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PRIFYSGOL  
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**Dŵr Uisce**

Energy Recovery in Water Services  
Adennill Ynni yn y Diwydiant Dŵr



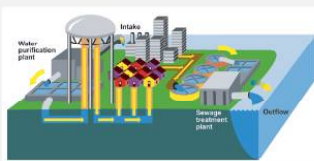
**Dŵr Uisce 2017 Conference  
Sustainability in Energy & Water Resources:  
Research & Practice**

**Daniele Novara, 27/10/2017**





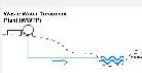
### Hydropower from water networks



Water utilities are among the **largest electricity users** of industrialized countries, and therefore also responsible for a significant quota of **CO2 emissions**.

There's potential for energy recovery in almost any water network!

- 2 MW in Ireland and UK
- 1.5 GW across Europe!

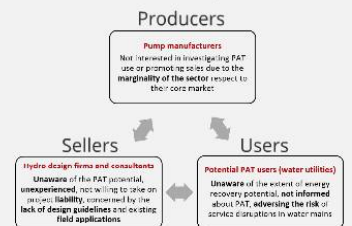


### Pumps as Turbines (PATs)

- + Low purchase price
- + Compact dimensions
- + Mass manufactured
- + Short delivery time
- + Easy maintenance
- + Proven results

