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# Low-head low-cost hydro power by conversion to air pressure

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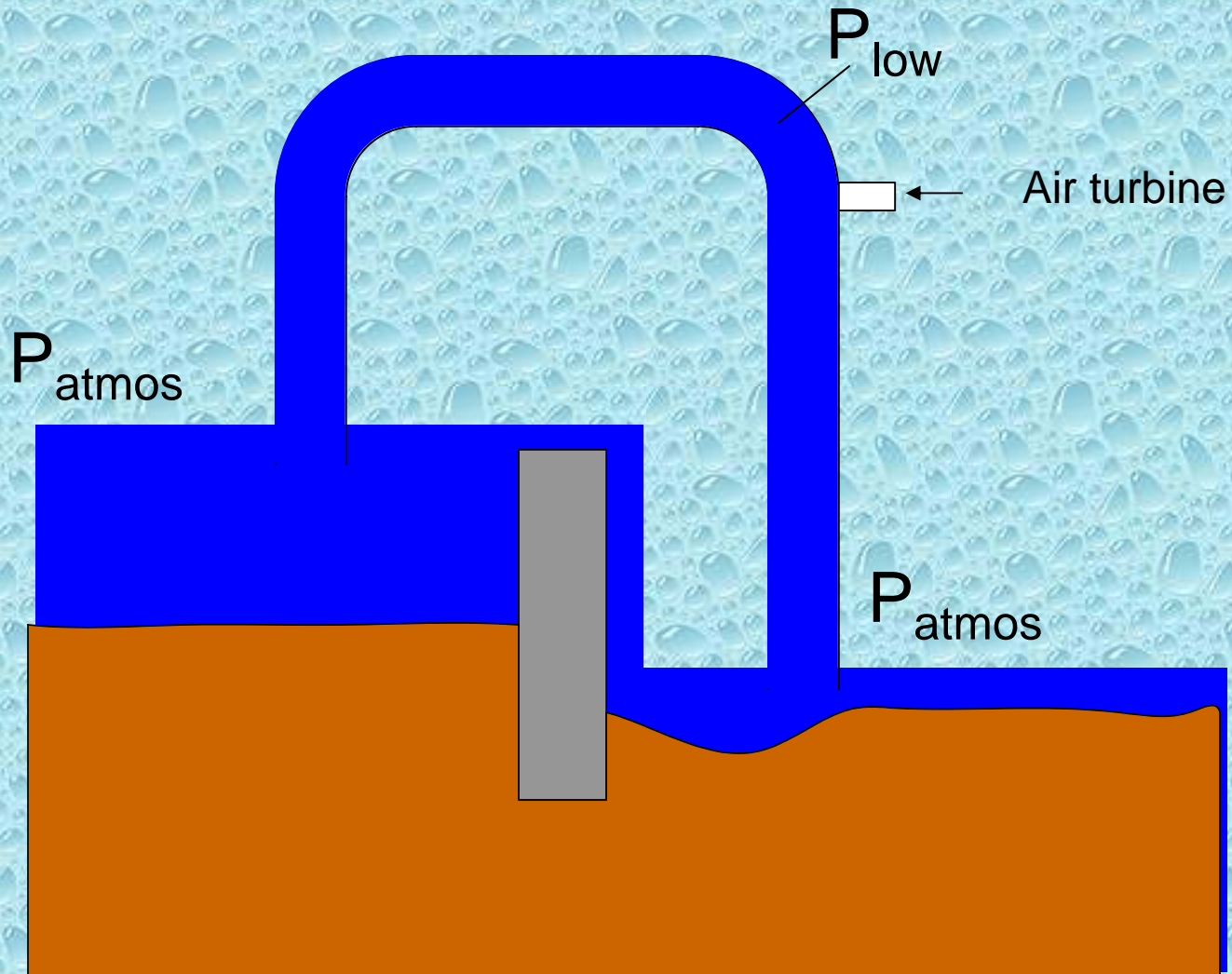


## Overall concept :

$$\text{pence per kWh} = \frac{\text{total cost}}{\text{total energy}}$$



- Introduction to siphonic hydro
- Typical Sizes
- Work so far
- Present Project





## Cost saving:

(ESHA) report on conventional low head cost 50 % electromechanical, 50% civil engineering [[i](#)].

