August 25, 2011

Day Four 25 August 2011		
RETScreen Training on RE&EE Project Analysis by ECREEE		
Location: KNUST, Kumasi, Ghana		
Time	**Session**	
09:00	**1**	*RETs_2*: **Wind Energy Technology**: Power point presentation - Energy Project Analysis and demonstration of calculation of case studies on Wind power generation
10:30		Tea/coffee/cocoa break
11:00	**2**	Case Studies: Group work – Discussion of group work - comments
12:45		Lunch break
14:00	**3**	*RET_3*: **Mini-Hydro Power Generation** -Power point presentation – example of case study -Case study: Hydro power generation – Group discussions - Project Analysis of case studies from the ECOWAS region to be undertaken by the participants in working groups – Presentation of calculations of case studies by working groups and discussions
15:30		Tea/coffee/cocoa break
16:00	**4**	*RET_4:* **Thermal Energy Analysis** Power point presentation – Solar Thermal heat – Case study –Group discussions *RET_5:* **Biomass based combined heat and electricity generation**
18:30		**End of Day Four**

5. Wind Energy Project Analysis

5.1 Objective

Present wind energy projects analysis using RETScreen

What do wind energy systems provide?

- Electricity for
  - Central-grids
  - Isolated-grids
  - Remote power supplies
  - Water pumping

…but also…

  - Support for weak grids
  - Reduced exposure to energy price volatility
  - Reduced transmission and distribution losses

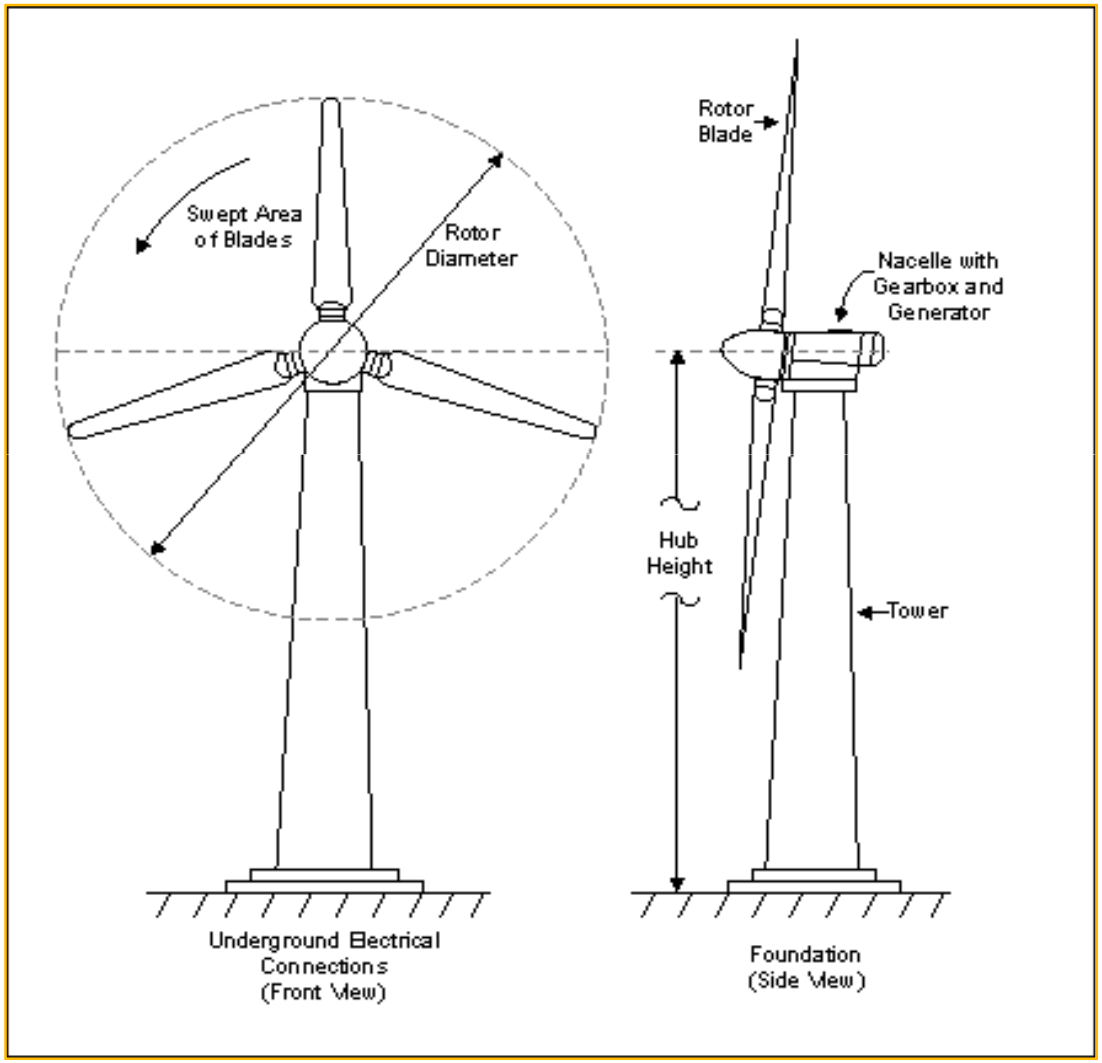
San Gorgino Windfarm, Palm Springs, California, USA

