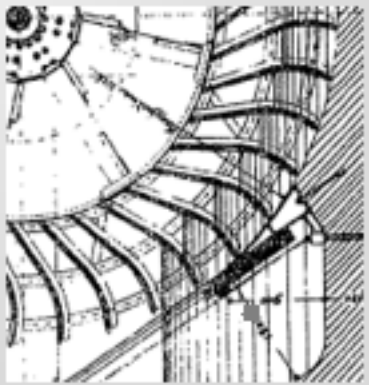
Reinventing the Wheel

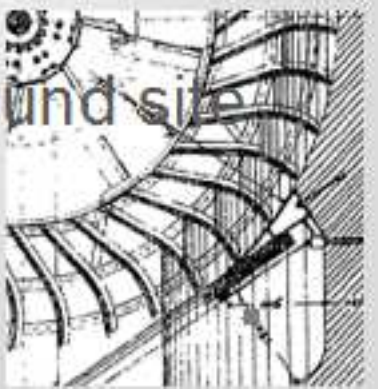
Penny J Carruthers

With thanks to Ross Carruthers & William Harvie



World End Weir, Edinburgh

- The old West Mill in Dean Village
- Land either side built up
- Major sewer network
- Gorgeous
- Very violent floody little river
- Previous study found site uneconomical

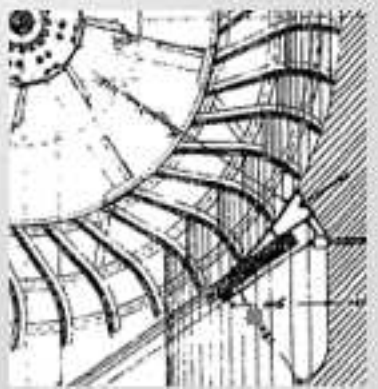


A Different View

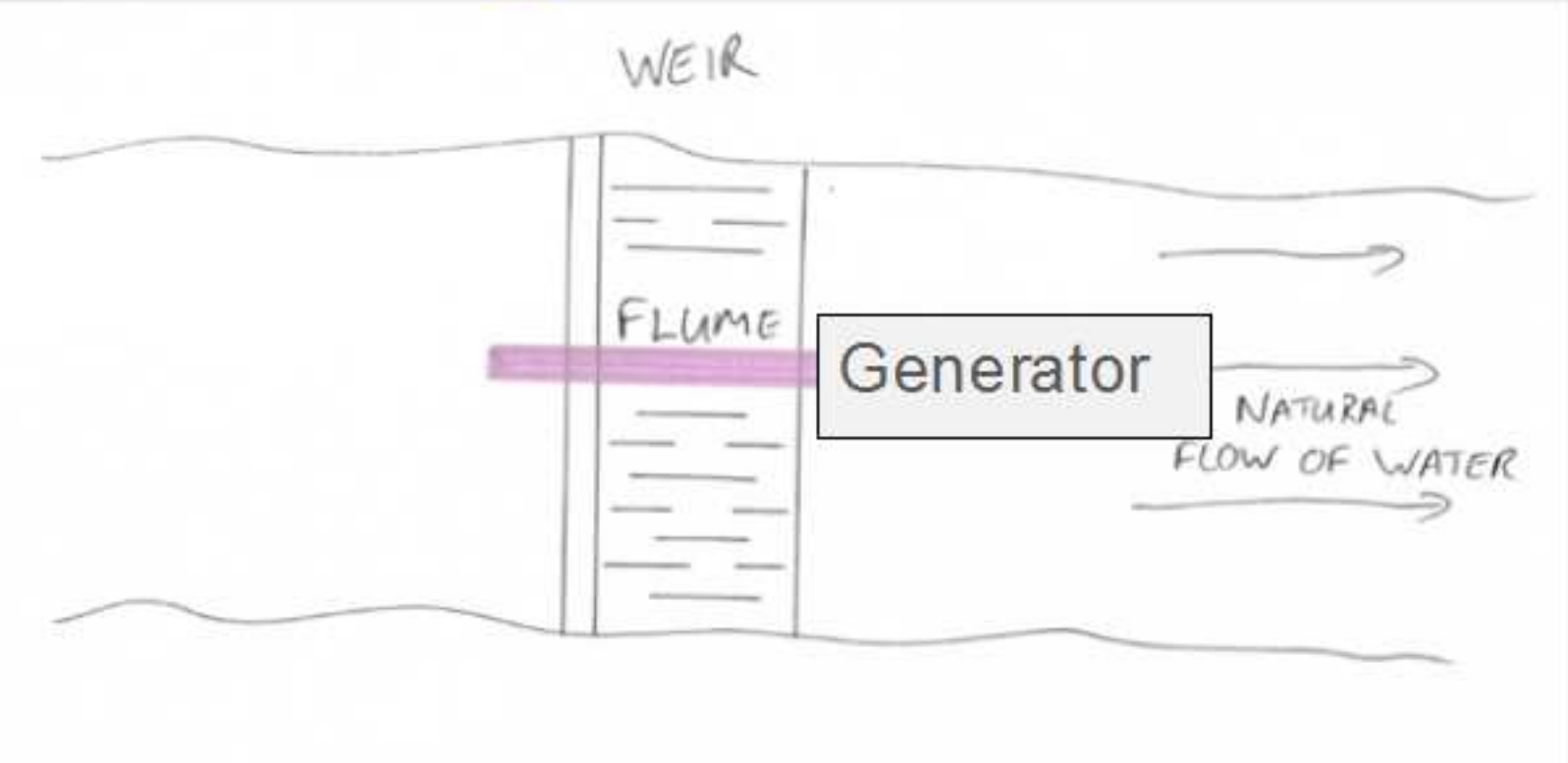
- Nothing can be done to increase % of water used without sacrificing the environment
- The main factor determining electrical output is generator efficiency