### Siphonic Hydro

- Air turbine quicker and cheaper
- Less civil costs

[[i](#)] Guide on How to Develop a Small Hydroplant, European Small Hydro Power Association, Available at [www.eshabe.be](http://www.eshabe.be) (February 2007)



## Typical size

$$H = 1.2 \text{ m}$$

$$v = 4.9 \text{ m/s}$$

For max. power reduce  $v$  to 3.4 m/s

$$\text{If } r = 0.2\text{m}$$

$$Q = 0.43 \text{ m}^3/\text{sec} \text{ (25 600 lpm)}$$

$$P_{\text{pipe}} (1/2 \rho A v^3) = 2.5 \text{ kW.}$$

$$H = 60\%,$$

$$P_{\text{out}} = 1.5 \text{ kW or } 13 \text{ 000 kWh per annum.}$$

10 p/kWh gives £1300 per annum



## The theory

Driving head =  $H$

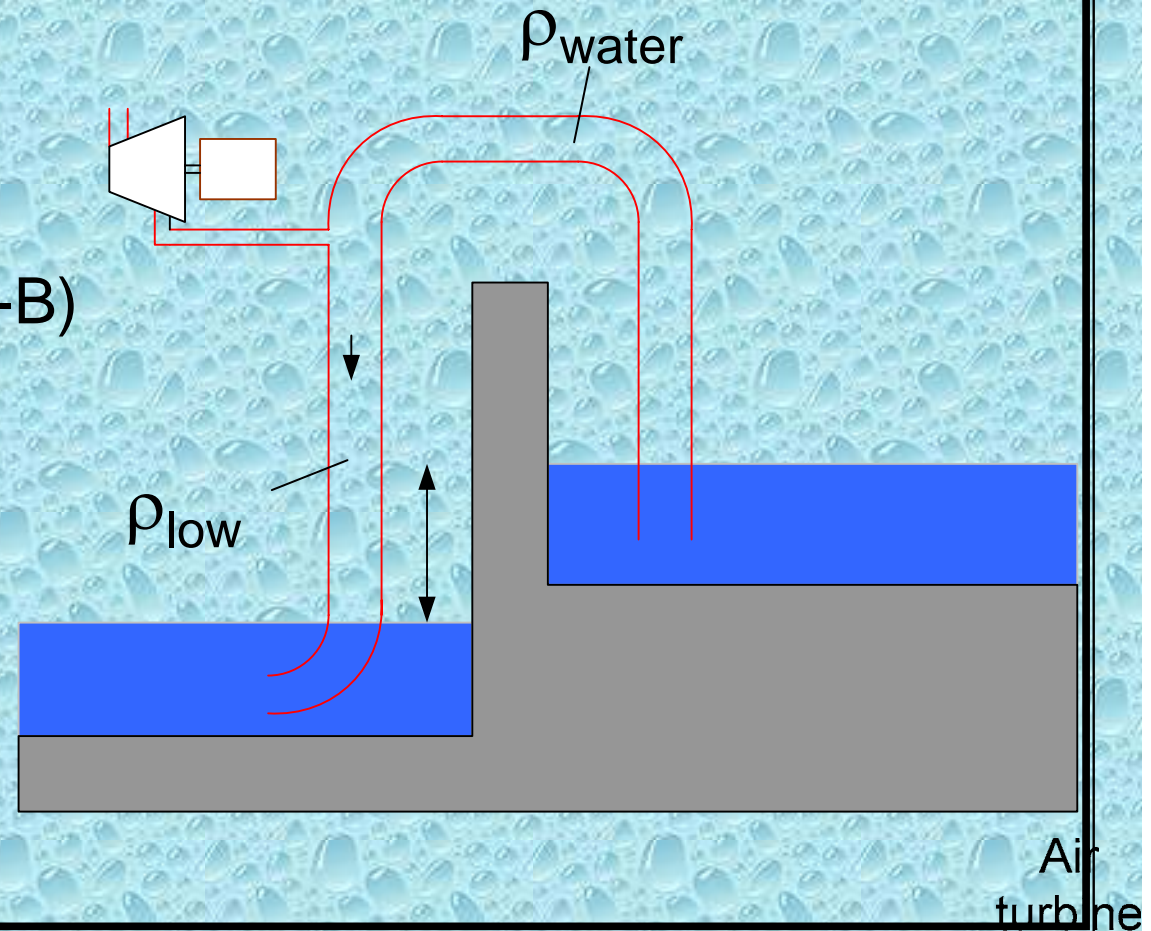
Bouyancy head =  $B$

Effective power out =  $f(H-B)$

i.e. high  $B$  for high  $\eta$

Need high  $\alpha$

Practical limit of  $\alpha = 0.25$





