Water Resources Engineering and Management

(CIVIL-466, A.Y. 2024-2025)

5 ETCS, Master course

P. Perona, M. Leite-Ribeiro and M.P. Bieri

Junjia Kang, Giulio Calvani

Practical Work : Case study hydropower optimal water allocation and financial study

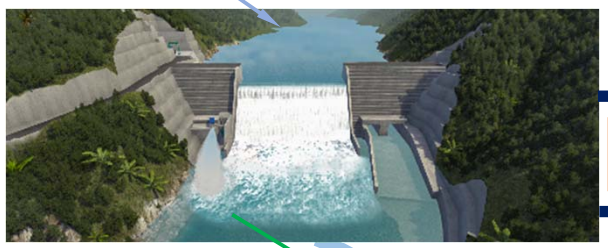
Content and Goals

- Define **cashflows** of a hydropower project
- Develop **discounted cashflow model**
- Perform **economic analysis** by defining corresponding IRR and NPV
- Perform **financial analysis** and assess project from investors' and lenders' point of view

Part 4

Part 5

Case Study



Inflow

Ecological flow

Headworks
FSL = cst

Alternative 2 Waterway L = 17 km

Alternative 1 Waterway L = 11 km

Design discharge:
Q = 100 m^3/s

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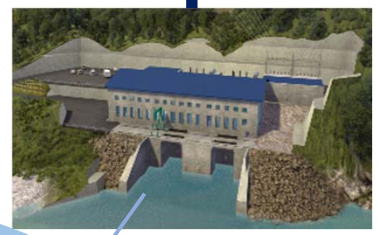
Q = 100 m^3/s

Alternative 1
Powerhouse
Head H_{gross} = 350 m



Alternative 2
Powerhouse
Head H_{gross} = 500 m

Irrigation needs

Case Study – Inflow

Inflow to Headworks:

Month	Inflow Q_m [m³/s]
January	75
February	55
March	52
April	36
May	45
June	75
July	75
August	120
September	143
October	156
November	146
December	100

Assumptions:

Ecological flow: 10% of inflow

Irrigation needs:

- Dry season (January to July): 30% of inflow
- Wet season: 10% of inflow

Case Study – Operation Conditions

Assumptions:

Design discharge:	100 m^3/s
Gross head:	H_{gross}
• Alternative 1:	350 m
• Alternative 2:	500 m
Head losses (const.):	$dH = 5\% H_{gross}$
Net head:	$H_{net} = H_{gross} - dH$
Planned/unplanned outages:	5%
Efficiency:	90%

Electricity tariff

Base Case Scenario:

• Peak:	8h/day	US Sc 6 /kWh
• Off-peak:	16h/day	US Sc 3 /kWh

High Demand Scenario:

• Peak:	8h/day	US Sc 10 /kWh
• Off-peak:	16h/day	US Sc 5 /kWh

Concession period: 20 years

Operation and Maintenance (OPEX):
2% of CAPEX/year

Case Study – Cost Estimate (CAPEX)

Assumptions:

Civil Works:

- Dam (incl. spillway, bottom outlet, power intake, river diversion): USD 120 million
- Waterway: USD 20 million/km
- Powerhouse: 30% E&M cost

Equipment:

- Electromechanical (E&M): USD 0.4 million/MW
- Hydromechanical (HM): USD 50 million

Miscellaneous:

- Contingencies, unmeasured items, indirect cost: 30% of cost

Construction time: *3 years*

Case Study – Economic Assessment

Assumptions:

Cost disbursement:

- Start of year 1: 10%
- Mid of year 1: 25%
- Mid of year 2: 30%
- Mid of year 3: 35%

Discount rate: 6%

Construction time: 3 years

Project tasks (Week12 – 12/05/2025)

Your tasks today:

Use spreadsheet: WREM-project_4_for students.xlsx

Exercice 4.1:

Define construction cost for both alternatives.

Exercice 4.2:

Define mean annual revenue for both alternatives.

Exercice 4.3A:

Define the project cashflows and prepare the discounted cashflow model.

Exercice 4.3B:

Define economic IRR and NPV for both alternatives.

Exercice 4.3C:

Compare the two alternatives in regard of IRR and NPV and discuss their economic attractiveness.