IEA TCP HYDROPOWER - Annex XVI
Hidden and Untapped Hydropower Opportunities in Existing Infrastructures
ON-LINE WORKSHOP PROGRAM: Task 2 session

When	What	Who
11:55 - 12:35	**Task 2 - Portfolio of cases study on refurbishment projects aiming to improve performance and production of existing HPP**	**Chair: Y. Miyanaga**
11:55 – 12:05	Presentation of the tasks and case histories in Japan Introduction from Japan	Y. Miyanaga
12:05 – 12:15	Short overview of 1-2 recent projects in USA	C. Hansen
12:15 – 12:25	Methodology to identify refurbishment opportunities & case studies in Switzerland	C. Nicolet
12-25 – 12:35	Discussion – Wrap up	Y. Miyanaga

Overview of Task 2 and Case Histories

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Task 2 Leader

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Overview of Task 2

Objective

- To identify Hidden and Untapped Hydro Opportunities (HUHOs) from existing hydropower improvements through case history studies.
- To provide a methodology for further development of HUHOs.
- The result will contribute to an overall target of the Annex XVI.

Work plan

- Review of methodologies for improving performance
- Case history study
- Preparation of the report

Scope of case histories

Type of projects

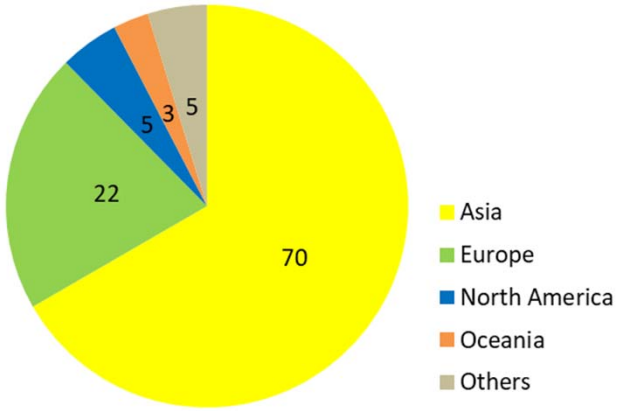
I. Renewal and upgrading of existing facilities
II. Expansion and redevelopment of existing facilities
III. Operational improvement of existing hydropower plant

Requirements for HUHOs

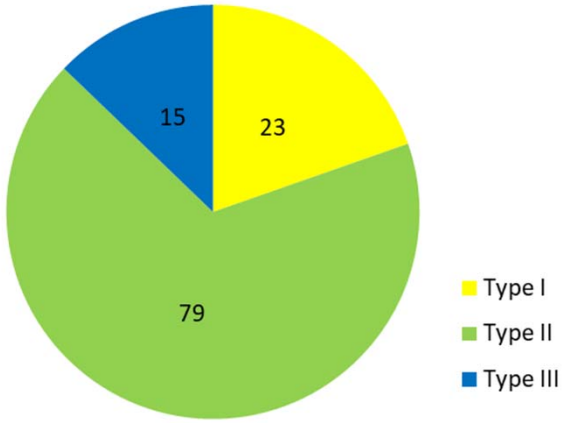
A) Development of untapped potential
B) Technical innovation/ advancement
C) Response to the market/ social needs

Status of case history study

- Based on the project type and the requirements for HUHOs
- Source: Annex XI, Annex XV and other literature
- 105 case histories have been collected as of April 2021.

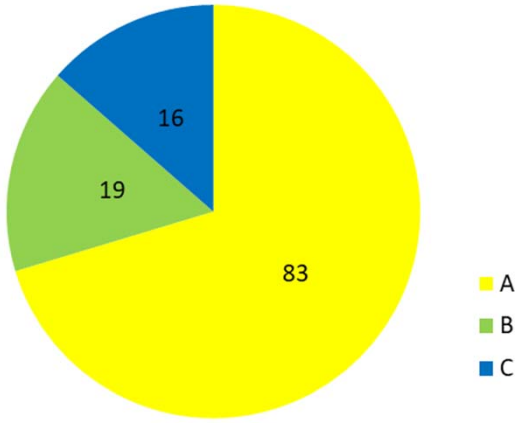


By region



By project type

Some projects overlap between types



By requirement

Some projects overlap between requirements

Characteristics of case histories: Type I

- Renewal and upgrading projects

Requirements	Major characteristics	No. of cases
A) Untapped potential	Utilization of untapped potential in river flow/reservoir Water diversion from other catchments	9
B) Technical innovation	Improvement of durability of turbine/generator (Ex. 1) Improvement of partial load efficiency of turbine/generator Reuse of existing parts and downsizing of renewed facilities Improvement of flow capacity of headrace channel	10
C) Market needs	Upgrading of frequency control/ phase adjustment functions Improvement of pumped storage function	6