Photo Credit: Warren Gretz/ NREL Pix

Wind Turbine Description

- **Components**
  - Rotor
  - Gearbox
  - Tower
  - Foundation
  - Controls
  - Generator
- **Types**
  - Horizontal axis
    - Most common
    - Controls or design turn rotor into wind
  - Vertical axis
    - Less common

Schematic of a Horizontal Axis Wind Turbine



Utilisation of Wind Energy

- **Off-Grid**
  - Small turbines (50 W to 10 kW)
  - Battery charging
  - Water pumping
- **Isolated-Grid**
  - Turbines typically 10 to 200 kW
  - Reduce generation costs in remote areas: wind-diesel hybrid system
  - High or low penetration
- **Central-Grid**
  - Turbines typically 200 kW to 2 MW
  - Windfarms of multiple turbines

Off-Grid, 10-kW Turbine, Mexico

Photo Credit: Charles Newcomber/ NREL Pix

5.4 Classification des réseaux éoliens

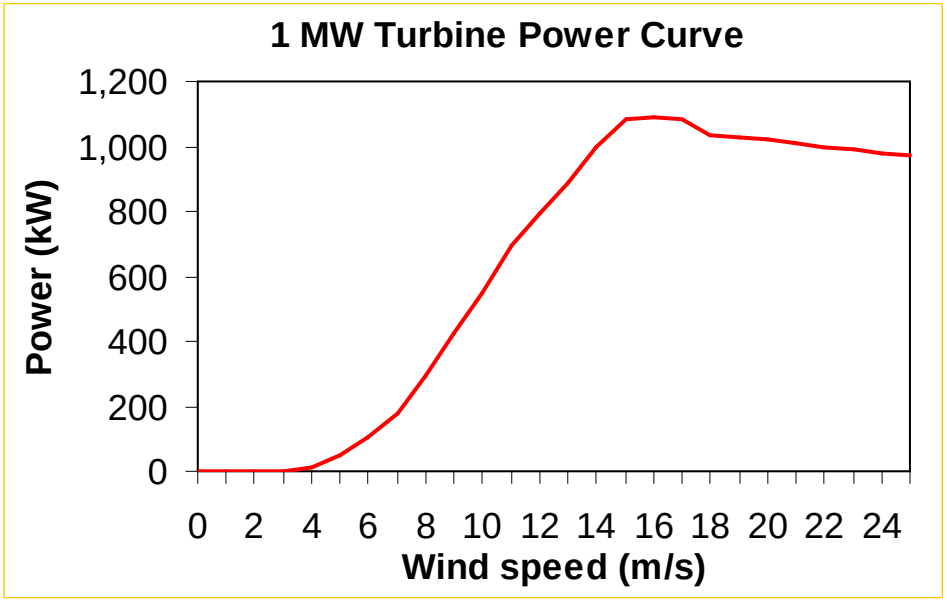
- **Hors réseau**
  - Petites éoliennes (50 W à 10 kW)
  - Chargement de batteries
  - Pompage de l’eau
- **Réseau isolé**
  - Éoliennes de 10 à 200 kW
  - Les systèmes hybrides éolien-diesel réduisent les coûts de production dans les régions éloignées
  - Taux de pénétration élevé ou bas
- Réseau central
  - Éoliennes de 200 kW à 2 MW
  - Parcs éoliens de plusieurs machines