- If the amount of water can be significantly increased
- Mechanical efficiency less important
- 90% of 20% = 18%

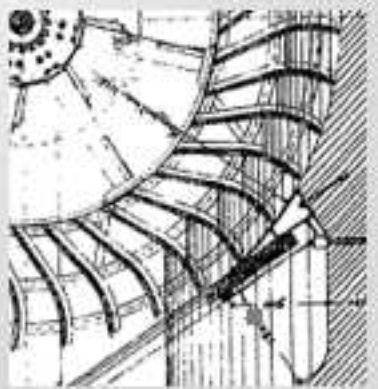
  75% of 40% = 30%



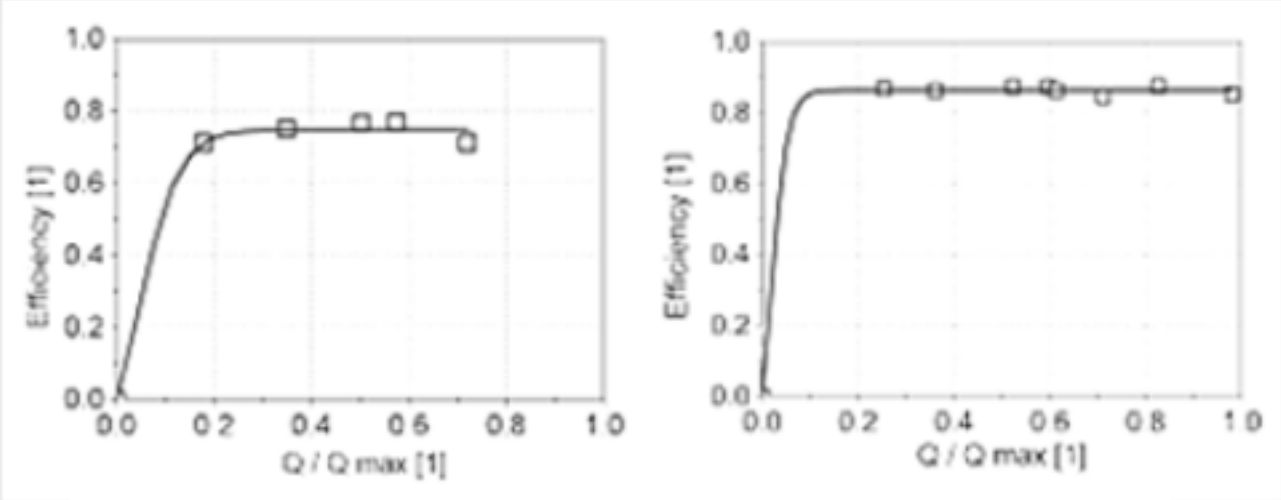
Where can you put a generator?



