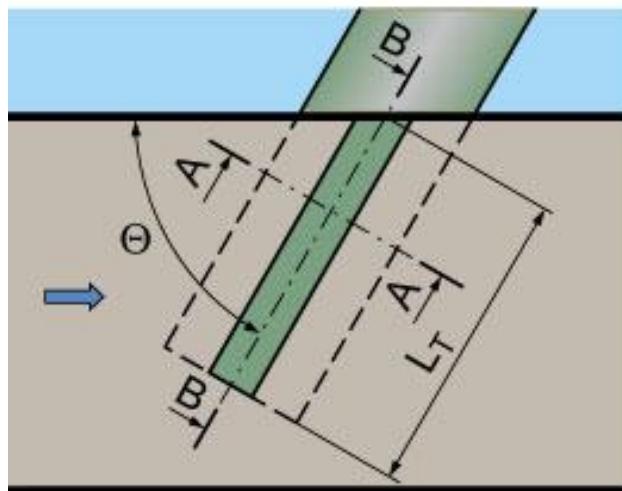
Section A-A



Section B-B

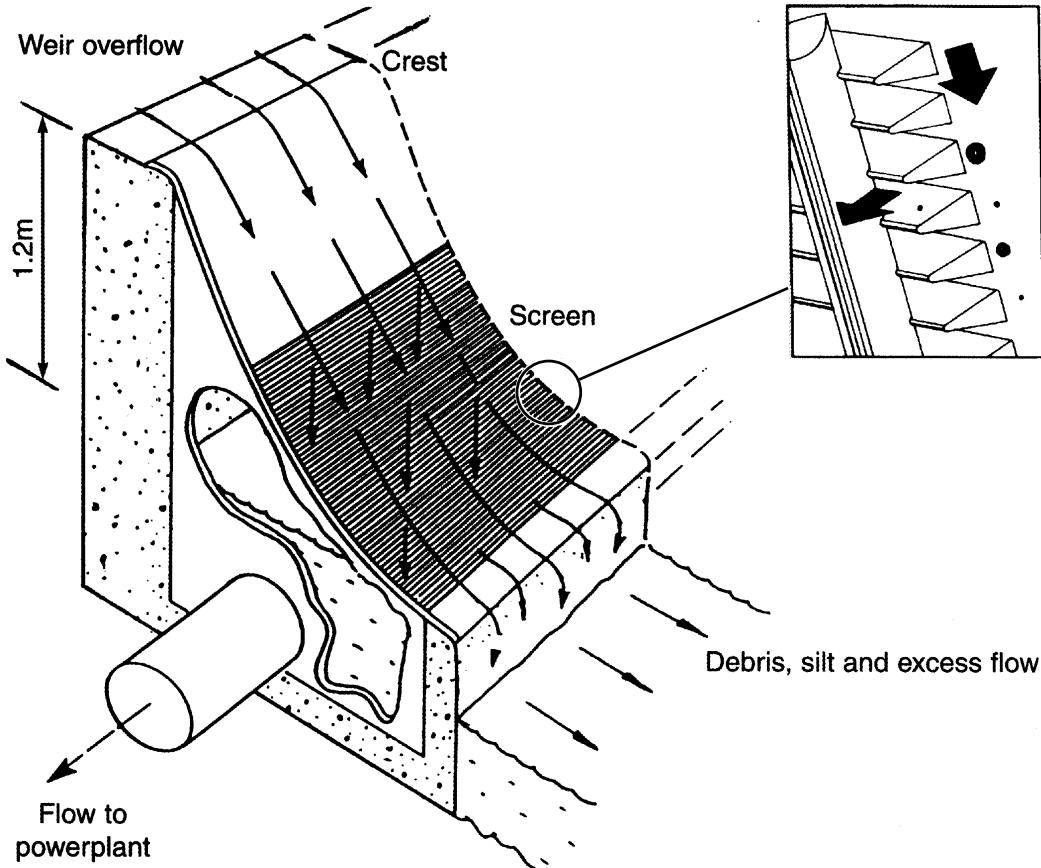


Plan view



- $L_T$  length of vortex tube
- $D$  inner tube diameter
- $t$  slot width
- $e$  difference in height between upper and lower slot edge
- $\Theta$  angle between tube axis and main flow direction
- $\alpha$  inclination of tube axis

# Coanda Screen



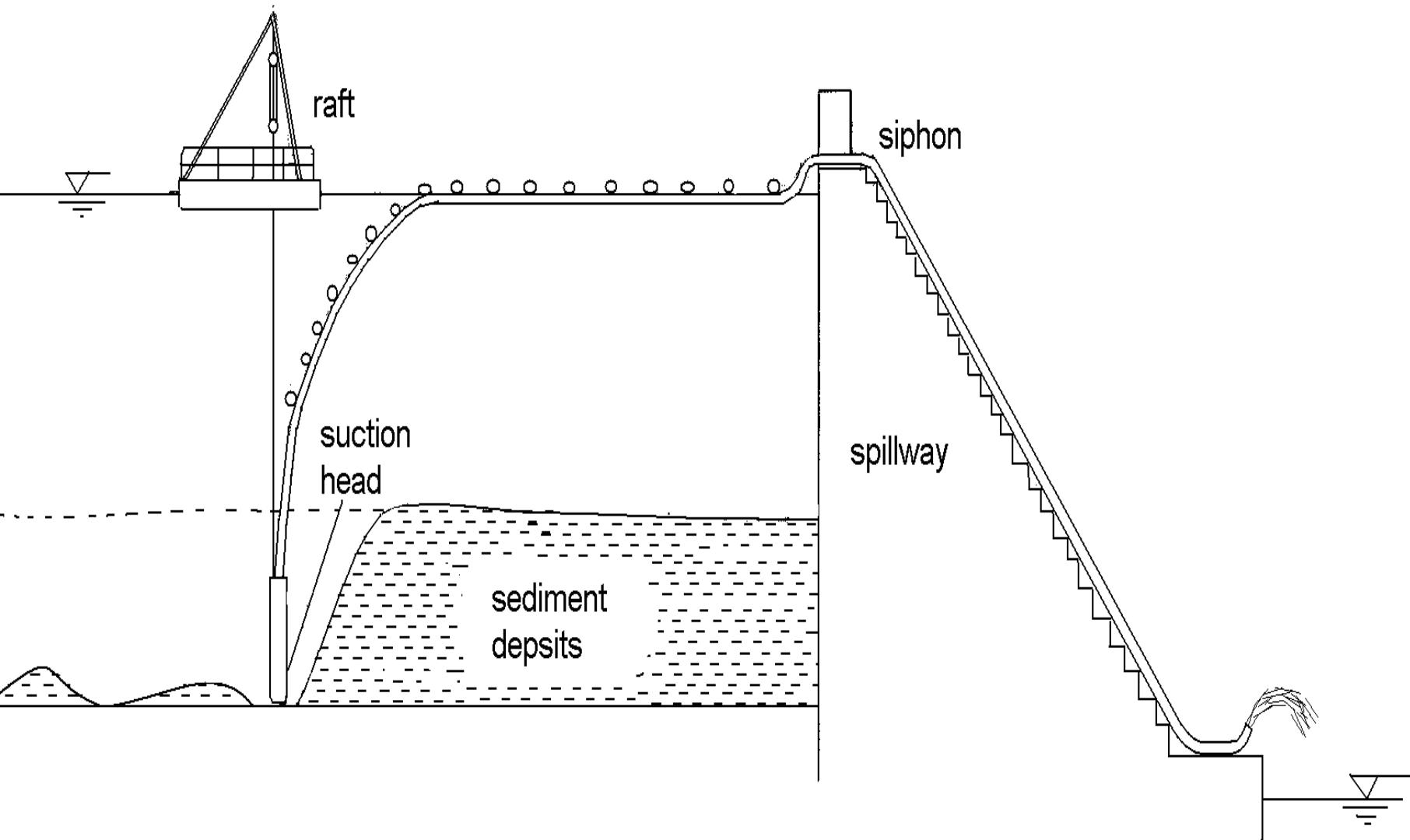
- High sweeping velocity - debris washed off screen
- High capacity - shear and Coanda effect
- 0.14 cumec per m width





*Raft for operating in the reservoir*







Malana, summer 2005



Malana: discharging 80 m<sup>3</sup>/hour



# Thank You



# **Sediment Management in Hydropower Plants**

**Small hydropower Conclave**

December 15, 2025

**India International Centre, New Delhi**

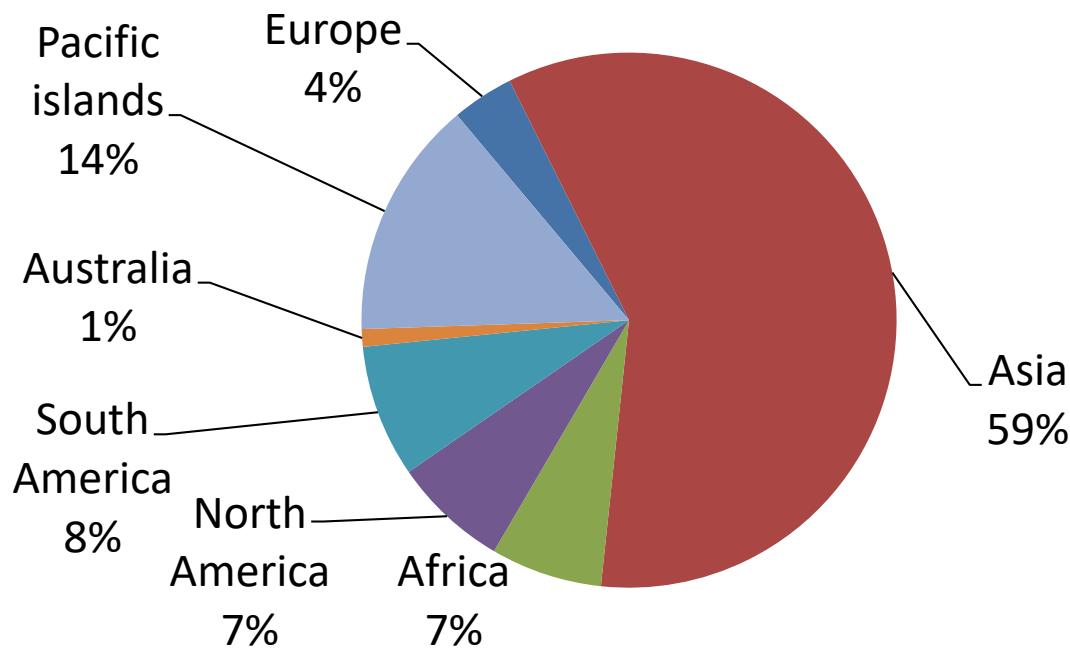
By

**Anant Kumar Rai, PhD**

**Mechanical Engineering Department, NIT Warangal**

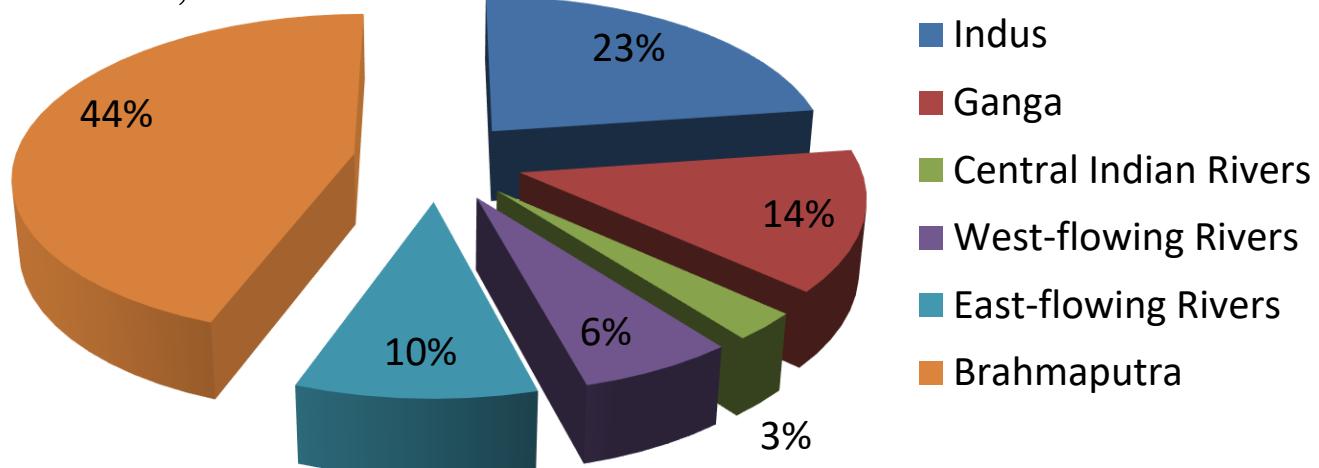
**Contact: [anant@nitw.ac.in](mailto:anant@nitw.ac.in)**

# Introduction

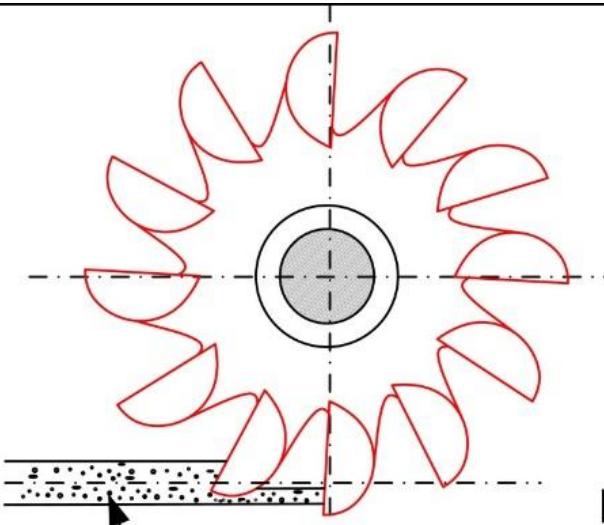


Impact of high suspended sediment –  
(a) Loss of Reservoir Storage & (b) Hydro-abrasive erosion of turbine parts and hydraulic structures

Source: Dedkov and Gusarov, 2006



Source: Shukla, 2015



Suspended sediment  
contained in water jet  
(CAUSE)



Initial Pelton bucket profile

Hydro-  
abrasive  
erosion  
(PROCESS)



Final eroded profile

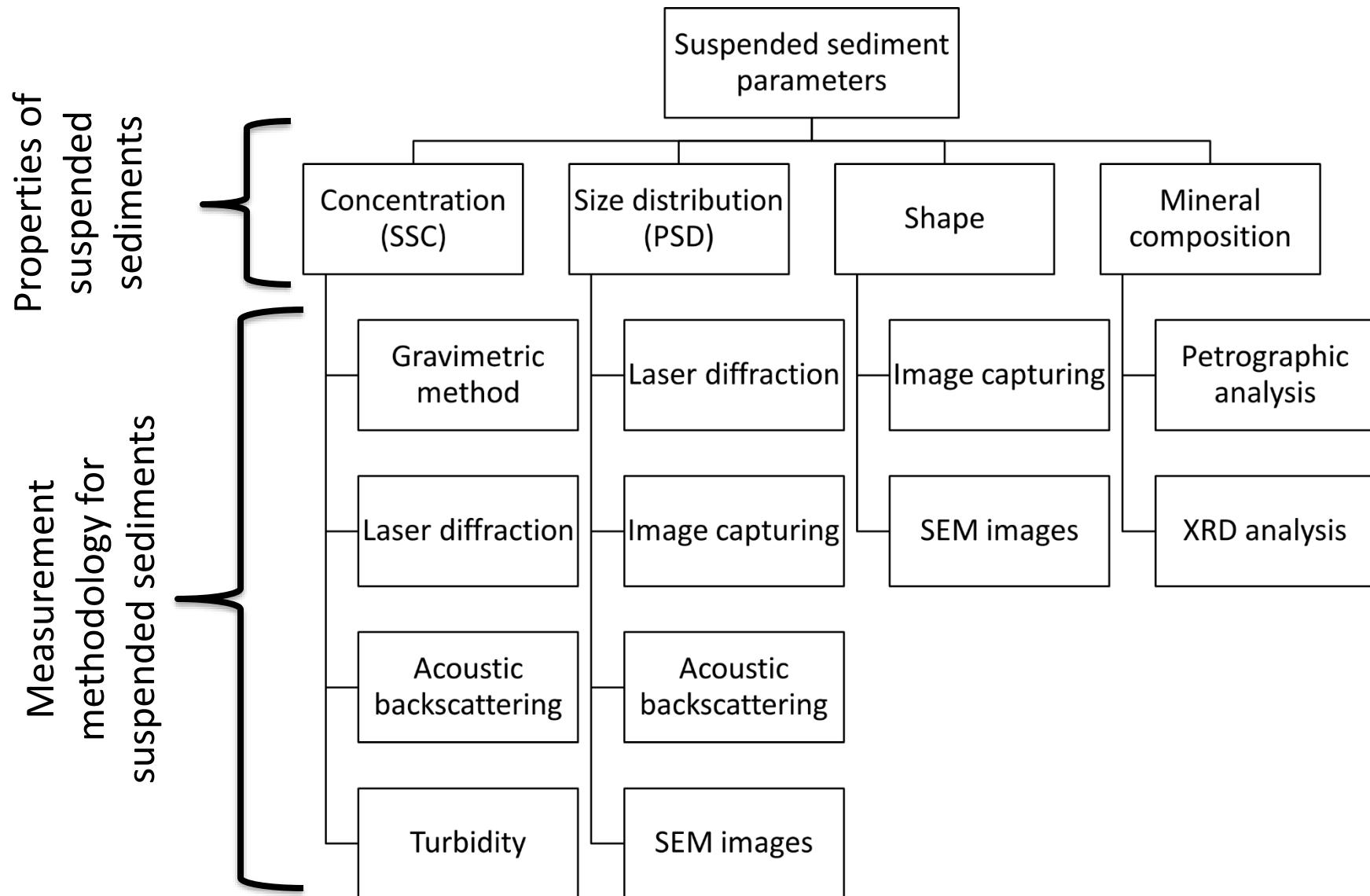
Reduction in bucket thickness, drop  
in efficiency and energy loss

(EFFECT)

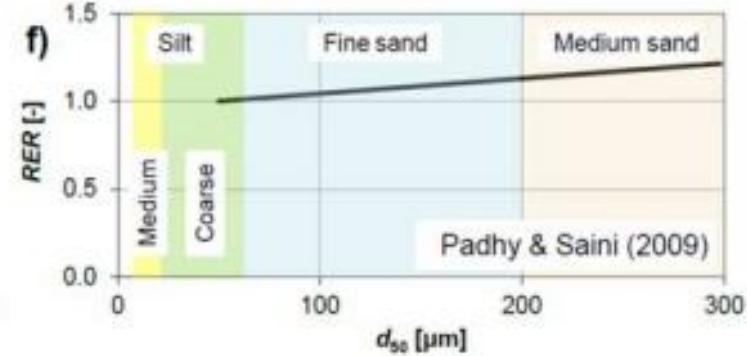
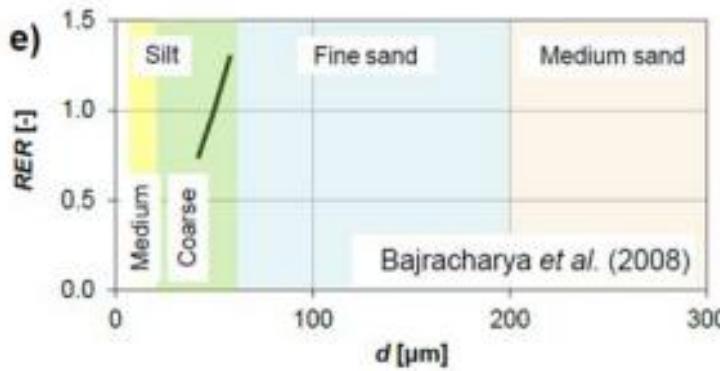
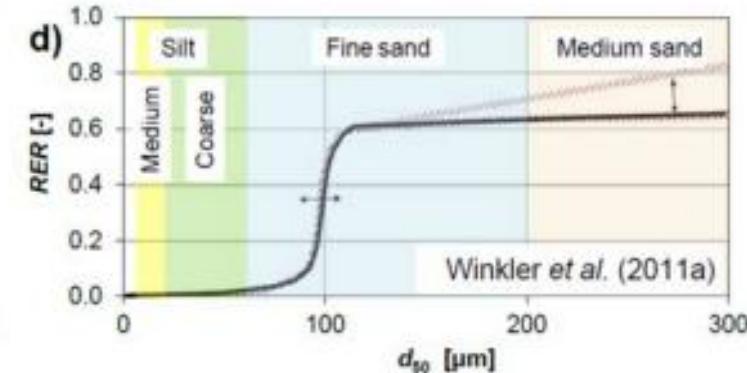
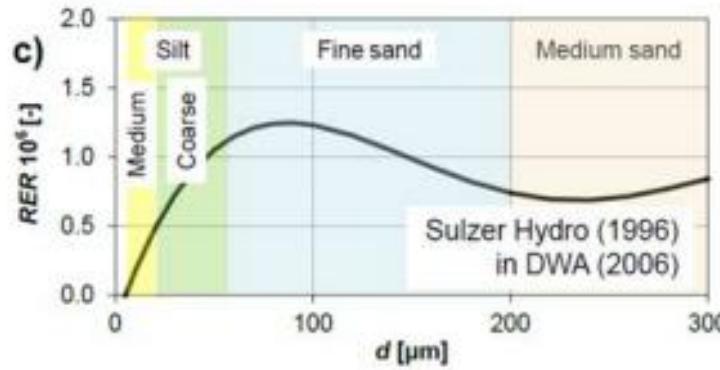
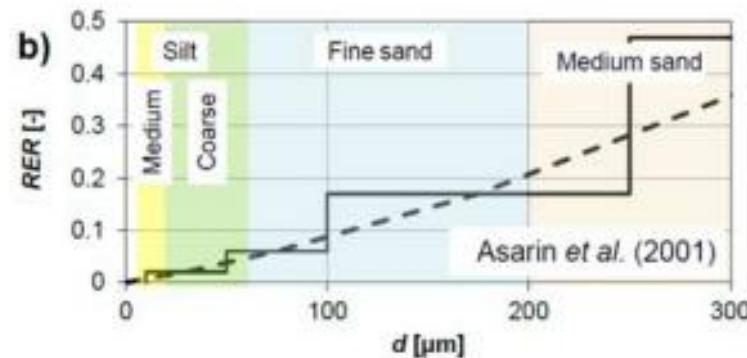
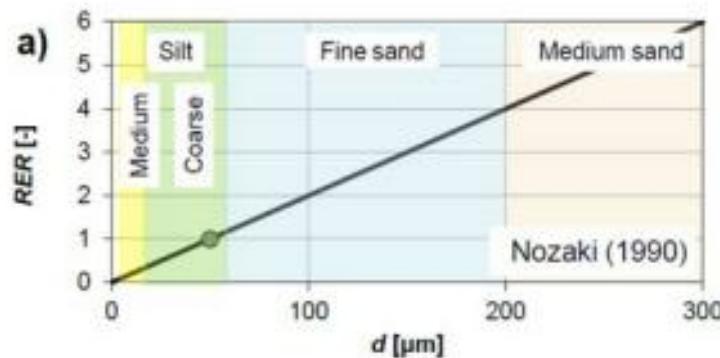


Eroded Pelton wheel of  
Toss HPP (2 × 5 MW)

# Parameters of suspended sediments and its measurement methods



# Effect of sediment size



Relative erosion rate (RER) as a function of the particle diameter

# Sediment measurement in Laboratory from manual samples

## Portable Laser Diffraction Sediment Sensor

Measuring parameters: Sediment size and concentration



## Sediment Size and Shape Analyser

Measuring parameters: Sediment size and shape distributions



## Sieve Analyser

Measuring parameters: Sediment size analysis



# Continuous sediment measurement at site

## Portable Online Turbidity and suspended solids Sensor

Measuring parameters: Turbidity and suspended sediment concentration continuously



## Online multi-frequency acoustic sensor

Measuring parameters: Sediment size and concentration continuously

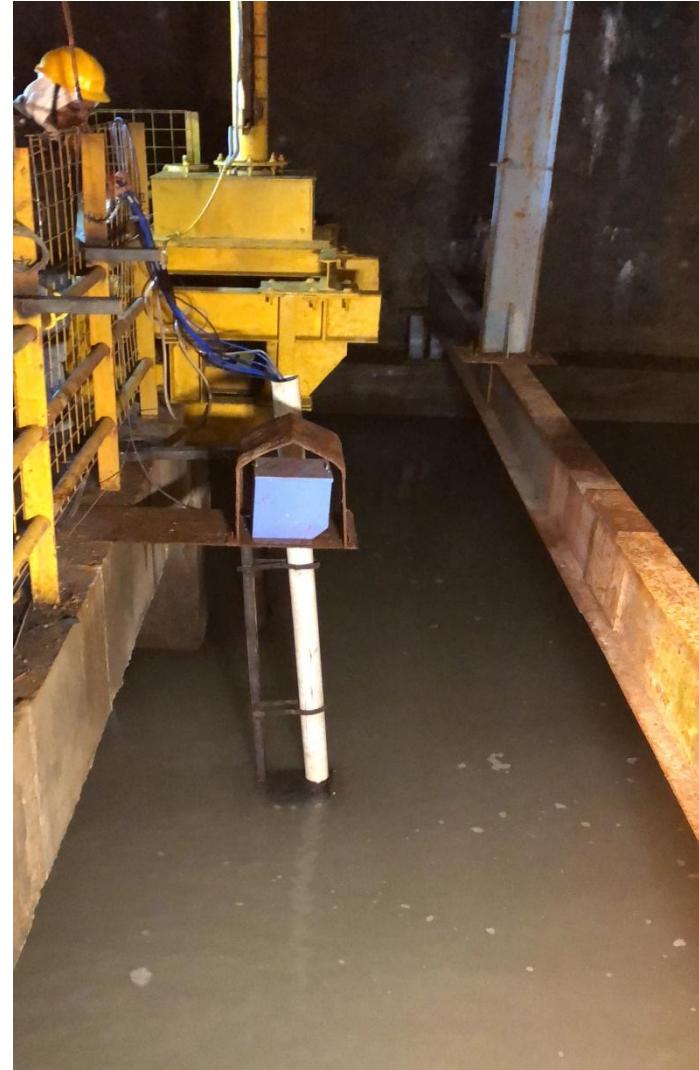


## Online Laser Diffraction Sediment Sensor

Measuring parameters: Sediment size and concentration continuously



# Installation of continuous sediment monitoring sensors



# Case Study

- Toss HPP (2X5 MW)
  - Two vertical axis 4-jet Pelton turbine units
  - Design head: 174 m
  - Design unit discharge: 3.5 m<sup>3</sup>/s
  - Pitch Circle Diameter: 1089 mm
- Suspended sediment measurement
  - A multi-frequency acoustic instrument was installed in desilting cum forebay tank for continuous monitoring of SSC and PSD
  - Twice daily manual sample collection for SSC, PSD, shape and mineral composition

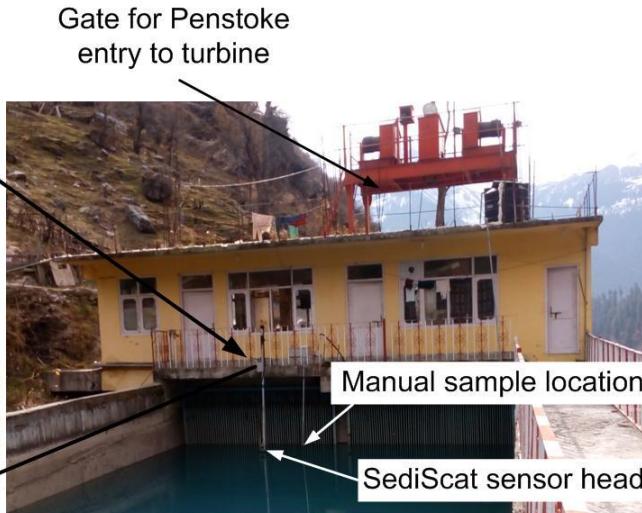
# Suspended sediment measurement



(a) Full view of Desilting tank during monsoon season



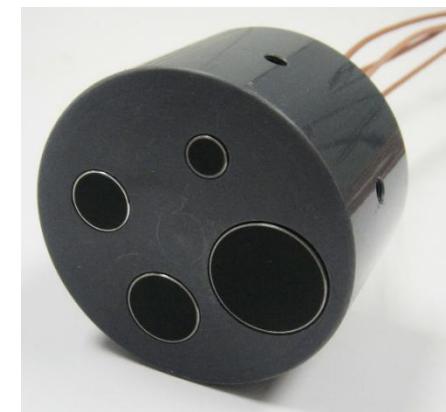
(c) SediScat electronic box during measurement in monsoon season



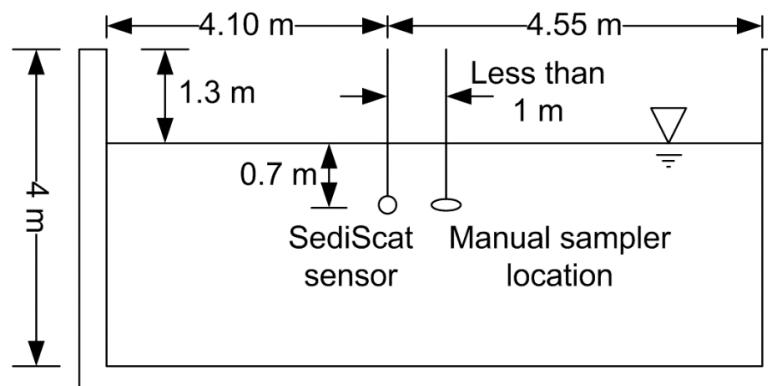
(b) SediScat installation location just before entry to Penstoke seen after monsoon season