Hors réseau, éolienne de 10 kW, Mexique

Photo : Charles Newcomber/ NREL Pix

Wind Resource

- High average wind speeds are essential
  - 4 m/s annual average is minimum
  - People tend to overestimate the wind
  - Wind speed tends to increase with height
- Good resource
  - Coastal areas
  - Crests of long slopes
  - Passes
  - Open terrain
  - Valleys that channel winds
- Typically windier in
  - Winter than summer
  - Day than night



Examples: Europe and USA
Central-Grid Wind Energy Systems

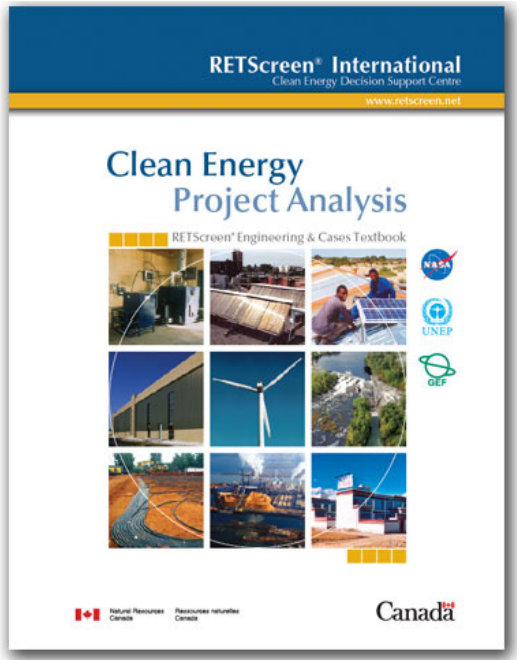
- Intermittent generation not a problem: 17% of Denmark's electricity is from wind with no additional reserve generation
- Quick projects (2 to 4 years) that can grow to meet demand

Photo Credit: Danmarks Tekniske Universitet

Photo Credit: Warren Gretz/ NREL Pix

- Land can be used for other purposes, such as agriculture
- Individuals, businesses, and co-operatives sometimes own and operate single turbines

