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The Innovation Partnership

PLANNING AND IMPLEMENTATION WORKBOOK

FOR THE INSTALLATION OF A MICRO HYDRO ELECTRICITY GENERATION FACILITY

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
The European Agricultural Fund for Rural Development: Europe Investing in Rural Areas

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Prepared by:

Nigel Woodruff
The Innovation Partnership Ltd
118 High Street,
Manchester, M4 1HQ
Tel: 0161 834 4401
Fax: 0161 834 4402
Email: tipl@innopartners.com

The Innovation Partnership

With contributions by:

Jacques Sisson – HEP and CAMS Officer, Environment Agency (Bangor)
Chris Blake – Managing Director, The Green Valleys Initiative
Rhys Owen – Head of Conservation & Agriculture, Snowdonia National Park Authority
Dafydd Watts – Sustainable Energy Project Manager, SWEA
Steve Arnold – Assistant Programme Manager, Ynni'r Fro Programme, Energy Saving Trust,
Andy Tickle – Head of Planning and Campaigning, Peak Power Project
David Williams – CEO, British Hydropower Association

Prepared for:

Gwynedd Economic Partnership – Innovate Programme

Gwynedd County Council
Council Offices
Shirehall Street
Caernarfon
Gwynedd, LL55 1SH
Tel: 01286 679628
Fax: 01286 678962

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Gwynedd Economic Partnership www.economigwynedd.info, www.gwyneddeconomy.info
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Part 1: Introduction

1.1 Background to Micro Hydro

Hydro power is one of the oldest forms of energy generation and for centuries – up to the start of the industrial revolution – was a major source of motive power in the UK. It uses the kinetic energy in water (the energy in its movement) to turn machinery or to turn a generator and produce electricity (usually via a turbine).

Micro hydro is a term used for hydroelectric power installations that typically produce up to 100 kW of power. These installations can provide power to an isolated home or small community, or are sometimes connected to electric power networks. Similarly, schemes can be divided based on the head of water (the height the water drops) available at the site, with the normally accepted classifications being:

- High head > 200m
- Medium head 50-200m
- Low head <50m

Hydro is one of the most efficient and reliable renewable energy technologies and offers the following key features:

- Very efficient conversion of water power into electricity
- Constant generation over long periods
- High level of predictability, varying only with annual rain patterns
- Power fits demand, ie output is greatest in winter
- Robust technology – systems can last for over 50 years (many have lasted longer)
- Low maintenance requirements and running costs
- Desirable payback for grid-connected systems

Humans have been using water to generate power for over 4,000 years and during that time three main types of technology have been developed:

- Waterwheels
- Archimedes screws
- Turbines

For medium and high head sites (head >50m), the only realistic power source for the generation of electricity is a turbine and, in the recent past, these have also been seen as the solution of choice for the generation of electricity for low head sites (head < 50m). However, the cost per kW of electricity produced tends to increase with decreasing (power) rating and – partly for this reason – the two oldest methods of energy conversion, the waterwheel and the Archimedes screw have been re-assessed for their use as power generators. The final choice of technology will always be site specific and will depend upon a number of unique factors such as environmental, financial, historic and planning.

1.2 Direct Benefits of Micro Hydro

- Environmental Benefits

Hydro electric generation is clean energy; it does not rely on the combustion of fossilised hydrocarbon material which releases carbon dioxide into the atmosphere. The UK is committed via the Climate Change Act (2008) to reduce carbon dioxide emissions and it is therefore essential that *clean* sources of energy are exploited in order to reduce dependence on fossil fuel energy production. Hydro electric generation, if considerately applied, is a sustainable form of energy production. It only taps into the potential energy of existing systems in the same way that solar and wind generating technologies do.

- Financial Benefits

As fossil fuel sources are exhausted, not only is the cost of their extraction set to increase but a reduced supply couples with increasing energy demand will lead to dramatic increases in the market price for energy. This was illustrated by the sudden and sharp transport fuel increase in the UK in 2008 as British Gas and other suppliers raised their tariffs by up to 35%.

The UK government has recognised the benefits of renewable energy generation and supports renewable energy generation through several means, the most significant being the introduction of Feed in Tariffs (FITs). This support is paid to renewable energy producers in various amounts according to type of technology and the power produced. Many renewable energy producers use their own electricity on site and export their excess to the national grid. The electrical units

(kWh) are sold for a minimum price of £0.03 per kWh offering further financial gain for producers. The differing rates of support are shown in Table 1 – *'FIT Rates for Renewable Technologies'* which shows the latest 2011 rates. Although hydro electric generation does not receive as high a payment as some other technologies, the reliable availability of water and the 24 hour a day generation of a hydro electric generator means that the energy output and therefore financial return of the hydro electric system can be higher than other technologies.

