Renewable Energy and Heat Technologies

Following an energy audit and the implementation of an energy management plan to reduce energy usage to a minimum, many clubs may wish to consider looking at alternative sources of energy supply through the installation of renewable energy and heat technologies.

Below is a *simple overview* of the kind of technologies available to small businesses and further information sources. (Reference: Renewable Energy Exchange Renewables Guide www.fitforfarming.com)

Solar Photovoltaic

Solar Photovoltaic (Solar PV) panels generate electricity from sunlight. The PV cells are made from photosensitive material that generates an electrical current when exposed to sunlight. Generated electricity can be used by your club or exported to the local electricity grid network or sometimes stored in batteries.

Solar PV systems are rated by their maximum output under ideal conditions: A good location can generate over 950kWh per 1kW installed capacity per year. PV systems commonly use crystalline silicon cells arranged on a panel usually around 1.5m x 1m in size with an output of around 200W. Panels can be linked in an array to provide a larger power output.

Ideally systems are south facing with around a 35^{o} angle to the horizontal, but other installation situations are common and can still perform well.

Material lifetime expectations can be 20years or more with less than 20% efficiency loss over their lifetime. PV systems should require little maintenance and can generate electricity even on cloudy / overcast days.

Systems can be roof mounted or ground mounted and connected to the grid via an inverter, isolator switch, fuse box and meters. Mounting area required is typically around 7sqm per kW installed and should be away from obstructions casting shadows.

Costs and performance of PV systems naturally vary and there are economies of scale for larger installations. A significant proportion of the cost is in the physical installation, so quality / type of roof and ease of access is important. Whilst FiT tariff levels have been reduced, falling costs of solar panels have meant that installing a solar PV system is at an all-time low and attractive returns can still be very achievable.

Many landowners can now enjoy 'permitted development rights' meaning they can install up to a 50kWsolar PV system on a commercial property without the need for planning permission. The new Energy Performance Certificate (EPC) level D requirement for solar PV installations does not apply to farm buildings that are not heated or cooled)

Solar Thermal

A solar thermal system absorbs the energy from the sun via solar collectors, usually roof mounted, to provide hot water for domestic or small commercial use. Naturally, savings from this system depends on the level of hot water use and the fuel system it is supplementing e.g. minimising the use of electric immersion heaters or oil fired boilers can generate very substantial savings.

Solar thermal is a well-established technology, with low running costs and maintenance requirements. The can be integrated with a pre-existing heating system or part of a new build or heating system refit. A typical solar thermal system comprises of a roof mounted solar collector connected to a twin coil hot water tank via a thermostatically controlled pump.

A back up heating system is needed to bring the water up to temperature when the solar powered system cannot, e.g. during overcast winter mornings.

Ideally systems would be south facing with around 35^{o} angle to the horizontal, exposed to sunlight for a maximum time during the daylight hours with no obstructions casting shadows over any section. Larger systems benefit from economies of scale, as the physical installation costs do not greatly increase. The extra cost is primarily for materials. The quality and type of roofing, together with ease of access will affect installation costs.

Biomass Heating

Using biomass fuel for heating can produce tremendous savings in heating costs. Sourcing of a reliable and affordable fuel supply should be one of the first considerations when looking at the viability of this form of renewable technology.

Biomass boiler systems may utilise wood chip or reformed sawdust pellets as a fuel source. Whilst the food fuel can be purchased, you may well be able to source fuel from your own woodland and for this to be chipped on site.

Other potential biomass fuel sources could be local surplus crop waste such as straw bales which can also be burned very economically in 'straw boilers' or boilers with a multi fuel capacity. However this generally produces more ash and clinker than wood based materials, so boilers typically need more maintenance.

Many systems can be fully automated, both in terms of the feed of the fuel into the boiler and also the start-up of the boiler, meaning they can operate in the same way as a conventional oil or gas boiler. Whilst the boiler unit itself is only slightly larger than a traditional boiler, space is needed for other components of the system including the fuel store and possibly a thermal heat store.

Wood fuel is burnt at a very high temperature in a specially designed burner. A large volume of water is heated to around 80-90^{o}C and stored in well insulated tanks. This provides hot water and space heating for buildings, either directly or via heat exchange systems.

The capital cost of a biomass boiler system is higher than a conventional fossil fuel system, so you need to consider how well utilised it will be over the course of a year. The biggest savings can be made in situations where you have an opportunity to link several buildings together at you club in a 'district heating scheme'. Clubhouse, pro-shop, maintenance facility and other buildings can all be linked via pre-insulated pipework.

Any opportunities to 're-sell heat' can have a significant impact on the financial returns available from investing in a biomass heat system.

Wind Turbines

Wind turbines convert the power of the wind into electricity via an arrangement of blades on a rotating shaft and an electrical generator. The electricity can be used either on site, stored or exported to the grid.

Location, wind speed and the size of the turbine are the key aspects when considering this technology on your golf course. Turbines are sized by the maximum generation capacity.