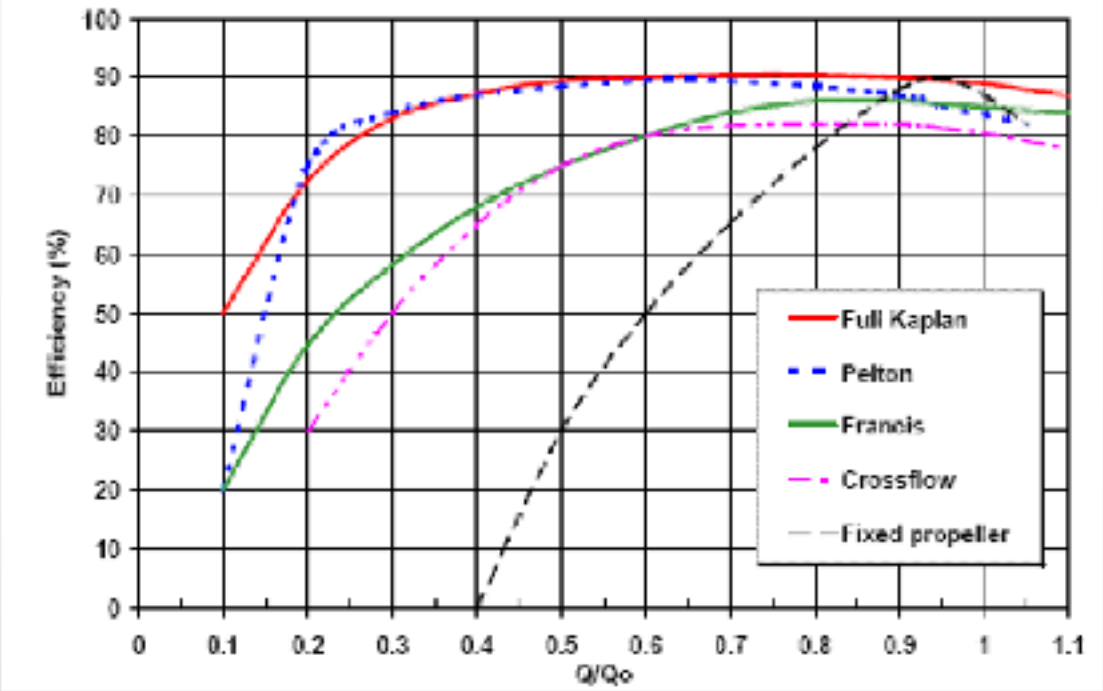
Archimedes Screws
Turbines
Water Wheel



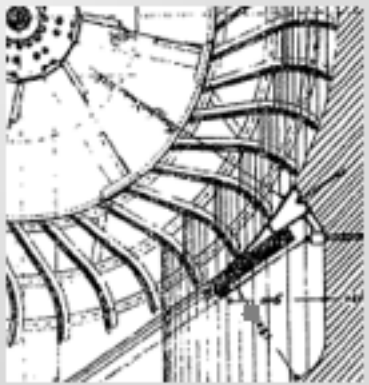
Range of Flows

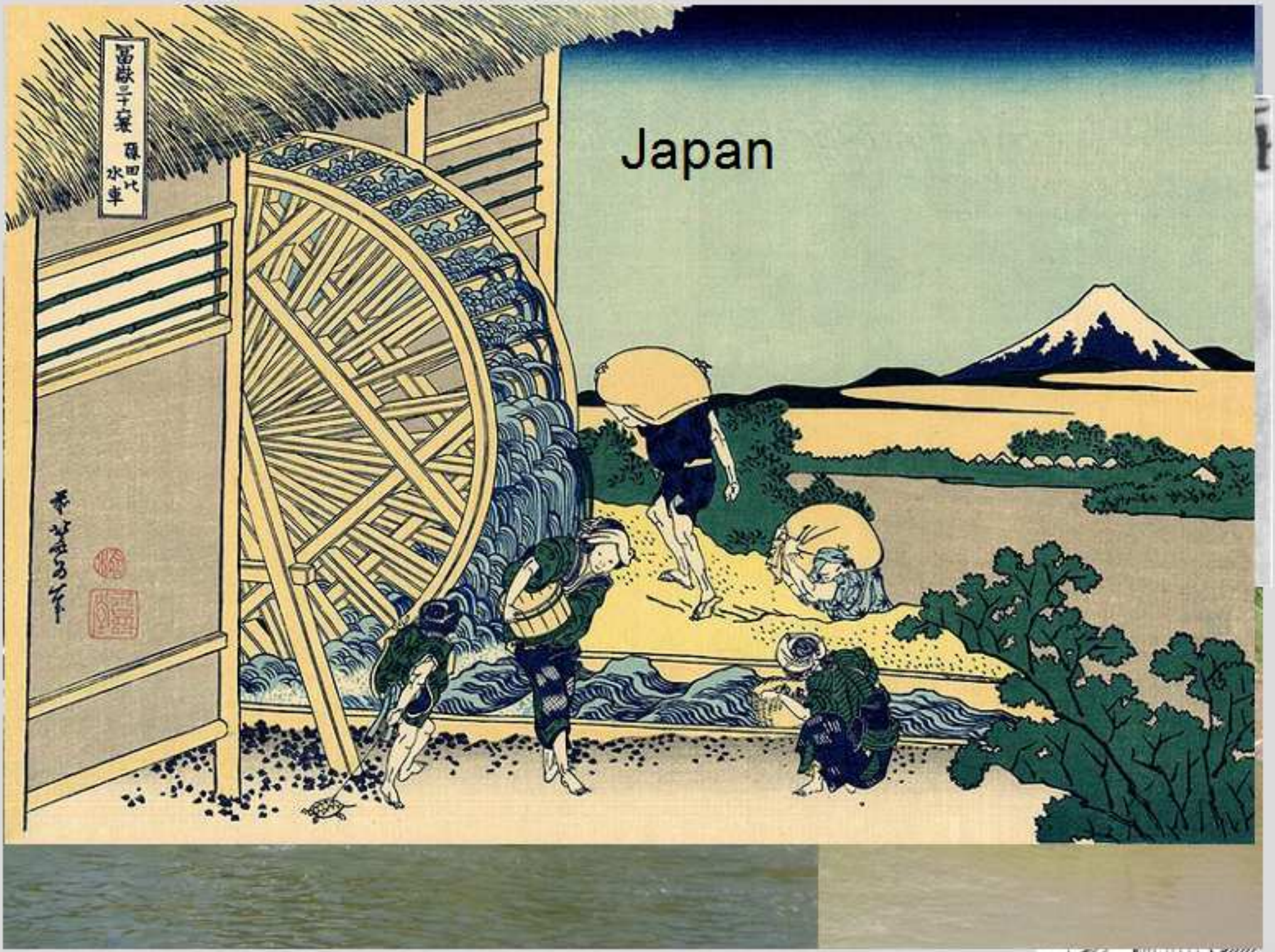


Wheel

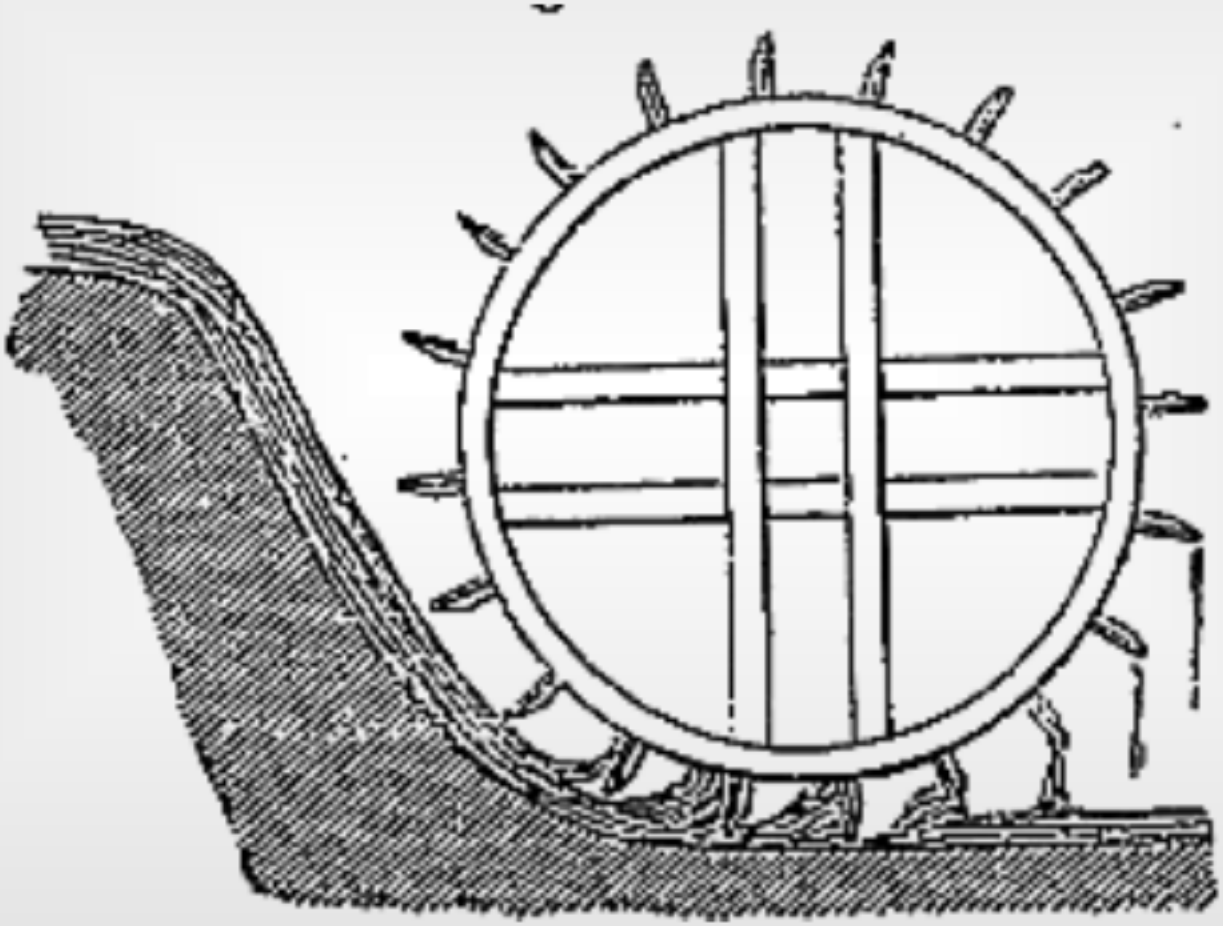


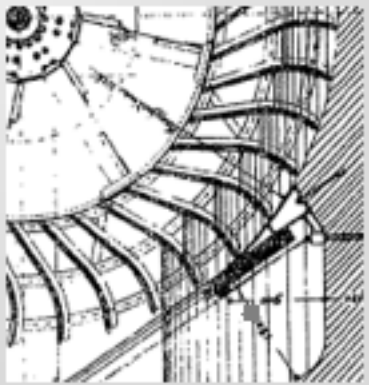
Turbines



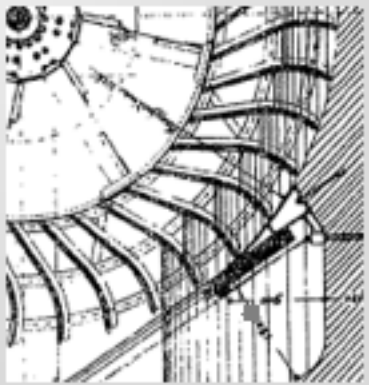

Japan

Impulse Wheels





Potential Energy Wheels



Type of Wheel

Cost Assumptions

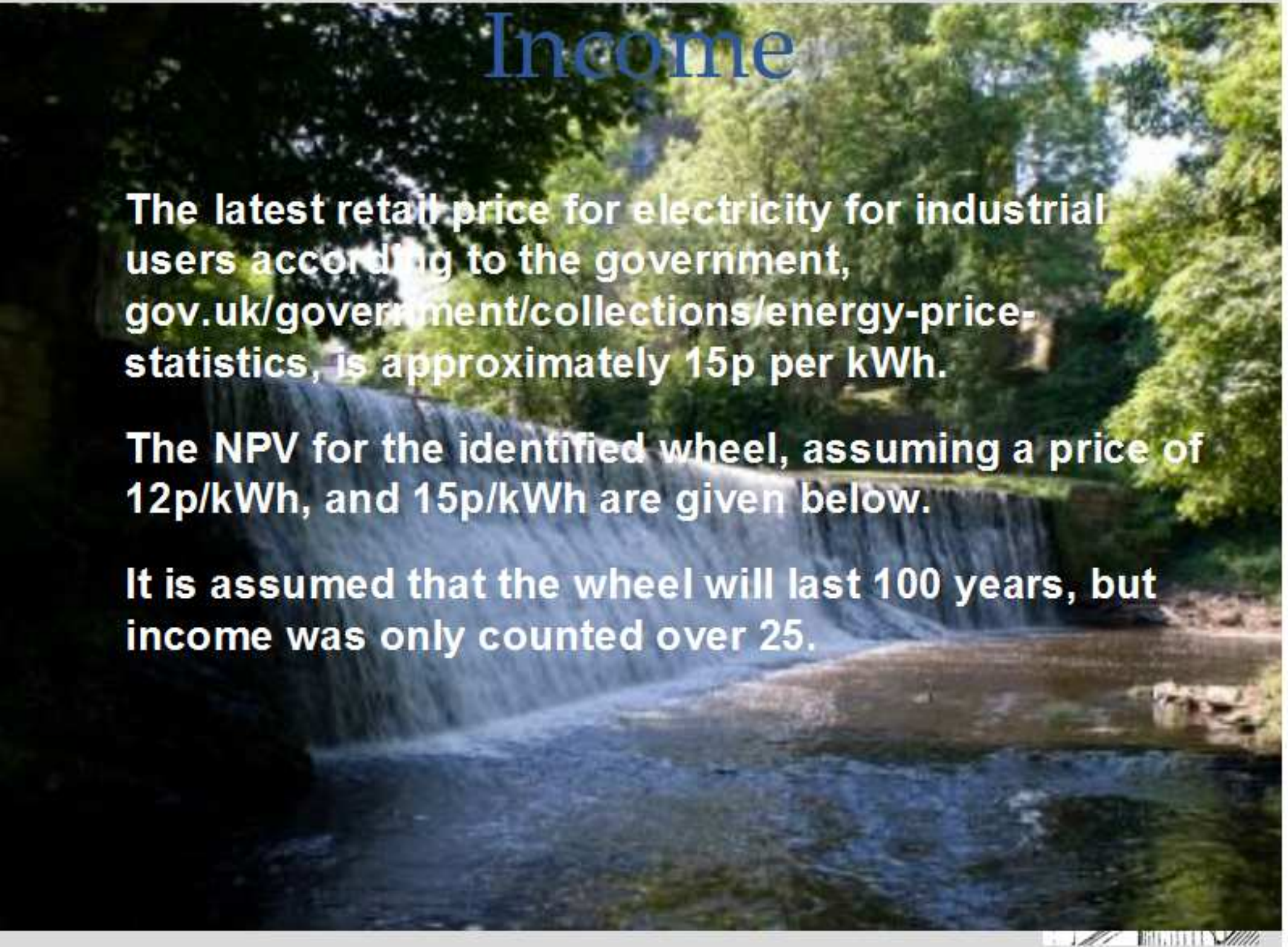
1. *Opus Insertum* - stones cast into the concrete for wheel pit.