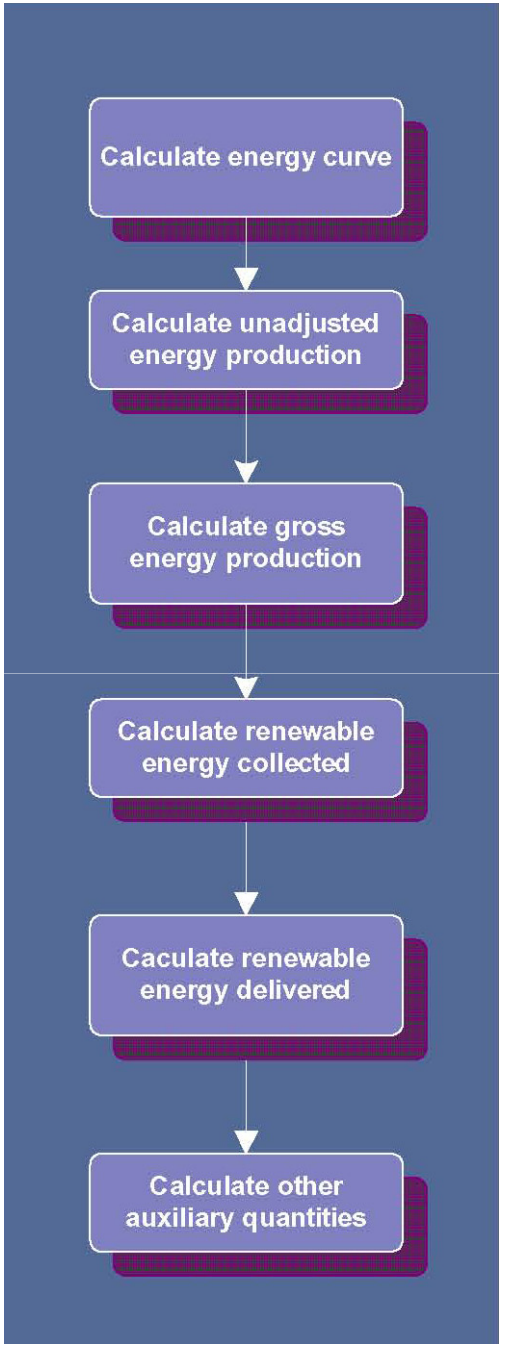
RETScreen®
Wind Energy Calculation



See e-Textbook

Clean Energy Project Analysis:
RETScreen® Engineering and Cases

Wind Energy Project Analysis Chapter



Conclusions

- Wind turbines provide electricity on and off grid world-wide
- A good wind resource is an important factor for successful projects
- Availability of production credits or Greenpower rates are important for on-grid projects
- RETScreen® calculates energy production using annual data with an accuracy comparable to hourly simulations
- RETScreen® can provide significant preliminary feasibility study cost savings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Merci