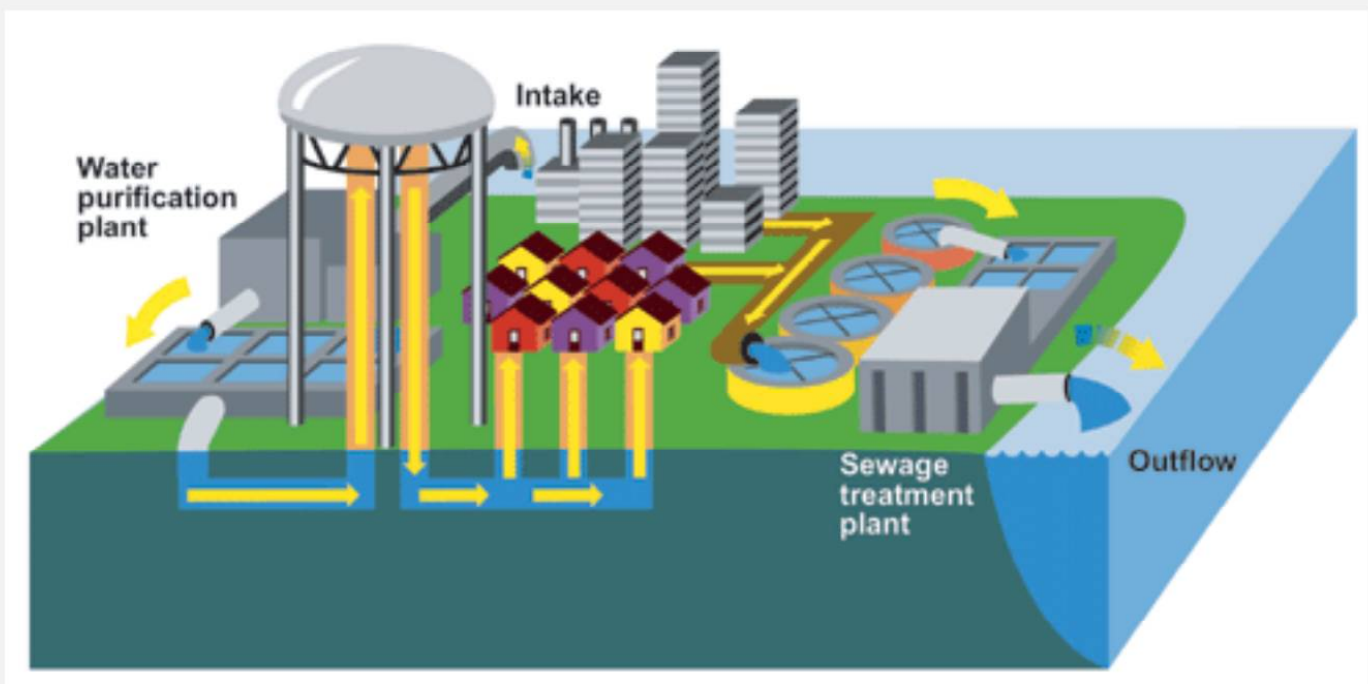


### Bottlenecks to PAT implementation?





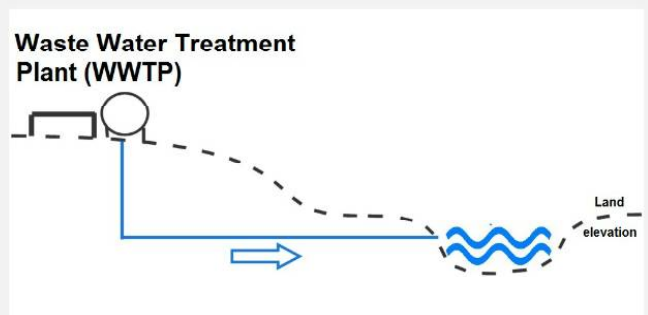
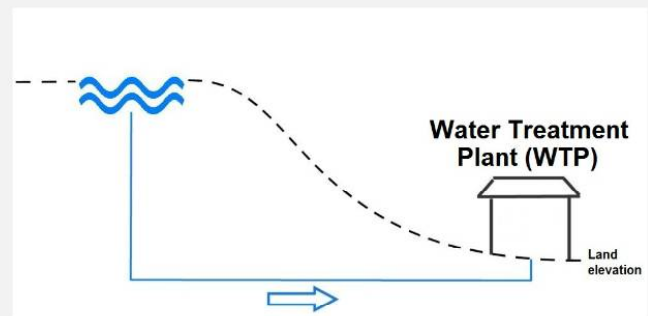
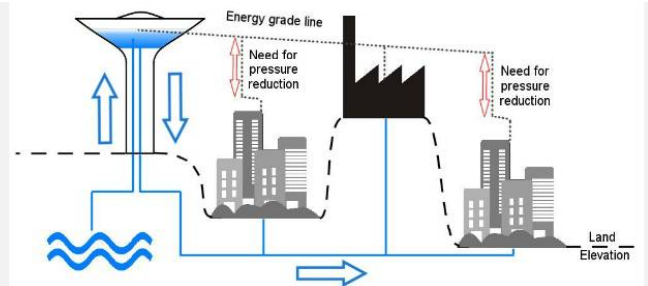
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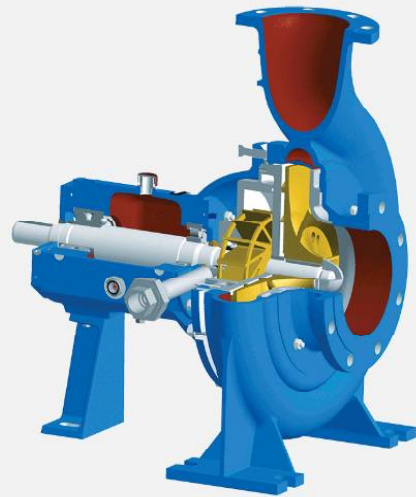
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# Pumps as Turbines (PATs)



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# Bottlenecks to PAT implementation?

## Producers

### Pump manufacturers

Not interested in investigating PAT use or promoting sales due to the **marginality of the sector** respect to their core market

## Sellers

### Hydro design firms and consultants

**Unaware** of the PAT potential, **unexperienced**, not willing to take on project **liability**, concerned by the **lack of design guidelines** and existing **field applications**

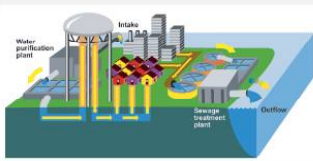
## Users

### Potential PAT users (water utilities)

**Unaware** of the extent of energy recovery potential, **not informed** about PAT, **adversing the risk** of service disruptions in water mains