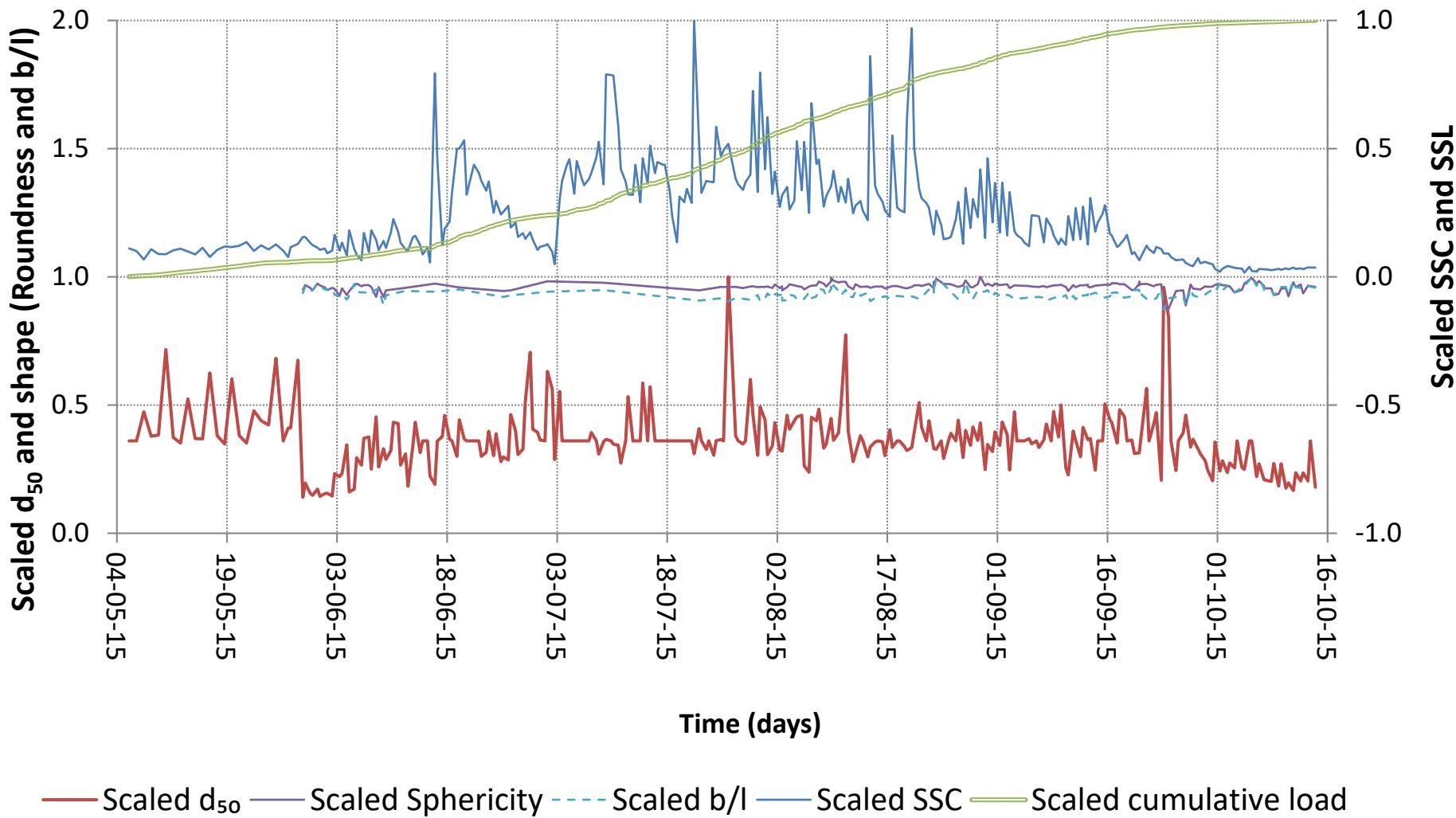
Manual sampler used before pump sampler



Sensors operating at 0.5, 1.0., 2.0 and 4 MHz



# Suspended sediment parameters from Toss HPP



# IEC 62364 (2019) Model

$$S = W^x \cdot PL \cdot K_m \cdot K_f / RS^p$$

$$PL = \sum SSC \cdot K_{size} \cdot K_{shape} \cdot K_{hardness} \cdot t$$

Prediction of erosion based on the inflow of sediments – **Hydro-abrasive erosion model**

# Strategies For Mitigation



# Desilting Arrangements

- **Preventive:** Entry of sediment checked before its entry into the head regulation.
- **Curative:** The sediment is excluded from the channel after its entry with the channel.
- **Desilting Devices are**
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**Desilting tank in  
Uttarakhand 5MW  
SHP project**

**Desilting tank in  
Himanchal Pradesh  
3MW SHP project**



# Design Criteria of Settling Basins

Silt Size to be removed:

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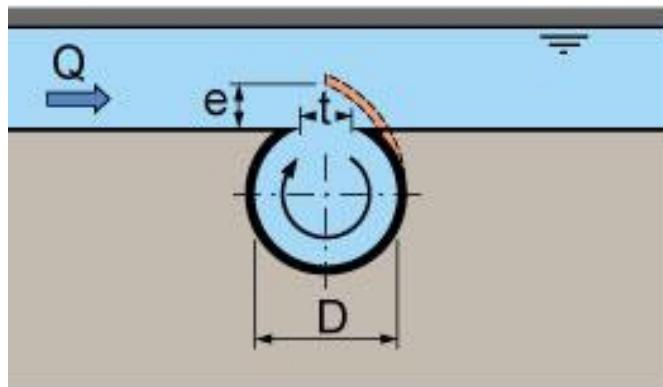


**D-tank of Khaulı SHP  
station (2x6 MW)**

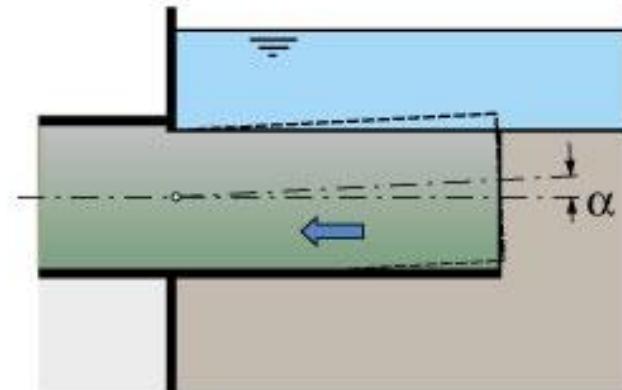


# Vortex Tube type Ejector

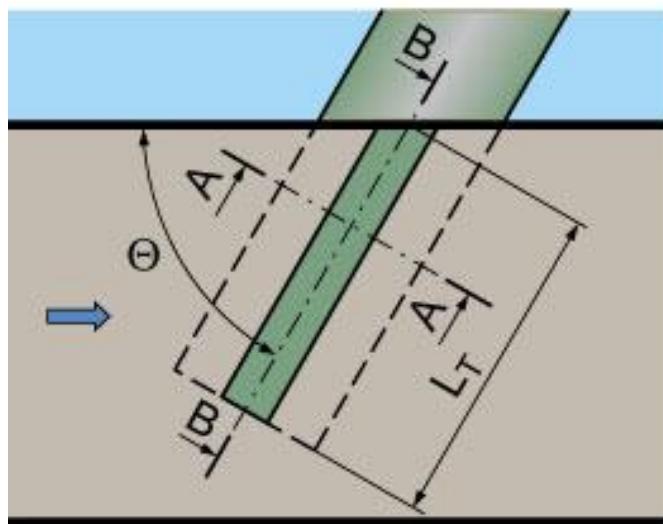
Section A-A



Section B-B

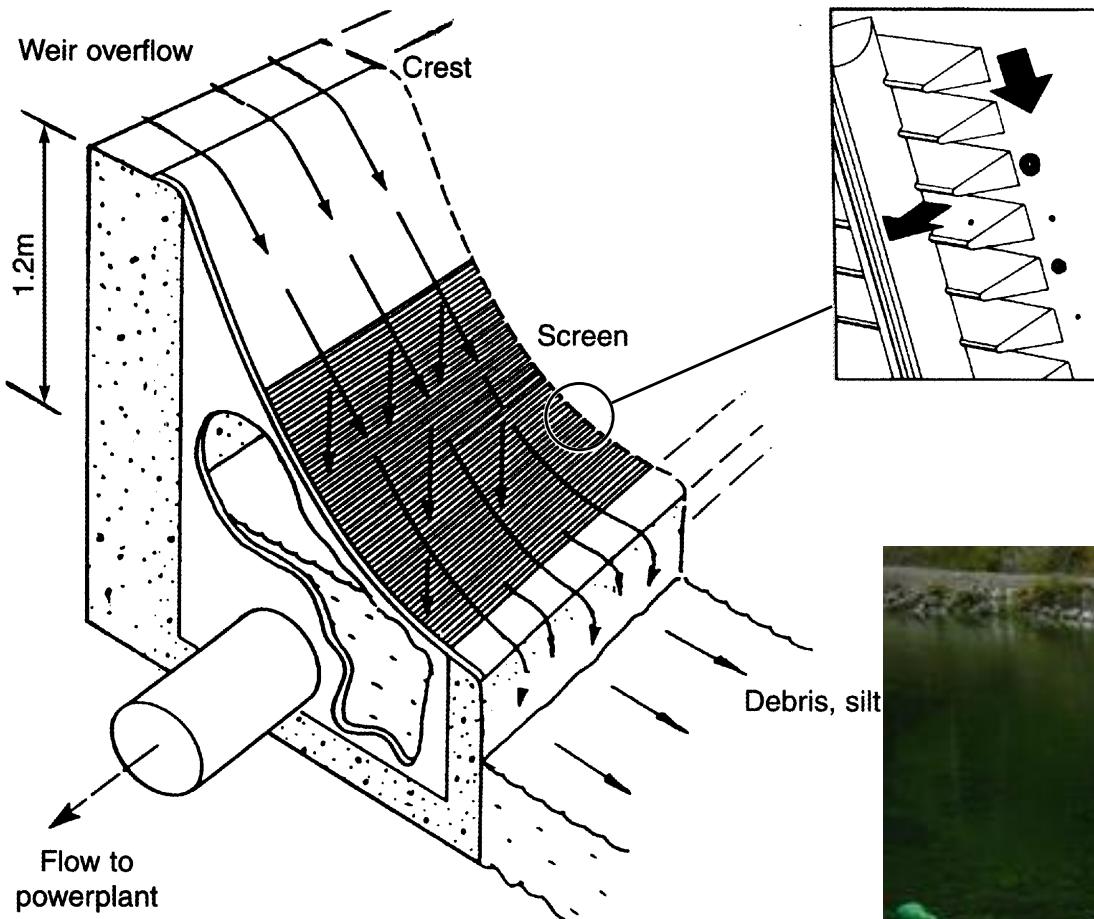


Plan view



$L_T$	length of vortex tube
$D$	inner tube diameter
$t$	slot width
$e$	difference in height between upper and lower slot edge
$\Theta$	angle between tube axis and main flow direction
$\alpha$	inclination of tube axis

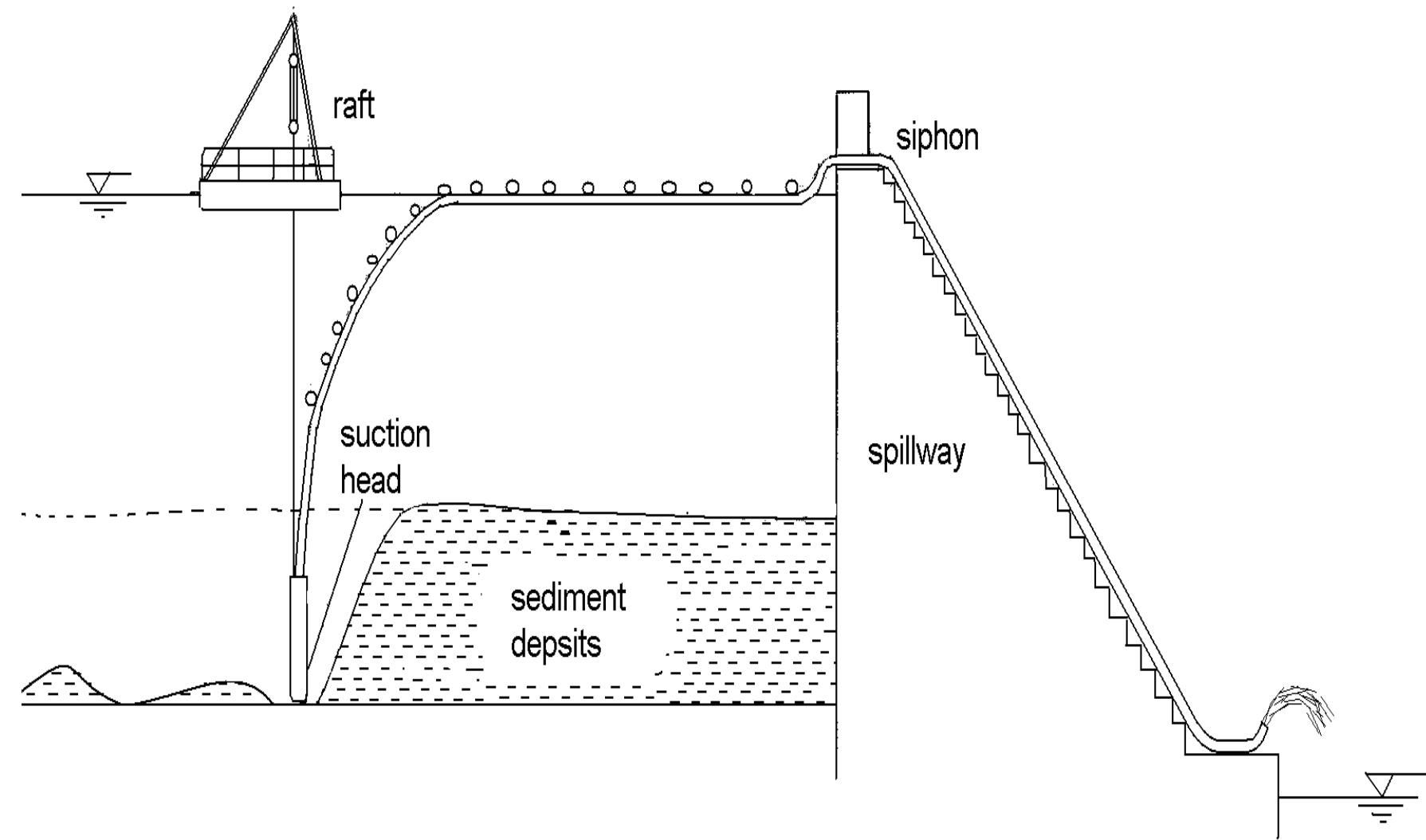
# Coanda Screen



- High sweeping velocity - debris washed off screen
- High capacity - shear and Coanda effect
- 0.14 cumec per m width



# Raft for operating in the reservoir



# Raft for operating in the reservoir





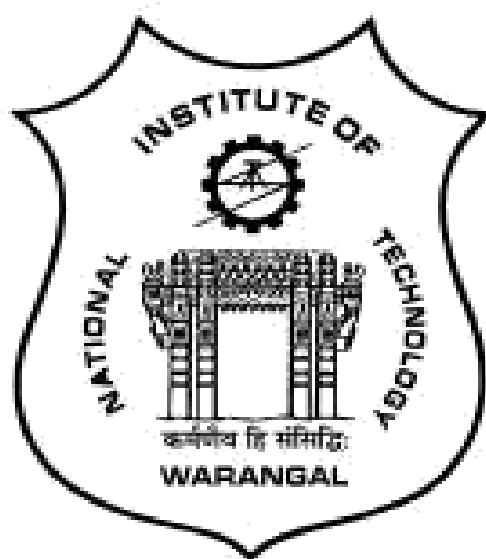
# Malana, Summer 2005



Malana: discharging 80 m<sup>3</sup>/hour



# Thank You



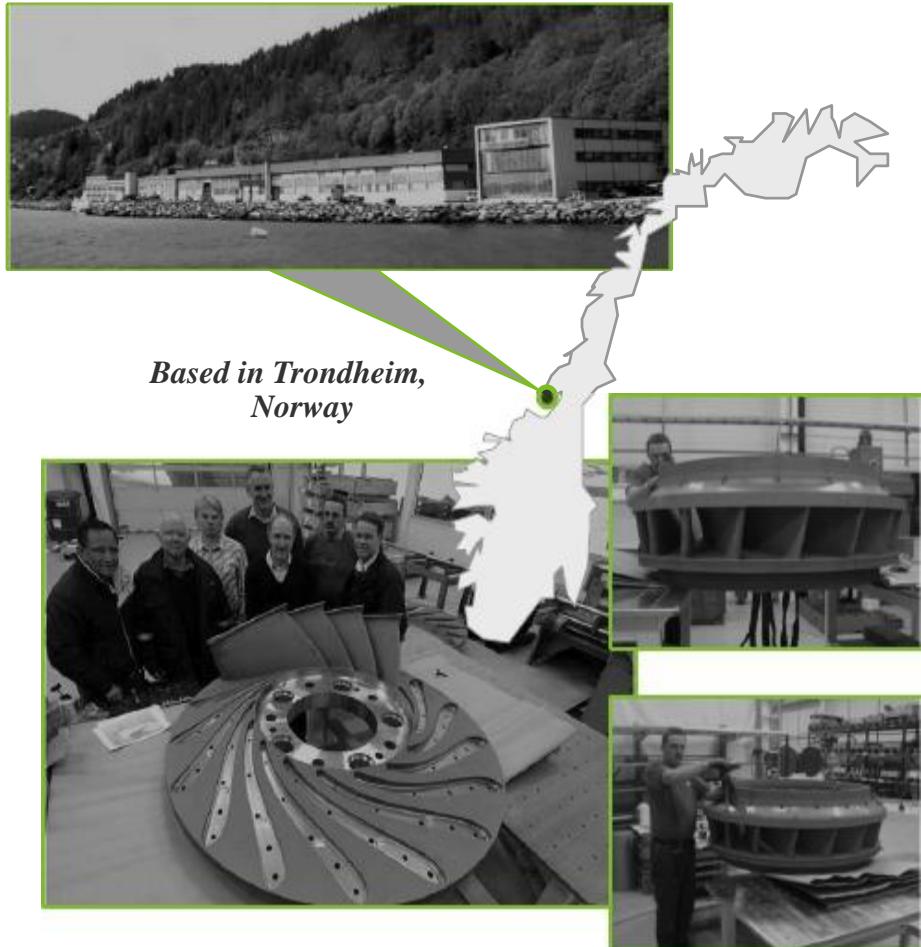
# **Small Hydro Power Conclave**

# **DynaVec Presentation on**

# **Silt – Impacts and Remedies**

## Introduction to DynaVec

- Established in 2007 as a spin-off company from the Norwegian University of Science and Technology (NTNU)
- Developed and patented a technology for runners that are detachable with blades & buckets as spare parts
- Only company with a commercial break-through for fully HVOF coated Francis runners with diameters less than 4 meters
- Headquartered in Trondheim, Norway.  
Sales offices in Lima, Peru and New Delhi, India.  
Commercial agents in Chile, Colombia.



DynaVec develops and manufactures world leading erosion resistant runners

# Sediment Erosion

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# Sediment Erosion



# Facts



## Erosion

- Decrease of efficiency
- Change of flow/pressure increase the cavitation
- Frequent maintenance/repair
- Increase of maintenance cost



## Cavitation

- Decrease the efficiency of the runner
- Frequent maintenance repair
- Increase of maintenance cost



## Efficiency

- Loss of energy generation and income
- Potential to improve the efficiency by new flow and mechanical design

# The DynaVec solution



## DynaVec technology

Designed to handle erosion



Separate crown



Band



Necessary  
vanes



- The DynaVec Francis runner consists of separate crown, band and the optimal number of vanes that are bolted together instead of welded as for a traditional runner
- Both the crown and band have grooves for each of the runner vanes which have flanges that fit into the grooves
- The parts are connected with a necessary number of pre-stressed bolts

Patented & Proven technology

# Dynavec Solution-Monsoon runner



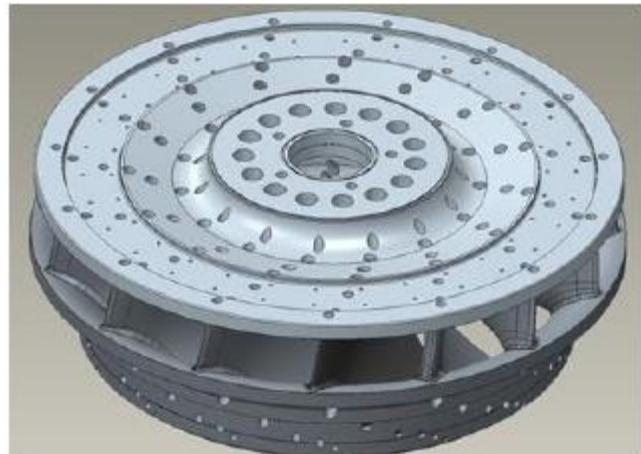
+



+

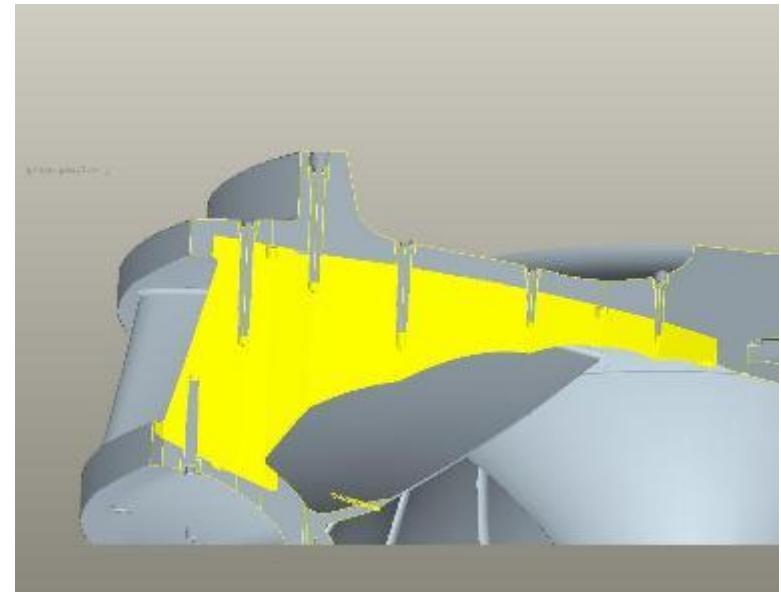


+ Bolts =



Confidential

# Dynavec Solution-Monsoon Runner



# Dynavec Solution-Monsoon runner



## Assembly – Prior to coating



Confidential

# Dynavec Solution-Monsoon runner



## Assembly – After coating



Confidential

# Francis Runner – Value Proposition

## Main benefits of bolted runners

Enables manufacturing of fully hard-coated (HVOF) erosion resistant runners regardless of size

Enables applying coating at 90 degrees on all surfaces  
&  
Simpler logistics

## Benefits of bolted runners – End Customer

- **Increased energy generation and revenue** due to minimal operational downtime
- Increased weighted efficiency
- Increased TBO – Lower operational & maintenance costs
- Reduced sediment erosion and cavitation
- No impact of thermal stress forced by welding - No risk of crack and cavitation (high-head plants)

### Modular solution –

Enables quick repair, assembly and easy transport in parts

- Faster and easier disassembly and easier maintenance on-site
- Exchangeable runner vanes (spare parts)

First-mover in commercializing fully hard coated runners in high-erosion areas

# The Pelton Technology

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# The Pelton Technology



# The Pelton Technology

## Bolted runner

- Fully Forged
- Exchangeable

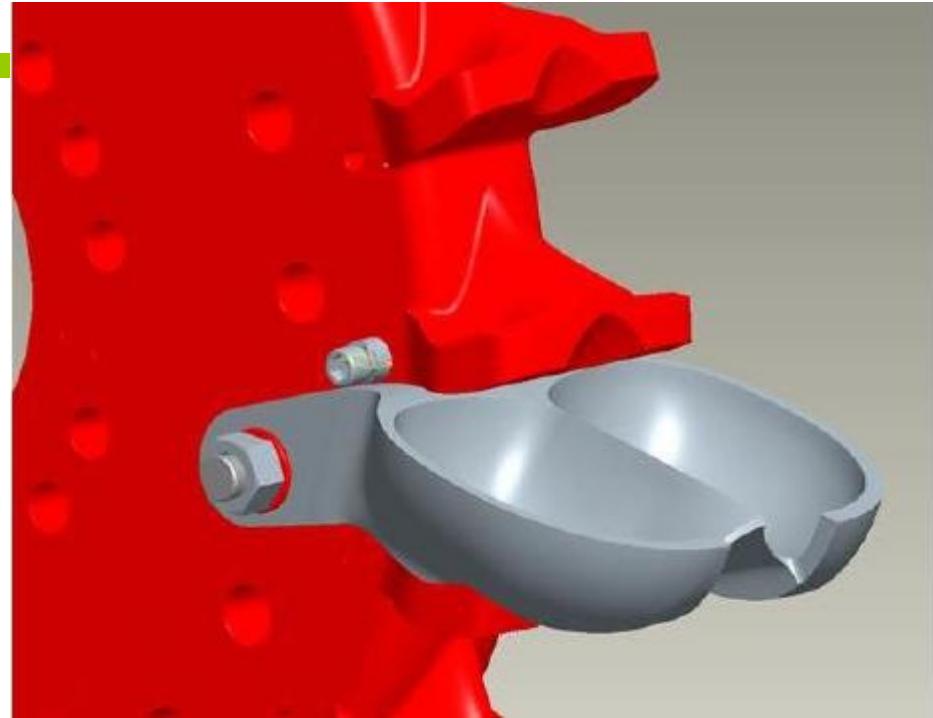
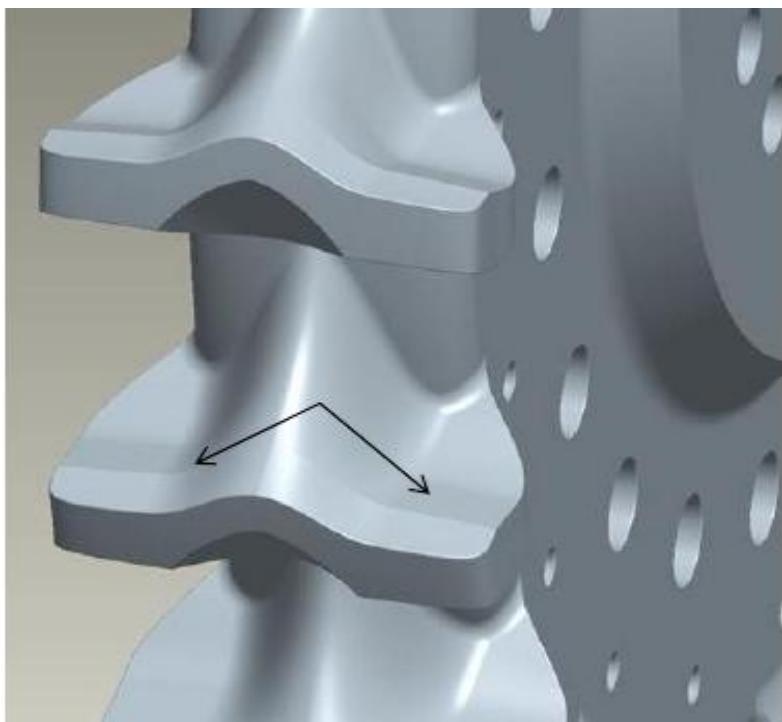
## Buckets

- More Easy production
- Simple Repairs
- Ease of HVOF coating



In the most attractive, untapped, geographical areas for hydropower today, there are significant erosion problems related to sediments in the rivers

# The Pelton Technology



In the most attractive, untapped, geographical areas for hydropower today, there are significant erosion problems related to sediments in the rivers

# The Pelton Technology



# The Pelton value Proposition



## Bolted pelton runner

- 100% hard coated (HVOF) erosion resistant runners
- Increased weighted efficiency
- Easy to exchange buckets (spare-parts)
- No operational down-time
- Increased maintenance intervals
- Easier & cost effective maintenance
  - better access
- Simpler & better HVOF coating
  - 90 degrees to every surface
- Faster & easier logistics
- On-site maintenance



# Competitive advantage

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# Competitive advantage

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- Enables production of fully hard coated (HVOF) erosion resistant runners even for the smallest runners
- Increased sediment load in one monsoon period
- Reduced sediment erosion (no loss of efficiency)
- Extra energy generation
  - No down-time
  - Increased Time Between Overhaul (TBO)
  - Increase/maintain turbine efficiency
- Reduced maintenance cost
- Reduced risk of cracks and cavitation
- Short delivery time, 9 months from order to delivery

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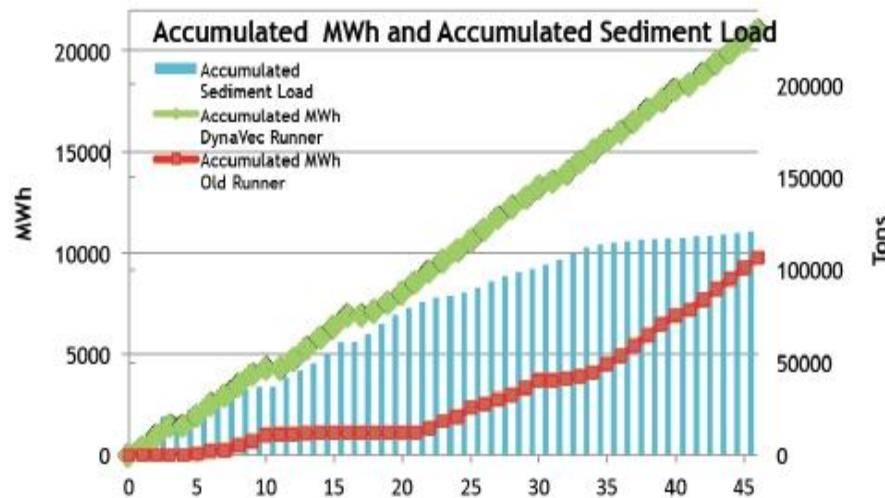
# Cahua Power Plant, Peru

- significant additional generation for DynaVec runner



- First fully HVOF coated runner installed at the Cahua power plant in Peru in cooperation with SN Power in 2009

## Accumulated MWh comparison to a traditional runner



HPP Cahua able to generate 30GWh extra energy annually (10-15%) as a result of changing to the DynaVec runner

## Facts

- SN Power, Peru is today capable of generating an additional 30GWh annually as a result of changing to the DynaVec fully coated runner
- 30GWh represents a **10-15%** increase of annual energy generation

- In addition:
  - Improved efficiency by 2%
  - Increased power by 1,7 MW, from 22 MW to 23,7 MW
  - Increased Time Between maintenance
  - Reduced cost of not needing several back up runners in various states of repair

# Case study – La Higuera

## The cost of stopping the runners during monsoon season



### Illustration of revenue lost from stopped runner

<u>La Higuera</u>	
MW per turbine	90
Numbers of turbines	2
Total effect (MW)	180
Price per MWh (EUR) <sup>1)</sup>	155
Hours of service	24
Lost revenue per day EUR	671,328
Lost revenue for 5 days	3,356,640
Lost revenue for 10 days	6,713,280

### Lost revenue from maintenance of runner at La Higuera

- July 2013 – PO for 2 x 90MW Francis runners for La Higuera
- The plant has significant erosion challenges caused by sediments
- A simple calculation shows the significant savings from avoiding one day extra of maintenance at the hydropower plant or to avoid stopped generation due to too high sediment concentration during the monsoon period
- The order was a direct customer demand (Tinguiririca Energy) for a technology capable of generating energy throughout the monsoon period regardless of high sediment concentrations
- Cooperation project together with Andritz Hydro

A few hours only without energy generation due to high sediment content or needed maintenance would immediately give a positive ROI

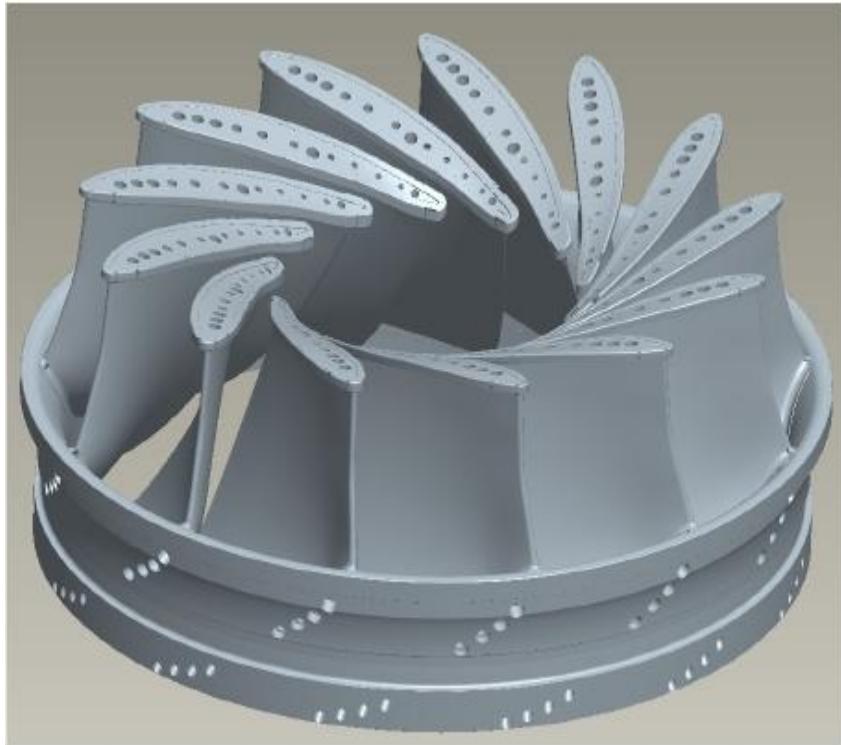
The cost from stopping the La Higuera power plant during the monsoon period is significant, even for shorter periods

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□ Few International References.