Table 1: Feed in Tariff (FIT) Rates for Renewable Technologies

Technology	Scale	FIT Rate/KWH
Hydro	< 15KW	20.9p
Hydro	15-100KW	18.7p
Hydro	100KW-2 MW	11.5p
Wind	1.5-15kW	28.0p
Wind	15-100kW	25.3p
Solar PV	4-10 kW	37.8p
Solar PV	10-100 kW	32.9p

Source: Energy Savings Trust, 2011

1.3 Indirect Benefits of Micro Hydro

There are several other indirect benefits of hydro electric generation and, though difficult to quantify, these are both real and significant.

- Preservation of the Uplands

The ability of the uplands to store water helps to regulate the flow of water into the fluvial system and prevents both flood and drought events. The peat soils are formed from layer upon layer of semi-decomposed plant matter, principally sphagnum mosses. These mosses serve two functions. The living mosses act as a water purification system, reducing silt loads in upland streams making them more suitable habitats for many species. The semi-decomposed matter, kept from full decomposition by the waterlogged acidic conditions, acts as a globally important store of carbon[1]. The bogs have been systematically drained over centuries in order to increase their agricultural value but this draining has allowed the bogs in some

[1] http://www.wildlifetrust.org.uk/facts/peat.htm

areas to dry out. When dry, the mosses are able to decompose completely releasing the stored carbon into the atmosphere, compounding the effects of human induced climate change[2]. By encouraging landowners to consider hydro electric generation, land that once had little agricultural value becomes a new income stream, providing an economic disincentive for draining the land.

- Supporting Rural Communities

Currently, 43% of the entire EU budget is spent on agricultural support[3]. The recent financial crisis and recession has prompted the need for cutbacks in government spending. These cutbacks will affect all communities within the UK, both urban and rural. In rural communities the average 19% cut in departmental budgets[4] will undoubtedly result in a cut back in services.

Rural areas are already poorly served by public transport services and suffer from higher fuel costs associated with increased mileage. Individual or community-owned micro generation presents the possibility for rural communities to become, in part, financially independent despite the cuts in government spending.

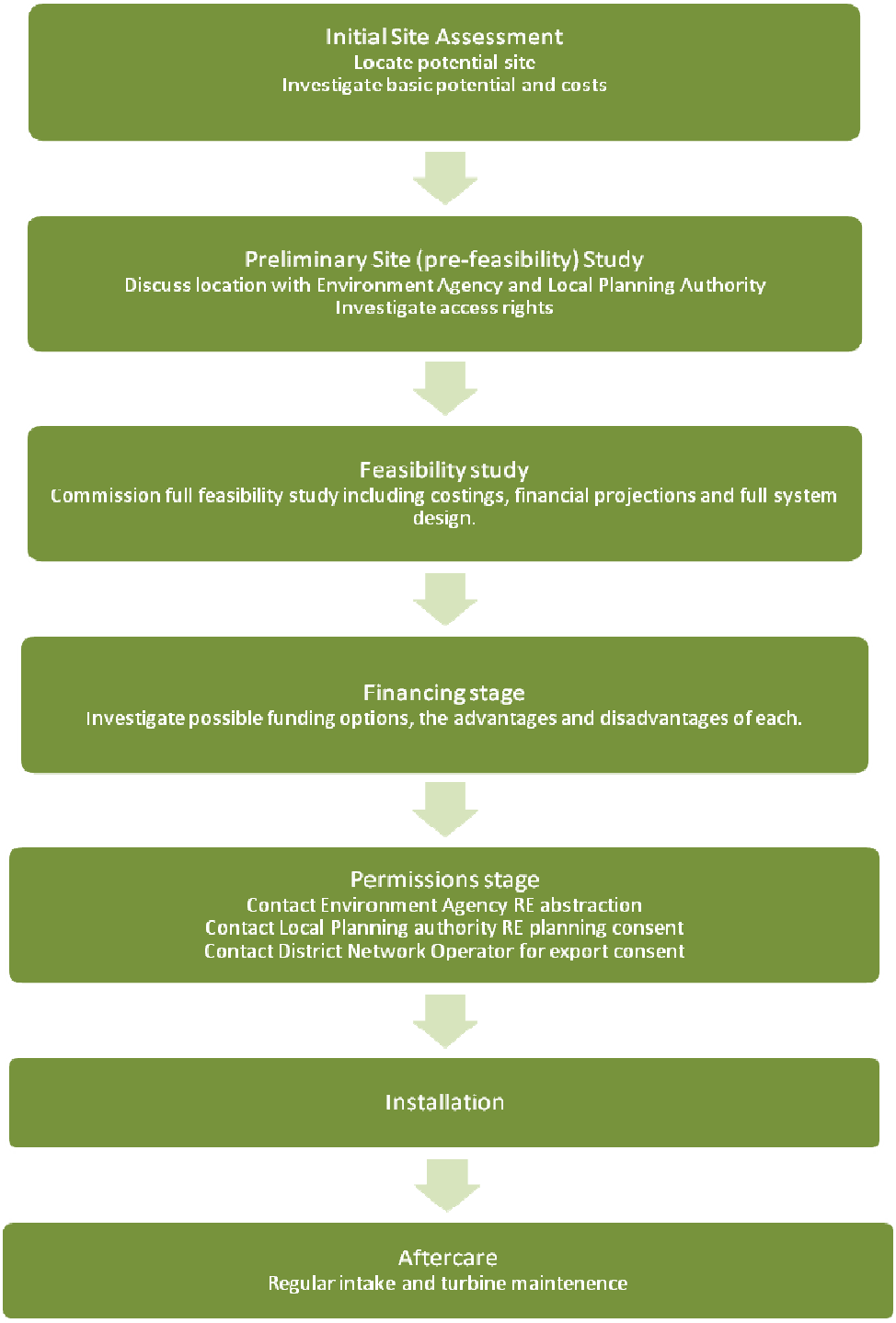
More specifically, research has indicated that there are hundreds of suitable sites within the Snowdonia National Park and Gwynedd and that modern micro hydro systems can, through electricity production and grants, cover their cost in as little as four years, and can carry on producing power and revenues for well beyond 20 years. As with other European countries, such developments can help to resolve fuel poverty issues over the coming years.