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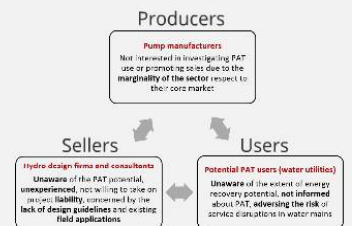
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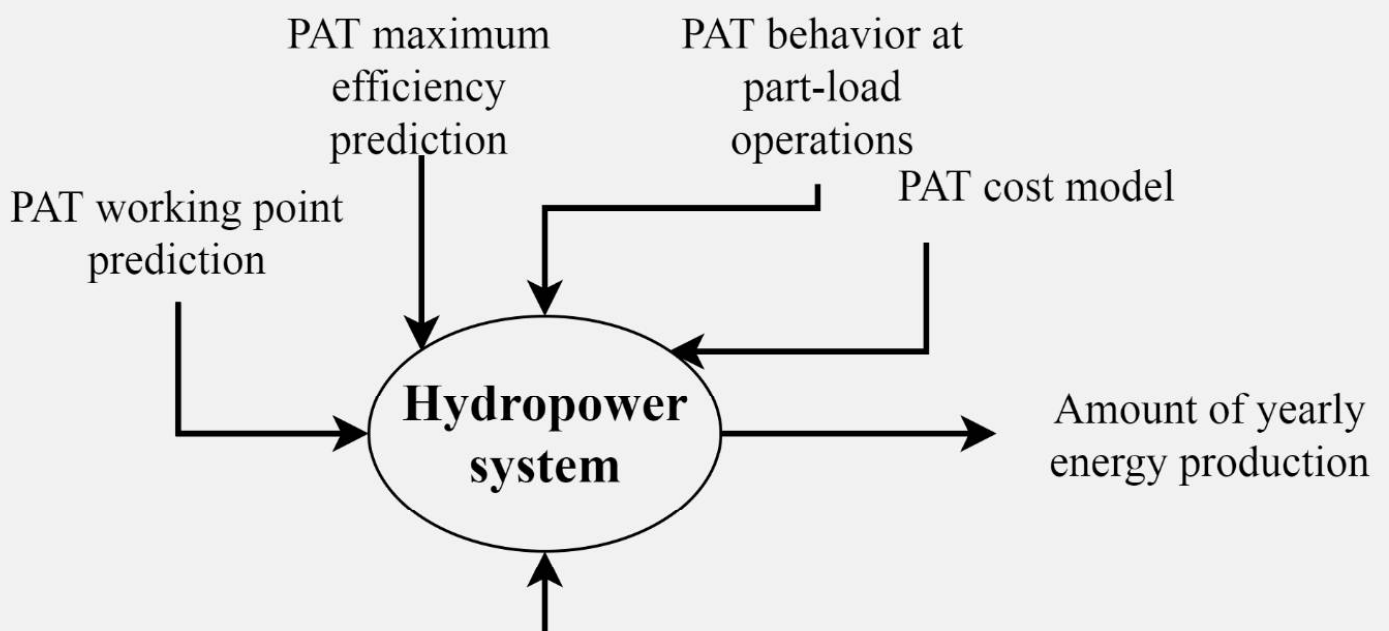
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### Bottlenecks to PAT implementation?