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## □□ Band with blades



# Bolted runner Forrest Kerr

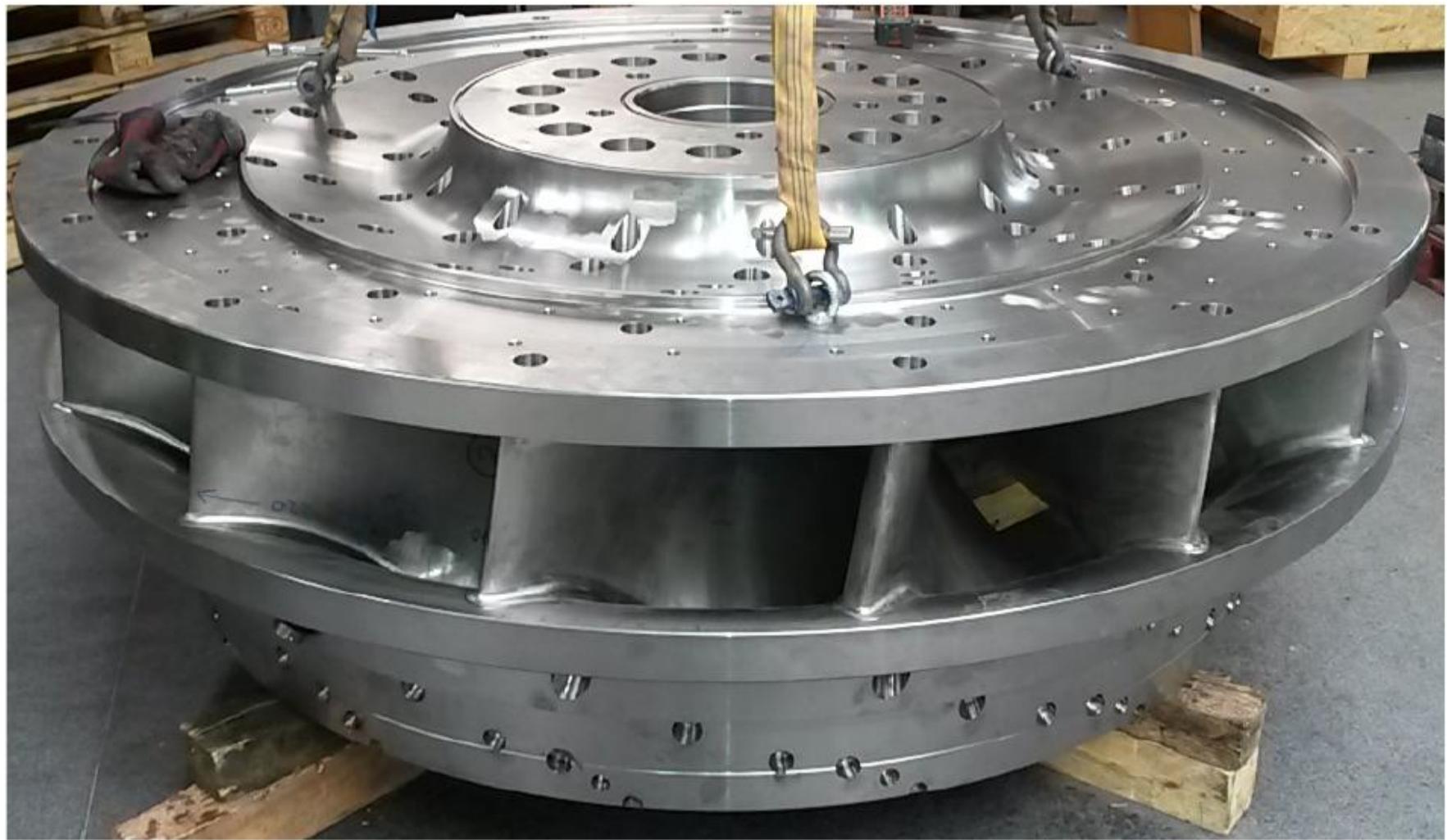
- Forrest Kerr, assembled



## La Higuera 90MW – partly assembled



## La Higuera 90MW – Fully assembled



## La Higuera 90MW – Fully assembled



## Khimti 12,7MW bolted pelton





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# Thank you

email – Navneet.vij@dynavec.no





## Small hydropower Conclave 2025 Federation of Indian Small Hydropower (FISH) Hydrokinetic Turbine Technologies and Opportunities 15 December, 2025

Presented By

**C S Pant**

**Assistant Professor**

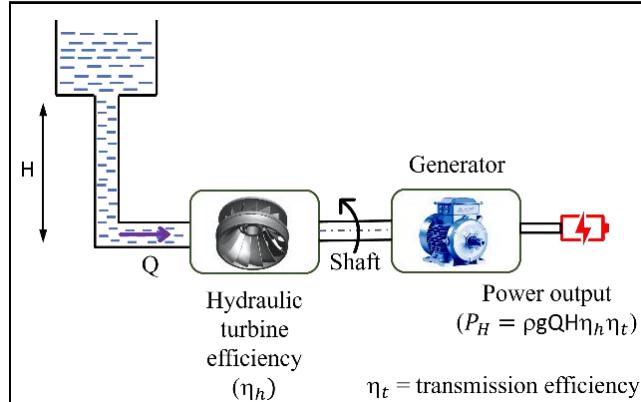
**Department of Hydro and Renewable Energy  
Indian Institute of Technology Roorkee**



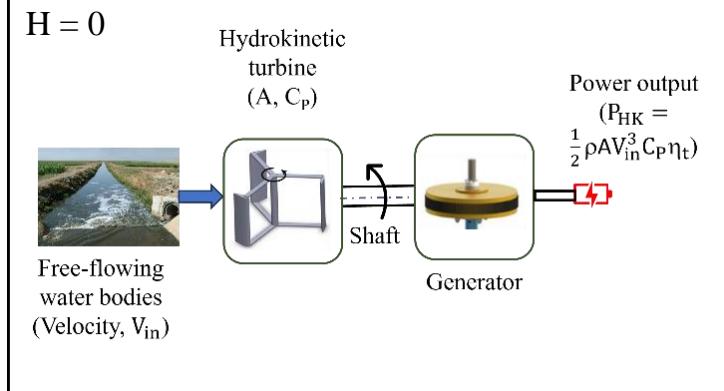
# Hydropower

## Hydropower conversion systems

### Traditional system



### Untraditional system

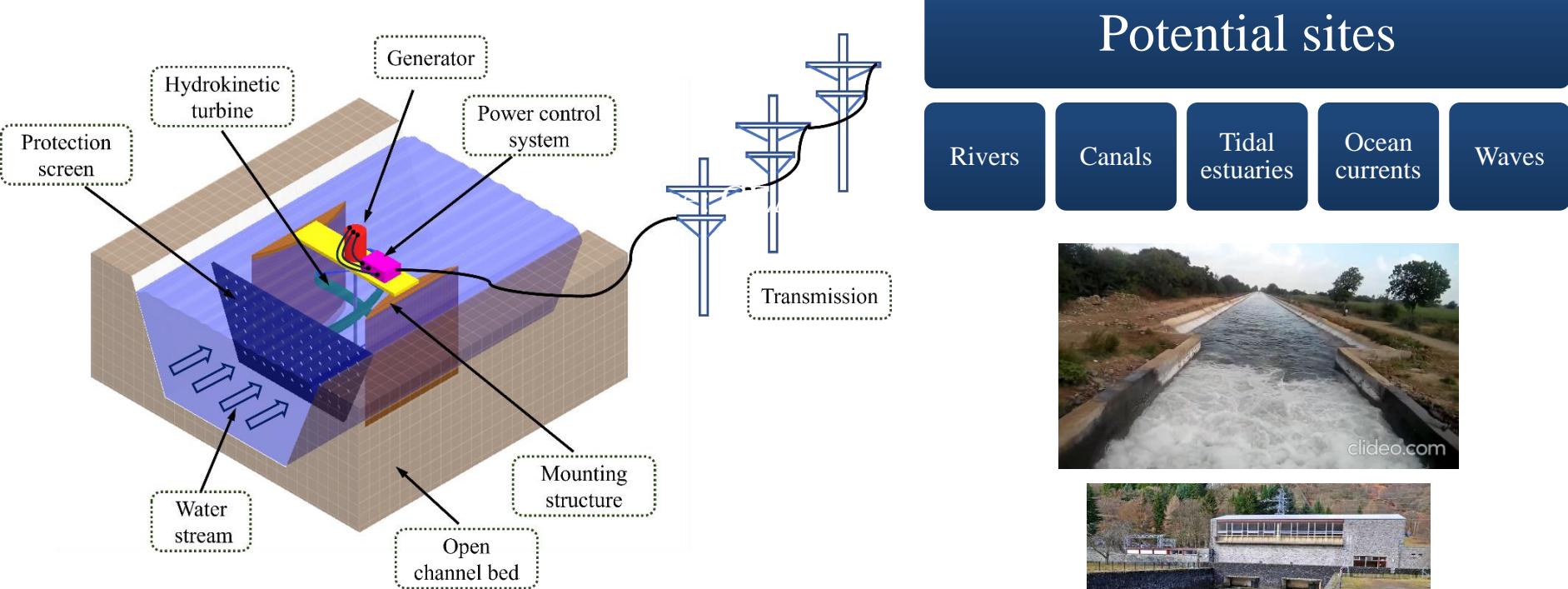


- ✓ High energy density
- ✓ Well-established technology
- ✓ Low cost of energy
- ✗ Bulk civil structures
- ✗ Impacts local wildlife
- ✗ Acquires important agricultural lands

- ✓ 100% renewable electricity
- ✓ Absence of bulk civil structures
- ✓ Good choice for off-grid electricity
- ✓ Works at zero-head applications
- ✗ Less power output & efficiency
- ✗ High cost of energy relatively

# Hydrokinetic Turbine (HKT)

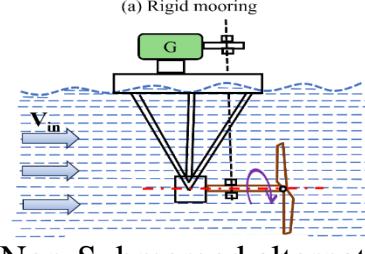
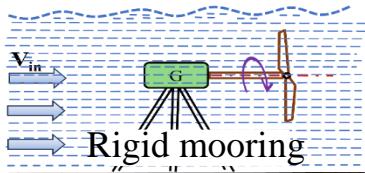
- HKT is renewable energy technology that converts moving water currents into mechanical energy, which can be further used to generate electrical energy.



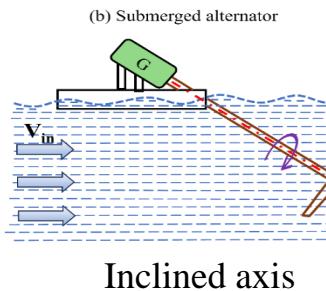
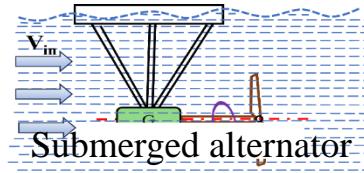
Typical components of hydrokinetic energy conversion system

Typical sites for deployment

# Classification of HKTs



Non-Submerged alternator

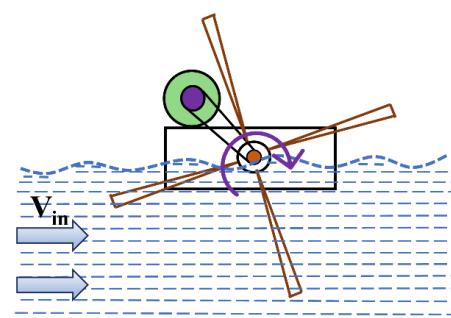


Inclined axis

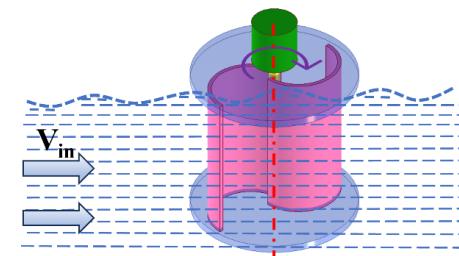


## Axial-flow turbines

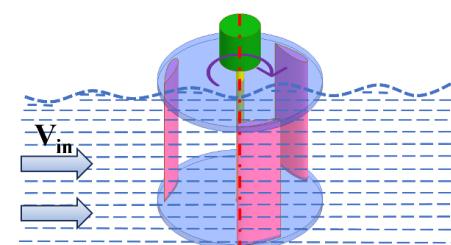
- Water direction  $\parallel$  rotational axis of rotor
- High power coefficient ( $\geq 45\%$ )
- Submerged generator
- Poor debris resistant
- Lower noise
- Design complex
- Applications: Tidal and marine currents



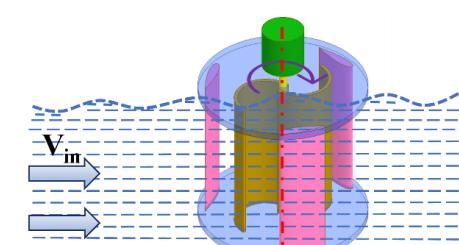
In-plane axis



Drag-type turbine



Lift-type turbine



Hybrid turbine  
(d) Hybrid turbine



## Cross-flow turbines

- Water direction  $\perp$  rotational axis
- Low power coefficient ( $\leq 35\%$ )
- Generator above the water surface
- Good debris resistant
- Higher noise
- Design simple
- Applications: River and canal currents

# Energy conversion

kinetic energy (movement of water as a mass):

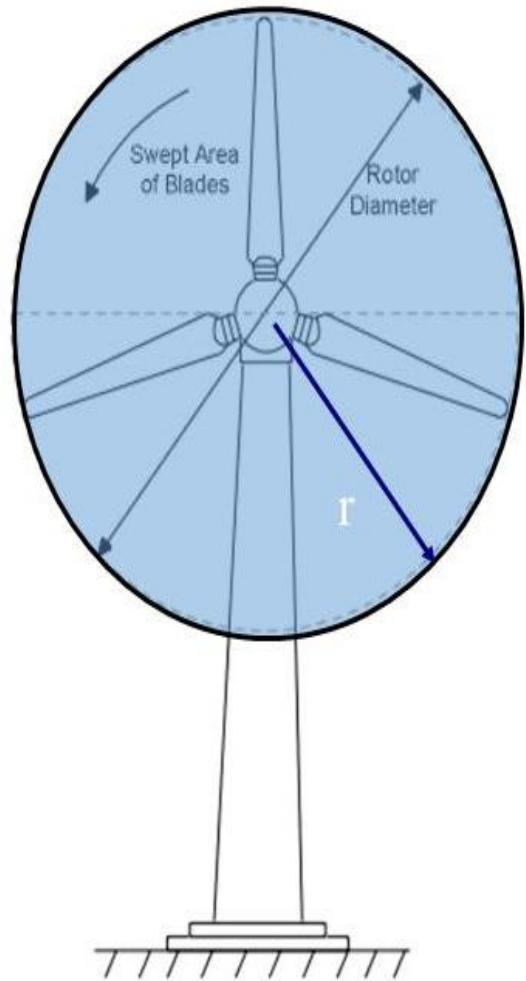
$$Power = (K.E)/time = \frac{1}{2} \dot{m} V_1^2$$

How can we find out mass flow rate of water passing through the turbine

$$\dot{m} \left( \frac{kg}{s} \right) = \rho \left( \frac{kg}{m^3} \right) \times A(m^2) \times V_1 \left( \frac{m}{s} \right)$$

Swept area of  
 t/b (m<sup>2</sup>)      Water velocity  
 (m/s)

$$Power = \frac{1}{2} \rho \times A \times V_1^3$$





# Energy conversion

$$\text{Power Coefficient, } C_p = \frac{\text{Power extracted by the turbine}}{\text{Power available}}$$

$$C_p = \frac{P_T}{\frac{1}{2} \rho \times A \times V_1^3}$$

$$P_T = \frac{1}{2} \rho \times A \times C_p \times V_1^3$$

**Maximum value of Power Coefficient ( $C_p$ ) that can be achieved by any hydrokinetic turbine is 59% and this is known as the Betz limit.**

**Similarly, we can define Thrust coefficient ( $C_T$ ) = Torque developed/Torque available =  $T / (\frac{1}{2} \rho \times A \times V_1^2 \times R)$  or sometimes in terms of force**

# Energy conversion

- Tip speed ratio (TSR):

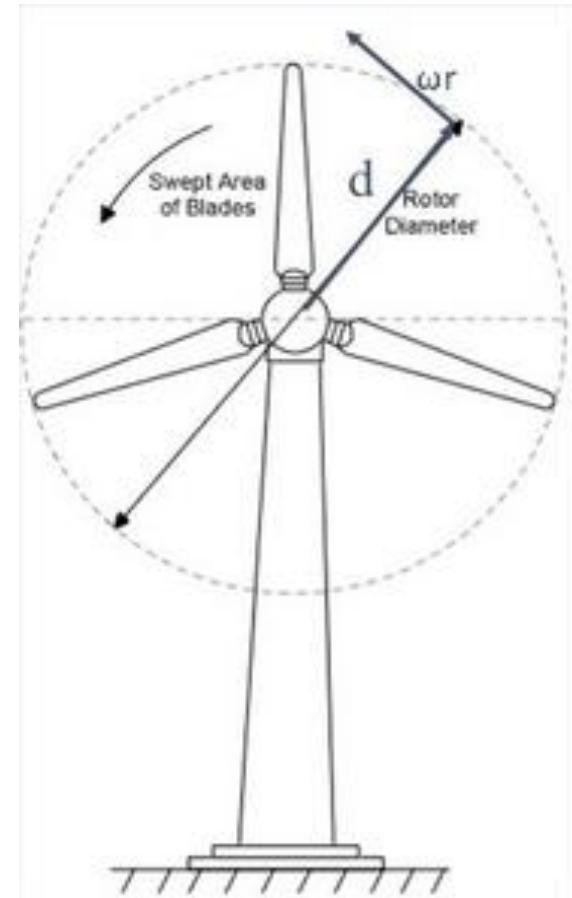
$$\text{Tip speed ratio } (\lambda) = \omega r / V_1 = 2\pi N r / 60 * V_1$$

$\omega$  = rotational speed (radian/s)

$r$  = radius of swept area (m)

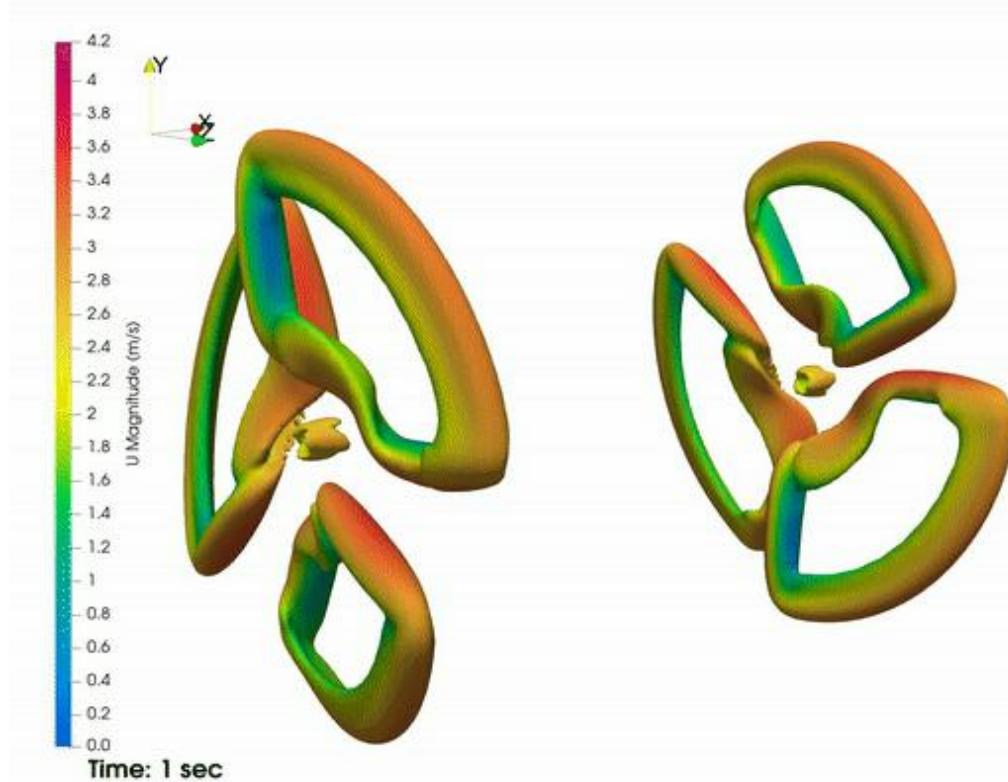
$N$  = rotational speed (rpm)

$V_1$  = wind speed without rotor interruption (m/s)



**HAWTs and Darrieus rotors:** outer tip turns much faster than wind speed owing to the aerodynamic shape, thus have TSR as high as 9.

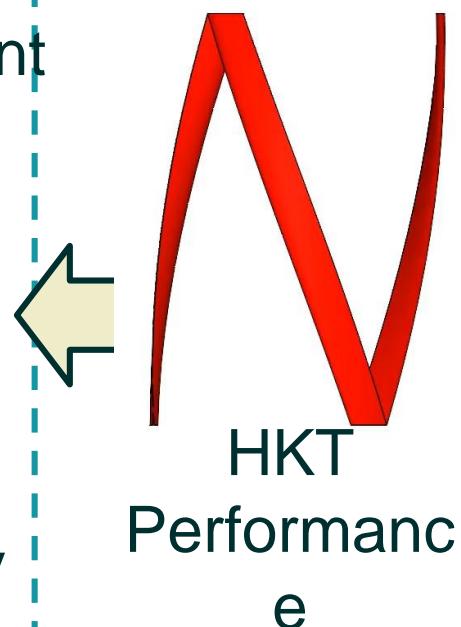
# Wake recovery downstream of an HKT (Pant et al. 2023, PoF)



# Factors Affecting Performance of HKT

## Performance Parameters

- 1 Power coefficient
- 2 Torque coefficient
- 3 Tip speed ratio
- 4 Wake Recovery Distance



## Design Parameters

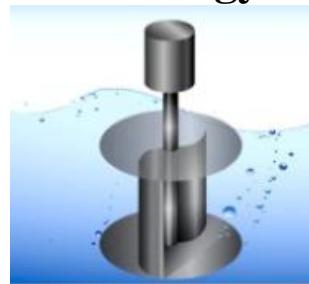
- 1 Blade profile
- 2 Solidity
- 3 Helix angle
- 4 Aspect ratio
- 5 Section inclination angle
- 6 Struts and number of steps

# Approach to Assess Hydrokinetic Potential

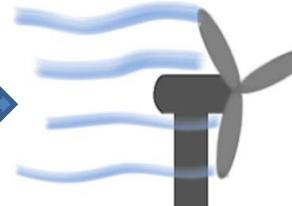
## Potential Site



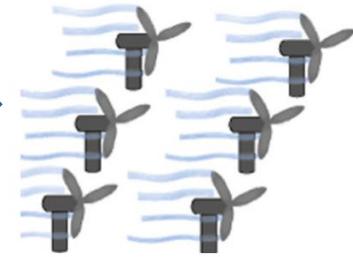
## Technology



## Wake Recovery



## Array of HKT



Bathymetry

Velocity

Density,  
Temperature

Sediment  
Properties

Selection of the device  
on the basis of

Site characteristics

Wake Formation

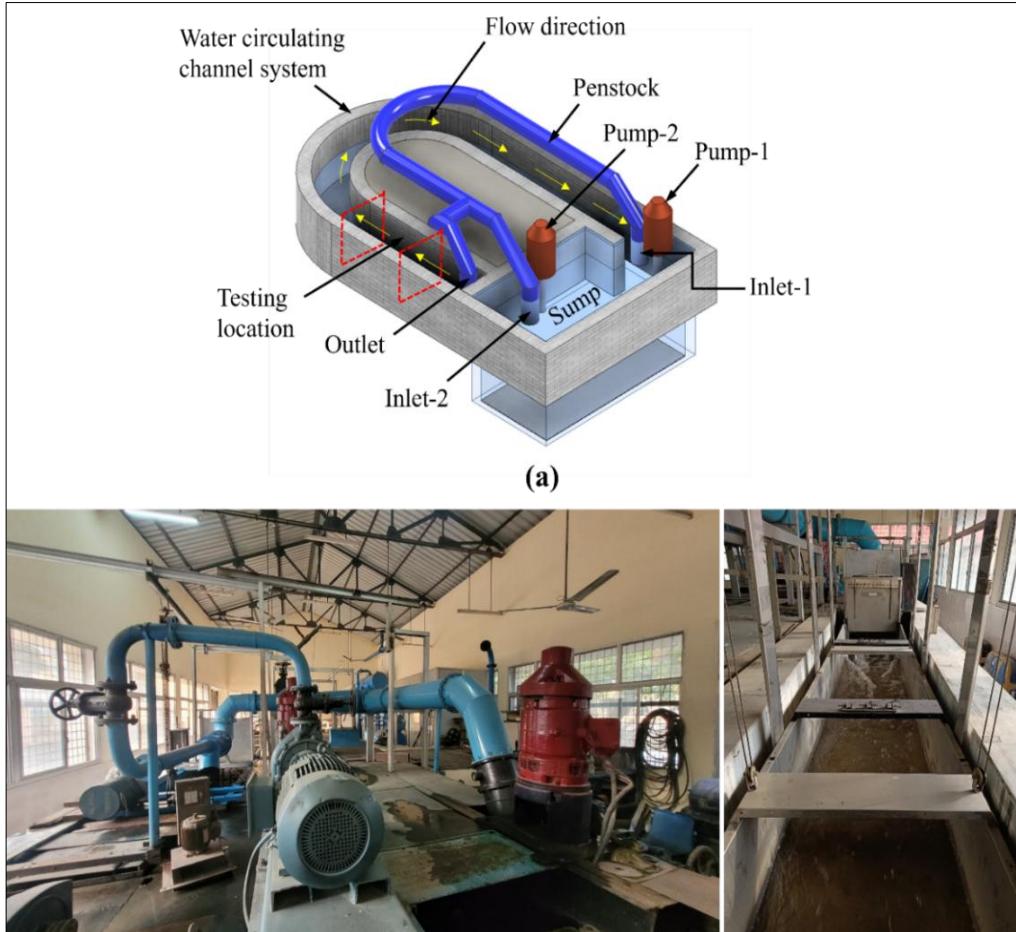
Wake recovery distance

Impact on  
Energy Gradient Line

Array Arrangement

# Performance assessment of HKT

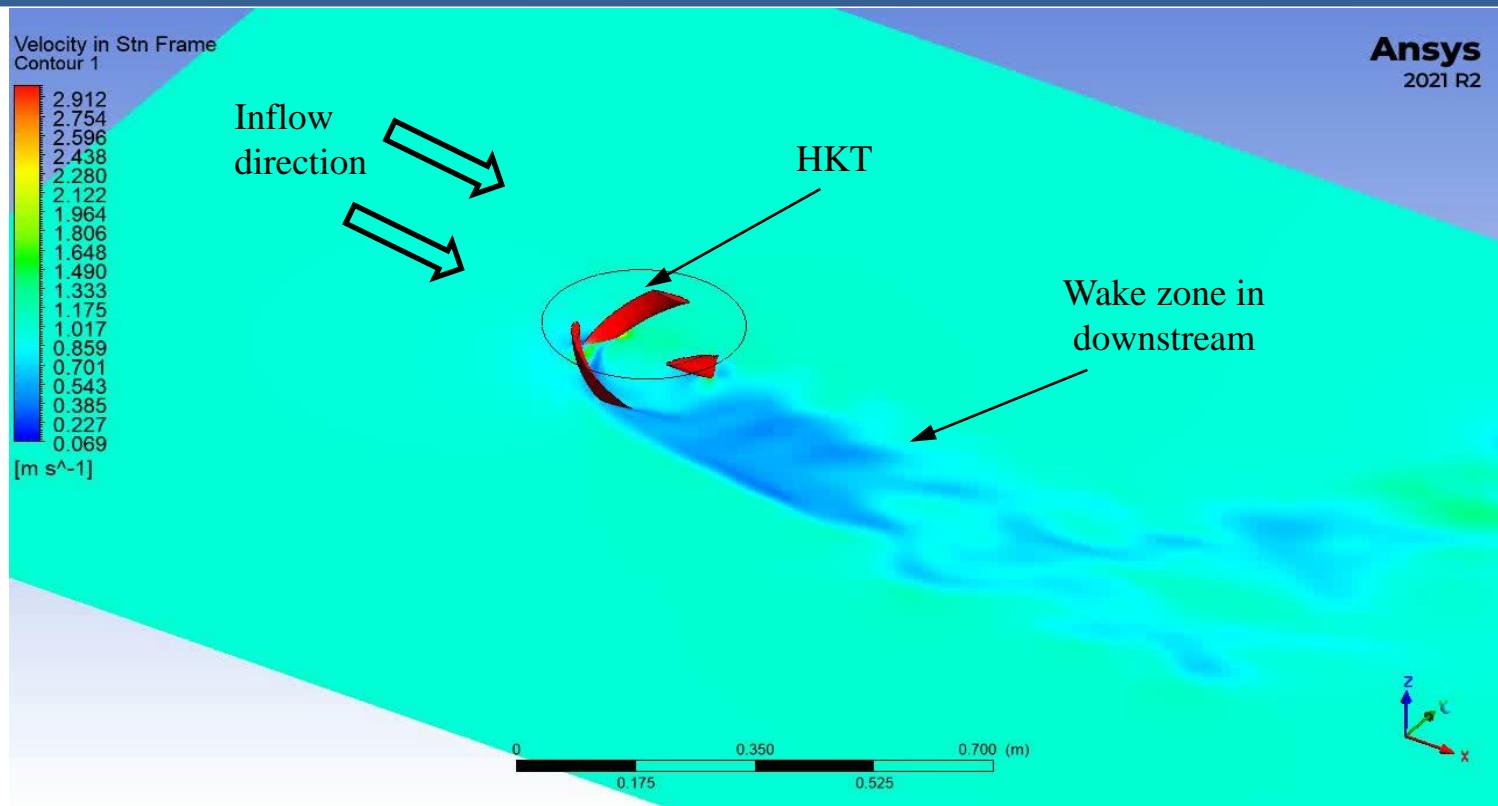
## ➤ Existing Experimental Facility at HRED, IIT Roorkee



(a) Schematic representation of experimental test rig;  
 (b) photograph of test rig; and (c) open water channel.

- Dimensions of channel:
  - Length = **4000 mm**
  - Width = 700 mm
  - Depth = 500 mm
- Approximate uniform flow was observed at a distance of **2500 mm** from inlet of channel, where the turbine was deployed.
- Array of HKT not possible
- A maximum of 150mm height model can be tested.