Next: Energie Eolienne, quelques cas d'etudes pratiques

6. Small Hydro Project Analysis

Run-of-River Small Hydro Project, Canada

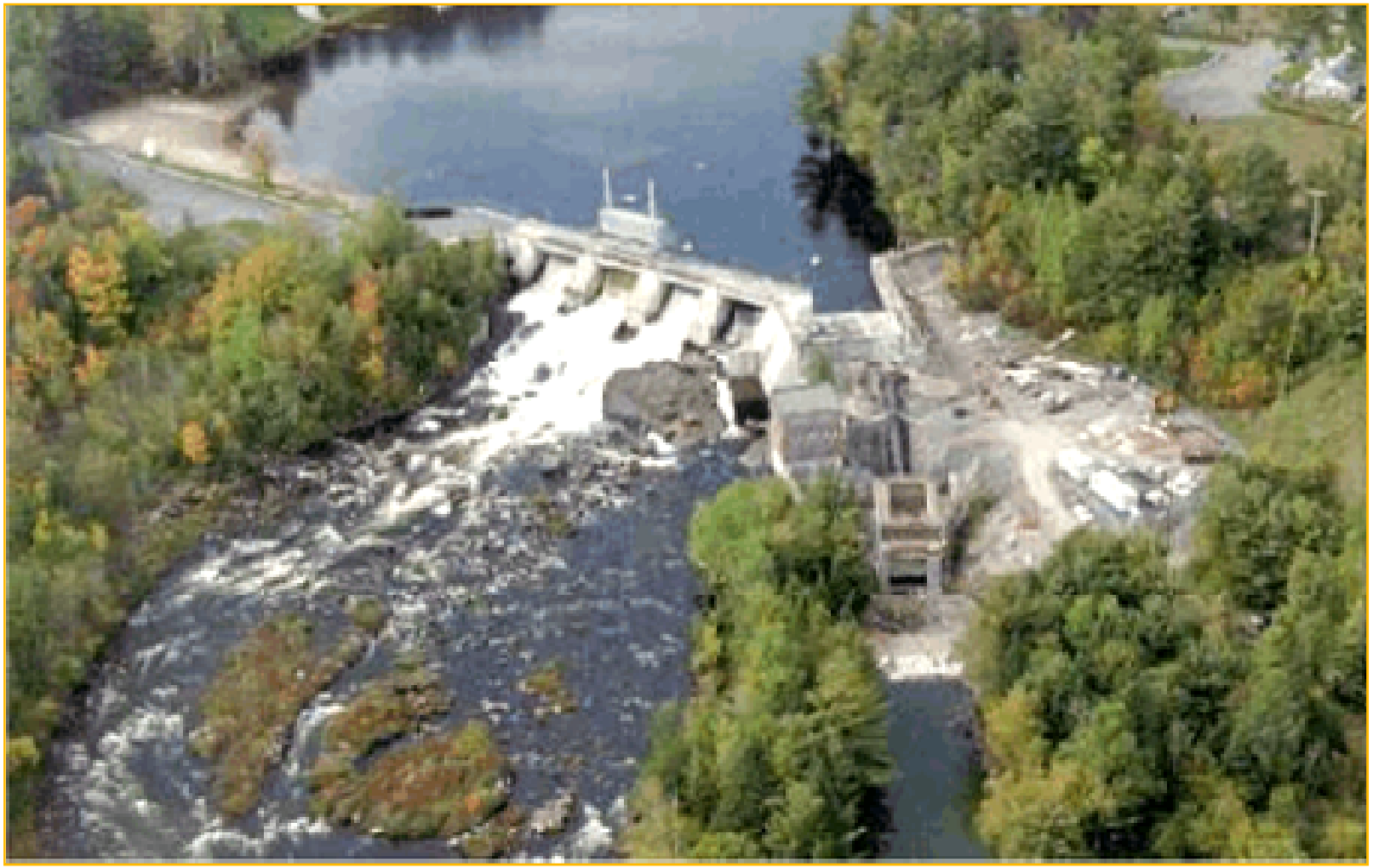


Photo Credit: SNC-Lavalin

Objectives

- Review basics of Small Hydro systems
- Illustrate key considerations for Small Hydro project analysis
- Introduce RETScreen® Small Hydro Project Model

What do small hydro systems provide?

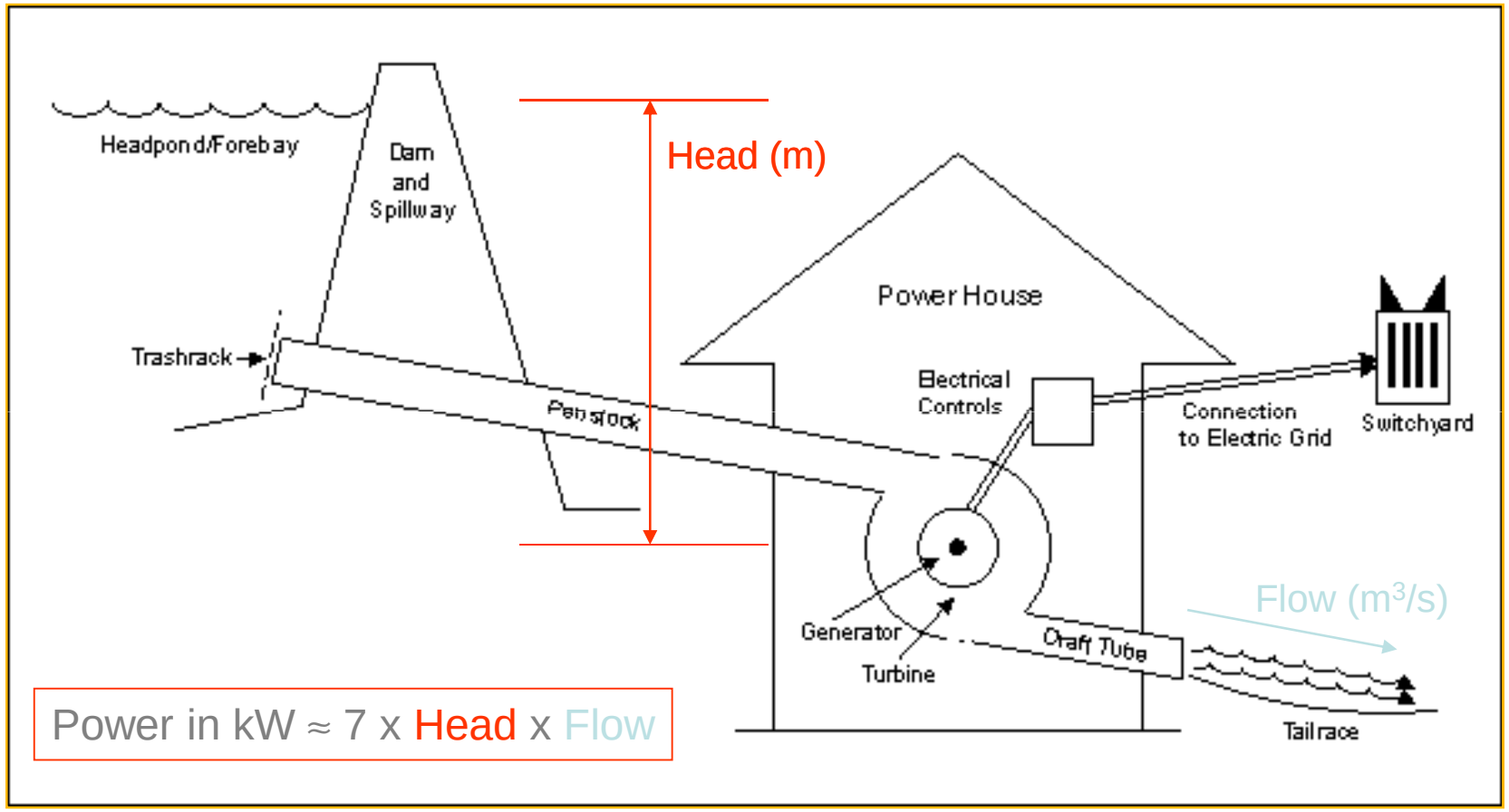
- Electricity for
  - Central-grids
  - Isolated-grids
  - Remote power supplies