A typical stand-alone grid-connected turbine installation consists of the generator unit (turbine blades and generator), mast and concrete foundation. Electricity is passed to the local circuit connection via an underground cable and an inverter which converts the electricity into a usable form such as 240 AC). Meters are used to measure the electricity generated and exported into the local grid. Grid connected systems need to comply with distribution network operator's (DNO) technical regulations. Systems >10kW often require a 3-phase electricity supply.

Planning permission will be required for all but the smallest of turbines (e.g. those with a mast <10m and turbine blade <1m.) If your land is in a designated area such as a National Park or Area of Outstanding Natural Beauty or close to an airfield or radar installation, securing planning permission may be difficult. Proximity to neighbours can also have an impact on planning permission.

The key requirement for a turbine installation is a good wind resource. 4m/sec average annual wind speed is generally considered to be the minimum required in order to generate significant electricity. Taller masts, whilst more costly, increase the yield of turbines, though securing planning permission may be more difficult.

An ideal location will be in open fields, away from any trees, buildings that could cause turbulence and so reduce wind speed. However to keep cabling costs down, the location needs to be as close to a grid connection as possible.

Small turbines up to 15kW can be ideal to match a landowner's budget or specific power needs, however the best returns are more likely with bigger turbines. If the necessary funding is not available, the renting of your site for a third-party wind energy developer may be an option.

There are costs implications for the electrical transmission line length from the turbine location to the nearest electrical supply. Systems > 10kW often require a 3-phase electricity supply.

Heat Pumps

Ground source heat pumps (GSHP) harness the solar energy stored in the ground to provide heat to a building using a coil or loop in the ground and a heat exchanger. Liquid circulates the coil and absorbs heat from the surrounding earth.

Air source heat pumps work in a similar way, but extract heat from the outside air, using an evaporator coil fixed on an outside wall of the building.

Systems use electrical motors in order to pump the water around the system but the amount of energy generated is up to 4 times the energy put in.

A well-insulated building is strongly recommended to maximise the benefits from a heat pump system.

There are three main components of a ground source heat pump system; the ground loop for collecting the heat, the heat pump for upgrading the collected heat to temperatures suitable for building heating, and the heat distribution system.

The Ground loop: An antifreeze and water mix circulates this system absorbing heat from the relatively constant temperature ground. Depending on the space available and the surrounding geology the ground loop can either be laid horizontally in trenches dug about 1.5m depth or vertically in a drilled bore hole.

The Heat pump: Operates like a reverse fridge taking heat collected from the ground loop and, via a compressor and evaporator system, upgrades the heat energy to temperatures of 40-60^{o}C.

Ground source heat pumps require a large open area in which to lay a horizontal ground loop. The size of area needed is all related to the heat demand of the building. A smaller area is needed for a vertical bore hole, but the installation costs are higher.

Ground source heat pump systems typically cost up to three times more than air source systems, so air source gives a quicker payback. However, ground source pays in the long run due to lower running costs.

Hydropower

Hydropower systems generate electricity from a generator driven by a flow of water over a turbine. The suitability of a potential site will depend on the head (vertical fall), flow (volume of water passing each second), and will dictate pipeline size, turbine type, rotational speed and generator size and the consequent power output. Careful design is needed in order to maximise efficient generation of power from a watercourse. Electricity is generated in a powerhouse form which it is then connected to the grid or to local properties.

Low head hydropower systems might only need a fall of a couple of metres at a weir, whereas in a high head system water might be collected high up on a hill side and diverted into a pipe down to a turbine lower down. To generate the same amount of power a low head scheme needs more water, so those tend to be found on larger rivers. High head schemes may only use the water from a stream.

Planning permission is required for a hydropower scheme as it normally involves damning or redirection of a watercourse.

Further Advice and Funding

Investment in solar thermal and biomass heating systems are being incentivised by the Renewable Heat Incentive (RHI), based on a tiered index-linked tariff system payable for 20 years linked to heat output. The Renewable Heat Premium Payment (RHPP) is a grant scheme for domestic users looking to invest in renewable heat installations, including biomass boilers.

Renewable Energy Association - http://www.r-e-a.net/
Community renewables funding - http://www.r-e-a.net/resources/community-renewables

The Renewable Energy Exchange (REX) - various events held in Scotland which provides a unique brokerage service, facilitating meetings between those planning renewable projects and suppliers of renewable technologies and related services. wwwww.fitforfarming.com

Resource Efficient Scotland – http://www.resourceefficientscotland.com/ - Free Government Business Support Service including the Savings Finder tool.

Energy Savings Trust Scotland - http://www.energysavingtrust.org.uk/scotland/Organisations

Carbon Trust Resources- http://www.carbontrust.com/resources

Information in this article is intended to provide only a general outline of the subjects covered. It should neither be regarded as comprehensive nor sufficient for making decisions in place of professional advice for the specific needs of your club. Scottish Golf accepts no responsibility for any loss arising from any action taken or not taken by anyone using this guidance.

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