# Design algorithm for PATs

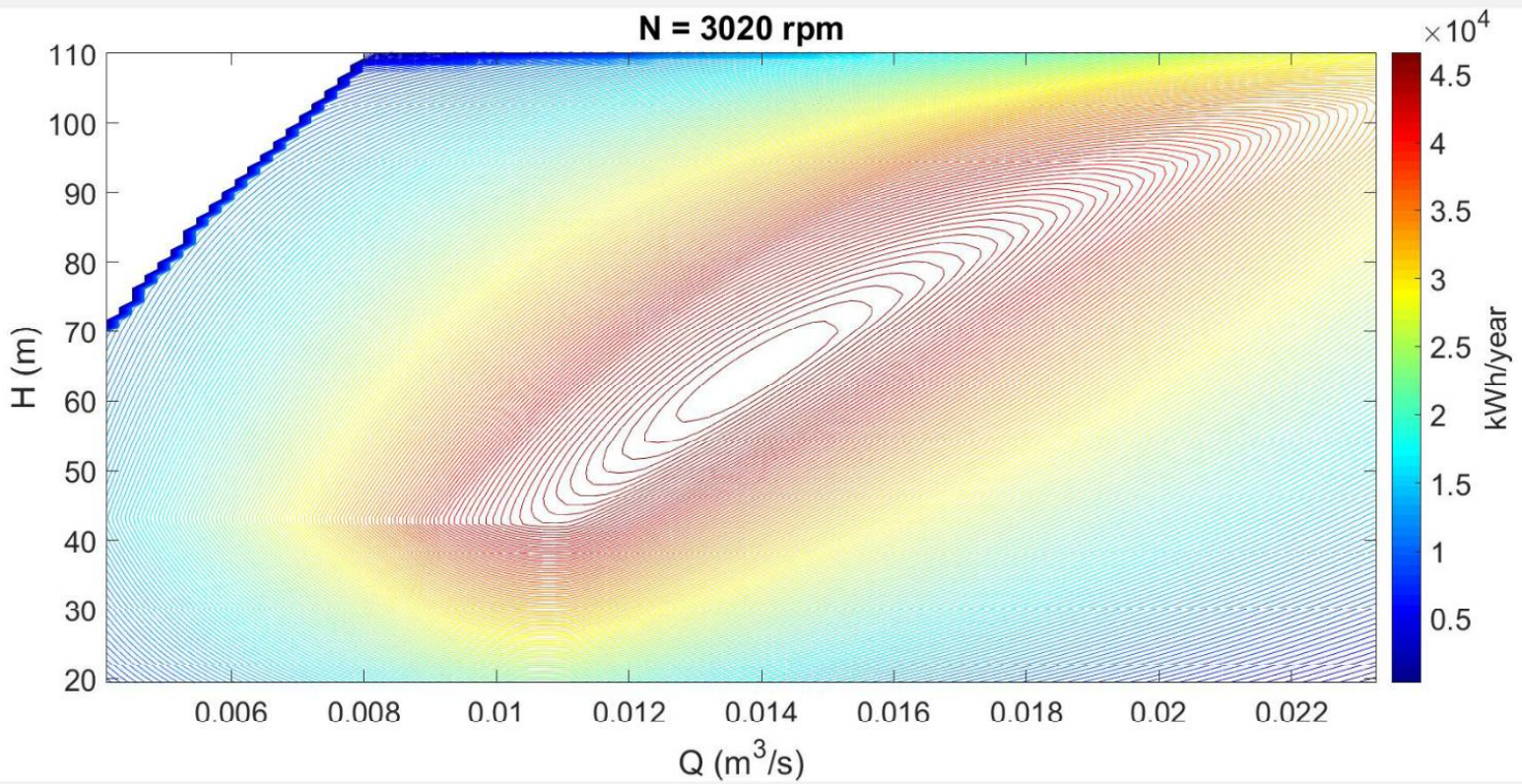


Pump design parameters to be selected:

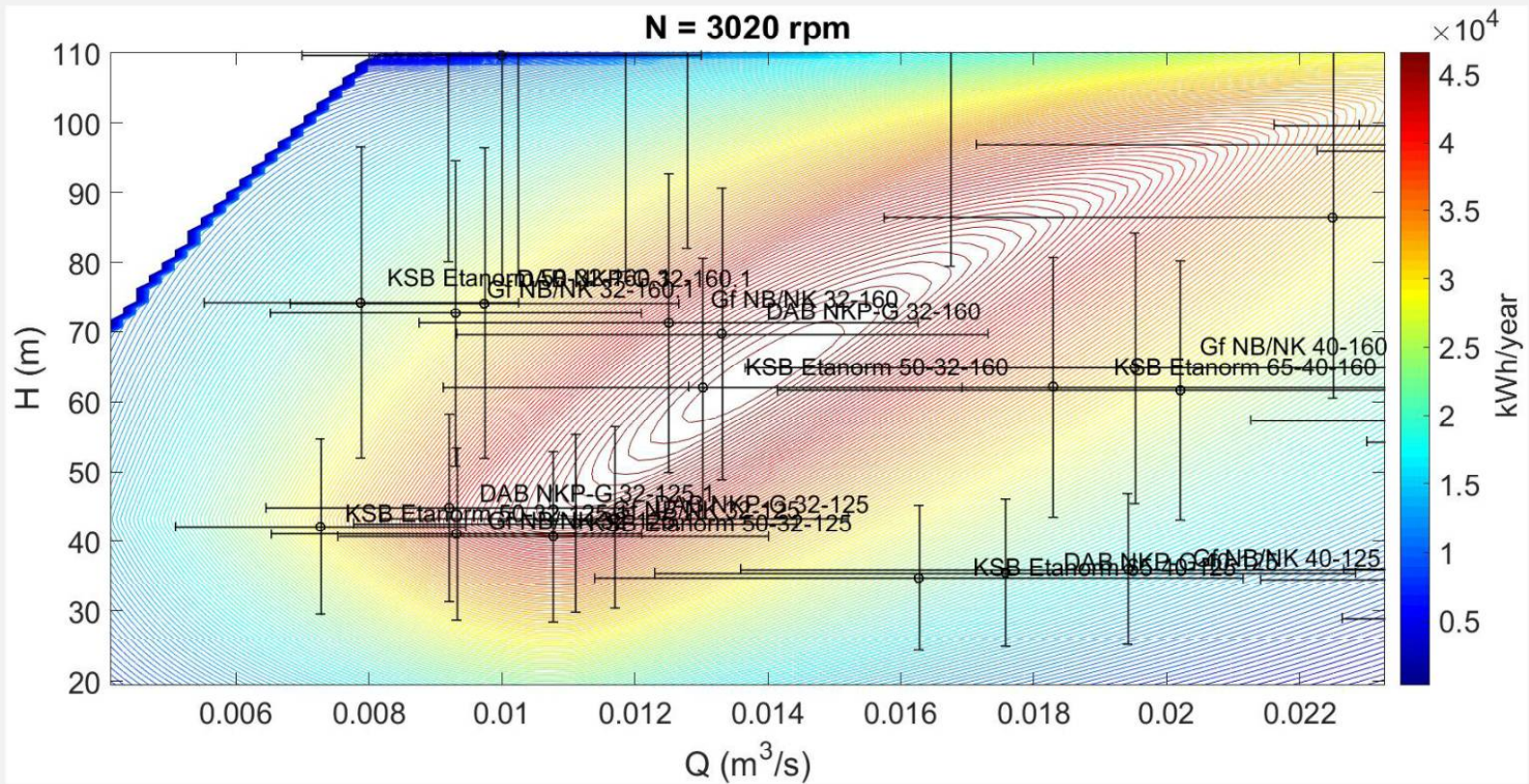
- shaft speed  $N$  (RPM)
- Nominal flow rate  $Q$  ( $\text{m}^3/\text{s}$ )
- Nominal hydraulic head  $H$