…but also…

  - Reliability
  - Very low operating costs
  - Reduced exposure to energy price volatility

Photo Credit: Robin Hughes/ PNS

Small Hydro System Description



World Hydro Resource

- More rain falls on continents than evaporates from them
- For equilibrium, rain must flow to the oceans in rivers

	Technical Potential (TWh/year)	% Developed
Africa	1,150	3
South Asia and Middle East	2,280	8
China	1,920	6
Former Soviet Union	3,830	6
North America	970	55
South America	3,190	11
Central America	350	9
Europe	1,070	45
Australasia	200	19

Source: *Renewable Energy: Sources for Fuels and Electricity*, 1993, Island Press.

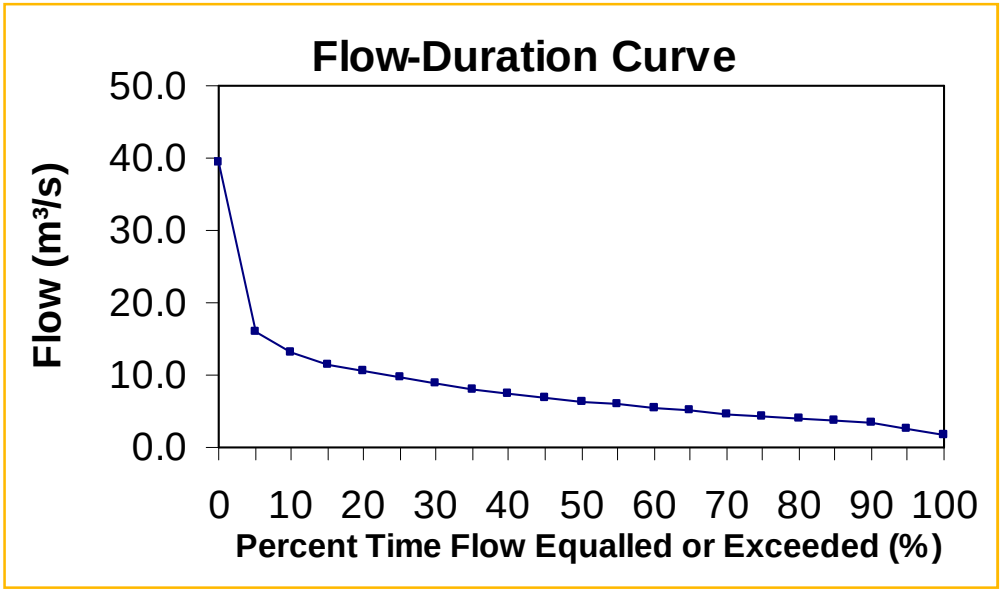
“Small” Hydro Projects

- “Small” is not universally defined
  - Size of project related not just to electrical capacity but also to whether low or high head