[2] http://news.bbc.co.uk/1/hi/sci/tech/6502239.stm
[3] http://ec.europa.eu/budget/budget_glance/what_for_en.htm
[4] http://www.hm-treasury.gov.uk/spend_index.htm

Part 2: Planning Your Own Micro Hydro Installation

The flow chart below (adapted from information provided by The Green Valleys, a Community Interest company promoting renewable energy generation in and around the Brecon Beacons in Wales) shows the key stages that need to be considered when assessing the opportunity for installing a micro hydro facility.

Figure 1: Key Planning Stages in the Micro Hydro Process



2.1 Initial Planning Stages

The Environment Agency states that two of the major barriers to developing a micro hydro scheme are the relatively high cost of site assessment and the large outlay of capital in implementing any project. Feasibility studies are usually undertaken by a consultant to establish the viability of the scheme and hydro capital costs are usually more site-specific than for any other form of renewable energy. As a result, making initial cost estimates is difficult. To minimise costs and risks, there are three stages to progress through before deciding to go ahead with a micro hydro scheme:

2.1.1 Initial Site Assessment

An individual landowner or community group can undertake an initial site assessment by asking themselves two key questions:

- Approximately how much electricity can I generate?
- Are there any fundamental (environmental, ecological, cultural heritage, planning or grid connection) issues which would inhibit the development?

To answer the first question above, Peak Power, a project investigating micro hydro potential in the Peak District, provides the following equations:

HEAD

The head **(H)** of water across the site will need to be measured (in metres), either:

- For medium-high head sites: crudely counting off the contour levels on an OS map or using a hand held GPS; for more accuracy a surveyor's (dumpy) level should be used *or*
- For low head sites: either physically measuring the water drop (tape measure or calibrated rule/staff) or, better, by surveyor's level

FLOW

Flow **(Q)** can be measured in a number of ways:

- If you are on a sizeable river, you may be lucky enough to have a nearby gauging station operated by the Environment Agency. Flow data is available free from www.ceh.ac.uk/data/nrfa/index.html
- A notched weir can be set up to record daily flows which can then be averaged (seewww.britishhydro.org/mini-hydro/index.html)

- A low cost desk estimate, using the HydrA computer model, is available from www.devondare.org at £50 per site or a more costly, but more sophisticated version at £175 per site from www.hydrosolutions.co.uk
- If time or resources do not allow for physical measurement or modelling, perceived flow can be estimated as follows: the speed of a float is measured over a defined distance and a rough cross-sectional area of the stream is calculated. Multiplying the speed (metres per second) by the area (metres squared) will give flow in cubic metres per second (m3/s)

