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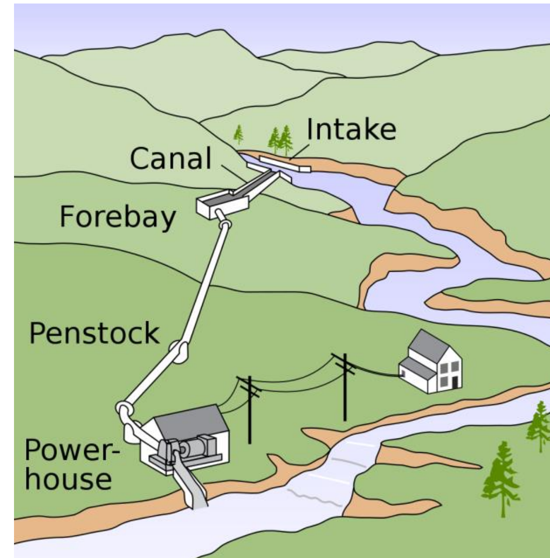
Renewable Energy generation
Micro hydro

Renewable energy generation
Microhydro

- Possibly the go-to option if possible
- Range from several watts to megawatts
- All-day power
- Automatic
- Can have issues with rainy/dry seasons



Renewable energy generation
Microhydro

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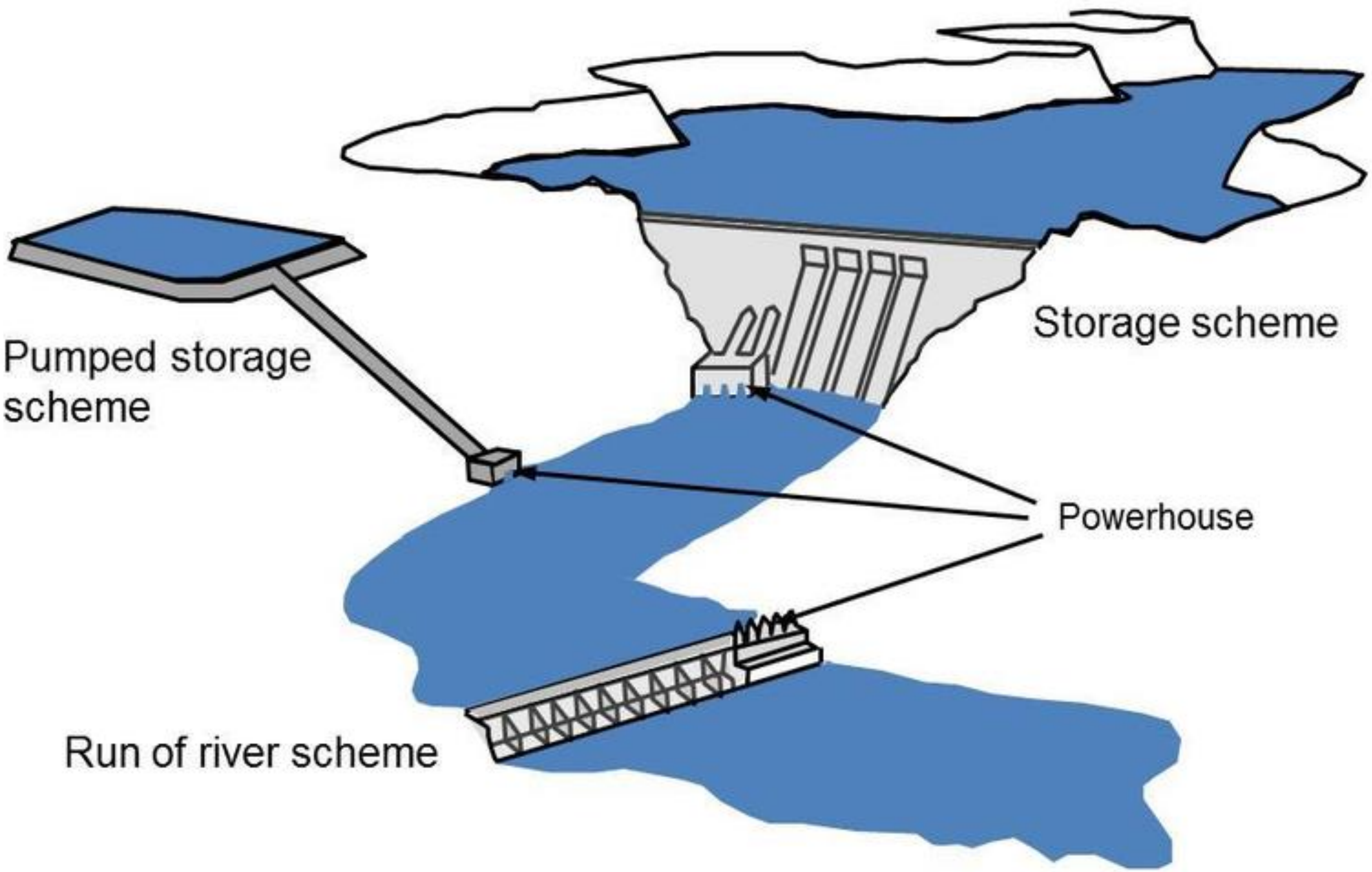

