Project cycle and planning tools

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ECOWAS Regional Centre for Renewable Energy and Energy Efficiency
Regional Workshop on Small Scale Hydropower

Project cycle and planning tools

- Course of planning and implementing
- Timelines (examples) for different types of hydropower projects.
- Relevance of common tools for analyses and planning.
- Presentation of planning/appraisal tools such as RETScreen, HOMER

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The 'classic approach' for project preparation and implementation hydropower projects

Project Preparation	Project Implementation
1. **Desk study**	1. Tendering
2. **Initial site assessment / Reconnaissance visit**	2. Contracting
3. **Pre-feasibility study**	3. Construction & installation
4. **Feasibility study**	4. Testing & commissioning
5. **Detailed design**	5. Normal operation (Operation and Maintenance)

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Pre-Feasibility and Feasibility Study
Purpose

pre-Feasibility Study	Feasibility Study
• **Defines and compares several options** for development / layout – ease of construction – costs – operational aspects – environmental impact – etc. • Detailed description of the rationale for selection of the most attractive option.	• **Detailed analysis** of the most attractive option. • Detailed **design**, allowing **accurate cost estimates** (BoQ) (not yet construction design / site drawings) → Allows **final decision** for developer → **'Bankable'** document

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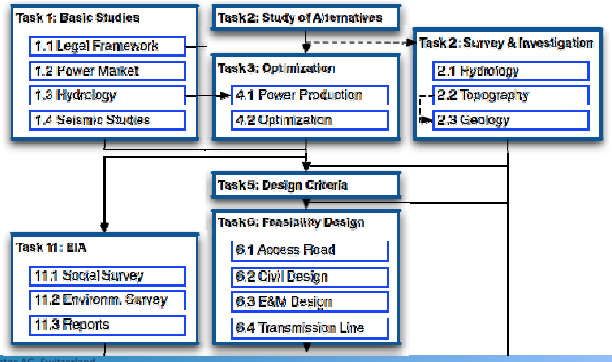
Typical structure / scope of works for a feasibility study for large HPP (1)



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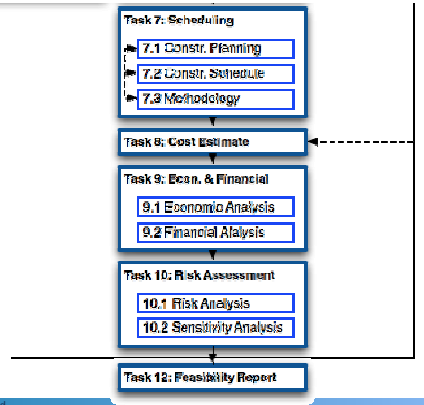
Typical structure / scope of works for a feasibility study for large HPP (2)



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The expected accuracy of cost estimates depends on the stage of development

Level	Usual assumed error	Approach
Desk Study	approx. 30%	Based on cost for similar projects
Initial Site Assessment		
pre-Feasibility Study	better than 20%	Detailed BoQ based on preliminary design.
Feasibility Study	better then 10%	Detailed BoQ based on FS-level design.

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Project cycle and planning tools (15 min)

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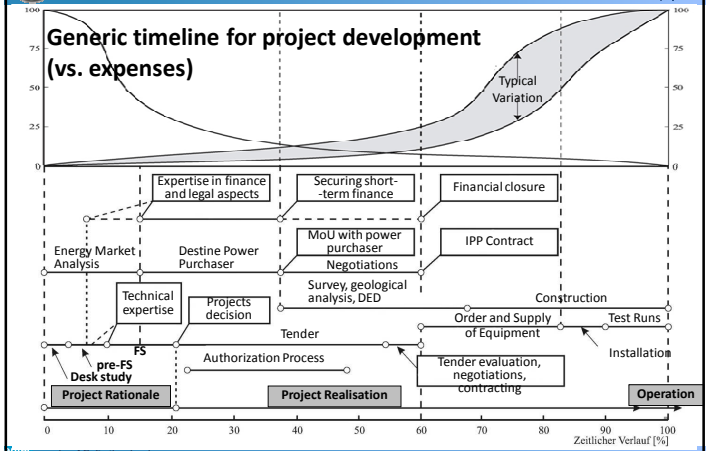
Generic timeline for project development (vs. expenses)