POWER

A conservative yet realistic estimate of potential electrical power (Pe) can then be made using the formula: **Pe** (kW) = **e%** (estimated system efficiency) **x H** (head in metres) x **Q** (flow in m3/sec)

Using an example system efficiency of 60% (6 x 1 metre head x flow of $10m^3/s$ = **60kW**), the amount of energy produced per year can then be estimated as follows (with 8760 being the number of hours in a year):

Energy (kWh/yr) = **Pe** (kW) x **CF** x **8760**

and where **CF** = capacity factor which varies depending upon the flow used for hydro power but can be taken as 0.4 (i.e. that the system will be running for 40% of the year) for the initial assessment. Capacity factors for hydro are usually higher in reality (usually upwards of 0.5) but for initial estimates it is better to be conservative. Using the worked example above, energy capture would be:

60 kW power x 0.4 capacity factor x 8760 = 210,240 kWh per year, or 210 MWh/y

To answer the second question, relating to scoping potential environmental, planning and other site constraints, this is usually the time to call for expert advice from both the relevant local planning authority (ie for Snowdonia, the National Park Authority) and the Environment Agency. If at all possible, this would indeed be the correct stage to submit a completed pre-application form (WR315 – see section 2.3.1) to the Environment Agency.

2.1.2 Preliminary Site (pre-feasibility) Study

Once a potential site has been found and a basic DIY assessment undertaken, it is almost always necessary to professionally explore the potential of the site. A full feasibility study can be expensive and it is good practice to first complete a simple pre-feasibility study (sometimes called a viability assessment) to determine whether the site has potential before time and money is spent on a formal feasibility study. This study should be undertaken by an experienced hydro power professional and should cost between £300 and £1,000.

The Green Valleys group states that if you are considering a community micro hydro project then this is the stage when all landowners involved should be approached and consulted as without a landowner's permission, no installation can take place. It is important to remember that where a stream or river marks the boundary between two landowners, both of those landowners have equal rights to the water in the stream and both must give full permissions for access and abstraction. A benevolent or absent landowner is often the greatest ally of a community-owned renewable power project and both the Forestry Commission Wales and Welsh Water (Dwr Cymru) own land that is suitable for micro hydro and who are approachable for community-owned projects.

2.1.3 Feasibility Study

A professional assessment of the site will undoubtedly be required by both the local planning authority and the Environment Agency, and should cost in the range of £2,000 for a domestic scheme to £10,000 for a commercial scheme. Typically any company offering an installation service will also offer a system design and feasibility study service. Any feasibility study commissioned for a prospective installation should at the very least, include details of:

- *Geographical analysis* – discussing the catchment area of the proposed installation as well as the particulars of the local geography and topography on site. This analysis should enable the description of the Abstraction regime required for the proposed system design.

- *Civil works* – A description of any required preparation of site, the intake structure, the forebay tank, turbine house and any discharge infrastructure needed.
- *Turbine and generating equipment* – A description of the generating equipment and an explanation of its suitability to the proposed installation
- *Grid connection* - details of the proposed grid connection location and technique demonstrating that the connection will be sufficient to deal with the generation capabilities of the proposed system.
- *Energy resource and projected income* - Although it is unrealistic to expect the feasibility study to accurately predict rainfall levels in the coming years, an educated estimate of annual income based on catchment area analysis and system design.
- *Full detailed costing of the proposed installation* - This should include parts and labour as well as the costs of any permission required for installation.
- *Other features* – the feasibility study should highlight any anomalous features such as listed buildings, nature reserves or sites of special scientific interest (SSSi's), including preserved trees that may possibly be affected by any installation. The feasibility study should also highlight any potential planning or environmental issues that may stand in the way of a proposed installation.

2.2 Financing Stage

The Energy Savings Trust suggests that costs for installing a hydro system can vary considerably depending on the location and the amount of electricity it can generate. A typical 5kW scheme suitable for an average home might cost £30,000 - £40,000 including installation.

The Green Valleys Initiative provides the following costed example for a 15kW facility:

Component Costs of Hydro Electric Installations

The installation of a hydro electric generator is a major financial undertaking and it is important to understand the component costs of an installation. Here The Green Valleys have provided a capital breakdown of a typical 15kw installation.

The installation includes an intake, buried penstock (pipe that carries the water from the source to the turbine) across improved pasture connected to a turbine encased in a turbine house. The installation also includes grid connect work and planning consent and abstraction licence consultancy. These figures are based on the particulars of a site and are by means of an indication only.

