Micro-Hydro In Scotland
How can I use it?

- Hydropower basics
- Constraints to development
- Low head site selection and system design
  - Tea Break
- High head site selection and system design
- Development process
- Grants, financing and income
High Head Site Selection and System Design

Where *should* I put one?

- Typical sites
- Site layout
- Turbine and control systems
- Case study: Brideswell
Typical Sites

- Medium to low flow (burns and small rivers)
- High head (10 to 300 m)
- Old hydro turbine
- Old mill sites
Site Layout

- Intake
- Low-pressure pipe
- High-pressure pipe
- Turbine
- Tailrace
Turbine and control systems

- Pelton and Turgo turbines
  - Spear-nozzle flow control
  - Good part-flow efficiency
  - Can be direct drive
  - Fish and debris screening required
- Crossflow turbine
  - Guide-vane flow control within turbine
  - Reasonable part-flow efficiency
  - Can handle high volumes of water
  - Fish and debris screening required
Case Study: Brideswell

• Gross head = 18.5 m
• Available flow = 60 l/s
• Theoretical power = 10 kW
• Actual power = 3.7 kW (grid connection limit)
Intake

- 60 l/s abstraction
- 8 l/s hands-off flow
- Wedge-wire screen
- Automated screen cleaner
Pipeline

- Push-fit, rubber sealed culvert pipe
- Joints concreted in where head >5m
- Drain-down flange at lowest point
- Air vent at highest point
Turbine

• 4-jet custom built turgo turbine
• 3.7 kW induction motor as generator
• On average enough power for 4 average households
Development Process
How do I put one in?

• Feasibility
  – Desk-top study
  – Site survey

• Design
  – Site layout
  – Intake design
  – Turbine specification

• Permission applications
  – Planning
  – Abstraction
  – Electricity network connection
Development Process
How do I put one in?

• Construction
  – Civil works tendering
  – Project management & site supervision

• Commissioning
  – Turbine installation
  – Electrical contracting
  – Testing

• Maintenance
  – Bearings and screens
Grants, Financing and Income

Is it worth it?

- Grants
- Financing
- Income
Grants

- Scottish Rural Development Program (SRDP)
  - Competitive program
  - Up to 40% of capital costs (50% in LFA)
  - Complex application process

- Scottish Community and Householder Renewables Initiative (SCHRI)
  - 30% of capital cost up to £4,000
  - More available for community projects
  - Feasibility funding available for community projects
Financing

- Savings or liquid capital
- Bank loan
- Community funding: local buy-in
- Wider cooperative
Income

- Displaced demand
  ~12 p/kWh
- Export to grid
  ~7 p/kWh
- Renewables Obligation Certificates (ROCs)
  ~5 p/kWh
- Total effective income
  ~11 to 17 p/kWh
Micro-Hydro In Scotland
How can I use it?

- Hydropower basics
  - $P = \lambda Qgh$
- Constraints
  - Geographic, environmental, planning and electrical
- Low head systems
- High head systems
- Development process
  - Feasibility, design, permissions, construction, commissioning and maintenance
- Money
  - Grants, financing and income