Money for new energy

Building energy equipment choices are set to change, thanks to the latest government incentives. Dr Tom Shelley reports on what's coming up and what's going down

The economic landscape for meeting building energy requirements is changing, following two main developments: the feed-in tariffs for energy generated from renewable sources, which have already gone live; and the renewable heat incentive, scheduled for April 2011 – political developments notwithstanding. At the same time, HVAC equipment and energy management systems continue to become cleverer and more efficient. So it's time for plant engineers to review their equipment and see if they might do better.

Government subsidies arise because, wisely or unwisely, the UK has agreed to a 15% renewable energy target by 2020, as part of the EU's binding commitment to 20%. Since all energy from renewables in the UK totalled just over 2% in 2008, and heat generated from these sources was just 1%, financial incentives are seen as a route to encouraging uptake – buoyed by the expectation that this might lead to new export industries.

Feed-in tariffs (www.fitariffs.co.uk) give a payment for every kilowatt-hour of energy produced from renewables, plus an additional payment for energy exported to the grid and a saving on energy from electricity suppliers. Payments range from 9p/kWh for large-scale anaerobic digestion (biogas) to 41.3p/kWh for small-scale photovoltaic retrofits. Maximum size for subsidised installations is 5MW.

Meanwhile, the renewable heat incentive is, at time of writing, still undergoing consultation and, assuming it happens, will attract payments from next spring. For this subsidy, there is to be no limit on size. The inevitable red tape can either be handled by a system provider or users can struggle through the procedures themselves.

Most of the technologies available to take advantage of these schemes are, at present, foreign made. Mitsubishi Electric, for example, has launched a new range of heat pumps, using air, water and ground sources, with capacities from 25kW to 200kW. Heat pumps are expected to qualify as renewables, as they harvest free heat energy, producing 3.5–5kW of heat for every 1kW of electricity they consume. The Mitsubishi products can each supply hot water at 70ºC, water for radiators and underfloor heating at 45ºC, or warm air for ducted heat systems.

Heat pumps were considered economically viable even before the new scheme and have been used for years in Scandinavia. The only downside to air source heat pumps is that, in cold, damp weather, evaporator coils are liable to ice up, so reducing efficiency. Indeed, in worst case scenarios, because the efficiency of electric power generation and transmission from gas fuel is only around 35%, it can be argued that a modern gas-fired condensing boiler has about the same impact on the environment as an electrically-driven heat pump, although a new boiler will not attract a subsidy.

Smaller and smarter

Potterton Commercial's new Eurocondense Three boiler is smaller and lighter than its predecessors, with a reduced footprint. Internally, it has a sectional aluminium-silicon alloy heat exchanger and a single burner assembly that slides out for servicing. Hydraulic, electrical and flue connections are all now top-mounted, saving floor space and making the boiler compatible with header and flue kits.

Noise is also down to 54dBA at 1m, as a result of redesigning the fan, bearings and inner acoustics. The boilers are available with 125, 170, 215, 260 and 300kW outputs. Up to 15 boilers can be installed in line or back-to-back, producing a maximum output of 4,500kW. NOx is less than 35mg/kWh, which is half the requirement of the most stringent Class 5 category in EN 483:2000.

Moving on, for plant engineers interested in taking advantage of feed-in tariffs, there are several new ideas. One is the Heatcatcher, which uses waste heat to generate energy by a Rankine cycle – but not one that involves boiling water to make

steam. It is manufactured by Calnetix Power Solutions in Florida, but marketed in the UK by Efficient Air in Polegate, East Sussex.

Managing director Darren Bryant says that the units capture heat using water, but harness refrigerant RT45FA as the working fluid, with a microturbine, connected to an alternator, running at 20,000 to 120,000rpm to produce power. Typical cost for a 100kW unit is around £250,000, but, as he comments: "If they were to sell more, the cost would come down."

An alternative strategy to get the feed-in tariffs is photovoltaics – adopting Evalon roofing membranes and/or Solyndra rods. These use the same basic PV material, rolled into cylinders. Both are only suitable for flat or very gently sloping roofs, and both are marketed by ICB in Bournemouth.

Hot solar roof

Chris Rigney of ICB claims that the cost is about £6,000 to £6,500/kW peak (average output over 24h is 20% of peak) and the panels are typically 10.5–12.5m^2. The PV films use copper indium gallium di-selenide CIGS, which makes them 12% to 14% efficient. That is much better than the alternative membrane PV material (amorphous silicon), at 4% to 5% efficiency, but not quite as good as crystalline silicon, which comes in at around 20%.

Evalon is a long established German roofing membrane, which can now be made additionally as PV film. Solyndra is the name of the Californian firm with the CIGS technology and the maker or the cylinders. The advantage of the cylinders is that they allow air to pass between them, so avoiding building overheats in summer, and they harvest energy both from direct sunlight and light reflected from beneath. Both systems have been installed on various industrial, commercial and public buildings in the UK, as well as in continental Europe.

BASF has been taking a miniature passive building on a semi-trailer around Europe to demonstrate how to construct a building that requires almost no conventional heating or air conditioning, yet remains warm in winter and cool in summer. The 24m^2 building, called MESH (mobile energy saving house), is made from wood, but uses BASF's Neopor expandable polystyrene for facade insulation, with Styrodur polystyrene foam panels beneath the foundation slab, on the flat roof and around the perimeter.

Its solar thermal panels use Basotect open cell melamine thermoset resin foam insulation. In the triple glazed windows, two flat strips of Ultradur polybutylene terephthalate are extruded into the profile, replacing thermally conducting metal reinforcement, and, at the same time, avoiding thermal bridges, while reducing weight by 20%. Then, on the surface of the glazing, a foil coating, made by Hornschurch, includes three BASF pigments to reduce heat build-up.

By the way, a passive building has a residual heat demand of 15kWh or 1.5 litres of heating oil per square metre per year for heating, according to Germany's Passivehausinstitut Darmstadt. Total energy for any extra heat, hot water and electricity must not then exceed 120kWh/m^2 per year.

Finally, while on the subject of heating and air conditioning, remember that very large savings can be achieved by using variable speed drives to control the speeds of ventilation fans and circulation pumps. Fan and pump energy consumption tends to ramp up as the cube of speed. So running one at, for example, half speed (as opposed to switching it on and off in equal time intervals at full speed) reduces energy consumption by a full 75%.

Since the price of power electronics has come down, while the cost of energy has risen, payback times are often just eight months or, at most, two years. Add in the fact that fan noise tends to rise according to the speed raised to the fifth power, and using drives wins all round.

Latest examples of cost savings include £29,000 off the annual electricity bill for the Jackson House office block in Manchester and £6,000 for the Castlegate Business Park in Monmouthshire. Jackson House has four ventilation fans, driven by motors rated at 45kW to 120kW, plus four pumps for the heating system. Payback time was 11 months. Castlegate Business Centre has two fans, rated at 22kW and 15kW. In its case, payback time was 16 months. Both used ABB drives. PE

Pointers

- Feed-in tariffs and the renewable heat incentive, both for energy from renewables, are increasing interest in the subject
- Feed-in tariffs grant payments for every kilowatt hour produced from renewables, up to 5MW
- The renewable heat incentive goes live next year, subject to consultation, with no limit on plant size
- Heat pumps technologies are continuing to mature and gain serious attention
- Photovoltaic materials continue to improve in efficiency and applicability

Packaged equipment, harnessing new materials and technologies, is making renewable energy systems more attractive