# CFD Simulation flow visualization



## Wake zone

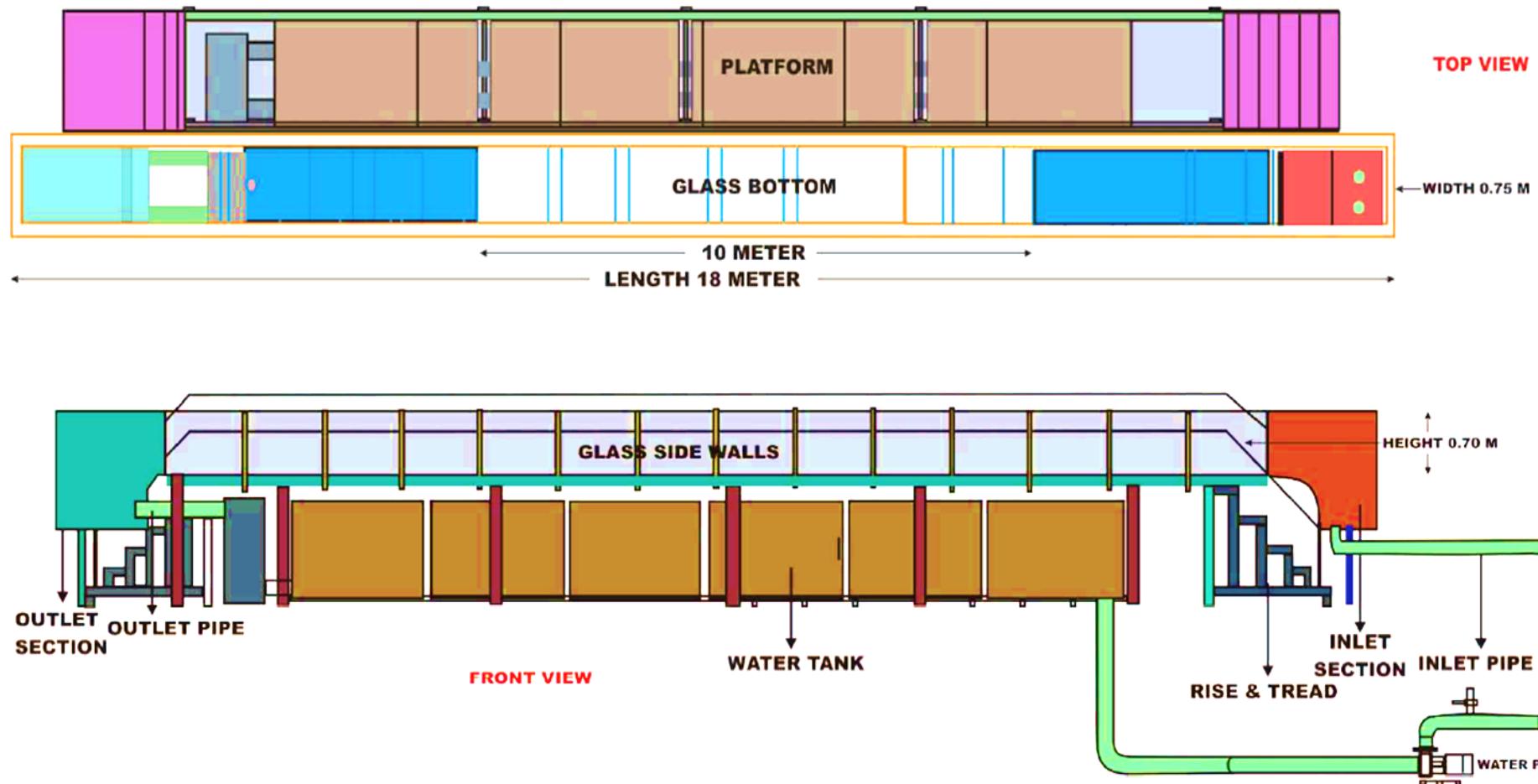
- Aspect ratio was observed to affect the velocity recovery in the wake upto a certain downstream distance only
- Identical wake length ( $\sim 10D$ ) observed for all models in the far-wake

Wake length defined as  $\geq 95\%$  streamwise velocity recovery, i.e.,  $\bar{V}^* \leq 0.05$

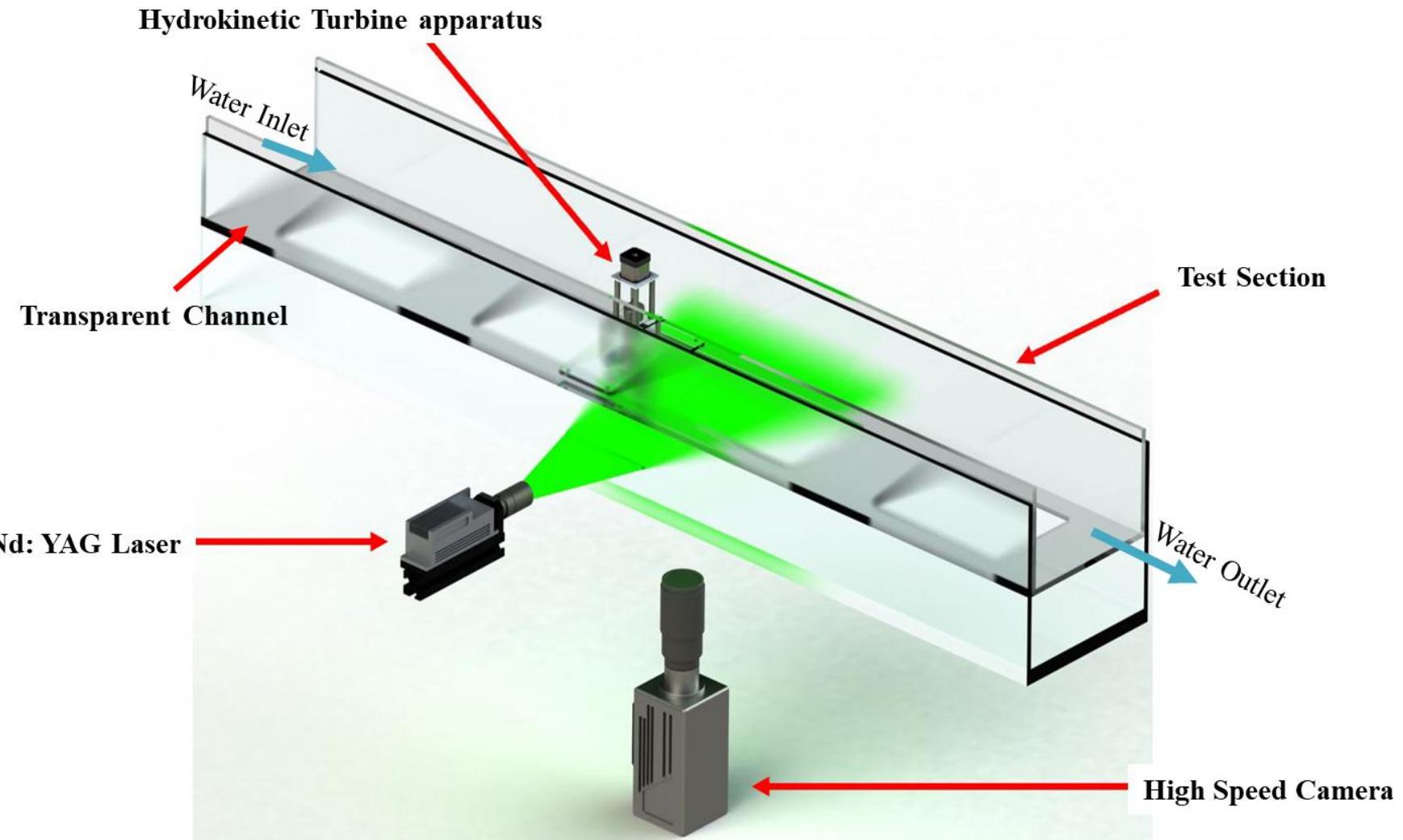


# **Development of Hydro Kinetic Turbines (HKT) Testing Facility under Centre of Excellence (COE) at IIT Roorkee**

# Tentative Design for Experimental Hydraulic Flume for HKT Testing



# Test Flume with PIV(Particle Image Velocimetry)



# GUI interface (using ML)



## 🌀 Darrieus Turbine Performance Predictor

Advanced Cp prediction with uncertainty quantification

### Input Parameters

#### Geometric Parameters

Height (m)  Diameter (m)  Chord Length (m)  Solidity

#### Operating Parameters

Velocity (m/s)  Tip Speed Ratio  Number of Blades  Pitch Angle (°)

#### Blade Configuration

Blade Type  Helicity  Helical Angle (°)  Airfoil Profile

### Calculated Parameters

Aspect Ratio	Reynolds Number	Radius (m)	RPM
1.500	70,866	0.100	75.6

### Prediction Results

### Prediction Result

Predicted Cp: 0.1745

# Challenges



- **Mechanical Issues:**
  - Inconsistent energy output: Variable Flow Velocities
  - Need for efficient designs at low cut-in speeds: Low Flow velocities
- **Mechanical Issues:**
  - Fatigue from continuous hydrodynamic loading
  - Corrosion and biofouling in harsh aquatic environments
- **Mechanical Issues:**
  - Turbine damage from floating debris and high sediment loads
  - Need for robust protective structures
- **Civil Issues:**
  - Challenging deployment in remote or deep-water locations
  - High operational costs for maintenance and retrieval
  - Structural alignment of the turbines
- **Electrical Issues:**
  - Efficient underwater cabling solutions
  - Managing energy losses over long distances



# Thank You





# R2 score explanation

- The coefficient of determination, commonly referred to as the **R<sup>2</sup> score**, represents the proportion of the variance in the dependent variable that is predictable from the independent variables. Mathematically, this is a well-established performance metric and is consistently referred to as the R<sup>2</sup> score across libraries such as **Scikit-learn** and **TensorFlow**, among others.
- To ensure methodological consistency, we computed the R<sup>2</sup> scores following the exact formula described in the research paper:  
*"On the Application of Machine Learning in Savonius Wind Turbine Technology: An Estimation of Turbine Performance Using Artificial Neural Network and Genetic Expression Programming."*

# JASH ENGINEERING LTD.

## Archimedean Screw Turbine



*When every drop counts...*

### Subsidiaries:

*Rodney Hunt Inc, USA*

*Mahr Maschinenbau GMBH, Austria*

*Waterfront Fluid Controls Ltd, UK*

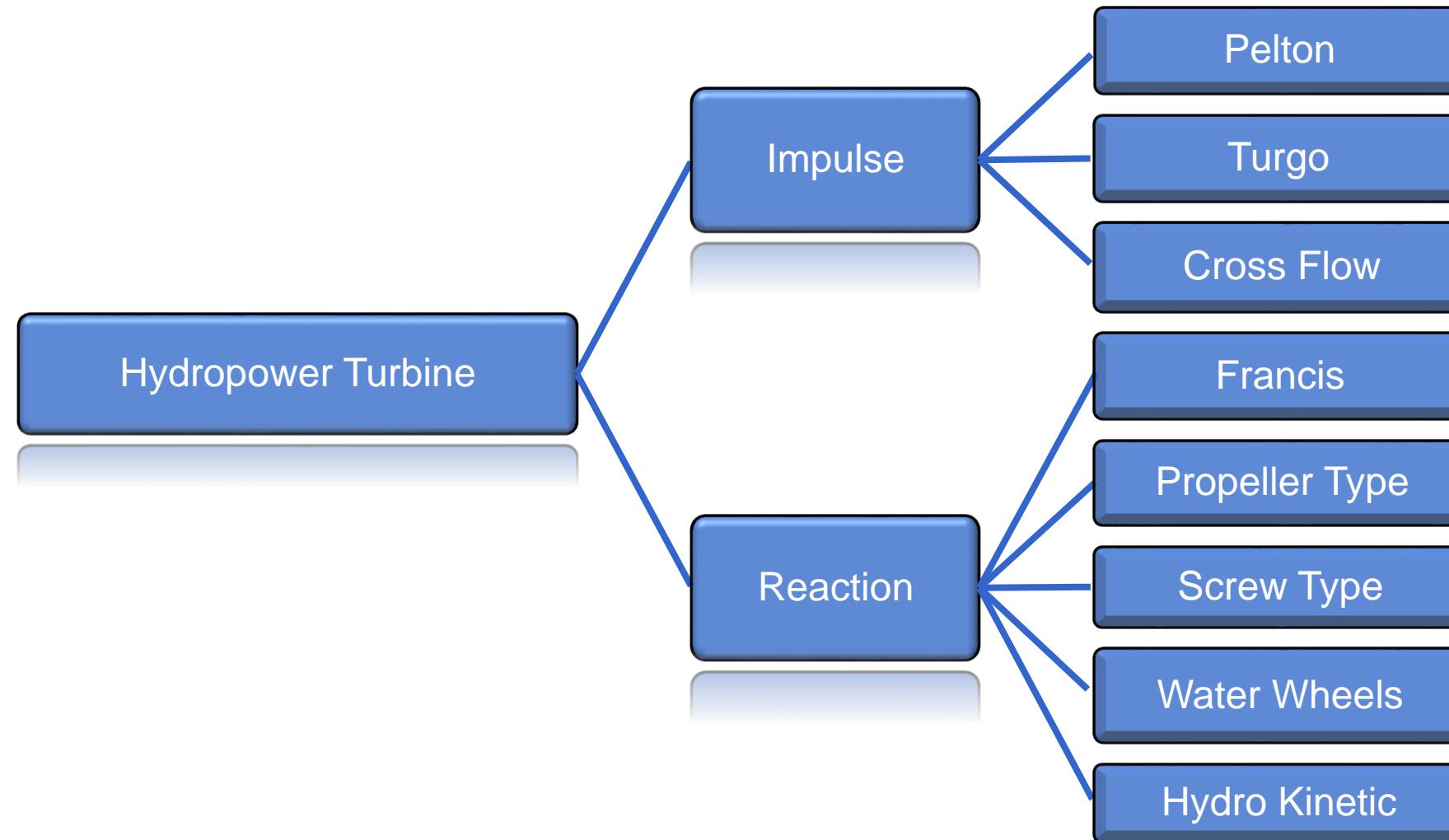
*Engineering & Manufacturing Jash Ltd, Hong Kong*

*Shivpad Engineers Pvt Ltd, India*

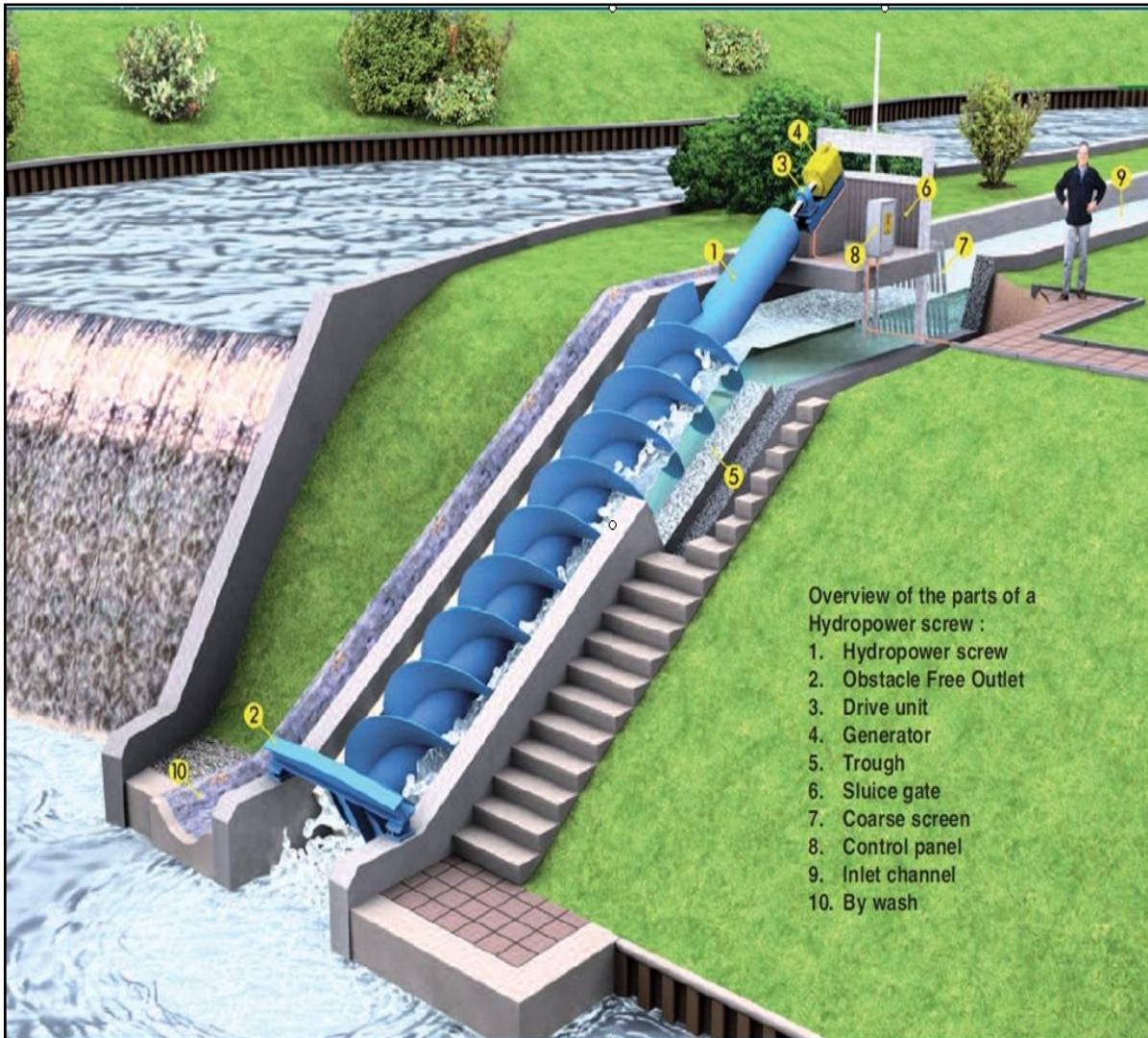


***Thinking Innovative, Since 1948***

*November 2025*



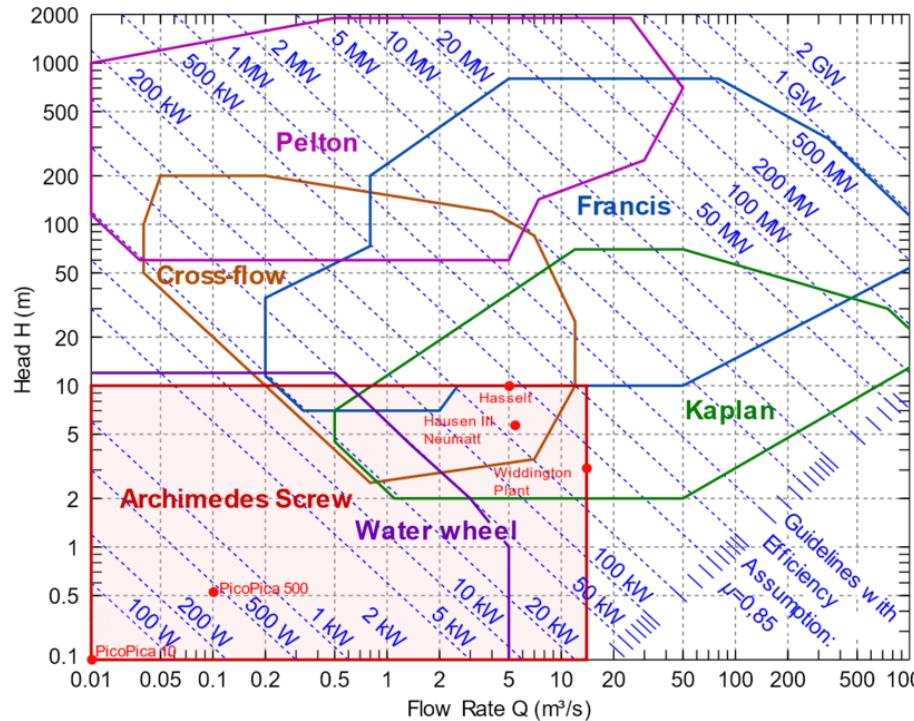
# ARCHIMEDEAN SCREW TURBINE



The screw turbine is a water turbine which uses the principle of the Archimedean screw to convert the potential energy of water on an upstream level into work.

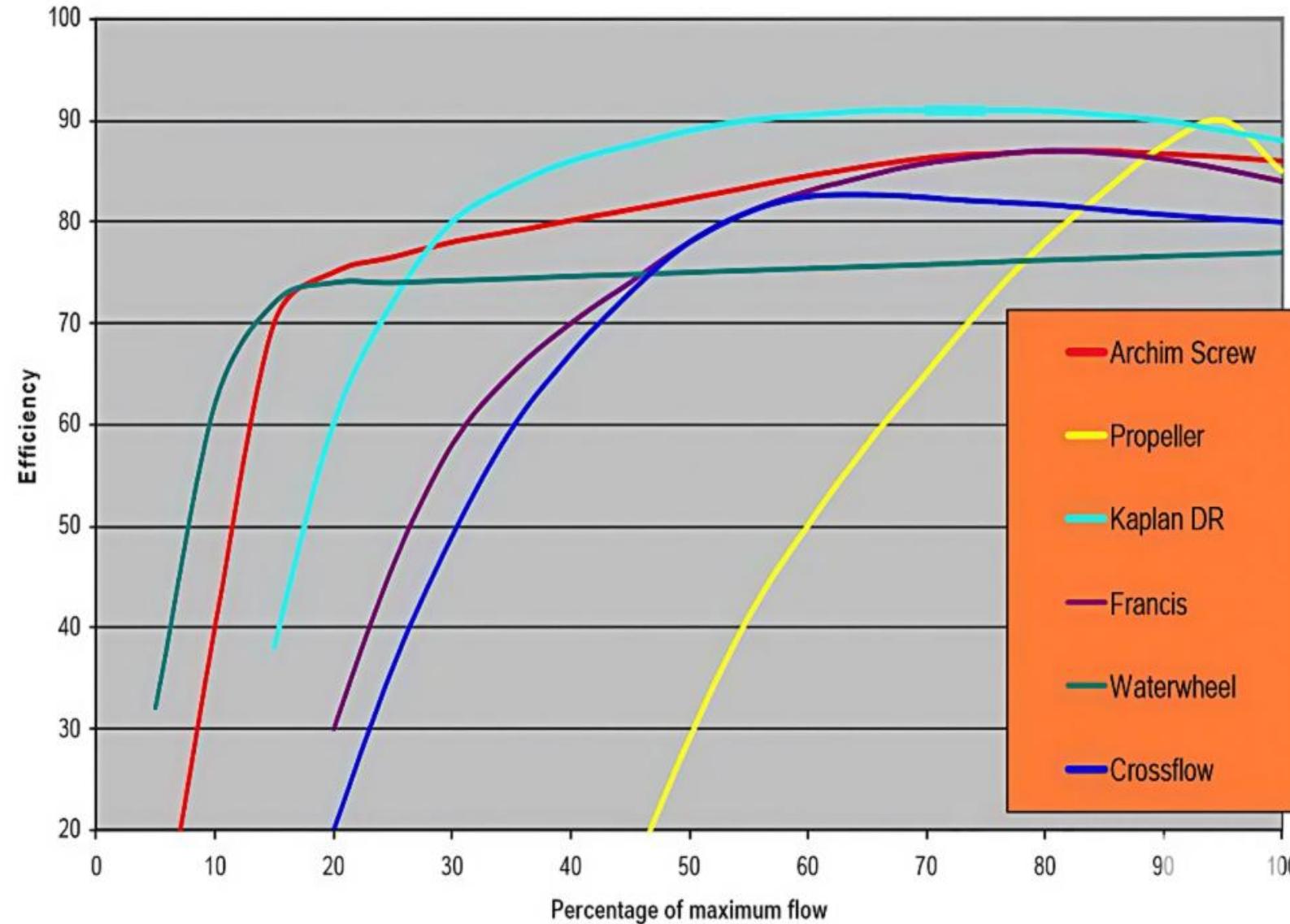
By placing the screw inclined in the flow direction of a river, the water stream is directed into the screw. When Water enters the screw, the combination of water weight, potential and kinetic energy of the water forces the screw to rotate. The Higher the potential or kinetic energy, hence a higher head or flow, the higher the output power.

# APPLICATION OF SCREW TURBINE



- At a run of the river, canal or dam toe site.
- As a replacement for small turbines in plants requiring overhaul.
- At the tail race of existing hydro power plants to further increase power generation capacity.
- At the outfall of sewage treatment plants to reduce power purchasing costs with the use of self generated electricity.
- At existing water intakes to make use of residual ecological flow passing over weirs.
- As a replacement for outdated water wheels.



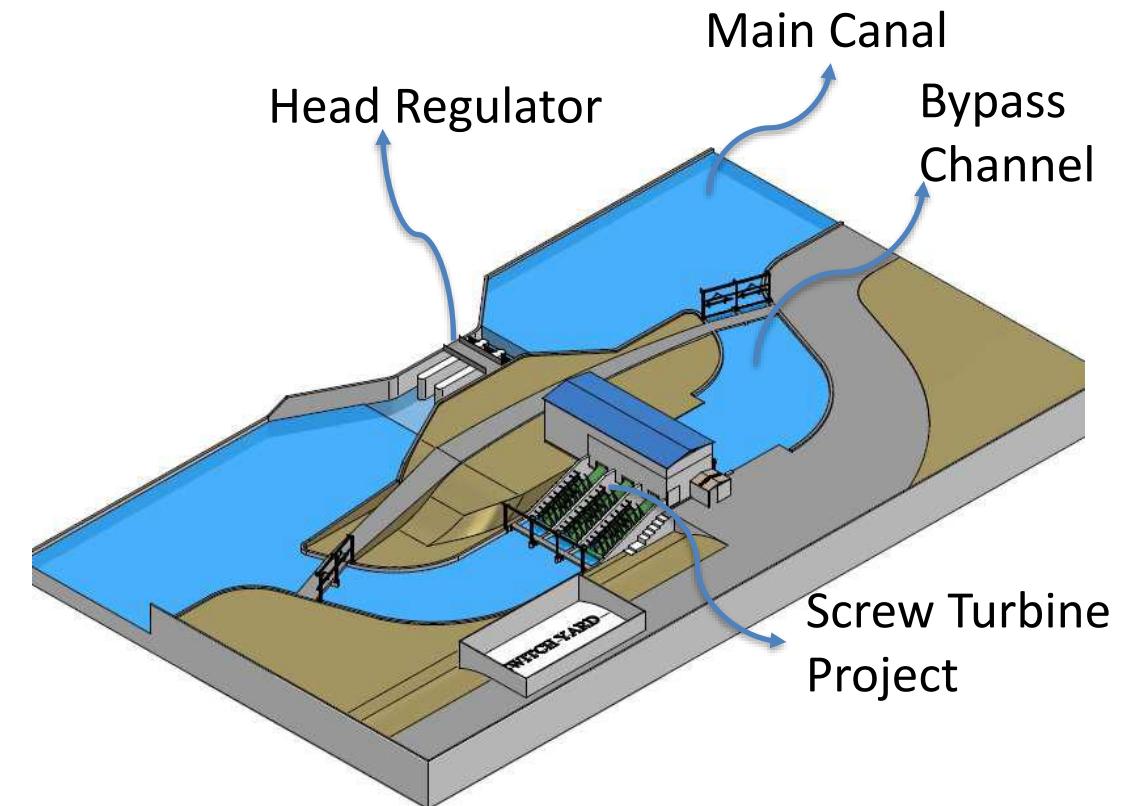
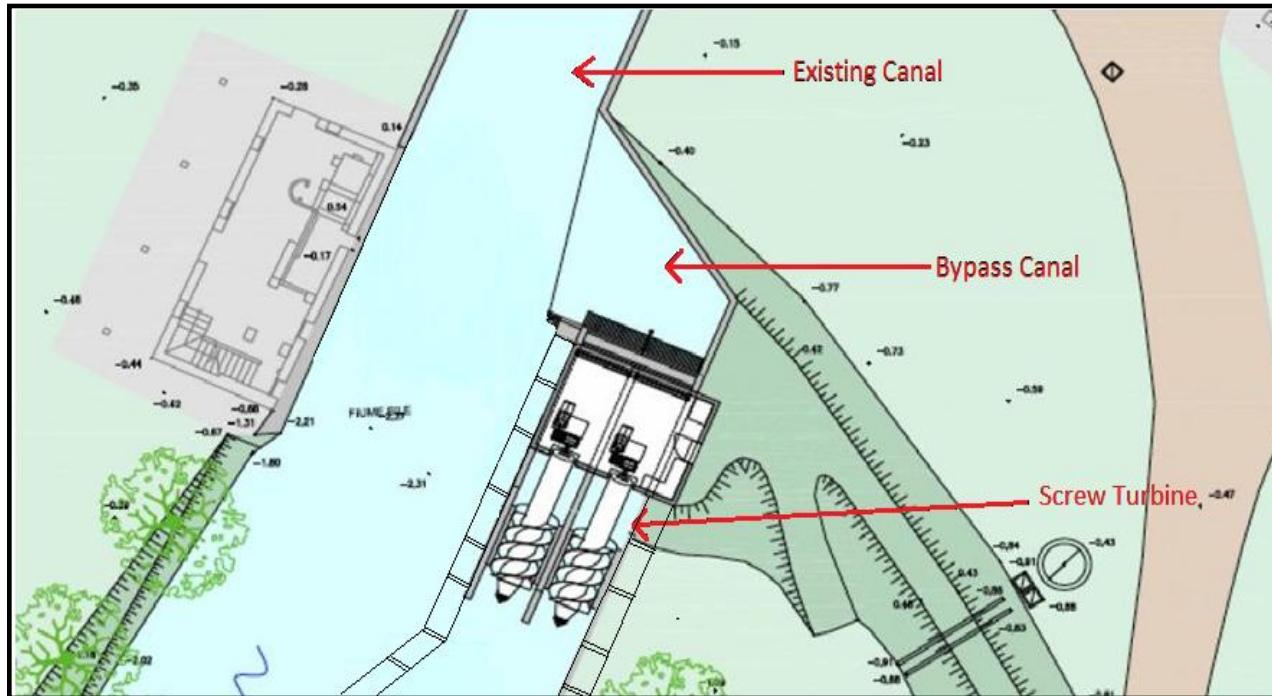


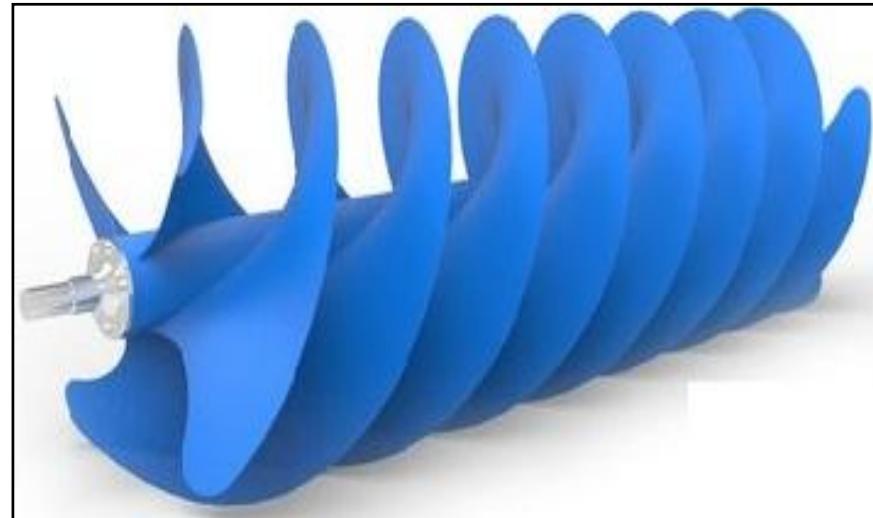
An Archimedes turbine can be used from heads lower than 1 meter all the way up to 10 meters and for flows from 0.1 cumecs to 11 cumecs .

Further, an Archimedes turbine can allow for power generation at varying loads without a massive drop in efficiency, something that is not possible for conventional turbines.