Intake	£5,000
Penstock	18,000
Turbine house	£8,000
Manifolds and fittings	£4,000
Turbine	£1,500
Generator and controller	£9,000
Electrical Installation	£16,000
General installation	£2,700
Permissions consultancy and apps	£4,000
Total	**£68,200**

Based on monthly flow duration statistics, the above 15kW system will generate a total of 60,768 kWh in each year. With FIT of 20.9p/kWh and a guaranteed export tariff of 3p/kWh then the system can generate a gross income of over £12,000 per annum meaning that the system will pay back in 5-6 years. (Note: 2010 FIT levels utilised for this example).

As mentioned earlier, the financing of renewable electricity installations has recently changed with the announcement of the Feed in Tariffs (FITs). FITs have brought about a substantial change in the way that small-scale, renewable energy generation is subsidised. Until the introduction of FITs most small-scale renewable energy schemes were funded with grants to cover all or part of the capital cost. Now with the introduction of FIT the emphasis of the subsidy has moved from the capital cost to the price support through payments for price per unit generated. The FITs system has been designed to reward private investment and consequently many of the grants previously essential for funding small-scale renewables projects are no longer available.

For up-to-date information on financing rules and amendments to FITs arrangements please see the Micro Hydro Association's website (www.microhydroassociation.co.uk), and the other key sources of information such as the Environment Agency, the Energy Savings Trust, or the Carbon Trust.

It is also important to note that to be eligible for FITs, you need to ensure that you use approved installer companies and products which are listed on www.microgenerationcertification.org. Approved installer companies are members of a consumer code of practice which meets Office of Fair Trading requirements. A specific list for MCS-certified installers in Wales can be obtained from the Energy Savings Trust (www.energysavingtrust.org.uk).

Some parts of micro hydro installations, such as civil engineering works, can be undertaken by developers, communities or other companies, but to be eligible for FITs, the turbines, controls and electrical parts must be installed by an approved company. The turbine must also be listed as approved.

To be eligible for FITs, your approved installer will register your installation details and commissioning date on the MCS database. This provides verification required by Ofgem and your chosen energy supplier. As this is a new UK policy, this arrangement may be changed as a result of lessons learned in the early stages of operation. We recommend that you check the current process with The Energy Savings Trust before signing contracts with any particular energy supplier.

2.2.1 Sources of Capital for Community-Owned Schemes

When examining community-owned schemes specifically, Chris Blake of The Green Valleys suggests the following financing options:

- **Loan finance**

It can be possible to part-finance a hydro scheme through commercial loan finance. For hydro power systems these loans can be between 50-65% of the capital cost. For larger loans above £150-200k it may be possible to find a lender that is willing to lend to finance the scheme using the income generated by the scheme as the security for the loan. For smaller loans below £100k the costs of

setting up these, so called "non-recourse loans" can be prohibitive, especially without an asset, such as land, to act as security. The Green Valleys has set up a £0.5m umbrella facility with Finance Wales which allows individual schemes to benefit from loan finance (between £17,500 and £125k).

- **Private (non-State Aid) grants**

Although in short supply, funding is still available for some community projects through grants from Trusts and private companies, including some of the major energy companies. Demand for these sources is high and the application process is therefore lengthy, often with match funding requirements, but nonetheless they have the potential to represent a significant proportion of a community project's capital requirements.

There are many organisations that will help guide community groups through the available funding for projects such as The Energy Saving Trust's Green Communities[5]

- **Institutional Investment Capital**

Some investors will be attracted to the potentially high returns that FITs qualifying renewable energy systems can generate and it may be possible to get some investors to invest directly in the scheme or indirectly through a special purpose investment vehicle into a range of schemes.

- **Private investment capital**

A number of private individuals may be willing to invest in a scheme. This can be done as a single substantial investment directly into the scheme (say for £5-25k) or it can be part of more general fundraising where smaller sums are raised from a number of individuals. There are a number of ways of doing this but you do need to take professional financial advice as share or bond issues to the general public are regulated by the Financial Services Authority and there extensive regulatory considerations.

[5] http://www.energysavingtrust.org.uk/cafe

- **Community ownership**

In many cases the goal is community ownership in some form. But you need to be clear about what constitutes community ownership and what is viable given the capital that needs to be raised in each case. By community ownership many people understand that some form of incorporated body under community control is the full or part owner of the scheme. This is the goal but unless the community can secure capital grant in some form this may be an unachievable dream for most. Community involvement can mean private ownership with a significant proportion of the investors coming from the local community. This keeps the financial benefit within the community but is obviously very different from collective community ownership.

