

ROC = A Renewables Obligation Certificate (ROC) is a green certificate issued to an accredited generator for eligible renewable electricity generated within the United Kingdom and supplied to customers within the United Kingdom by a licensed electricity supplier. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

LEC = Levy Exemption Certificate, evidence of CCL (Climate Change Levy, set up to encourage the business and public sectors to improve energy efficiency and reduce emissions of greenhouse gases through a price based signal on energy usage), exempt electricity supply generated from qualifying renewable sources. LECs will be redeemed by suppliers to HM Customs and Excise to demonstrate the amount of non-climate change electricity able to be levied that had been supplied to non-domestic customers in the given period.

REGO = Renewable Energy Guarantees of Origin, ie electronic certificates attaching to electricity produced from renewable sources. REGOs were introduced on 27 October 2003 in response to the Renewables Directive - EU Directive 2001/77/EC Article 5. The purpose of this Directive is to promote an increase in the contribution of renewable energy sources to electricity production in European Member States.

FIT = Feed-in Tariff, an incentive structure to encourage the adoption of renewable energy through government legislation. Electricity utilities are obligated to buy renewable electricity (such as solar thermal power, wind power, biomass, hydropower and geothermal power) at above-market rates set by the government. The higher price helps overcome the cost disadvantages of renewable energy sources. The rate may differ among various forms of power generation. A FIT is normally phased out once the renewable reaches a significant market penetration, such as 20%, as it is not economically sustainable beyond that point.

## So, is it worth it ?

Well it certainly raises our awareness of the value of electricity, and has encouraged us to switch off more and convert more to low energy light bulbs ! And it has a considerable feel-good factor...just to know that every Kilowatt hour we generate is less using carbon fuels or nuclear power. We also feel that our commitment and experience is now there to pass on to others, so that, in time there will be more small scale hydro in the area, benefiting from our experience and example. Finally, it's additional interest for our visitors and a chance to literally see for yourselves the amount of water needed to turn a wheel, to drive a generator, to make enough electricity to run a few light bulbs, boil a kettle, or a very small electric heater ....quite a lot !

## Who was involved ?

### Project coordination

Peter Strong, Conservation Consultant    hazelbank@hotmail.com

### Engineering

Tony Baker Developments, Little Salkeld

### Electrics

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### Project initiator

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# Generating electricity at The Watermill.



From  
this.....

To 60  
of these



By way  
of  
this.....



These belts  
& pulleys



This  
Windy Boy  
inverter



& this  
export  
meter





## The story so far

For years visitors have asked us “Do you generate your own electricity ?”...and for years we have replied “Not yet”.....then “Well, why not?”...to which we have replied, the technology is too expensive, and the benefit too small, because we are a “low head” site with a relatively small flow of water, and the incentives have not been there, or too complicated to bother with.

Well, now that’s changed...a bit. We’re still a low head site, with a relatively small flow of water, but the technology is smaller, neater, simpler, and less costly; and the incentives are greater.

A couple of years ago we were looking at the possibility of installing a free standing turbine. We decided not to pursue this when we were advised that the cost was going to be around £20K - £30K, for an output of between 1KwH (Kilowatt hour) and 2KwH, and only available when we were not milling or when there was lots of water after heavy rain.

Meanwhile small-scale wind turbine technology was being refined. What made the real difference was the design of a compact alternator (generator) that could be fitted to a pulley wheel and then driven using belts. We already had a spare large pulley wheel inside the mill connected to the smaller waterwheel, which already drives the winnower for cleaning grain and the bolter for sieving white flour. So it was relatively simple to set up a belt drive to a small pulley wheel connected to the alternator. This gave us the necessary “step up” in speed.

The alternator turns at **XXX rpm**, and is connected, by way of a rectifier, to a “Windy Boy” inverter. This is a crucial bit of kit to synchronise the current from the alternator (which varies depending on the amount of water running over the waterwheel) so that it can be fed into the grid, by way of an “Export meter” which measures how much we are providing. The Windy Boy converts the rectified DC voltage from permanent magnet generators into grid-compatible AC voltage. It has a rolling display providing the following information :

- 1.Present feed-in power (Pac) and output voltage. Our feed-in power varies between 300w and 700w, producing an output voltage around 220v-260v.
- 2.Energy generated in current generating period (ie since turned on each day).
- 3.Total energy produced since installation (3<sup>rd</sup> September 2009), and the operational hours.

At present our average production is 2/3<sup>rd</sup> KwH per hour, so it takes 3 hours to generate 2 KwH. To put it another way, a feed in power of 600w is enough to run 6 X 100w light bulbs. At present we do not generate overnight (for safety reasons), and generation is restricted during milling (currently around 30-40 hours per week), so we are actually generating around 30hours/week, or c 20 Kilowatt hours/week.

Pac	545W
Upv	256V
E-today	1.10kWh
Mode	Turbine
E-total	26.2kWh
h-total	76h

## So, what did it cost, and what’s the payback ?

The cost of installation was just over £4,000. This breaks down into two main areas:

1. Engineering work to set up the belts and pulleys to drive the alternator.
2. Electrical equipment including alternator, rectifier, inverter, and export meter.

Payback is currently 15p/kilowatt hour, so, if we generate an average of 20 Kw/H per week, that’s 1000 Kw/H per annum, ( or one MegaWatt Hour, or Mw/H) for which we receive £150, so payback would be in thirty years... that’s 2039 ! However, there are two factors that could improve that payback - one is that we could get paid more if the value/cost of electricity rises; the other is that the Windy Boy inverter can accept two additional sources of energy, eg the second waterwheel, or a windmill, or photovoltaic panels. The infrastructure is nearly all in place.

## What about the paperwork ?

As we are using existing machinery within the mill, we already have an Environment Agency licence to “Abstract and Impound” water from the beck, and bring it down the mill race to turn the wheels, before returning it (aerated) to the beck. We have had to inform United Utilities, the Distribution Network Operator, and complete a G83 Form, designed for small scale generators (less than 16Amp per phase) to tell them what we are doing, the kit we are using and how it is set out, and the amount of power we are producing. We also have a contract with our energy supplier, Green Energy, so that they agree to pay us for electricity produced, and we agree to ensure it is maintained in good order.

## What about ROCs, LECs, REGOs and FITs ?

These are all different ways of measuring and paying for electricity generated. They are all managed by Green Energy and any benefits are included in the agreed rate they pay us, currently 15p/KwH. I know, you’re still wondering what a ROC, LEC, REGO and FIT are....so was I....here’s what came up on Google ...