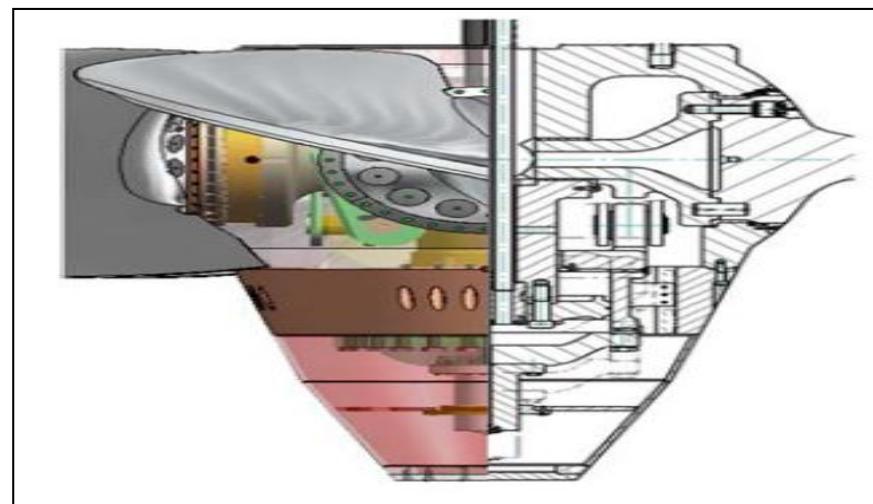
An Archimedes turbine can generate power from 20% of its design flow all the way up to 110% of its design flow.

# LAYOUT OF SCREW TURBINE PROJECT





- Archimedean Screw runners are simple and rugged in construction as compared to Kaplan runners.
- Kaplan runners are very complex and consist of various components for oil supply and circulation.
- Kaplan needs sealing arrangements for prevention of oil leakage.
- Kaplan needs servomotors for high-speed blade rotation.
- Screw runners only comprise of an inner tube and helical flights welded onto the tube.



# ADVANTAGES OF ARCHIMEDEAN SCREW



- Low Civil Cost
- Quicker Commissioning
- Faster Pay Back
- Wider Range Of Usage
- Simpler Design
- Easier Installation
- Higher Durability
- Higher Reliability
- Lower Maintenance
- Better Environmental Compatibility
- Very cost-effective compared with turbines and water wheels.
- Better efficiency with partial loads than comparable water wheel and turbines.
- Screws can be coated with the highly wear-resistant “NanoSeal” ceracomposite material.

As for any investment, the payback period for a hydropower project is one of the decisive factors for the evaluation of its viability. A short installation time, high efficiency in partial flow conditions and the ability to generate electricity 24x7 makes the hydropower screw an economically feasible investment.

Quicker commissioning allows you to start generating power and recover your investment earlier. **The payback period is usually 6-7 years.**

### General Rule of thumb Calculation

- Electrical Power Output:  $P(\text{kW}) = H (\text{m}) \times Q (\text{m}^3/\text{s}) \times g (\text{m/s}^2) \times \eta (\%)$
- Annual Energy Production:  $\text{kWh/year} = P(\text{kW}) \times 8400(\text{hours})$  (Considering 15 Days for Maintenance)
- Annual Revenues:  $\text{Revenue/year} = \text{Price/kWh} \times \text{kWh/year}$

# COMPARISON WITH ALTERNATE SOLUTIONS



TURBINE TYPE	SCREW	IMPULSE	KAPLAN
EFFICIENCY	Up to 90%. Remains same with varying load.	Up to 85%. Remains same with varying load.	Above 90%. Comes down Drastically with varying load
OUTPUT	Varies Proportionally to inlet Flow Works till 20% discharge	Varies Proportionally to inlet Flow Works till 40% discharge	Requires Constant Head And Discharge Works till 40% discharge
EASE OF INSTALLATION	Less Civil work, Takes Shorter installation time	Expensive, Requires Penstock	Very Expensive Civil Works and draft tube required
INSTALLATION PERIOD	15-20 Days	5-6 Months	10-12 Months
WEAR AND TEAR	Negligible, due to low turbine speed	High, due to cavitation and erosion	Very High, Due to speed and Erosion
RELIABILITY	Excellent Reliability	Require Regular Attention	Need Overhaul and Regular Attention
ENVIRONMENTAL COMPATIBILITY	Fish Compatible	Fish Incompatible	Fish Incompatible

# Featured Projects of the Archimedes Screw Turbine



SSNNL - VBC Gujarat

- Application – Canal-Based
- Discharge –  $4.4 \text{ m}^3/\text{s}$ –  $9.0 \text{ m}^3/\text{s}$
- Head Range – 2.7 – 6.5 m
- Generation – Total 5.15 MW From 21 Units at 6 Project location
- Screw diameter – 4240 mm- 4300 mm



2 x 130 kW – Bhikhi, Punjab

- Application – Canal-Based
- Discharge –  $6.2 \text{ m}^3/\text{s}$
- Head – 2.8 m
- Generation – 2 x 130 kW
- Screw Diameter – 3900 mm

# Featured Projects of the Archimedes Screw Turbine



Tillari – Maharashtra

- Application – Canal Based
- Discharge –  $11.0 \text{ m}^3/\text{s}$
- Head –  $2.93 \text{ m}$
- Generation –  $2 \times 235 \text{ kW}$
- Screw Diameter –  $4300 \text{ mm}$

# Featured Projects of the Archimedes Screw Turbine



Rithala WWTP – Delhi Jal Board

- Application – At the outfall of WWTP
- Discharge –  $1.0 \text{ m}^3/\text{s}$
- Head – 5.0 m
- Generation – 1 x 37 kW
- Screw Diameter – 1700 mm

# Featured Projects of the Archimedes Screw Turbine



- Application – At the Tail Race of an Existing Hydro Project
- Discharge –  $1.5 \text{ m}^3/\text{s} - 3.5 \text{ m}^3/\text{s}$
- Head Range –  $1.2 \text{ m} - 1.5 \text{ m}$
- Generation –  $1 \times 11 \text{ kW} + 1 \times 36 \text{ kW}$
- Screw Diameter –  $2100 \text{ mm} / 3000 \text{ mm}$

Poringalkuthu, Thrissur – Kerala SEB

# List of Credentials for Screw Turbine



Sr. No.	Capacity kW / Size mm	Qty	Project Details	Year of Installation
1	1 x 18.5 kW Screw Diameter – 1400 mm	1	Sewage treatment Plant, Indore Municipal Corporation, Kabitkhedi - Indore	2013
2	1 x 11 kW Screw Diameter – 2100 mm	1	Poringalkuthu Micro tail race Project, Thrissur District - Kerala	2016
3	4 x 263 kW Screw Diameter – 4240 mm	4	SHP 1 - Vadodara Branch Canal - SSNNL Project, Vadodara	2020
4	4 x 175 kW Screw Diameter – 4240 mm	4	SHP 2 - Vadodara Branch Canal - SSNNL Project, Vadodara	2021
5	3 x 234 kW Screw Diameter - 4300 mm	3	SHP 3- Vadodara Branch Canal - SSNNL Project, Vadodara	2019
6	3 x 200 kW Screw Diameter - 4240 mm	3	SHP 4 - Vadodara Branch Canal - SSNNL Project, Vadodara	2018
7	4 x 375 kW Screw Diameter - 4300 mm	4	SHP 5 - Vadodara Branch Canal - SSNNL Project, Vadodara	2021
8	3 x 200 kW Screw Diameter - 4300 mm	3	SHP 6 - Vadodara Branch Canal - SSNNL Project, Vadodara	2019
9	1 x 36 kW Screw Diameter - 3500 mm	1	Poringalkuthu Micro Hydro Electric Project, Thrissur, District - Kerala	2025
10	2 x 130 kW Screw Diameter - 3900 mm	2	Bhikhi Distributary, Sahoke Village - Punjab	2021
11	1 x 37 kW Screw Diameter – 1700 mm	1	DJB Rithala WWTP - Delhi	2024
12	2 X 235 kW Screw Diameter – 4300 mm	2	Tillari Canal Left bank Project - Maharashtra	2025
13	3 X 362 kW Screw Diameter – 4100 mm	3	Amhata-IV Small Hydro Power Project – Madhya Pradesh	Currently under execution
14	3 X 470 kW Screw Diameter – 4300 mm	3	Hardi Small Hydro Power Project – Madhya Pradesh	Currently under execution



We are pleased to support – Contact us !

**Rishi Chopra**

**JASH ENGINEERING LTD**

31, SECTOR-C, INDUSTRIAL AREA,  
SANWER ROAD, INDORE,  
INDIA.

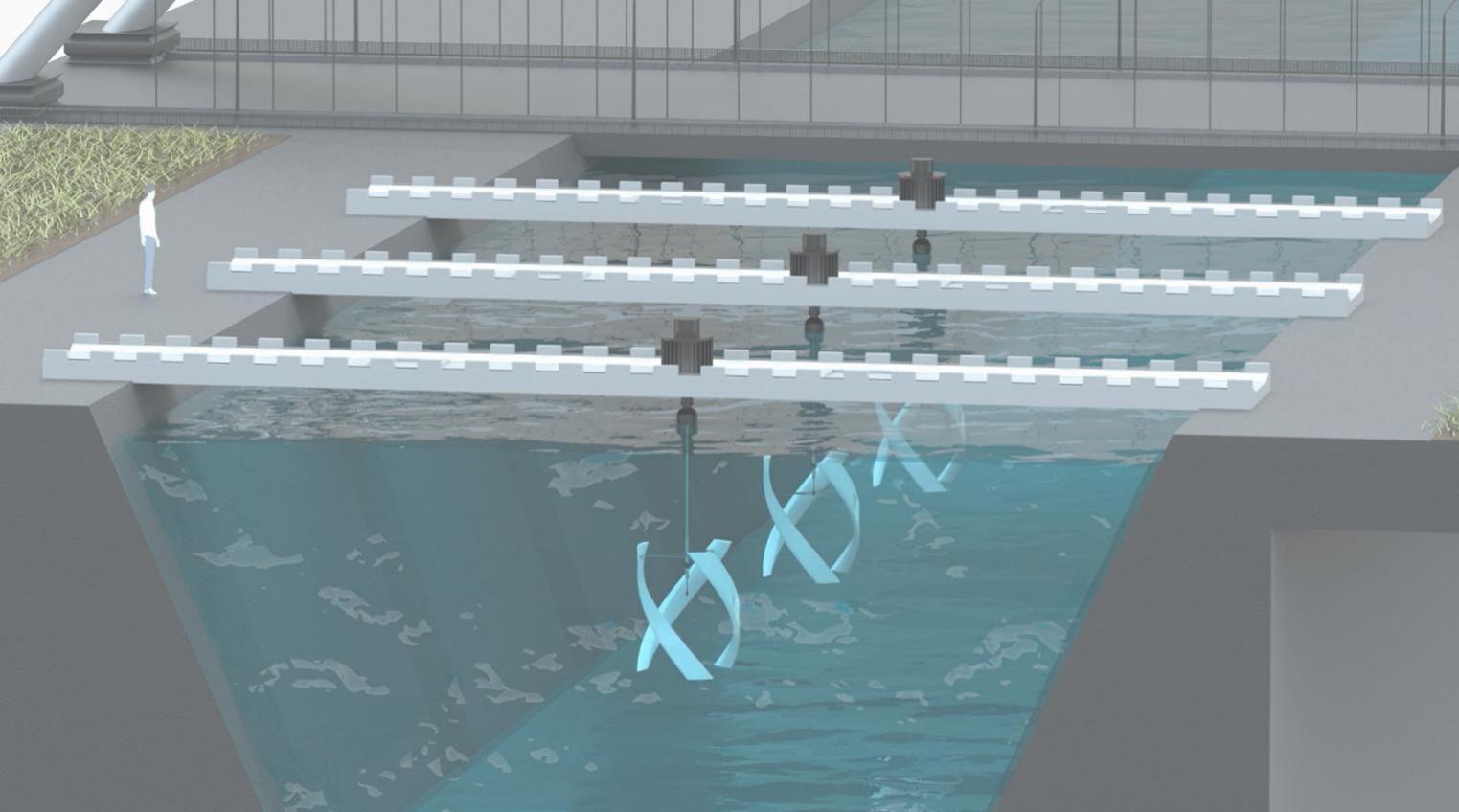
Ph. No. +91-731-2720143, 2720034  
Email: [info@jashindia.com](mailto:info@jashindia.com)  
Website: [www.jashindia.com](http://www.jashindia.com)



**Thank You**



# Micro Turbines for Macro Impact



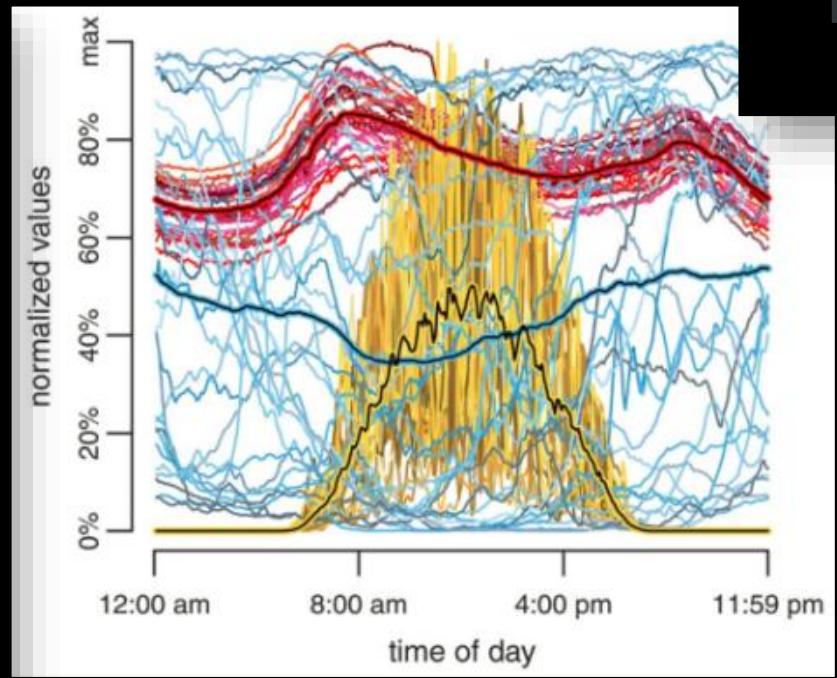
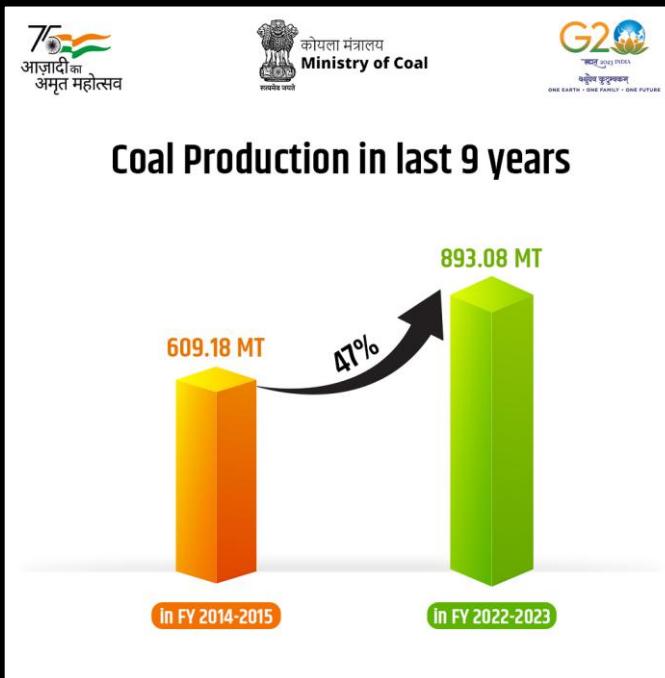
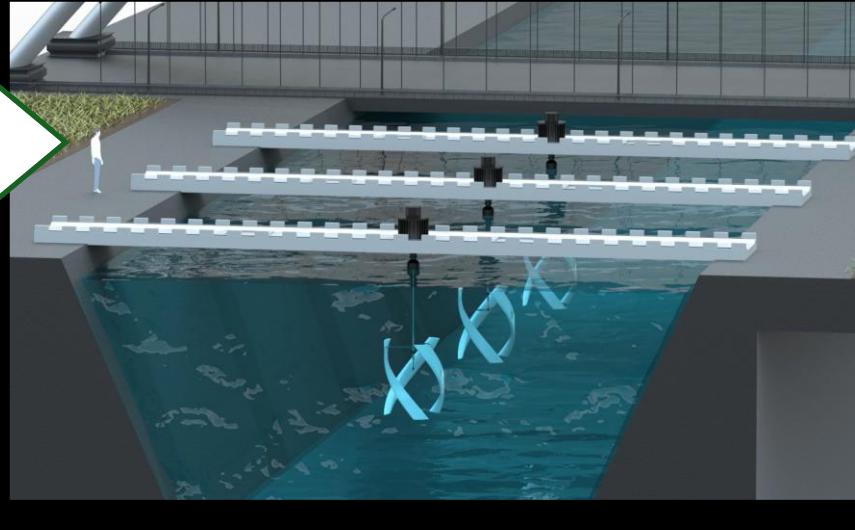
Patented Modular turbines  
Deployment at Scale  
Cost Competitive to Coal, Solar  
and Wind

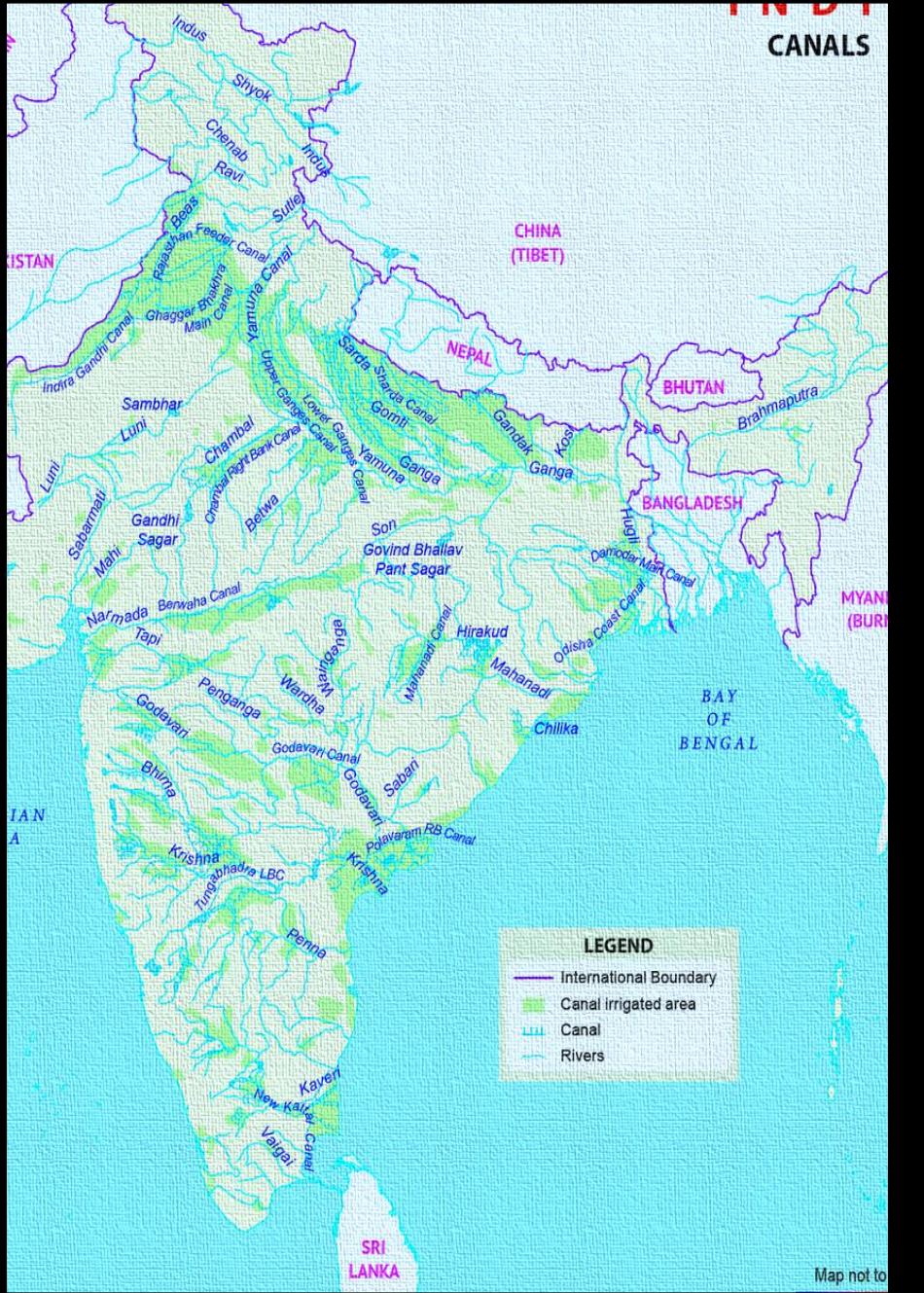
## Growing Energy Needs:

- 300M Indians lack reliable electricity.
- Traditional hydropower requires dams (ecologically destructive, high cost).

## Predictable RE:

- Patented, modular, Damless® hydro turbines.
- Generate clean energy from existing canals/rivers (no dams, fish-friendly).



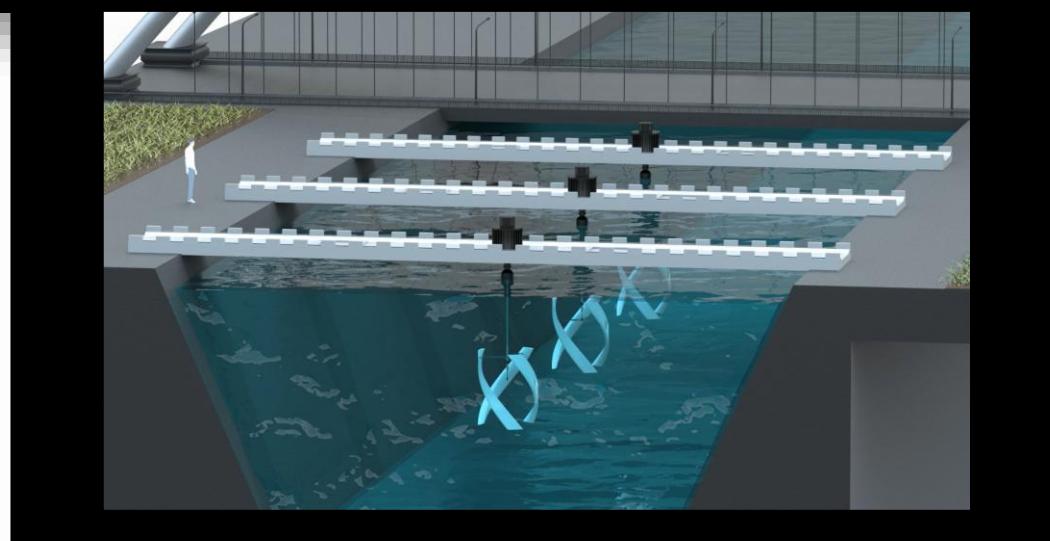
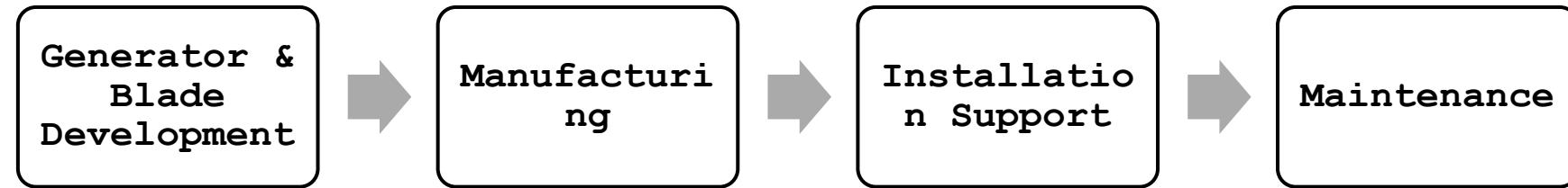


- Market:

- India's 175,000 km canals → 100GW untapped potential.
- Global small hydro market: \$3B+ by 2030.

- Traction:

- 81.25L grants (Startup India, HDFC, Cummins).
- EoI from UP, Gujarat, MP, Maharashtra
- Interest from PSUs like NTPC
- Private Hydropower Developers



- Traditional Value Chain:
  - Raw materials → Turbine manufacturing → Dam construction → Grid integration → Maintenance.
- Maini's Disruption:

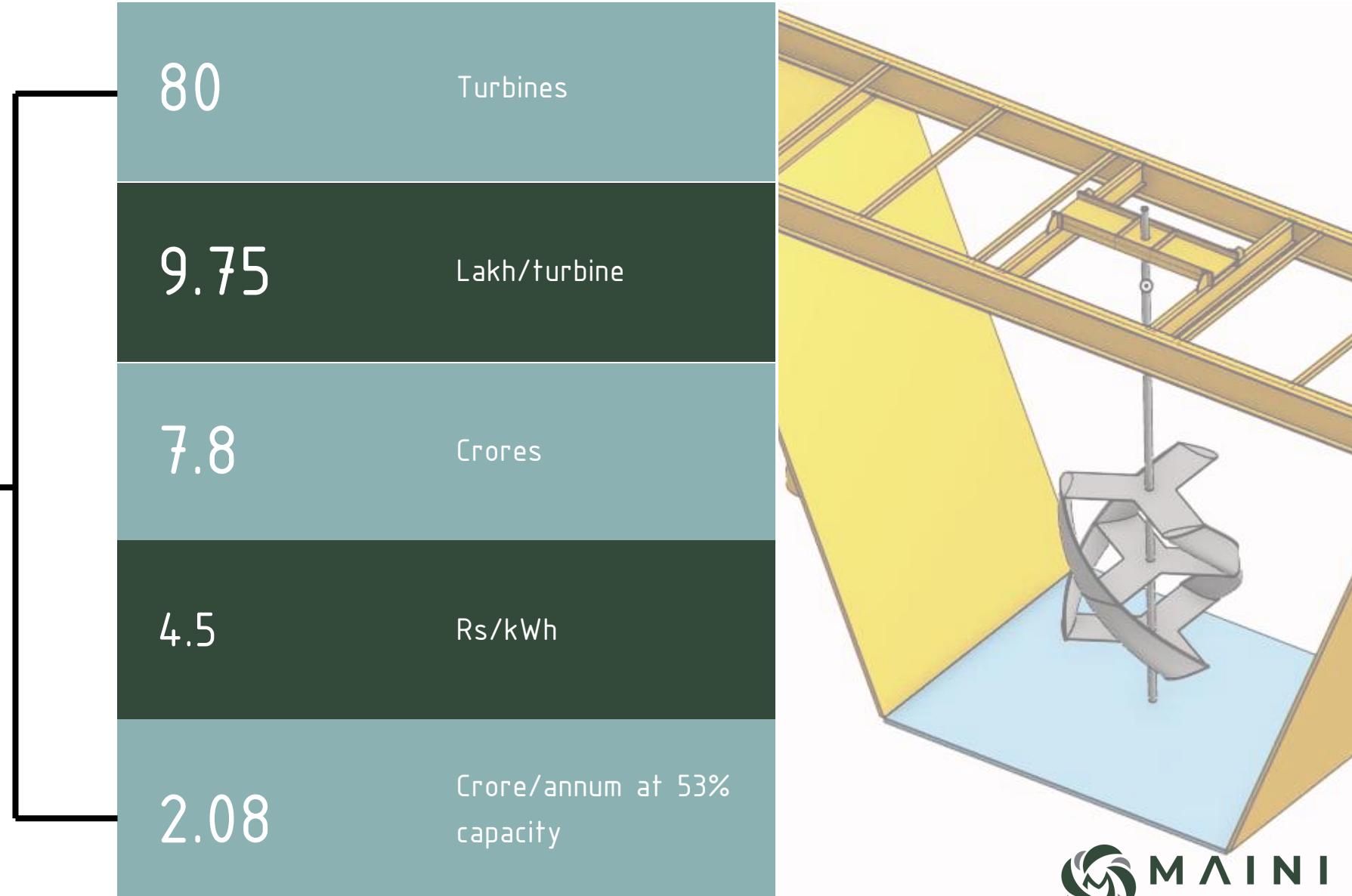
- Eliminates dam construction (modular, direct installation in canals).
- Focus on Technology Stack + manufacturing + installation + O&M.

# Key Metrics

Expected ROI  
3 years\*



\*Depending on site





# Milestones Achieved

- Stage: Lab Tested at IIT Roorkee, PoC completed, New 1 MW and 240kW pilot deployment in Maharashtra and Gujarat, licenses/permits secured, in partnership with state energy authorities.
- Achievements/Awards: Spotlight at CLIMAFIX Summit/IIT Madras; media



The news article features a photo of a woman with long dark hair smiling, and another photo of a river flowing through a green, hilly landscape. The text discusses a Mumbai engineer named Swati Maini who has developed a mini turbine to generate power from water streams or canals, aiming to help remote villages in backward areas like Gadchiroli and Melghat.