Support for community owned schemes is also available through the Welsh Government's Ynni'r Fro programme. This is an EU-funded project which offers support through a network of Technical Development officers, and funding towards the cost of the development and capital stages. If the scheme intends to use the FITs as a basis for its income, funding will have to comply with the relevant legislation as outlined in the section on FITs and grants above. Schemes have to have a likely capacity of at least 50kW to be eligible. If a scheme is large enough, there may be potential to look at a joint venture between a community-owned social enterprise and the landowner or a developer, where raising the necessary funding and the profits are shared.

Energy4all[6] also offers a model based on cooperatives where communities can invest directly in their own schemes or in stakes of schemes of larger developers. A summary of some of the funding models for community renewables can be found in the paper "Funding the Future" by Richard Hoggett[7]

2.3 Permissions Stage

The Environment Agency itself states that Hydropower schemes can be complex and need to be designed and managed carefully to avoid unacceptable impacts

[6] http://www.energy4all.co.uk

[7] http://tinyurl.com/fundingthefuture

on communities and the river environment. For example, changes to a river can increase the risk of flooding and have significant impacts on wildlife, especially fish.

The Environment Agency regulates the installation and operation of hydropower schemes in England and Wales and is keen to help you. Their 'Good Practice Guidelines' will help you to make sure that your scheme does not harm the environment. These Guidelines, together with more information about hydropower and the environment can be found on their website at www.environment-agency.gov.uk/hydropower.

Once you have an idea of the type of hydropower scheme you would like to set up, contact the Environment Agency by email at enquiries@environment-agency.co.uk or telephone 08708 506506. They will allocate an account manager to help with your application and guide you through the permissions process.

2.3.1 Environmental Consent

You will need permission from the Environment Agency to operate your scheme. Before applying for formal permission, you should complete the pre-application form, WR315, available by contacting the Environment Agency on 08708 506506 (Mon-Fri 8am-6pm) or from their website at www.environment-agency.gov.uk/hydropower. This will help the Environment Agency to understand what you are proposing and support you in preparing your full application. Their guidance will let you know which permits you may need. The Environment Agency will consider:

- **Abstraction**

You need the Environment Agency's agreement for the amount of water your schemes can take from the river to flow through a hydropower turbine. An Abstraction licence gives permission to abstract water and to discharge the water back into the waterway. It is important to call the Environment Agency and discuss the proposal even before the feasibility study takes place in order to highlight any potential pitfalls or barriers in the way of development as soon as possible. The basic cost of the application is around £135 but there may be other associated costs including the advertising of the application and surveys as required by the Agency.

- **Impoundment**

Construction of a new weir or modifications to an existing structure will require an Impoundment licence. A new or raised weir will change the water levels and flows in the river by impounding more water above it. The Environment Agency will need to agree these changes with you.

- **Flood Risk**

You need the Environment Agency's agreement for any works in or near rivers that have the potential to increase flood risk. This will include both the construction works and the finished scheme.

- **Fish Passage**

For many schemes, the Environment Agency will require a fish pass to allow fish to pass safely up and down the river.

2.3.2 The Planning Process

In almost all cases you will also need planning permission from your local planning authority to develop a hydropower scheme. It is important to contact your local planning authority to discuss your plans at an early stage. If the scheme is in a designated site or a National Park the planning authorities will be Countryside Council for Wales or Natural England, or the relevant Park Authority. They will consider issues such as

- The appearance of the scheme, they will consider whether it is sympathetic to the local landscape
- Pollution, in particular with hydro electrics, any noise pollution resulting from an installation.
- Disturbance to the local area during the construction of the installation, to local residents and disruption to the local traffic
- Preservation of any structures of historical importance in the area, be they listed buildings or other archaeological features. The feasibility study stage mentioned above should highlight any anomalous features such as listed buildings, nature reserves or sites of special scientific interest (SSSIs or SACs) including preserved trees that may possibly be affected by any installation

Your will have to provide a Design and Access Statement and other information with your application. In England it is likely to need a Flood Risk Assessment, or a Flood Consequences Assessment in Wales.

If the potential impact on the environment is considered significant enough, you may have to prepare an Environmental Statement to go with your planning application. This should be done by a technically competent person and should also include the information the Environment Agency needs to decide which permit to issue. The local planning authority will consult with other people who may be affected by the scheme and the application may be decided by a Planning Committee of elected Councillors.

2.3.3 Consulting the Local Community and Other River Users

Harnessing the power of rivers through hydropower schemes is just one of many river uses. Schemes can have an impact on other users including water abstractors, anglers, canoeists or those who enjoy the natural beauty of an area. Impact can be seen as beneficial or negative so it is important to involve other river users in your plans. The best schemes are those that offer multiple benefits to many river users and these can involve angling, recreational or even educational enhancements.