# Theoretical PATs

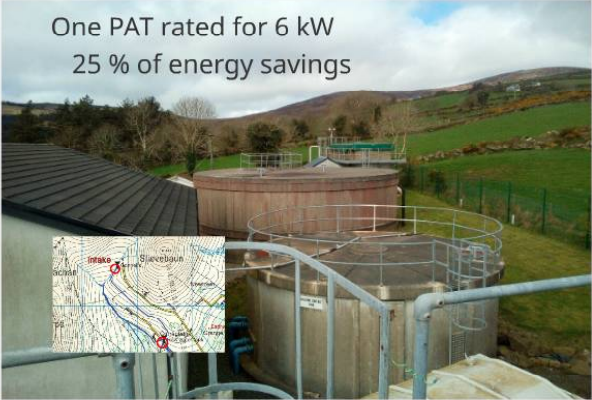


# Which available pumps are near-optimal?



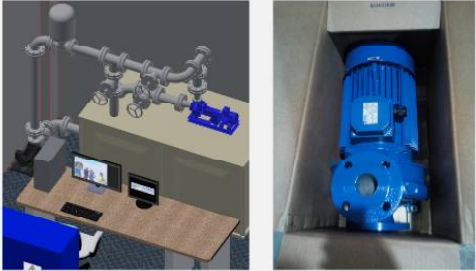


# Full-scale demonstration plants



## Laboratory experimental setup

Pump as Turbine up to 4 kW



1 kW multistage PAT

6 kWh/day

Powering equipment and  
up to 6 LED street lamps