**Mumbai Girl's Mini Turbine Generates**

TOI City Nagpur Mumbai Delhi Bengaluru Hyderabad

This story is from January 6, 2023

Mumbai girl's startup produces power from streams, canals

Vaibhav Ganjapure / TNN / Updated: Jan 10, 2023, 23:33 IST

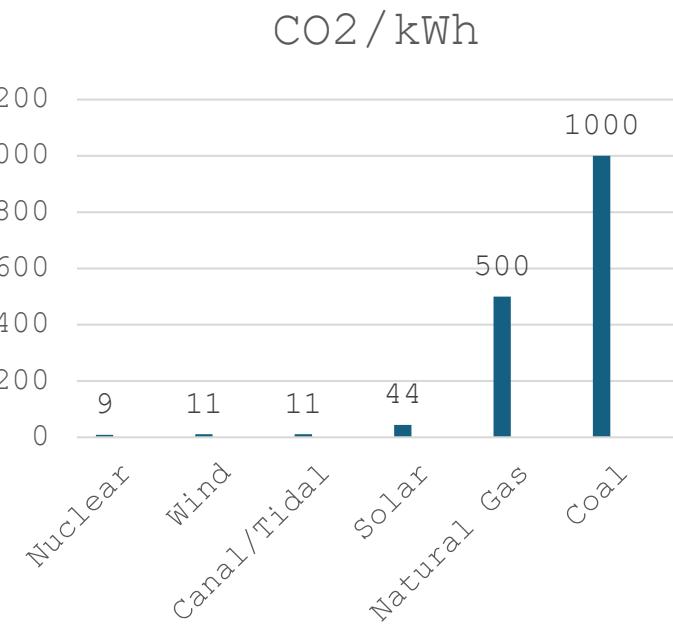
Share AA Follow Us



# Lifecycle CO<sub>2</sub> Emissions

Renewable Energy Generation

Emission-free | Hydro- Predictable | Combating Climate Change



- 100% Recyclable
  - The manufacturing and construction phase accounts for the primary carbon footprint of wind turbines due to the raw materials used, such as steel, concrete, and aluminium
- Circularity:  
Components can be dismantled, sorted, and processed through regular



A. Thermoplastic and Steel Combination blade



B. Aluminium Casted Parts



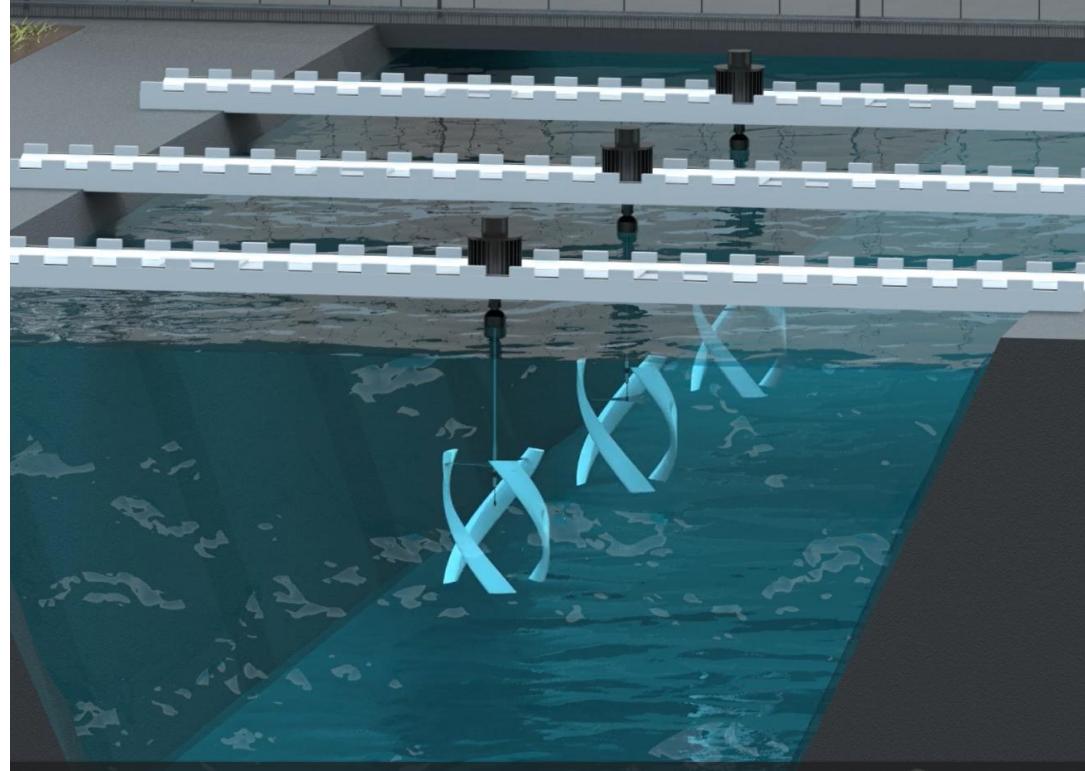
C. 3D prints for mo

# Pilot Project: Pune



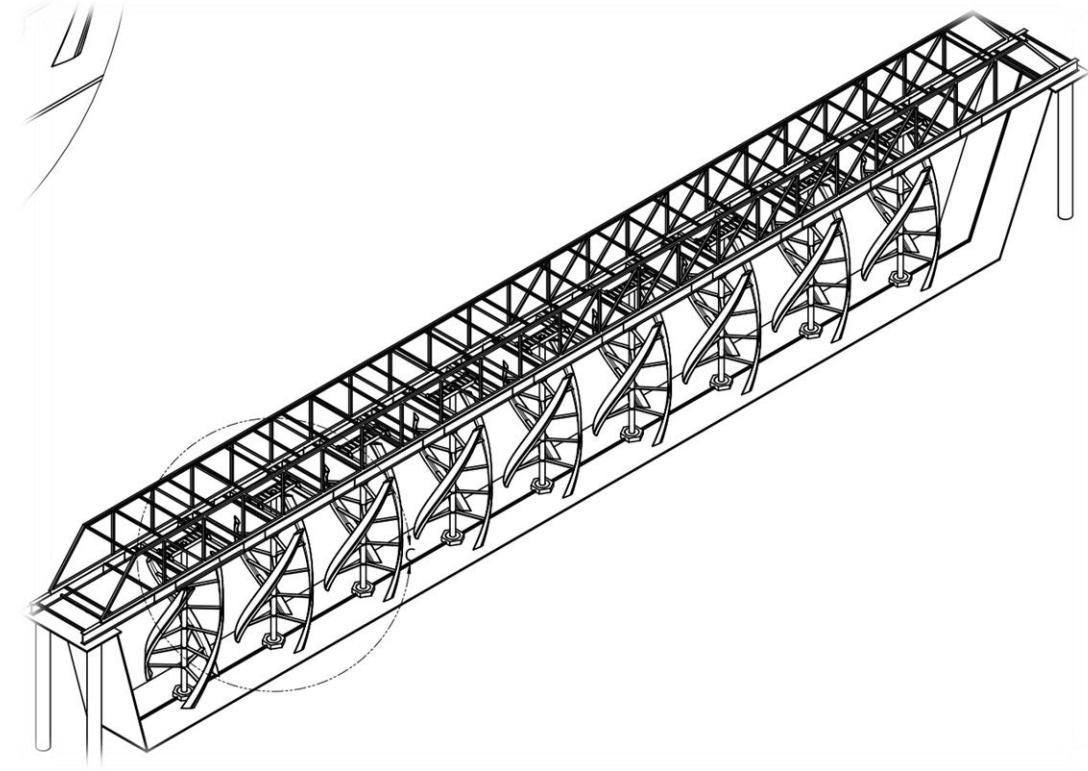
15 kW on each  
bridge

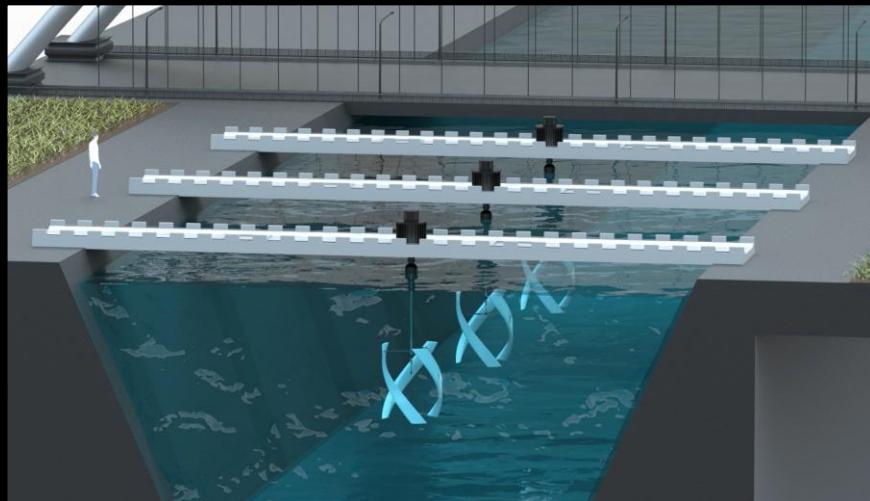
20m distance  
1km for 1MW



180 kW on each  
bridge

20m distance  
200m for 1MW





M A I N I  
RENEWABLES



[www.mainirenewables.com](http://www.mainirenewables.com)



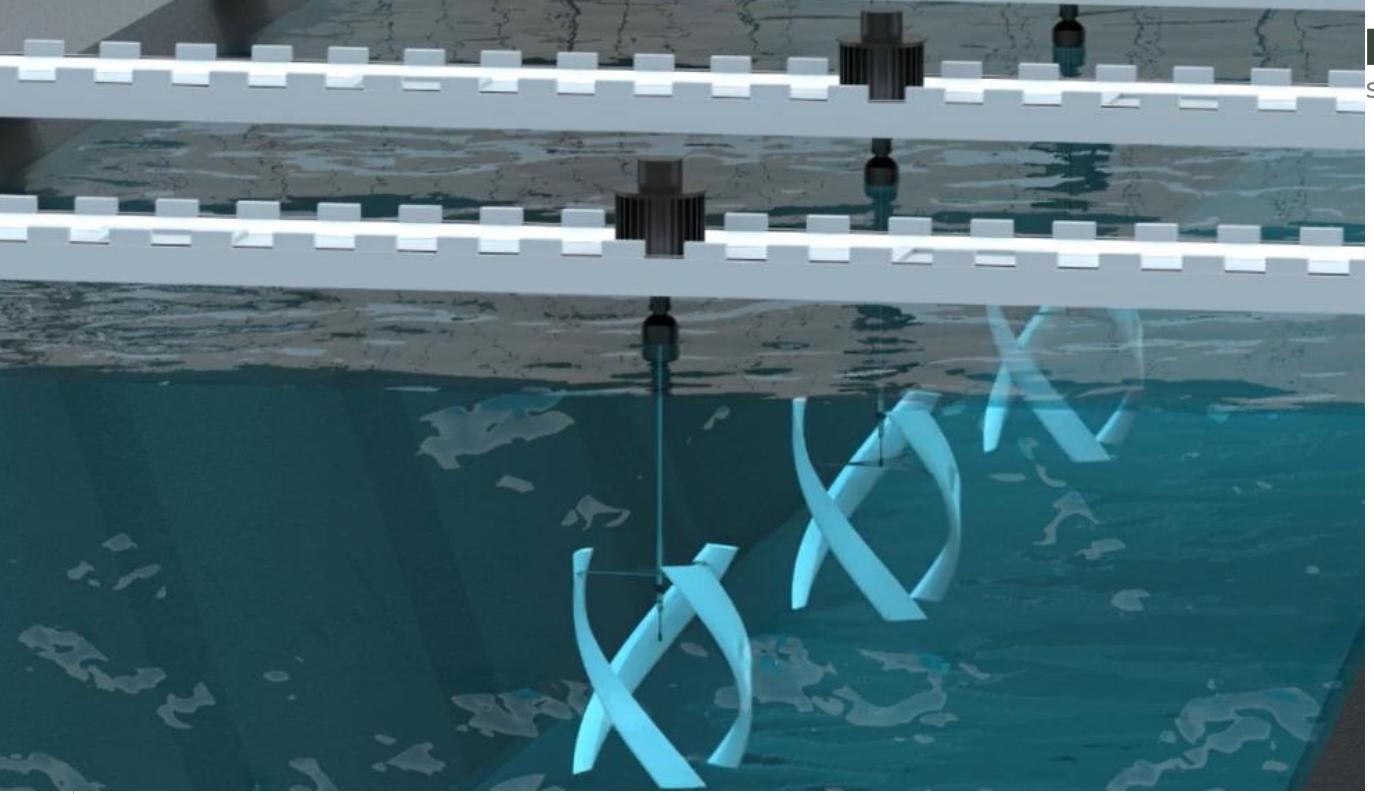
+91 7710814798



info@mainirenewables.com

# Product Differentiation

- Differentiated Product
- Focus on cost-leadership via modularity, targeting underserved canal networks
- niche process industry retrofits;
- strategic alliances with state governments,
- exclusive canal access permits,
- and collaborative R&D ensures technology and ma



## Competitor Analysis in Hydrokinetic: Global



Orbital Marine



Simec Atlantis



Gkinetic



ORPC



Emrgy



Hydroquest



Blade Runner Energy

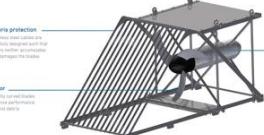


Tidal Sails



Instream Hydro

## Competitor Analysis in Hydrokinetic: India



Imp Power



Maclec

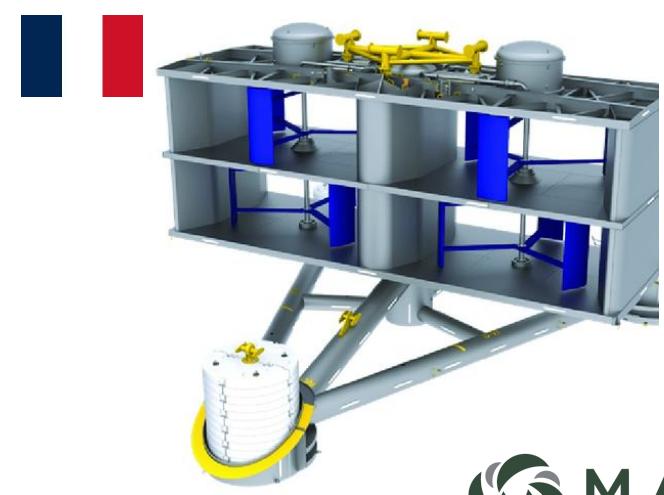
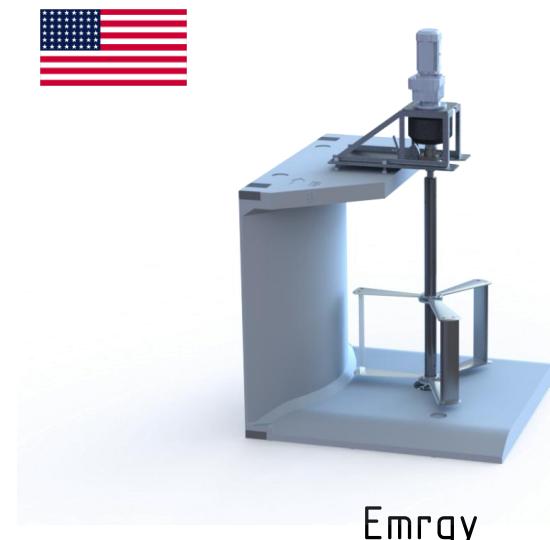
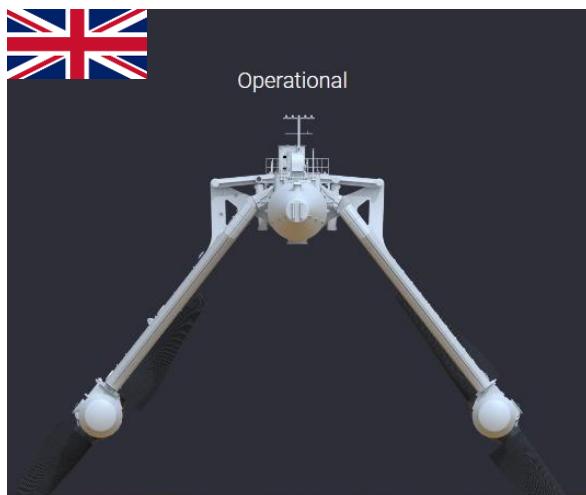
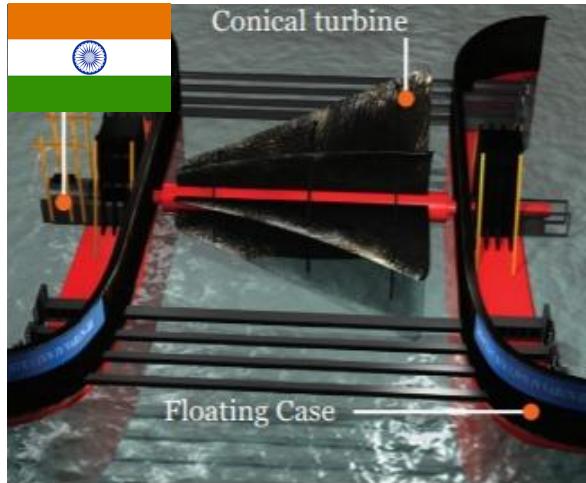


Jash Engineering



Hyki Tech

# Competitor Technologies



# GTM Strategy

- Why Unique:
  - Direct partnerships with governments/utilities
  - RE Developers for
    - Govt. liaison
    - contractual work
  - 30% lower costs vs. traditional hydro.
  - Scalable for rural (1kW) to industrial (1000kW+) needs.
- Phase 1 (Pilots):
  - Target Maharashtra canals (state irrigation partnerships).
- Phase 2 (Scale):
  - Expand to Gujarat, Uttar Pradesh
  - Secure partnerships with developers
  - Licensing Agreements for National Level Partnerships
- Phase 3 (Global):
  - American/European



Swati Maini

Founder

Design of Turbines for Hydrokinetic

Development of Industrial Water Treatment

Commissioning of Nuclear Fuel Canisters

NASA Design-Build-Fly Program



Sarthak Borude

ITI, Robotics & Electrical R&D  
Engineer



Rohin Bhat

R&D Design and Manufacturing



# The Team

TECHNICAL EXPERTS



Dr. Gaurav Saini  
PhD, IIT Roorkee  
Specialization on Hydrokinetic Turbines



Ramesh Urlam

Engineering Systems & Design, Port  
Design, Offshore Platforms &  
Oceanography Expert



Cdr. Tushar Giri (Retd. Navy)

Operations, Materials Procurement & Engineering



# Heartiest Greetings to all Delegates!



Nelumbo Technologies Pvt Ltd, Noida, India

FISH Conference  
15.12.2025, Delhi, India



## **Pankaj K Rajput**

CEO/Director

Nelumbo Technologies Pvt Ltd

Noida, India

Chartered Engineer

Electrical Engineer with 32+ years work experience  
in Electrical & Automation system design,  
engineering & projects management of Hydro, Solar  
& Thermal based Power Plants and Transmission  
Systems/Sub-Stations

...we automate the entire domain of electricity...

## Generation



- Turbine/Engine Controls
- Digital Governing Controls
- Digital Excitation Controls
- Gen, Trafo & Line Protection
- Power Plant SCADA

## Transmission & Distribution



- Control & Relay Panel (CRP)
- Substation Automation System (SAS)
- SLDC Gateways
- Disturbance Recording (DR)
- Phasor Monitoring Unit (PMUs)

## Industry Power System

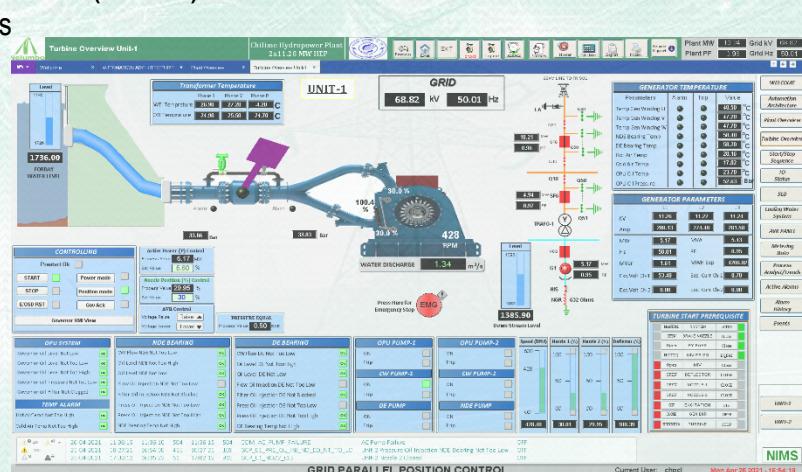


- Plant SCADA
- Load Management System
- Intelligent Load Shedding System
- Energy Management System (EMS)
- Power Quality solutions

## □ Power Plant Automation - Hydro, Solar, Thermal & HFO based

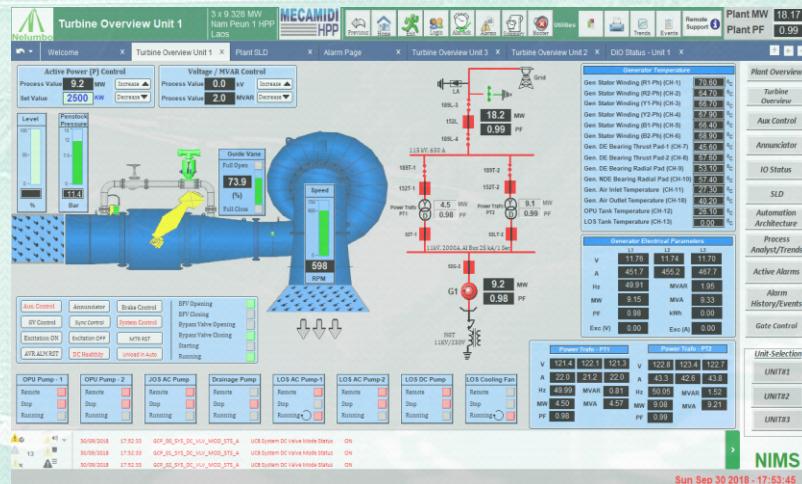
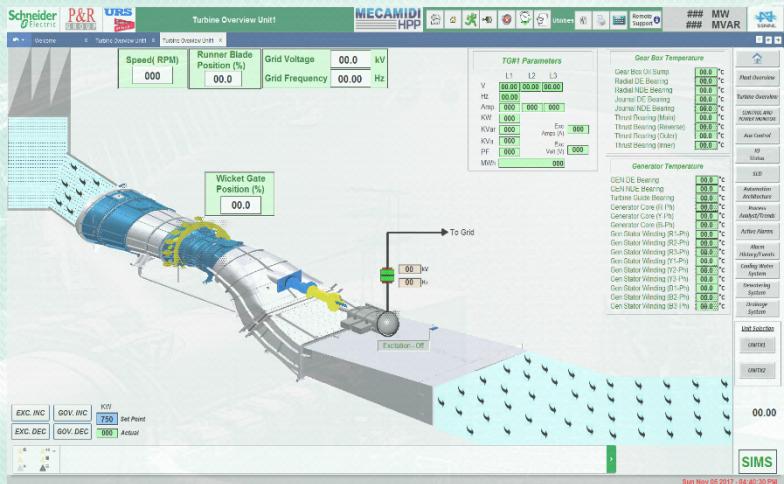
### ▪ Programmable Logic Controllers (PLC) / Remote Terminal Units (RTUs)

- ✓ Collects discrete and analogue data from Field Devices/Meters/IEDs
- ✓ Retransmits data to HMI/DC/Gateways
- ✓ Contains programmed sequence for power plant operation
- ✓ Contains digital speed governing of Turbines
- ✓ Facilitates Manual, Semi Auto & Auto mode of operation
- ✓ Facilitates Active & Reactive Power Management



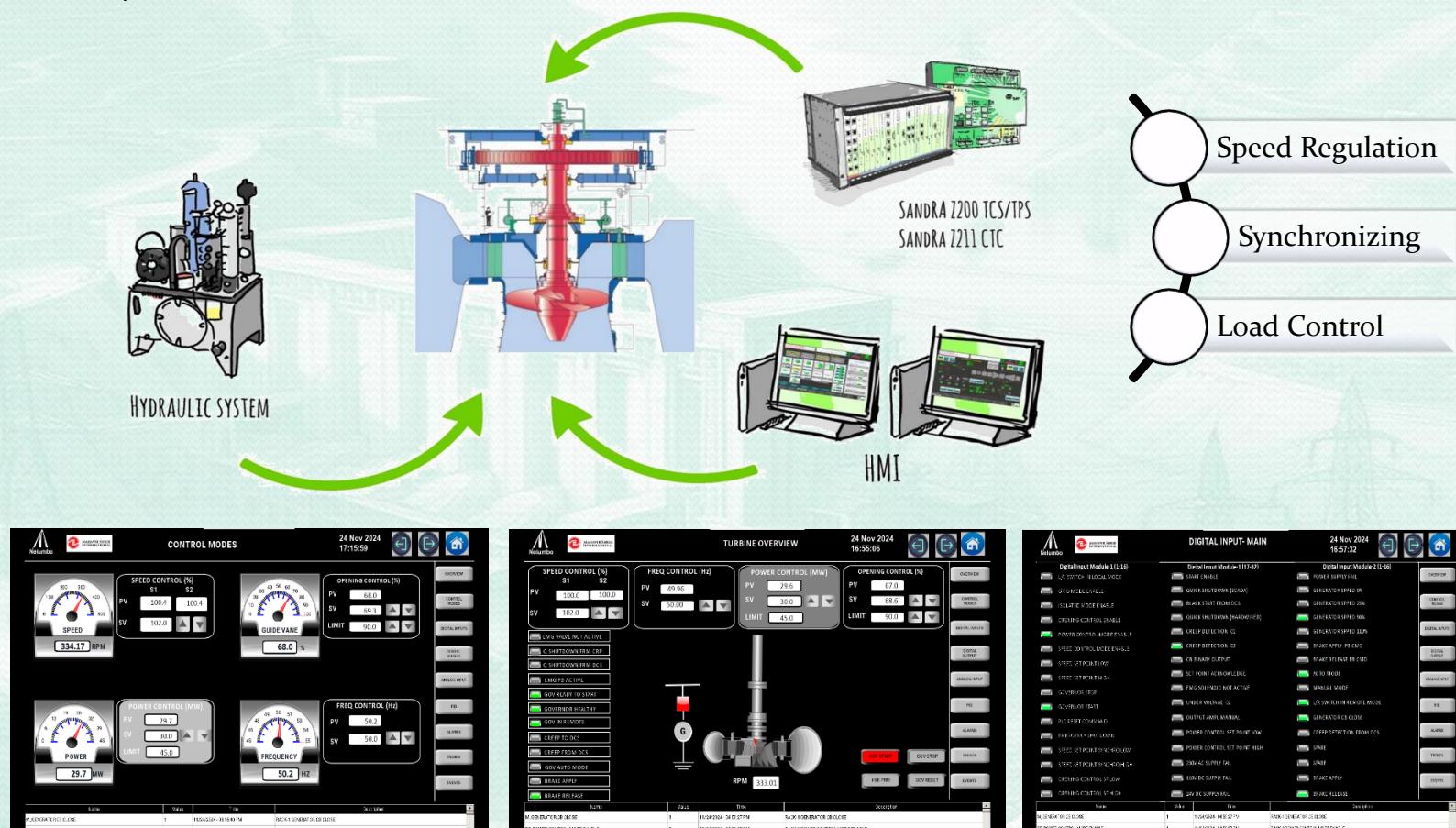
### ▪ Human Machine Interface (HMI)

- ✓ Provides Graphical interface of Power Plant to Operators/Users
- ✓ Provides alarms & events management for operator
- ✓ Provides historical trends for analysis
- ✓ Facilitates Set Points for Active & Reactive power management



## Digital Governing Control System

DGCS is a fully-integrated and configurable controller that utilizes proven microprocessor-based hardware with flexible IOs for the control & speed and load regulation of hydro turbine. A Human Machine Interface (HMI) on the panel-mount touchscreen allows the configuration of machine control functions. It serves the purpose of start-up assistance to operator as well as fine tuning of the system to desired performance. PC based configuration software makes it more flexible and user friendly.



## ❑ Digital Excitation Control System

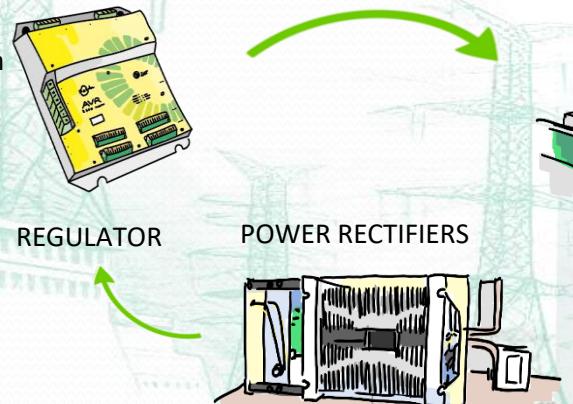
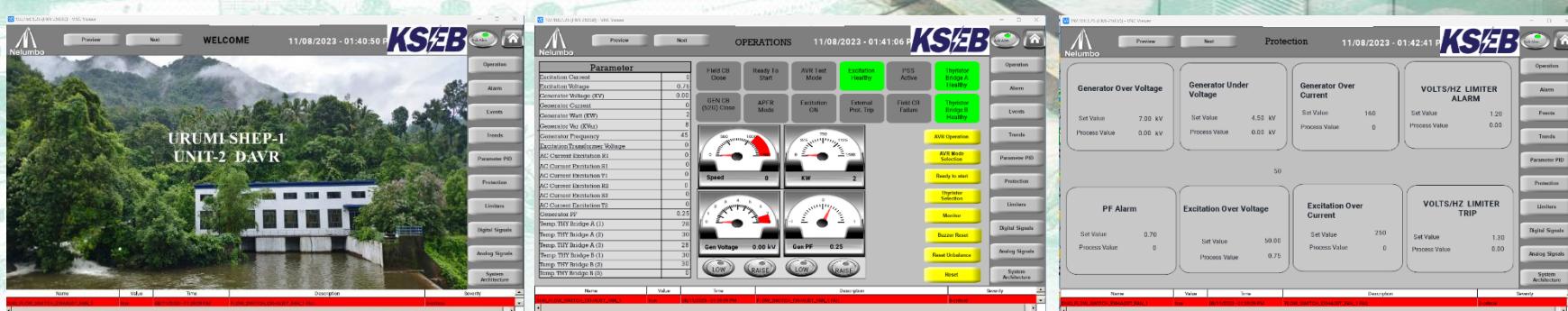
Digital excitation control systems for synchronous machines for various types of power plants i.e. **Hydro, Thermal, Gas, Diesel** etc...