Renewable energy generation
Microhydro

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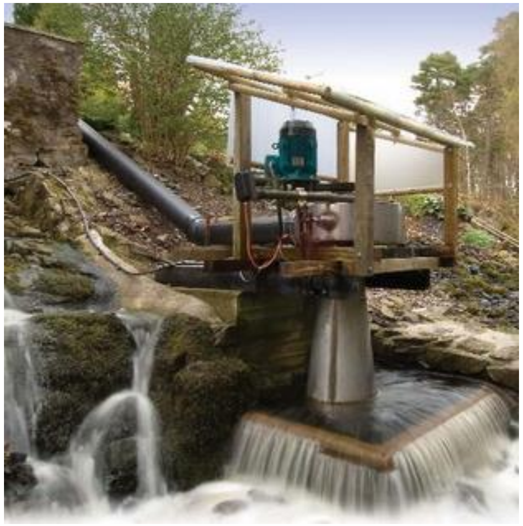
Pico	< 5 kW
Micro	5-100 kW
Mini	100 kW to 2 MW
Small	2 MW to 25 MW

Other terms used:
-low head,
-low pressure
-often run of the river

Examples are a small mill set in the rapids of a fast-moving stream or turbine-generator located in diverted portion of river



Predicting hydropower availability

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- Availability is less time-dependent than solar
  - May change season-to-season
- Scope areas around proposed microgrid or use maps
- Consider the distance of power lines between hydropower source and load
  - Think about cost of powerlines and power losses
- Measure the head i.e. the vertical distance the water flows
  - Want to find a point where a large change occurs in a short horizontal distance
- Low head more suited for submersible turbines (as little as a foot of head) and run-of-the-river
- High head more suited for dam or penstock type designs
- The greater the head, the cheaper the turbine

Predicting hydropower availability

- Calculate the flow rate
  - Measure the cross section of the river section with a weighted float
  - Measure the time it takes for the float to travel between two points on the river
  - Flow rate = (Distance float travels/time) x cross section

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Conservation of mechanical energy

$$\Delta\mathrm{PE} = \Delta\mathrm{KE}$$

$$mgH = \frac{1}{2}mv^2$$

(once head losses are included)

a useful relationship

$$v = \sqrt{2gH}$$

$$Q = \langle v \rangle A$$

$$P = \eta\rho QgH = \eta\rho\langle v \rangle AgH = \eta\rho A\sqrt{2}(gH)^{1.5}$$

$$P \propto H^{1.5} \qquad Q \propto H^{0.5}$$

Case studies- microhydro

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Ghandruk, Nepal

- 50kW station cost $51,000
- 283 households connected (176 W each)
- Promotion of low wattage cookers to drive demand
- Hotels provided an area for productive use