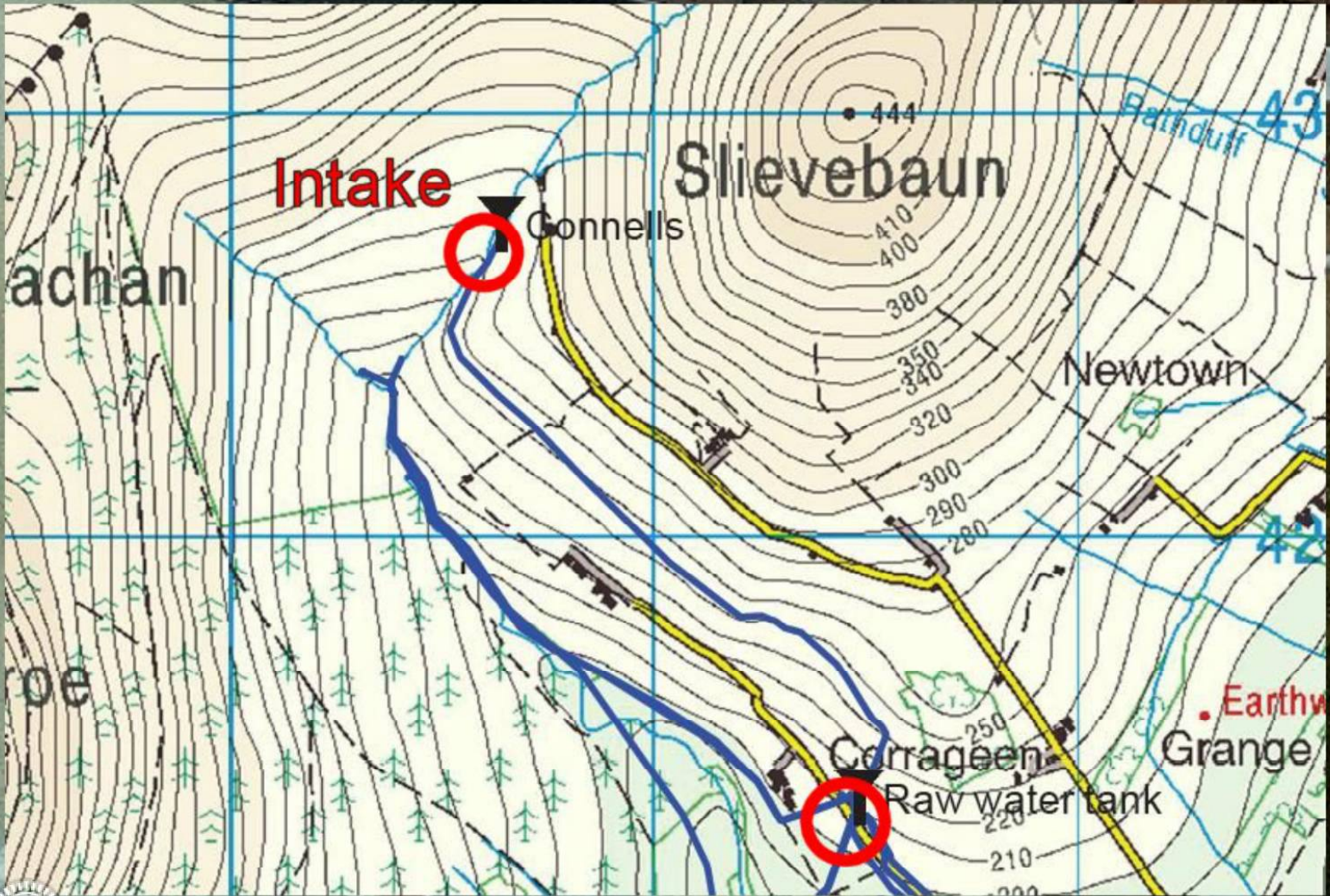




One PAT rated for 6 kW  
25 % of energy savings









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25 % of energy savings





# Run-off-river, 4 kW





Ty Mawr Wybrnant

Legend

Intake

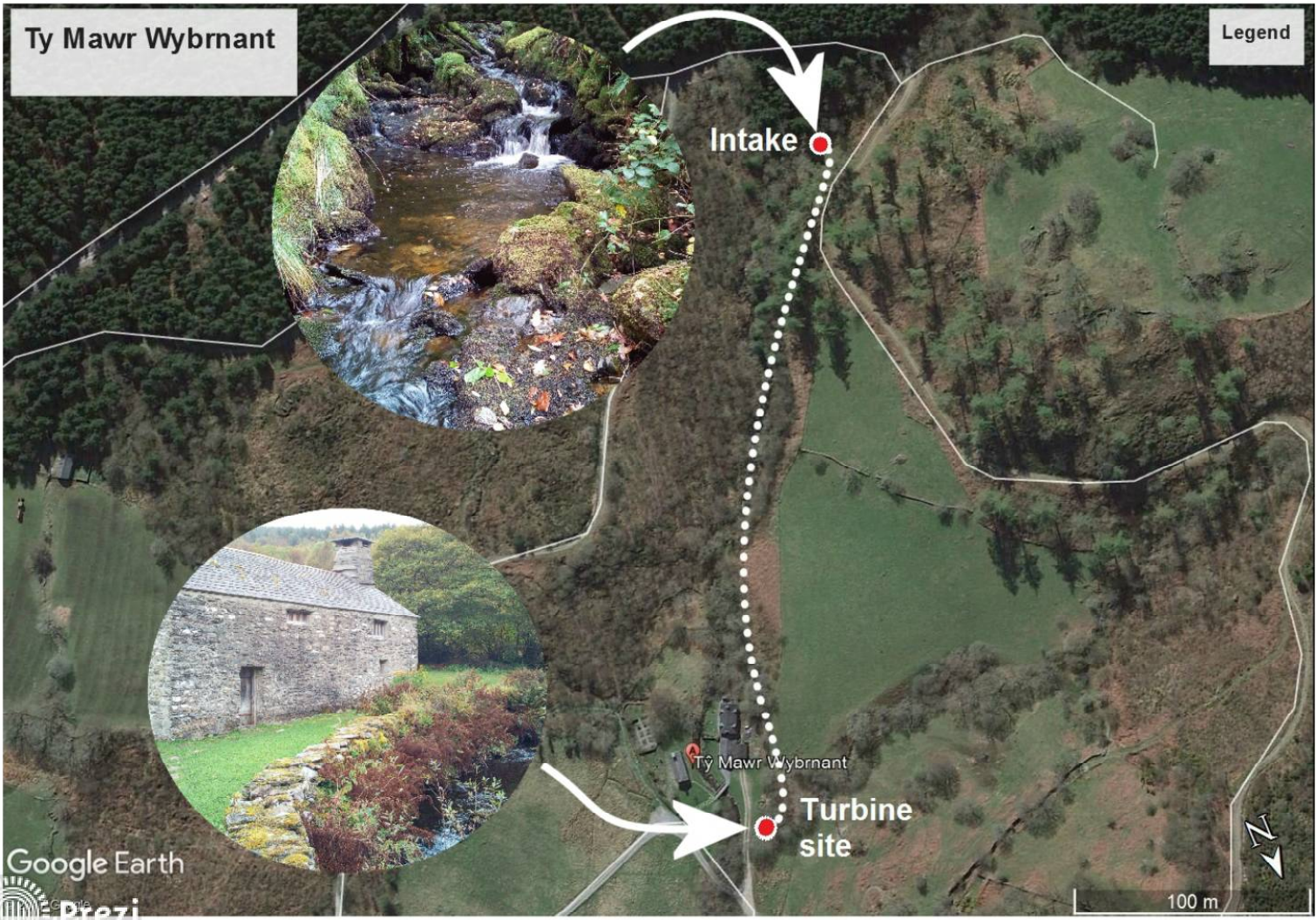
Turbine site

Ty Mawr Wybrnant

Google Earth

Prezi

100 m