Each river and each site is different so there isn't a standard list of people to contact but it would be a good idea to involve the following:

- Adjacent landowners and riparian (river or river bank)owners
- Local angling clubs and associations
- Local Rivers Trust (or Association of Rivers Trusts)
- Local Wildlife Trust
- Recreation interests (e.g. local boating, canoeing and rowing clubs)

Depending on the type of structure and local habitats, you should also contact the following organisations, as there may be extra requirements in certain cases:

- Natural England or the Countryside Council for Wales
- Natural England or Cadw (the Welsh Assembly Government's historic environment service)
- National Parks

The planning and permitting systems will ensure that those affected by a scheme have an opportunity to comment, but contacting them early will reduce the risk of subsequent delays during the planning process.

For *most* planning applications in Gwynedd you will need to consult with Gwynedd County Council planning department. However, if the installation lies either entirely or partially within the Snowdonia National Park then it is the National Park Authority that must be consulted and applied to. The National Park Management Plan is the overarching strategy for Snowdonia and it aims to promote sustainable environmental, social and economic growth within the Park. The Plan does promote the use of appropriately scaled micro-generation and community renewable schemes, including micro hydro schemes, but it is important to note that the Park Authority has adopted 'Guidance for Sustainable Design', which provides guidance on siting of installations and building orientation and includes details about the requirement for an Energy Statements, as part of any Design and Access Statement and planning application.

For further information regarding planning applications and micro hydro installations within the Park boundaries please contact the Park Authority on 01766 770274 or parc@snowdonia-npa.gov.uk. The Welsh Government has also published a series of leaflets regarding renewable energy which provide a useful outline prior to any in depth investigations[8].

2.3.4 District Network Operator (DNO) Grid Connect Permission

Consents for new electricity connections are handled by your local electricity supplier (also called Distribution Network Operator (**DNO**). In the case of the North Wales region, this is SP Manweb (0845 272 2424). Schemes that will provide around 10kW or more need a more complicated (three-phase) form of connection but your DNO will advise on this. Provision of any new connection will also be dependent on successful negotiation of relevant permissions to run wires or cables through adjacent land (particularly through a National Park). The cost of providing a long

[8] These can be downloaded from www.cymru.gov.uk

connection may prove prohibitive at some sites. It is therefore wise to tackle this process at a relatively early stage of any micro hydro project.

Although this all sounds quite daunting, micro-generation and small-scale community renewable energy schemes are encouraged and will be supported, especially where they make a contribution to improving the quality of life in smaller communities. For example, in its own words the 'National Park Management Plan' for Snowdonia states that one of its objectives is to "promote the use of appropriately scaled micro-generation and community renewable energy schemes".

2.4 Installation

Assuming that all of the necessary permissions above have been granted and that finance for the project has been secured, the installation of the hydro project is, by comparison, a relatively straightforward process. For community installations this is often where the whole community can get on board lending a hand where appropriate to reduce costs such as installing penstock (the pipe that carries the water from the source to the turbine) or construction of turbine housing. Remember though that in order to meet the MCS accreditation requirements discussed above, all work will need to be overseen by an MCS accredited installer.

2.5 Aftercare

Once a micro hydro has been installed and is operational, there are several aspects relating to aftercare that need to be considered. The Green Valleys suggests that intake screens will need to be regularly cleared of debris, especially during the autumn months' leaf drop. As well as this systems will need regular servicing and inspections to ensure that they are running correctly. Many installers will offer this service as part of the installation, this should be checked in the installation contract but it is important for both individuals and community groups to understand the servicing requirements of their particular system. There will also be insurance, equipment replacement, reporting and accounting.

Part 3: Case Studies

It may be useful at this point to examine how some real-life examples of micro hydro installations have worked out for the individuals/community groups who chose to invest in such schemes. Chris Blake of The Green Valleys stated that they presently have ten hydro electric installations ranging from a couple of kilowatts to 36kW, including:

- **Llanover Hydro:**

Farmer Alan Williams began his journey thinking about a wind turbine system to assist in his diversification plans for his business. He later discovered that he had an ideal site for a small-scale Hydro electric system and by 2007 his 10kW system was operational. He now generated 80,000kWh per annum and sells the majority of the electricity he produces directly to the National Grid.

The project took eight months to complete, with members of the Williams family helping out with the construction work. Now that it is finished the hydro turbine will generate approximately 50 megawatt hours a year, which is enough to supply 10 homes. The farm now enjoys a renewable source, which runs 24 hours a day seven days a week. After leaving the turbine the water is then returned to the same stream with no impact on the environment.