	Typical Power	RETScreen® Flow	RETScreen® Runner Diameter
Micro	< 100 kW	< 0.4 m^3/s	< 0.3 m
Mini	100 to 1,000 kW	0.4 to 12.8 m^3/s	0.3 to 0.8 m
Small	1 to 50 MW	> 12.8 m^3/s	> 0.8 m

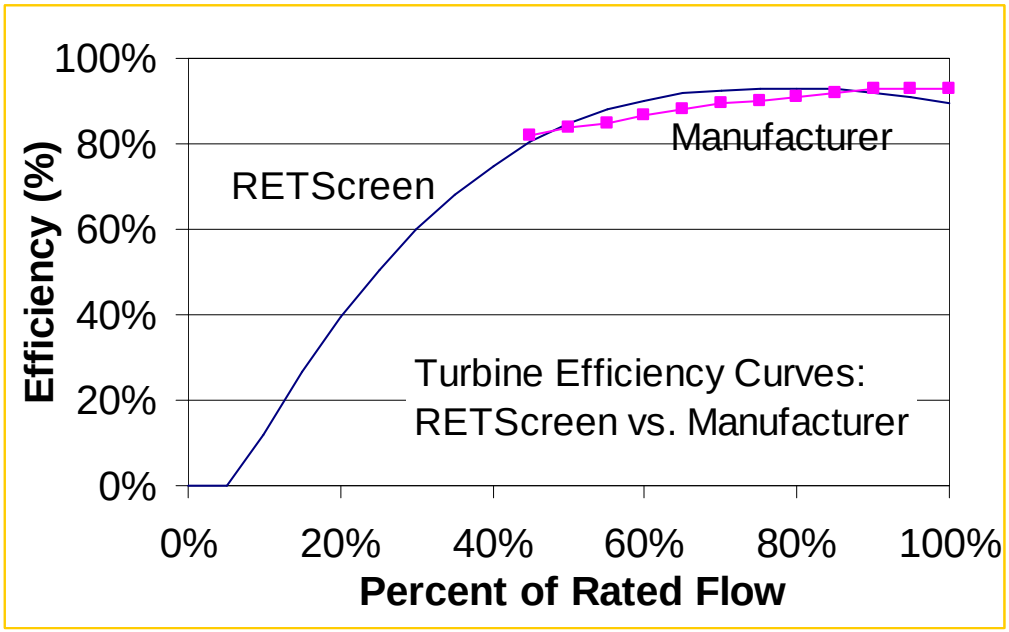
Site Hydro Resource

- Very site specific: an exploitable river is needed!
  - Change in elevation over a relatively short distance (head)
  - Acceptable variation in flow rate over time: flow duration curve
    - Residual flow reduces flow available for power
- Estimate flow duration curve based on
  - Measurements of flow over time
  - Size of drainage above site, specific run-off, and shape of flow duration curve



Example Validation of the RETScreen® Small Hydro Project Model

- Turbine efficiency
  - Compared with manufacturer's data for an installed 7 MW GEC Alsthom Francis turbine
- Plant capacity & output
  - Compared with HydrA for a Scottish site
  - All results within 6.5%



- Formula costing method
  - Compared with RETScreen®, within 11% of a detailed cost estimate for a 6 MW project in Newfoundland

Conclusions

- Small hydro projects (up to 50 MW) can provide electricity for central or isolated-grids and for remote power supplies
- Run-of-river projects:
  - Lower cost & lower environmental impacts
  - But need back-up power on isolated grid
- Initial costs high and 75% site specific
- RETScreen® estimates capacity, firm capacity, output and costs based on site characteristics such as flow-duration curve and head
- RETScreen® can provide significant preliminary feasibility study cost savings

Merci

Next: Energie Hydroelectrique quelques cas d'etudes pratiques

RETScreen Version 5

- Energy audit analysis

Soleil, source des energies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