## Areas of concern:

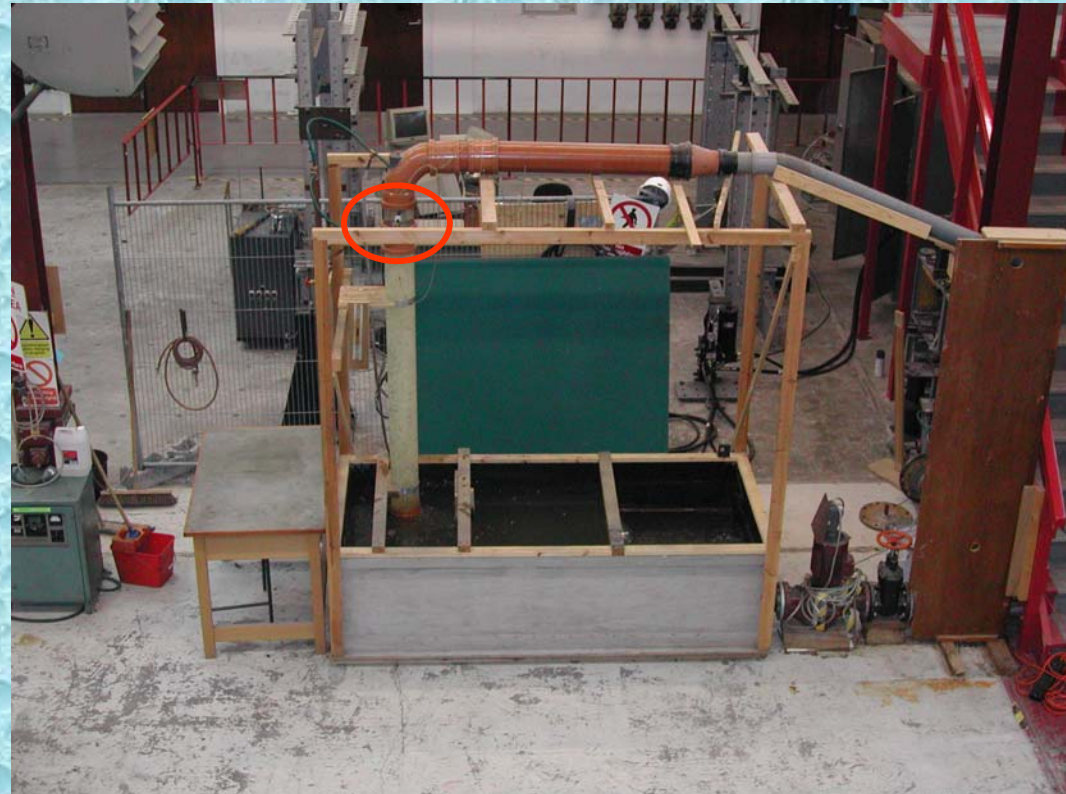
- the aeration process
- the stability of the aerated flow
- losses in the aerated flow.



# Laboratory Testing



$\alpha = 0.23$





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# Field Test-site

Stavely, Cumbria





## Aim of project

- Optimise the siphonic hydro process
- Demonstrate full scale system for 12 months
- Monitor site
- Give guidance on economics

## Outline:

36 months from Oct 2007

Year 1: Select site optimise design

Year 2: Build and Install

Year 3: Decommission and economic model



## Acknowledgements:-

-Joule Centre (*funding*)

-Yorkshire water (*support and potential project expansion*)

-BHA (*letter of support*)

*French, M. J., Widden, M. B., The exploitation of low-head hydropower by pressure interchange with air, using siphons, Proc Instn Mech Engrs 2001, **215** part A, 223-230*