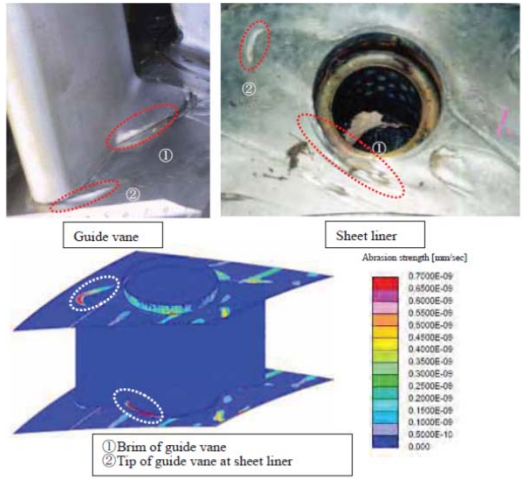
Some cases overlap between requirements

Example (1)

Reduction of sand abrasion of turbine, Himekawa #2, Japan

- Improved design of guide vane shape reducing sand abrasion using solid-liquid two-phase flow CFD analysis and field tests
- Extension of service life and repair interval of turbine.

Himekawa #2 refurbishment	
Project period	2005-2010
Turbine type	Francis
Max output (MW)	7.2 × 2units
Maximum discharge (m^3/s)	10.3
Effective head (m)	164.55



Sand abrasion and CFD analysis

Characteristics of case histories: Type II

- Expansion and redevelopment projects

Requirements	Major characteristics	No. of cases
A) Untapped potential	Utilization of environmental flow (E-flow) from dam Utilization of untapped potential in river flow, reservoir, channels, etc. Utilization of unused water head at dam (Ex.2)	69 (34 for E-flow)
B) Technical innovation	New construction of power plant utilizing unused river flow in existing power plant with advanced technologies Improvement of capacity factor by downsizing of turbine/generator	3
C) Market needs	Increase of peak supply capacity by expansion Expansion of pumped storage power plant Addition of pumped storage function at existing power plant	10

Some cases overlap between requirements

Example (2)

Utilization of unused water head, Shin-Taishakugawa, Japan

- Refurbishment of 80-year-old dam and construction of new power plant to increase net head from 95.2m to 129m
- Existing plant downsized but total maximum output increased by 204%

Shin-Taishakugawa redevelopment	Before project	After project
Year of commission	1924	2006
Maximum output (MW)	4.4	11
Maximum discharge (m^3/s)	5.7	10.0
Effective head (m)	95.2	129.0
Dam height (m)	62.1	62.4

The aged dam was reinforced in structure and increased its spillway capacity.

Characteristics of case histories: Type III

- Operational improvement

Requirements	Major characteristics	No. of cases
A) Untapped potential	Water diversion from other catchments	7
B) Technical innovation	Extension of flow range for power generation (Ex. 3) Improvement of capacity factor by downsizing turbine/generator Optimization of intake discharge management Improvement of flow capacity of headrace channel Refinement of reservoir inflow prediction (R&D)	14
C) Market needs	Extension of flow range for power generation (Ex. 3)	1

Some cases overlap between requirements

Example (3)

Extension of flow range for power generation, Valeira, Portugal

- A systematic methodology for range extension has been developed and applied to EDP's existing plants in Portugal.
- Applicable to many sites and increasing operational flexibility

Valeira, extension of flow range	
Project implementation	2019
Turbine type	Kaplan
Output (MW)	82 × 3units
Maximum discharge (m^3/s)	360
Net head (m)	28.5

Valeira HPP, run-of-river type

Summary and request for participants

- Many cases on utilization of untapped potential, innovative/advanced methodologies and response to the market needs can be identified through the case history study.
- The categorization of projects and requirements for HUHOs with case histories in this study is helpful to systematically identify HUHOs in the improvement of existing hydropower performance.
- The methodology can be applicable to a wide range of modernization projects by increasing the number and quality of case histories.
- Case histories from the annex members and WS participants are welcomed!
  - **Please contact hydropower-2@jepic.or.jp**

Thank you for attention!