Source: *Wasserkraftanlagen*, Jürgen Giesecke – Emil Mosonyi, Springer, 5th edt. 2009

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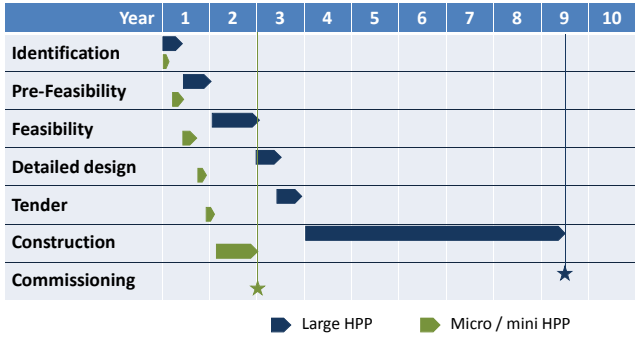
Generic example
Timeline for the development of a hydro power plants



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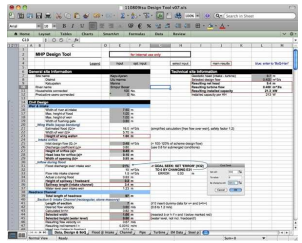
Tools

- In engineering (and analysis) a tool is usually a **specialised software** to fulfil or ease certain tasks.
- Such tools **work well for clearly defined tasks or standardised processes**. In the context of hydropower planning this applies to a number of 'sub-tasks', such as hydraulic calculations, planning / design of the transmission, or financial analysis.
- Most planners and engineers use a large number of **self--programmed tools** (primarily in MS excel) in their work.



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"Common" public domain tools
→ What should be considered, what should be avoided

In many (TA) projects tools were developed and some became available to the public (sometimes intentionally, sometimes not). Also a number of 'tools' of unknown source are circulated and exchanged.

Such tools should be **handled with great caution** as they

- often **do not provide suitable plausibility checks** (therefore may only be used by experienced professionals able to judge the plausibility of results and output and are able to draw appropriate conclusions (i.e. results are generated from any input -> "rubbish in – rubbish out").
- sometimes were **developed for a very specific context** and lack of the flexibility to adjust factors or assumptions to suit other environments.
- are often **poorly documented** (-> a good reason not to use a tool is if calculations can not be retraced or comprehended).
- **not supported** by any organisation or company.

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RETScreen
Clean Energy Project Analysis
Small Hydro Project Analysis

http://www.retscreen.net/

RETScreen Software Hydro Power Model can be used to cover many aspects up to pre-FS level

This software is **well established** (since more than 10 years), is very **well documented and supported**, and can be downloaded for **free**.

The **small hydropower module** can be applied for

- micro to small hydropower
- run-of-river and reservoir schemes
- projects worldwide
- on-grid and off-grid projects

It computes primarily

- **energy production** and emission reductions
- **cost estimates, financial viability** and risk (i.e. sensitivity)

RETScreen (2)

Limitations!
The user enters
- hydrological data (flow-duration curve)
- size and the layout of the required civil structures (basis for cost estimates)

→ **reliable results can only be expected if input is correct**

Available for **download** at
http://www.retscreen.net/
It is highly recommended to also download and study the
e-Textbook for "Small Hydro Project Analysis"
http://www.retscreen.net/ang/textbook_hydro.html

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HOMER
Energy Modeling Software for Hybrid Renewable Energy Systems

https://homerenergy.com/

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Tool for designing and analysing **hybrid power systems**, which contain a mix of conventional generators, combined heat and power, wind turbines, solar photovoltaics, batteries, fuel cells, hydropower, biomass and other inputs.
- on-grid and off-grid
- simulations of energy systems
- projection of their capital and operating expenses
- optimisation and economic feasibility of hybrid systems

→ **Detailed entry of data of specific systems required to allow simulation and optimisation of the ideal mix between various power sources.**

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Thank you for your attention!