- **Talybont-on-Usk Community Hydro Scheme:**

A 36kW Cross-Flow Turbine utilising the compensation flow from the Talybont Reservoir. Completed in 2006 the hydro installation now generates over £20,000 per year for the local community.

- **Dyffryn Crawnon Hydro:**

In 2007 Pip and Gill applied for assistance from the Brecon Beacons National Park Authority's Renewable Energy Assistance Program (REAP) and were awarded £2,067 towards the cost of the installation of a hydro generator with a 3.3kW potential. The generator is powered by a small spring that originates high up on the hillside. Pip decided on a renewable resource in an effort to reduce their impact on their environment and to use the resources available to them in a sustainable way. They decided on a hydro installation due to the availability of resources and the

consistency of supply. Pip and Gil consider it a benefit to not be reliant on the larger power companies for supply and to be able to maximize the sensitive use of the resources available to them. They were surprised by the bureaucracy of some of the grants available to them and agree that a step-by-step guide to all the elements of the installation process would have been helpful.

- **Abercraf Hydros:**

Howell and Llinos Williams applied to the Brecon Beacons National Park Authority's Renewable Energy Assistance Program (REAP) fund for funding and were granted £2,565 towards the cost of installing the Hydro electric system. This system was not eligible for any of the UK government grant schemes. Howell runs a system with a 11kW potential. This generates approximately 90,000 kWh per annum.

The Williams' household decided on a renewable source of energy supply in 2008 as a reaction to the rise in oil prices. They originally considered a wind turbine but a neighbour had installed a hydro system and this, combined with the abundance of water available, sealed the decision.

The Williams' consider the security of energy supply, the diversification of their farm business and the financial return from selling their excess electricity back to the National Grid as being the greatest benefits of the installation. They expect to pay back their investment within three years based on the trend of the last two years precipitation.

Howell experienced no unforeseen problems during the installation of the hydro system, which is housed in a small shed next to his house. The process of obtaining planning permission took some time but everything went smoothly and they recommend similar installations to all those with the available resources.

In addition to the Green Valleys projects, Tegwyn Jones, of Talyglannau Farm, Mallwyd, Powys, is hoping that the income he receives from harnessing one of the most natural of resources on his land will enable two of his sons to remain on the family farm when they finish their educational studies.

Tegwyn has already completed one hydro-electric scheme on his hill farm - most of it in the Berwyn Mountains SSSI - and he is currently in the process of adding a second at a separate location. Tegwyn says that, "My eldest sons are keen to work at home once they finish their schooling and I am hoping that these two schemes will be help to make this economically possible". In Tegwyn's first installation, rainwater falls 550 feet through a 10-inch pipe down the side of the mountain from two small weirs into a specially built power house where a turbine helps to convert into electricity, which is sold to London Electricity. When in full flow, the system produces around 95 kilowatts.

Part 4: Useful Contacts

If you decide that you are interested in installing a micro hydro scheme on your land, here are contact details for organisations that may prove both necessary and useful during the process:

Environment Agency
Tel: 08708 506506
www.environment-agency.gov.uk

Energy Saving Trust (UK)
Tel: 0800 512 012
www.energysavingtrust.org.uk

Ynni'r Fro Programme
Energy Saving Trust, Cardiff
Tel: 0800 512 012
www.energysavingtrust.org.uk/Wales/Ynni-r-Fro

Department of Energy and Climate Change
Tel: 0300 060 4000
www.decc.gov.uk

Welsh Assembly Government
Tel: 0300 0603300
www.cymru.gov.uk

Cadw
Tel: 01443 33 6000
www.cadw.wales.gov.uk

Countryside Council for Wales
Tel: 0845 1306 229
www.ccw.gov.uk

Ofgem
Tel: 020 7901 7295
www.ofgem.gov.uk

SP Manweb
Tel: 0845 272 2424

The Green Valleys
Tel: 07969 137719
www.thegreenvalleys.org

Snowdonia National Park Authority
01766 770274
parc@snowdonia-npa.gov.uk

Micro Hydro Association
www.microhydroassociation.co.uk

Association of Rivers Trusts
Tel: 01579 372142
www.associationofriverstrusts.org.uk

British Hydropower Association
Tel: 01258 840 934
www.british-hydro.org

The Wildlife Trusts
Tel: 01636 677711
www.wildlifetrusts.org

National Parks
Tel: 029 2049 9966
www.nationalparks.gov.uk

Planning Portal – Local Planning Info
Tel: 0117 3726372
www.planningportal.gov.uk