2. Galvanised steel parts, with high strength friction grip bolts
3. Wood planks for paddles.
4. Weir 4.2m high.
5. River flow, average 1.6m3/s
6. Minimum flow for fish pass 0.3m3/s

Costs

Item costs taken from industry standard estimates for generic items, and from manufactures' catalogues.

Cost from itemised bill of quantities	£200,000
Allowance for contingencies, 25%	£50,000
Cost for economic calculations	£250,000

Income



The latest retail price for electricity for industrial users according to the government, gov.uk/government/collections/energy-price-statistics, is approximately 15p per kWh.

The NPV for the identified wheel, assuming a price of 12p/kWh, and 15p/kWh are given below.

It is assumed that the wheel will last 100 years, but income was only counted over 25.

Net Present Value, Assumptions

1.	Interest rate	10%
2.	Annual maintenance	£3,000
3.	Average output	50kW
4.	Hours running per year	8,000hrs
5.	Price per kWh	£0.12
6.	Cost of installation	£250,000
7.	NPV over 25 years	£158,467

NPV with all the previous assumptions, but with an electricity price of 15p/kWh is: **£267,391**

Pictures

www.haivenu-vietnam.com

Thirty Six Views of Mount Fuji

Fairburn, W., 1871. *Mills and Millwork.* London: Longmans, Green and Co.

Muller, W., 1899. *Eisernen Wasserrader.* 1st ed. Leipzig: Verlag Von Veit & Comp.

Wolter, C. & Müller, G., 2004. The breastshot waterwheel: design and model tests. *Proceedings of the Institution of Civil Engineershttp://.*