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Desk study

- The purpose is to become familiar with the physical, hydrologic and socio-economic profile of the project area without visiting the site by using maps, hydrological data etc.
- In many cases potential sites can already be preliminary be identified and make the subsequent reconnaissance visit much more efficient.
- The desk study may also reveal the absence of a good hydropower potential and time and expenditures for traveling to the proposed site can be saved.
- The accuracy of preliminary cost estimates should be in the range of ± 30%.

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Reconnaissance site visit

- Short (one-day) visit to the proposed site to verify the findings of the desk study:
  - existing hydropower potential?
  - approximate power demand?

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Initial Project Assessment (1)
Usual steps / scope of works

1. Obtain maps (scale 1:50 000 or more detailed) of the project area and locate potential site
2. Know whether the HPP will be grid-connected or off-grid
3. Measure the catchment area upstream of the selected water intake point.
4. Obtain hydrologic data (e.g. flow gauging data) and estimate available stream flow.
5. Calculate minimum and average power output of the selected site.

on-grid	off-grid
6. Investigate closes point for interconnection and feasibility of connection.	6. Calculate approximate power demand of the prospective electricity consumers.

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Initial Project Assessment (2)
Usual steps / scope of works

7. Estimate the flow available or exceeded during 100days per year (or Q_{100} or $Q_{30\%}$)	7. Calculate the minimum capacity of the site (based on minimum flow)
8. Calculate the capacity of the site based on this flow.	8. Compare power demand with minimum electrical power output
9. n/a	9. Investigate alternative sources of electricity supply
10. Calculate energy production cost	
11. Sketch the retained solution of the power supply system	
12. Estimate project implementation cost	
13. Outline project objective and concept	

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pre-Feasibility study

- A pre-FS will usually be conducted to determine which of several proposed projects, sites or technical options are most attractive for MHP development.
- Preliminary assessments are reviewed and worked out with more detail. Development options are worked out and conclusions and recommendations are made in view to which of these options should be further taken to FS-level.
- The accuracy of preliminary cost estimates should be in the range of ± 20-25%.

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Feasibility study

- Assessment whether the implementation of the proposed scheme is desirable or not.
- On the basis of the FS the final decision for or against the project will be taken by the developer and the document shall allow him to present the project to potential lending institutions with sufficiently sound analyses and details.
- The accuracy of preliminary cost estimates should be in the range of ± 10-15%.

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Detailed design

- Preparation of the detailed layout of the scheme, the canal and structure drawings in final detail.
- The detailed design usually includes the preparation of the required tender documents.

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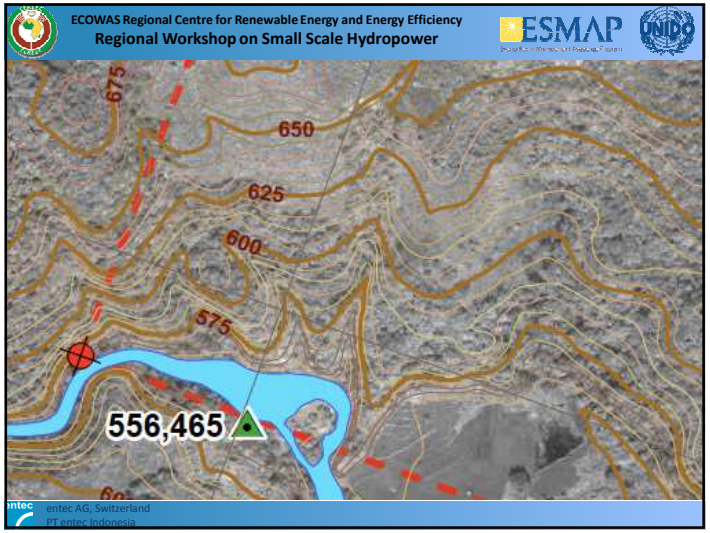
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