According to machine type:

- ❑ Static excitation system
- ❑ Brushless excitation system

According to applications:

- ❑ Single channel
- ❑ Dual redundant channels

The image displays three screenshots of the KSEB Digital Excitation Control System software interface, showing the following details:

- URUMI-SHEP-1 UNIT-2 DAVR** (Landscape View)
- OPERATIONS** (Operational Parameters and Control Buttons)
 

Parameter	Value
Excitation Opened	0.00
Excitation Voltage	0.00
Generator Current (A)	0
Generator Watt (kW)	2
Generator Vars (kVar)	4
Generator Frequency	45
Excitation Frequency	0
Excitation Transient Voltage	0
AC Current Excitation R1	0
AC Current Protection S1	0
AC Current Protection T1	0
AC Current Protection R2	0
AC Current Protection S2	0
AC Current Protection T2	0
Generator IP	0.75
Generator Frequency (Hz)	50
Gen. TTV Bridge A (G)	30
Gen. TTV Bridge A (G)	28
Gen. TTV Bridge B (G)	30
Gen. TTV Bridge B (G)	28
Gen. TTV Bridge C (G)	30
Gen. TTV Bridge C (G)	28
- Protection** (Protection Settings)
 

Setting	Value
Generator Over Voltage	7.00 kV
Generator Under Voltage	4.50 kV
Generator Over Current	160
VOLTS/HZ LIMITER ALARM	1.20
PF Alarm	0.70
Excitation Over Voltage	50.00
Excitation Over Current	250
VOLTS/HZ LIMITER TRIP	1.00

# Nelumbo...Journey so far...14 years of History

CRP+SAS for 6 Substations in UPPTCL. 150+ CRPs for PSDF/ PMDP/ DDUGJY/ IPDS schemes in J&K. Approval by RECPDCL. Intelligent Load Management System for Indo Rama, Indonesia. EBoP package (Digital Gov + Excitation + Protection + MV + SCADA for 2x11MW Chilime HEP in Nepal. **Magnolid started at Mumbai in Jan'2019**

**UPPTCL:**  
CRP+SAS for 15x132kV AIS Substations  
CRP+SAS for 7x220kV GIS Substations  
CRP+SAS for 3x400kV AIS Substations

Synchro

Generators of NTPC

CRPs for UPPTCL SCADA FRTUs to

**Control System for 100+ hydro turbines**

SAS for 132kV Wind Power, 132kV SAS for IPPs totaling

Substations in HEP in Laos. RTUs &

for 50MW Generator engines, CRPs to UPPTCL

Exports to Tanzania, Ethiopia, Bangladesh, Nigeria. Approval

Shifting of 1x10MW Indonesia. CRP up to

Got 1<sup>st</sup> Breakthrough Automation system in Arabia & Indonesia

Nelumbo Power Technologies Conceptualized

2011: Induction of  
**Nelumbo Icna Controls Pvt Ltd**  
(Manufacturing started)

**Generator Protection System up to 210 MW rated Machines**

132kV AIS SS  
220kV AIS SS

**Synchronization System up to 500 MW rated Machines**

RTUs, 3x220kV AIS SS

**BSPTCL:**  
CRP+SAS for 3x132/33kV Substations  
CRP+SAS for 3x132/33kV Substations

**Digital Governing Control System up to 35 MW rated hydro turbine**

Package Export to C

Energy Metering, 8xG

100MW Hydro power p

Controls, protection & SC

System replacement in Nepa

100MW Hydro power p

Controls, protection & SC

System replacement in Nepa

100MW Hydro power p

Controls, protection & SC

System replacement in Nepa

100MW Hydro power p

Controls, protection & SC

System replacement in Nepa

**Digital Excitation Systems rated up to 550 Amps**

132kV AIS SS

220kV AIS SS

33kV AIS SS

400kV AIS SS

132kV AIS SS

220kV AIS SS

33kV AIS SS

400kV AIS SS

132kV AIS SS

220kV AIS SS

33kV AIS SS

400kV AIS SS

132kV AIS SS

220kV AIS SS

**SCADA System up to 75MW rated Hydro Power Plants**

132kV AIS SS

220kV AIS SS

33kV AIS SS

400kV AIS SS

132kV AIS SS

220kV AIS SS

33kV AIS SS

400kV AIS SS

132kV AIS SS

220kV AIS SS

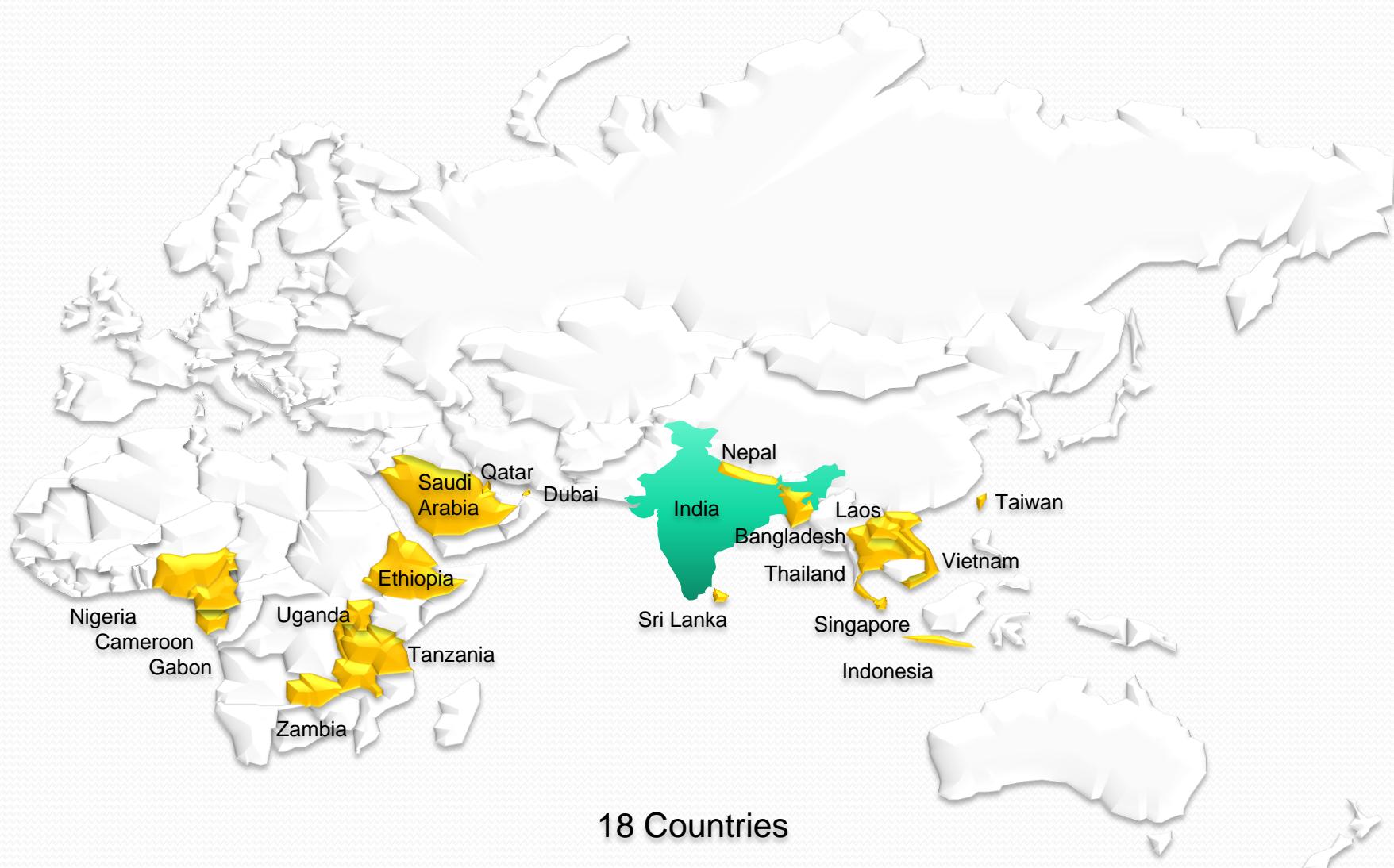
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

2019: Induction of  
**Magnolid Tech Pvt Ltd**

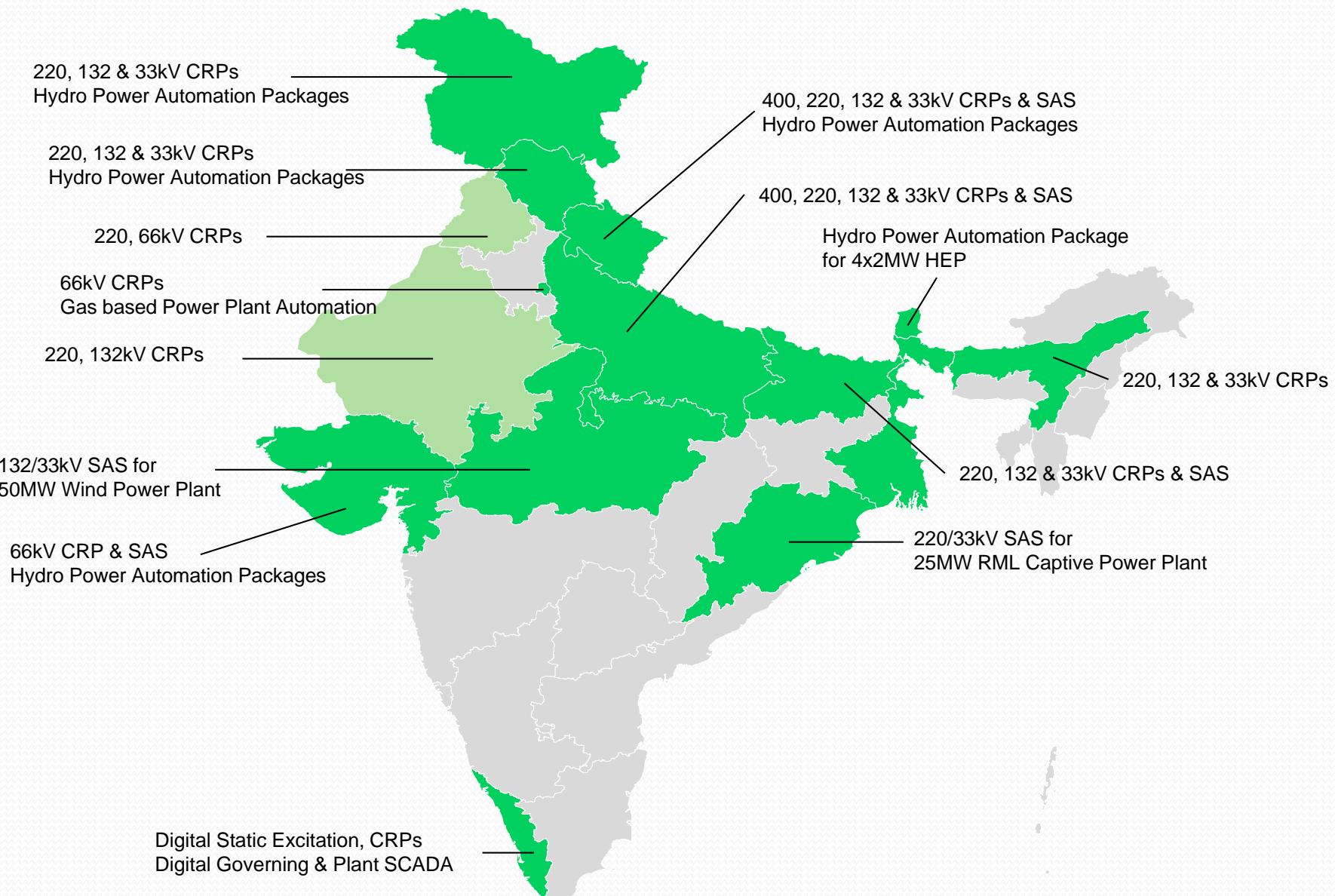
Company name changed to  
**Nelumbo Technologies Pvt Ltd**

...project references...geographically

# Nelumbo's Export on Global Map



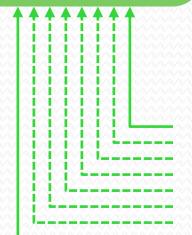
# Substation & Power Automation - Footprint in India



National Load  
Despatch  
Centre (NLDC)

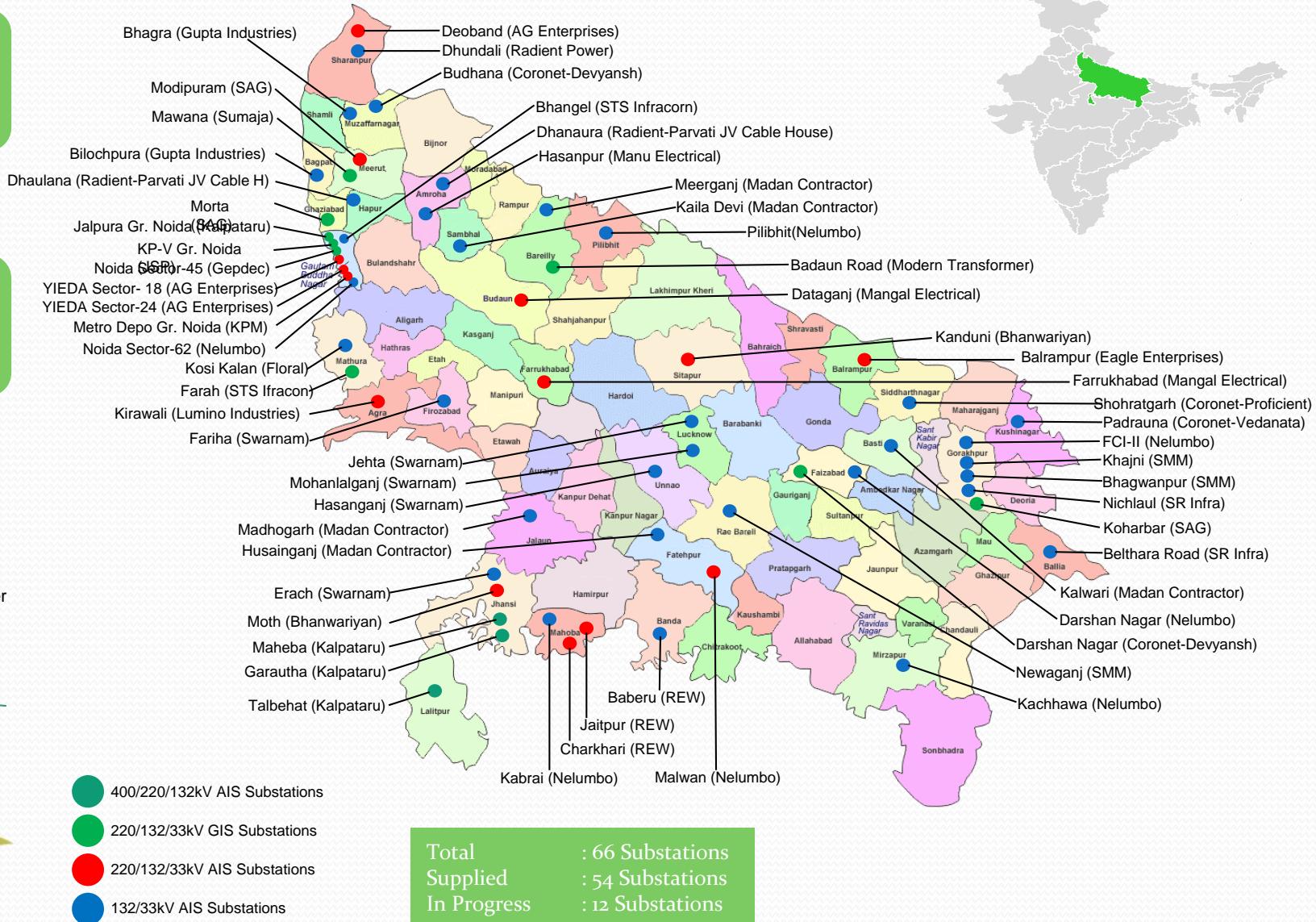
Control Centre  
(by GE/Alstom)

State Load  
Despatch  
Centre (SLDC)  
Lucknow



Data Telemetry over  
IEC104 protocol

OPGW for data  
transmission



## □ Control Panel Manufacturing

Technological innovation and the development of state-of-arts products are key dynamics in delivery of highly efficient control & automation solutions

- Turbine control console
- Generator protection panels
- Transformer protection panels
- Line protection panels (up to 400kV)
- Synchronizing control panels
- Mimic panels
- Instrumentation panels
- NGR/NGT panels
- LV Panels



# Trishuli Hydro Power Plant (7 x 3.5 MW), Nepal | Modernization Project

## The Challenge

An aging static excitation system at Trishuli Hydro Power Plant was obsolete, maintenance-intensive, and lacked spares, risking long shutdowns. The generator shaft was not designed for a brushless exciter, adding mechanical complexity.



## Our Solution

Nelumbo engineered a complete conversion to a modern brushless excitation system. This involved in-situ machining of the turbine shaft, precision mechanical coupling, dynamic balancing, and a redundant brushless AVR system with dual digital regulators.



## The Result

The plant now operates as a fully brushless generator system, ensuring zero brush/slip-ring maintenance, enhanced reliability and voltage stability, improved redundancy, and reduced lifecycle costs – all completed within the planned shutdown window.

...the way forward...

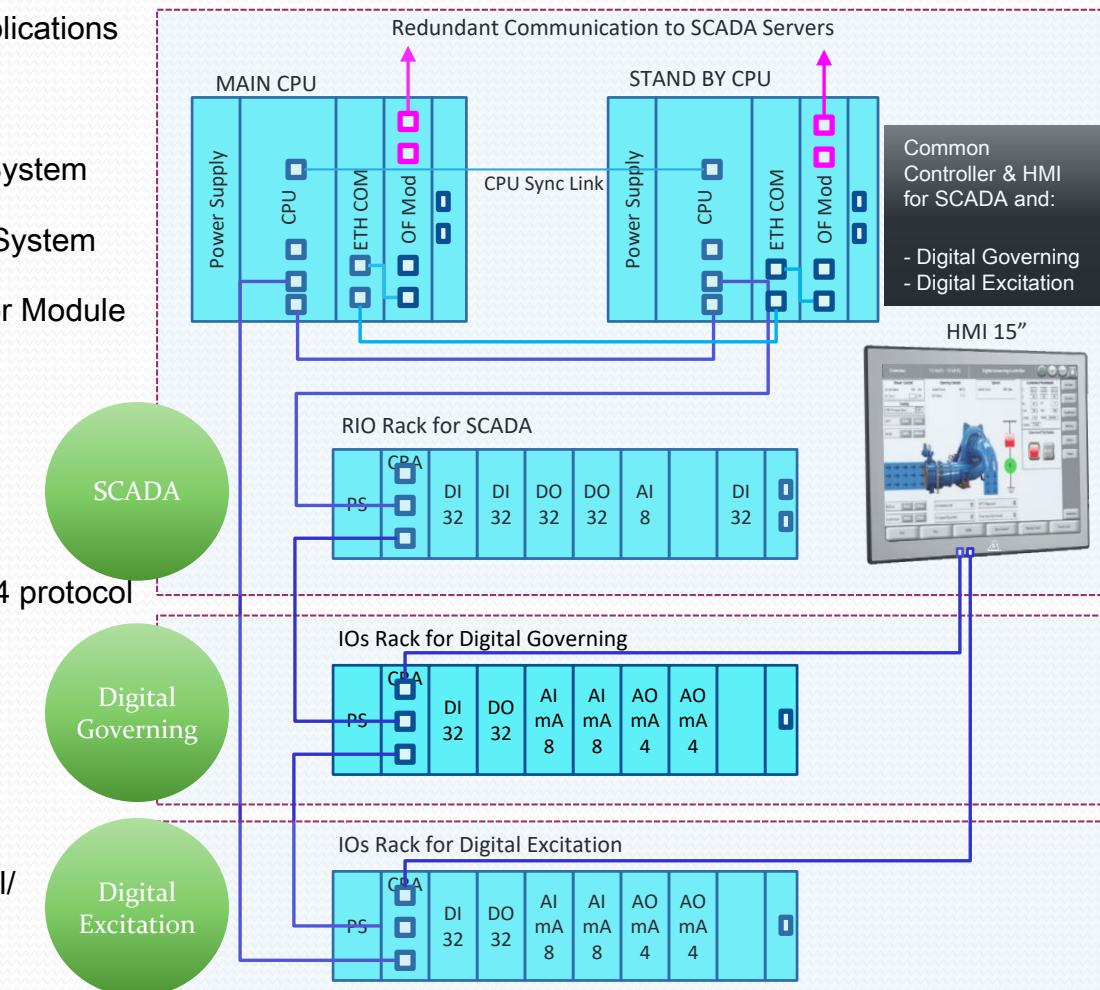
...the way forward...

## Combined SCADA, Digital Excitation, Digital Governing & Data Telemetry

- ❑ Redundant/Stand alone PLC CPUs for all applications
- ❑ 15" Capacitive Touch Screen HMI
- ❑ Add on IO rack for Digital Excitation Control System
- ❑ Add on IO rack for Digital Governing Control System
- ❑ Redundant/Non redundant Excitation Thyristor Module
- ❑ Aux system monitoring & control
  - ✓ MIV, OPU, LOS, Cooling system etc
- ❑ 3<sup>rd</sup> party/Remote com port, Modbus TCP/IP
- ❑ Communication gateway for LDC over IEC104 protocol

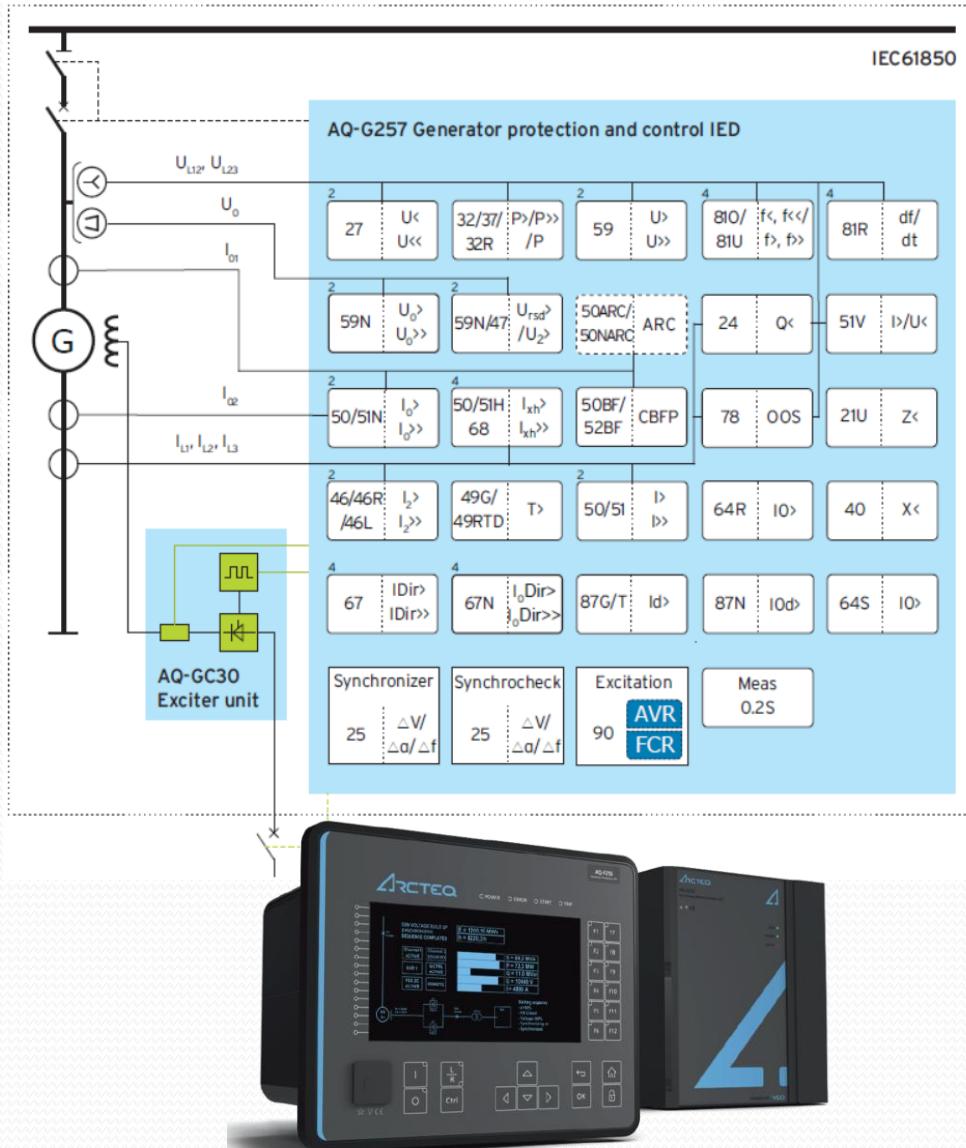
### Advantage over conventional Systems:

- ❑ Simpler design, Less space requirement
- ❑ Ease of Operation, Ease of Trouble Shooting
- ❑ Cost optimization as less external/interconnection wiring
- ❑ Shorter project commissioning schedules



...the way forward...

## Combined Generator Protection & Excitation Module





Power Generation

Power Automation

Operation & Maintenance

#### Mechanical Package

- Turbine
- MIV & OPUs
- Auxiliary systems
- EOT cranes

#### Electrical Package

- Generator with Excitation Systems
- Plant automation with Digital Governing
- Switchyard with SAS
- Protection, Lighting, Earthing systems

#### Engineering Services

- Plant Engineering Services
- Site installation Services
- Onsite O&M & AMC support
- Condition Based Monitoring (CBM)

# From River to Grid

## Hydraulics That Deliver



## Production Facilities

Ahmedabad, GJ  
**Year 2026 NEW!!**  
**(20,000 Sq.Mtr)**



2026  
**NEW!**

Navi Mumbai, MH  
(5000 Sq.Mtr)



Coimbatore, TN  
Plant-I (10197 Sq.Mtr)



Coimbatore, TN  
Plant-II (12750 Sq.Mtr)



# Coimbatore Plant II

## Inside View

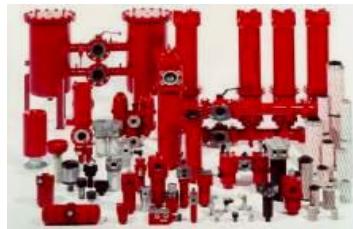


# Hydac Product Range

## HYDAC TECHNOLOGY



## HYDAC FILTERTECHNIK



## HYDAC FILTER SYSTEMS



## HYDAC PROCESS TECHNOLOGY



## HYDAC ELECTRONIC



## HYDAC FLUIDTECHNIK



## HYDAC ACCESSORIES



## HYDAC SYSTEM



**HYDAC**

**INTERNATIONAL**

# Hydac Product Range

## HYDAC COOLING



## HYDAC PRODUKTIONSTECHNIK



## HYDAC SERVICE



## HYDAC INTERNATIONAL



## Hydac, Group of companies

### HYDROSAAR HYDAC INTERNATIONAL



### Nordhydraulic HYDAC INTERNATIONAL



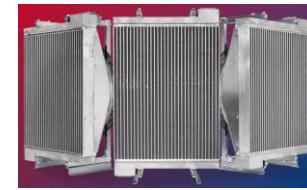
### Q|H|P.co.uk HYDAC INTERNATIONAL



### BIERI HYDAC INTERNATIONAL



### FUNKE



**HYDAC** | **INTERNATIONAL**

- Oil contamination is common during operation and causes abrasion in pumps, precision valves, actuators and other equipment in the circuit and may result in their malfunction or even premature failure.
- The main sources for the water ingress are insufficient bearing sealing, precipitation, humidity, oil-refill (new oil), splash water, underwater applications and cleaning operations.

Oil treatment is necessary to counteract

- Deterioration of condition due to dust or external elements ingress
- Moisture ingress

## CS 1000

The Contamination Sensor CS1000 series is a stationary particle sensor for the continuous recording of solid particle contamination in fluids. The output of the cleanliness class can be selected to be in accordance with either ISO, SAE or NAS.



## AS 2000

The AquaSensor AS 2000 is used for measuring and displaying the saturation level with water and the temperature in hydraulic and lubrication systems. The AquaSensor measures online the saturation level in percentage, independent of oil type, oil age and temperature.

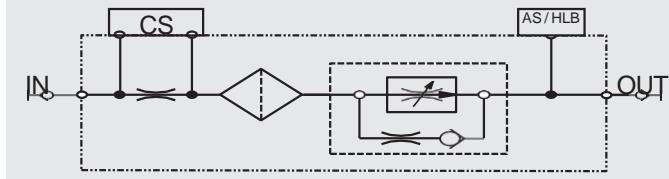


## FMM (Fluid Monitoring Module) Block

The FluidMonitoring Module FMM series combines the ConditionMonitoring products ContaminationSensor CS 1000 and AquaSensor AS 1000 from HYDAC in a single system. It serves the user as a robust and stationary system



Hydraulic circuit diagram



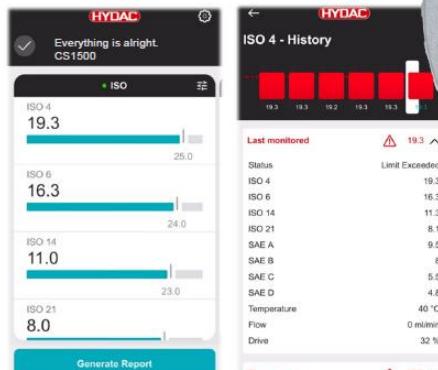
# CS1500 : Next generation Oil Condition Monitoring solution

## Simple | Smart | Connected



### Digital Interface

- Remote wireless access to sensor
- Device configuration with smartphone
- Measurement data visualization
- Cleanliness limits Wizard
- Embedded contamination handbook
- Advanced reporting via logs, screenshots and \*.pdf/ \*.csv



### Optional Physical Interface



Try new sensor interface!



### Communication Technologies

- Wireless Interface
- RS485 (HSI + ModBus RTU)
- Switch-Out (push-pull)
- Analog-Out (4...20mA)
- Ethernet (HSI, ModBus TCP)
- New interfaces e.g. CAN, MQTT or IO-Link in future



### Data Acquisition & Analysis

- Raw data acquisition and pre-processing
- Standard data interpretation acc. ISO/NAS/SAE
- Device memory for 20.000 events - depends on configuration, logging time from months to years
- 10 last events visually available as histogram for user via digital interface
- Advanced data interpretation - Smart Algorithms
  - Adaptive measurement algorithm
  - Turbidity indicator (water, air intake)
- Application-specific custom algorithms
- Sensor condition self-check





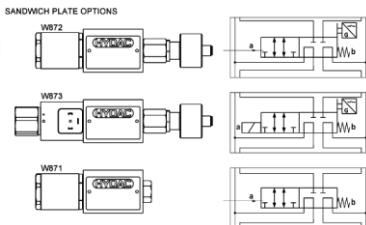
## Virtual Fluid Lab

- ✓ Intelligent algorithm to determine the **Remaining Service life of Filter** elements
- ✓ Can be used in all systems, requiring a continuous, intelligent monitoring.
- ✓ Suitable for both Stationary and Mobile applications.



## Smart Monitoring of Accumulator Pre-Charge Pressure

- ✓ Installation on the liquid side
- ✓ Easy to retrofit
- ✓ Signal output, if  $p_0$  is too low – Very important for Emergency Function
- ✓ Predictive planning of maintenance intervals



## Spool Position Monitoring valves

- ✓ Emergency Shutdown
- ✓ Hydraulic Operated / Solenoid Operated
- ✓ Important to know spool condition hence functional reliability

# Customized Training Programs

## For future ready team



To meet the growing demand for expertise in industrial and automation technologies, we offer excellent training facilities within our domain of specialization. We are proud to continue supporting knowledge seekers through our established training initiatives, which are designed to benefit customers, end users, technology partners, and educational institutions alike.

Our application-driven and hands-on training modules empower participants to enhance workplace procedures, identify errors more efficiently, and boost overall productivity.

- Basic Industrial / Mobile Hydraulics
- Advanced Hydraulics with Servo & Proportional technologies
- Industry / Application Segment specific customized training modules

For details on available schedule and training agenda, please get in touch with us.