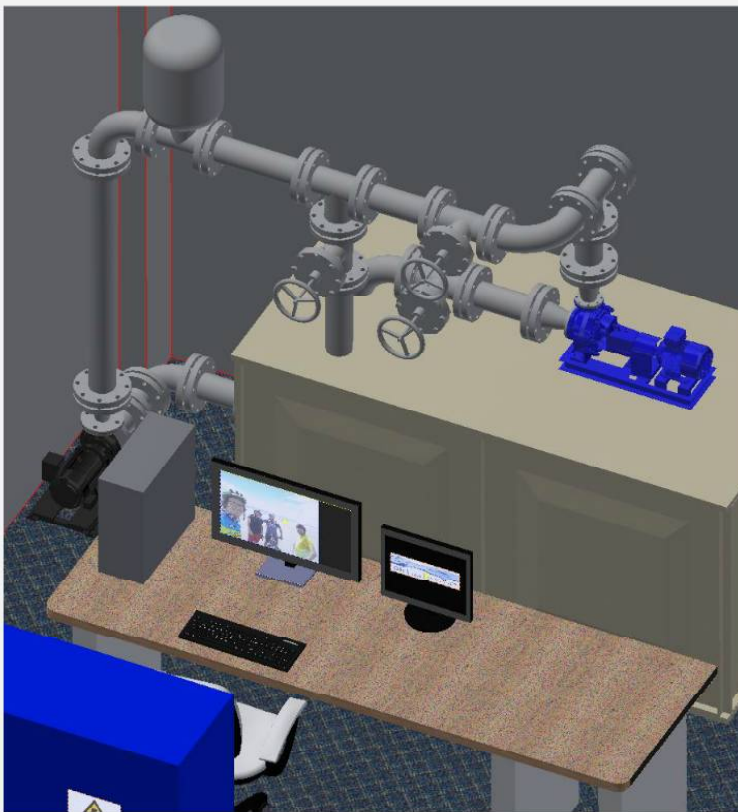


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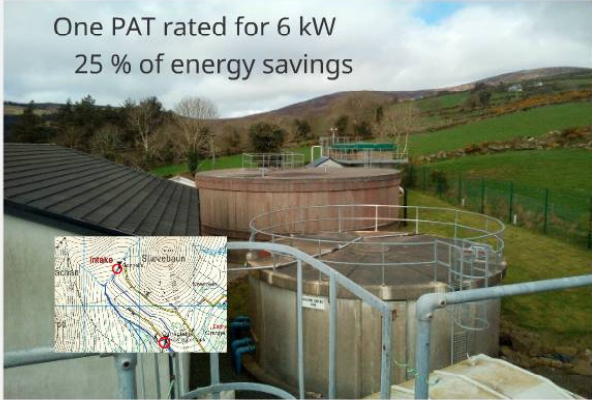
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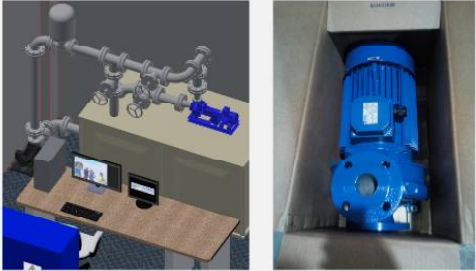


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# Thanks for your attention!

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