## Major Customers

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GE Renewable Energy



INTERNATIONAL

# Components and Systems for every application

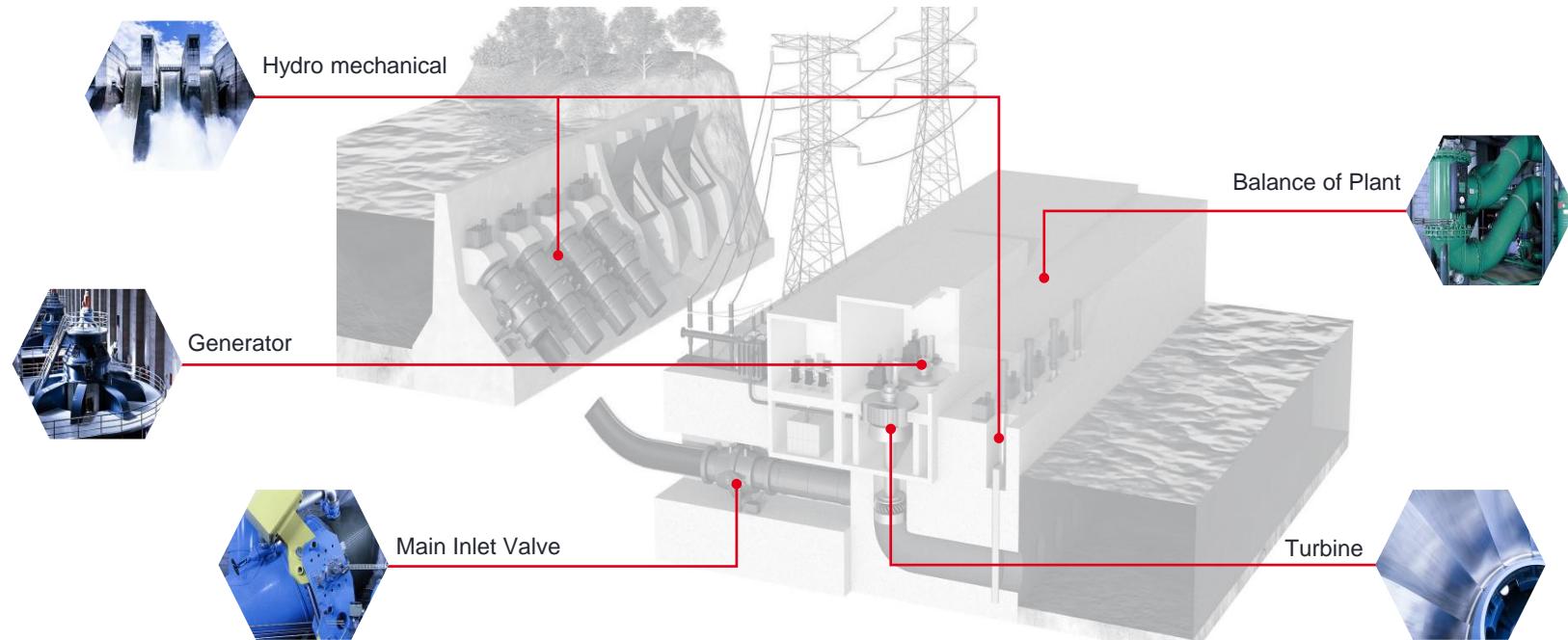
- Hydro Power
- Thermal Power
- Oil & Gas
- Steel Industry
- Bulk Material Handling
- Industrial Valves
- Rubber Machinery
- Marine
- Industry 4.0
- Didactics
- Wind
- Mobile
- M/c Tools



**HYDAC**

**INTERNATIONAL**

# HYDAC Applications in Hydropower

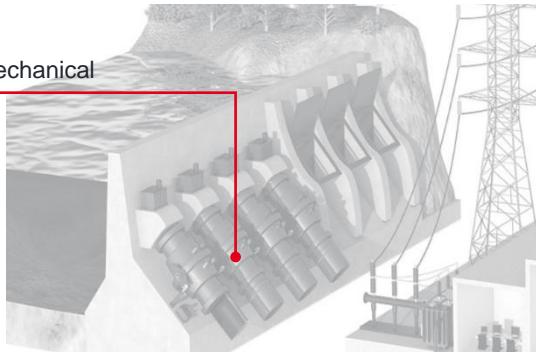


# HYDAC Applications in Hydropower

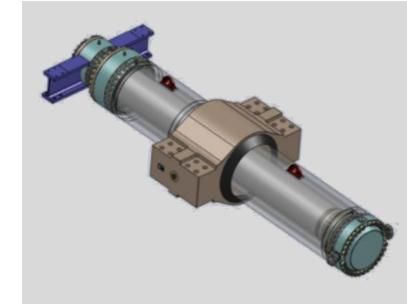
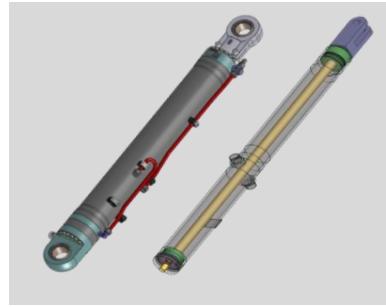
## Hydro mechanical



Hydro mechanical

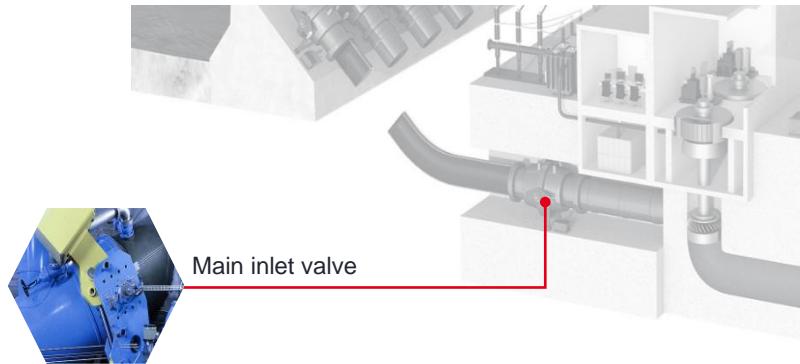


- Hydraulic power units (HPU)
- Various Cylinders

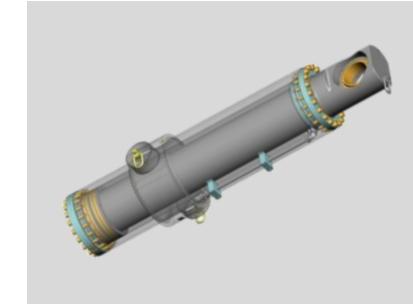


# HYDAC Applications in Hydropower

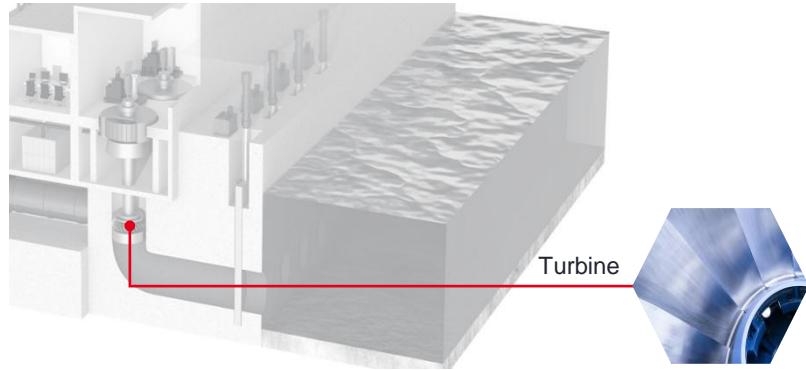
## Main inlet valve



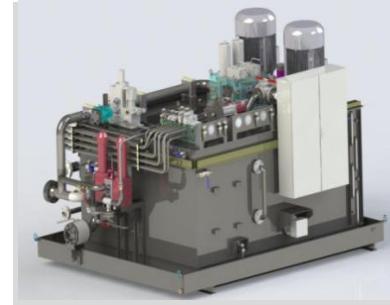
- Hydraulic power units (HPU)
- Accumulator stations for emergency shut-off
- Various Servomotors types (Cylinders)
- Safety filter for water operated Servomotors



# HYDAC Applications in Hydropower Turbine



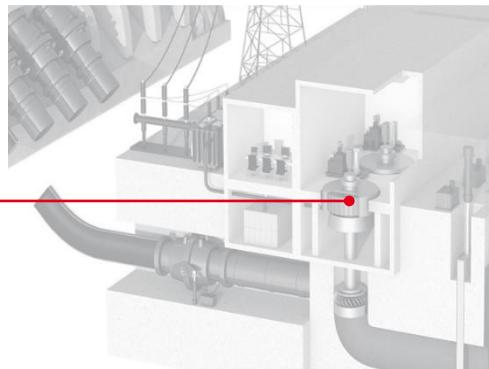
- Hydraulic governor systems
- Accumulator stations for emergency shut-off
- Servomotors for all turbines types
- RF3-skids for sealing and cooling water



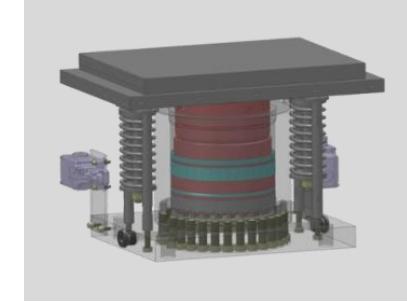
# HYDAC Applications in Hydropower Generator



Generator



- Oil cooling systems for various bearings
- Cooling water filtration of lubrication
- High pressure systems to lift the rotor during start-up
- Brake cylinders for lifting and braking



# HYDAC Applications in Hydropower Balance of Plant (BoP)



- Process filter for cooling water and fire fighting water filtration
- Condition Monitoring Products
- Nitrogen charging units for accumulator maintenance
- Filter Systems for service and maintenance



Thank you  
for your interest

**Contact:**

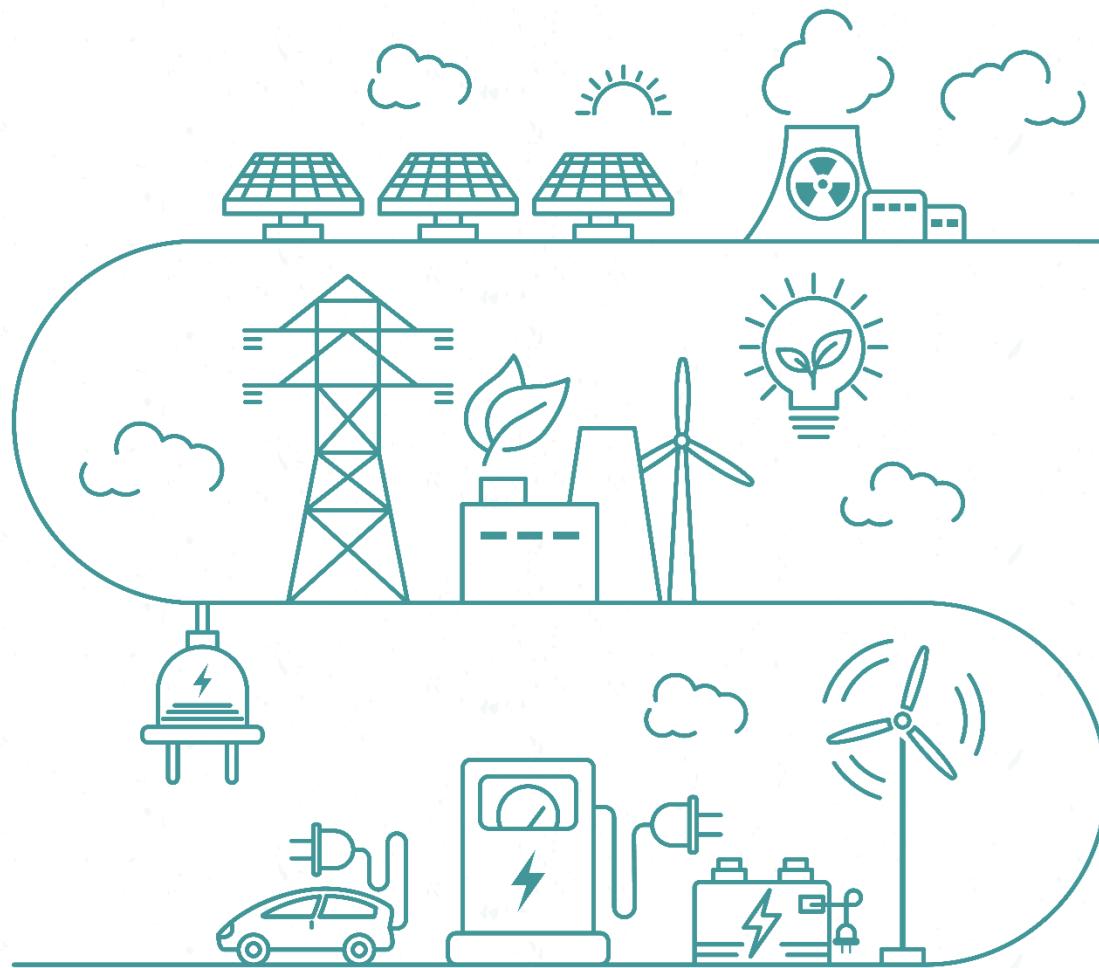
Swatantra Singh Lodhi

Hydac India Pvt Ltd.

Phone: +91 9560069992

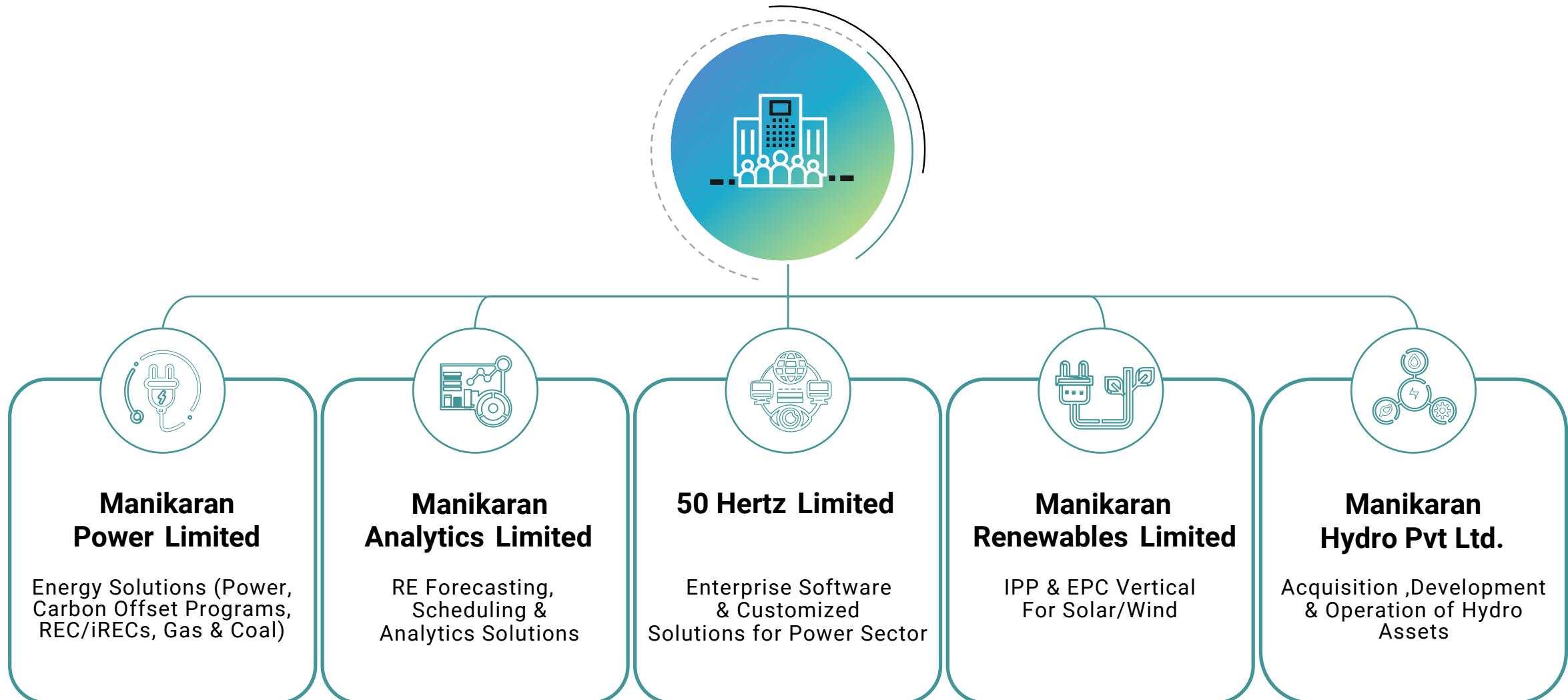
E-Mail: [Lodhi.ss@hydacindia.com](mailto:Lodhi.ss@hydacindia.com)





# MANIKARAN GROUP

# Manikaran Group Structure



# Manikaran Power Ltd

Energy Solutions Company in Power, Coal and Gas

**Category-I**  
Inter-State  
Trading Licensee

**500 Million**  
USD  
FY24  
Turnover

 **2500+**  
Clients



**100+**  
Employees



**11+**  
Billion Units  
Annual  
Traded Volume

## Awards by IEX

**Highest Registered  
Clients  
(Electricity), Highest  
REC  
Volume and Highest  
Electricity Volume  
Member**

**BBB+** Long  
Term Credit Rating

## Our Collaborations

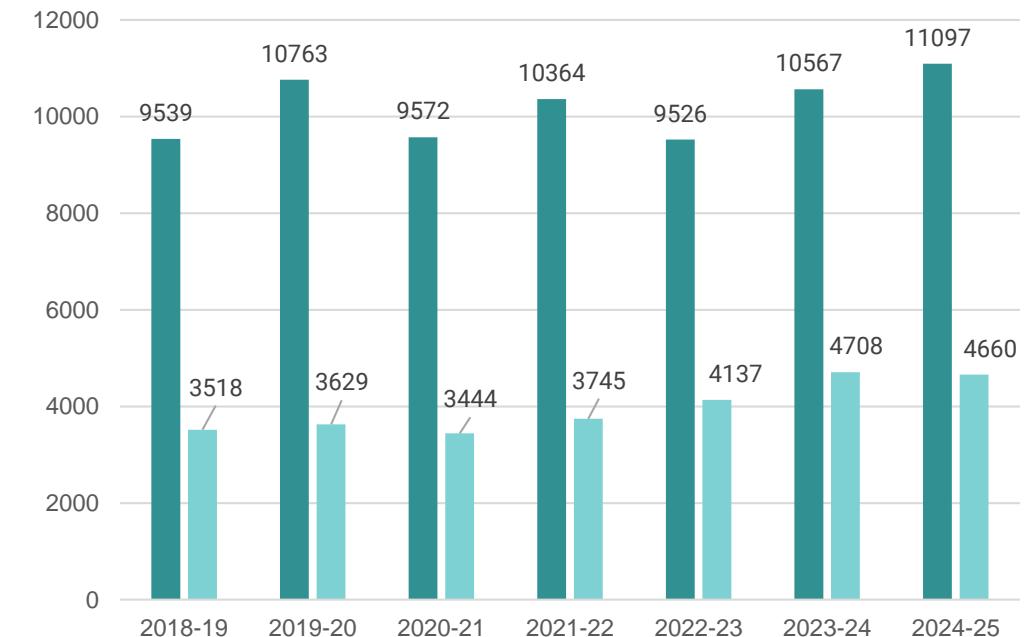


## Certifications

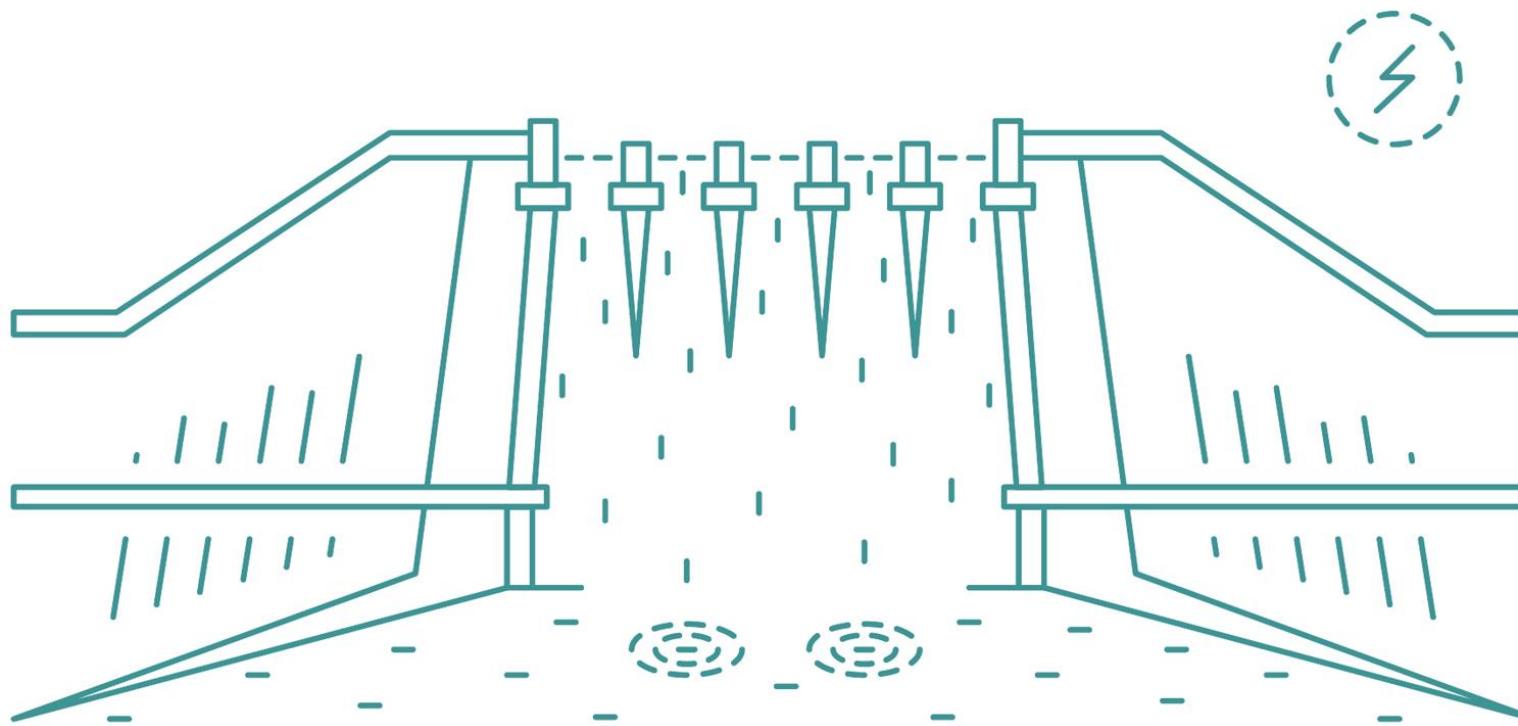


## Financial Performance

Traded Volume (MUs), Turnover (₹ Cr)



■ Traded Volume (MUs) ■ Turnover (₹ Cr)



**Manikaran  
Hydro Pvt Ltd**



10 MW (2 X 5 MW )  
(Upper Khauli and  
Drinidhar)

Acquired  
& Operational



Acquired  
& Under  
Construction

4.8 MW – SHP  
(Indira Priyadarshini Hydro  
Power Private Limited )

# Power Market Opportunities

## Power Market

Long/Medium Term

Short Term

Competitive  
Bidding

Bilateral  
Contracts

Power  
Exchange

Competitive  
Bidding

3<sup>rd</sup> Party  
Bilateral

Hydro generator can  
Participate in the  
tenders published by  
DISCOMs

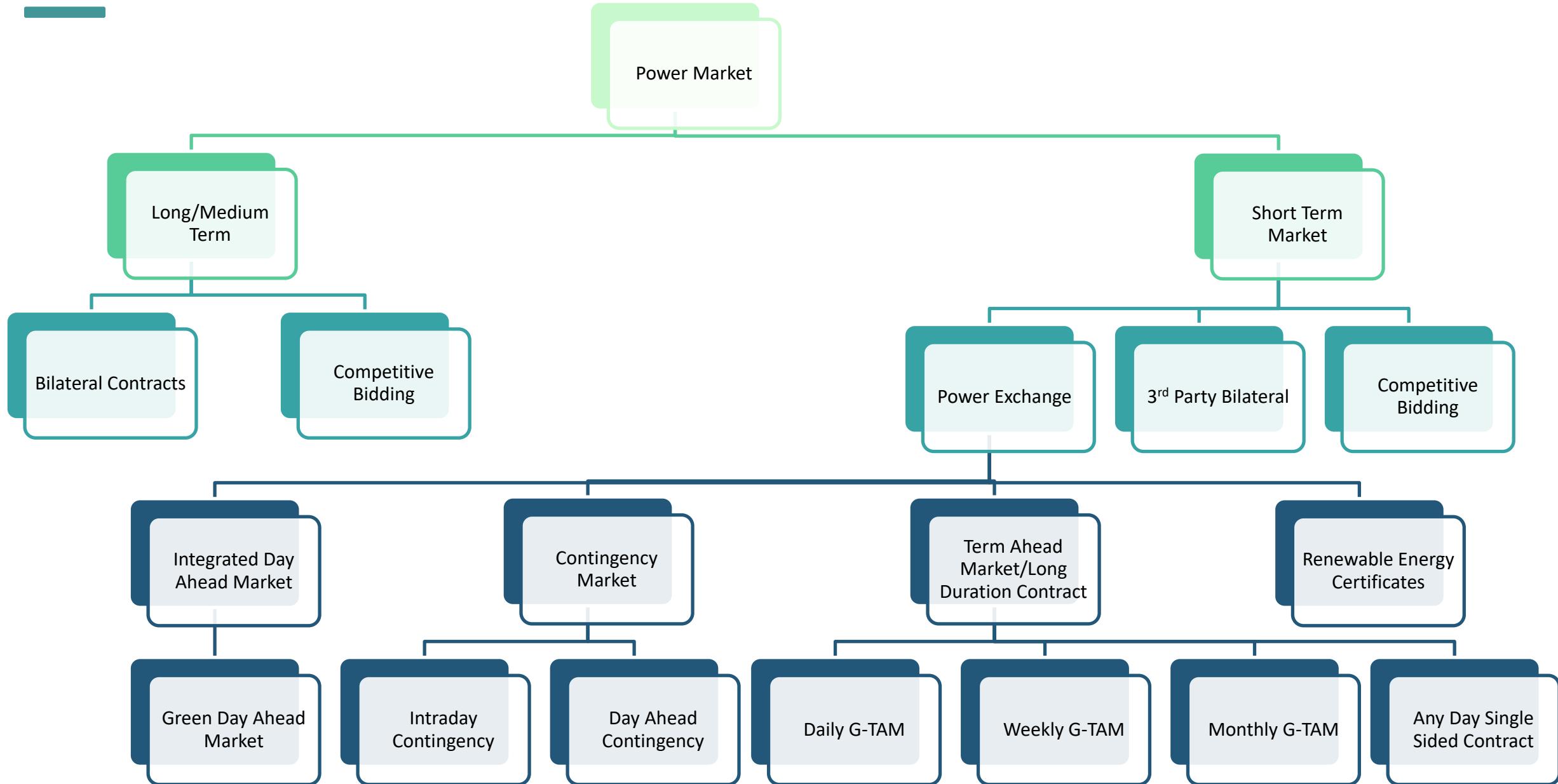
Hydro generator can  
contract with  
consumers/DISCOMs

Hydro generator can  
sell power through  
power exchanges

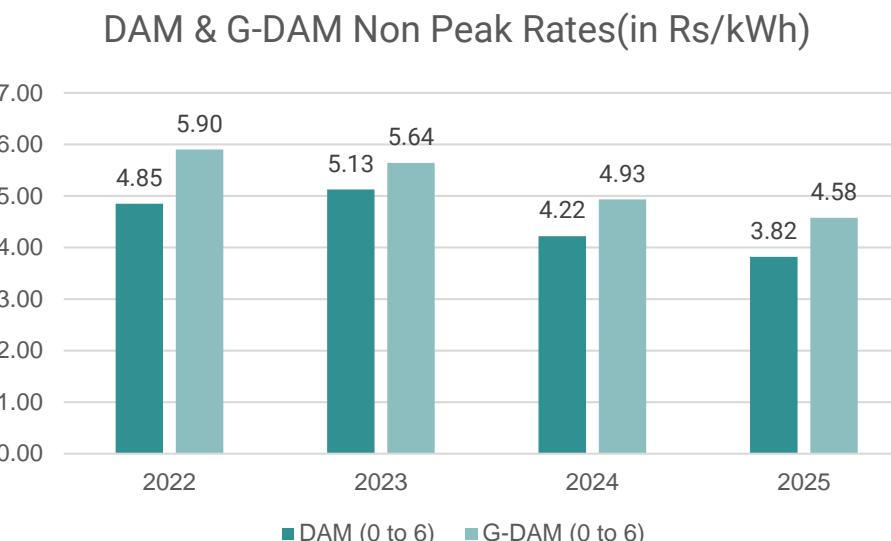
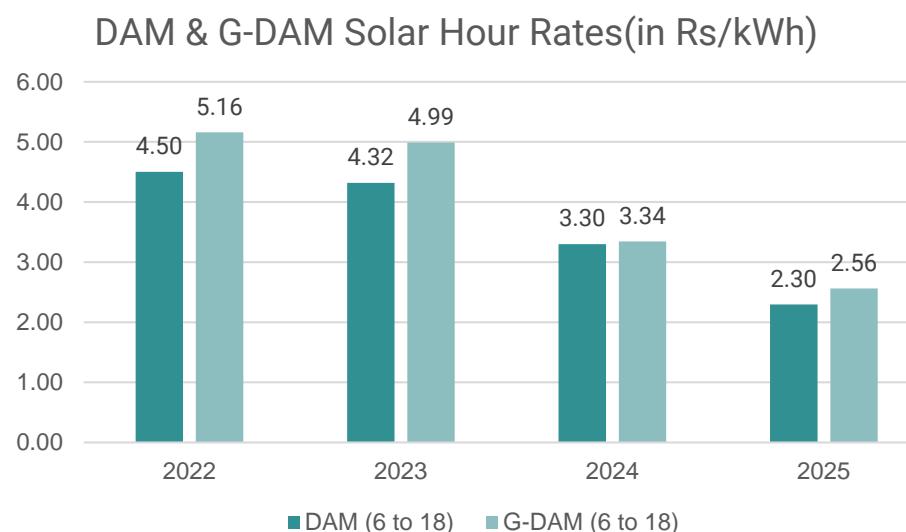
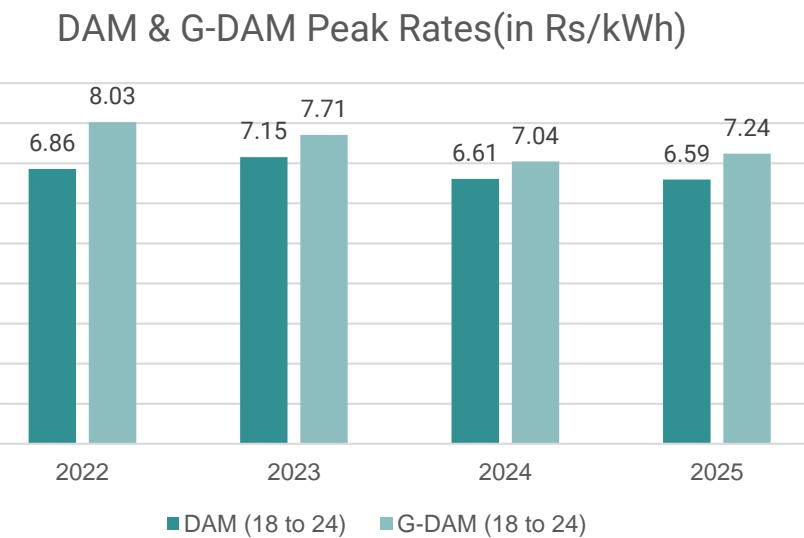
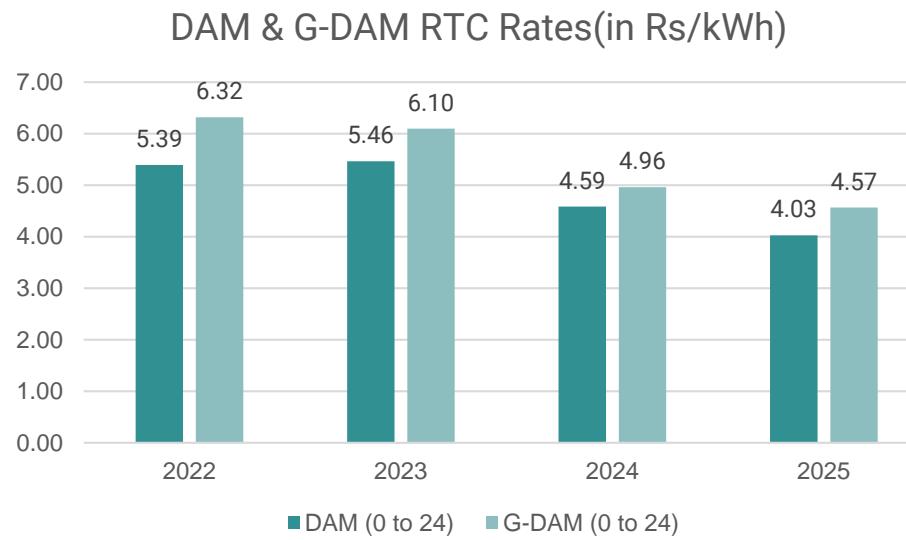
Hydro generator can  
Participate in the  
tenders published by  
DISCOMs

Hydro generator can  
sell power to  
consumers

# Power Market Segments



# Power Exchange Rates



# Opportunities for Sale of Power for Small Hydro

S. No.	Power Sale Opportunities	Tenure of Contract	Tariff
1.	Sale of Power to Nodal State Utility under preferential tariff	Long Term (Life of the Project)	Fixed tariff for entire contract period.
2.	Sale of Power on Power Exchange	1 to 90 days	Prices are discovered based on closed auctions (Volatile in Nature)
3.	Sale of Power under Group Captive Model	3-15 years	Prices are determined based on the Consumer Breakeven Tariff.
4.	Sale of Power Under 3 <sup>rd</sup> Party Bilateral Contracts to C&I Contracts	As Per Mutual Agreement	Prices are determined based on mutual consent.
5.	Sale of Power under Tender floated by State Utilities	Mentioned in tender document	Prices are discovered using Reverse Auction.



# THANK YOU



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