Towards Zero Carbon Cumbria

CAfS

Cumbria Action for Sustainability

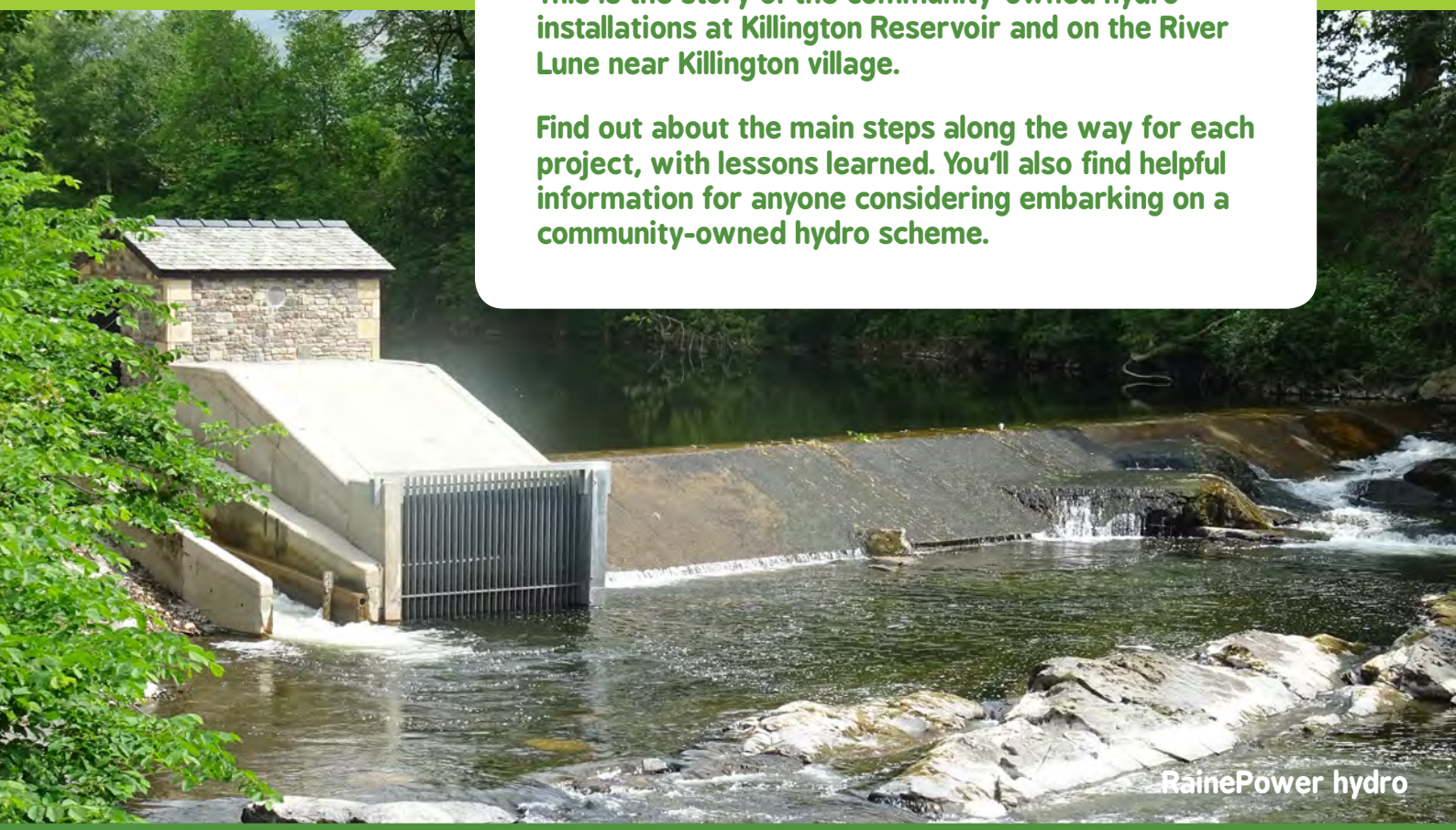
Case Study:
A Tale of Two Hydros

Two different community groups, two hydro schemes, two approaches, one corner of south-east Cumbria...

Killington Reservoir hydro

This is the story of the community-owned hydro installations at Killington Reservoir and on the River Lune near Killington village.

Find out about the main steps along the way for each project, with lessons learned. You'll also find helpful information for anyone considering embarking on a community-owned hydro scheme.



RainePower hydro

RainePower hydro scheme
River Lune, Killington

Hydro #1

This hydro installation is the product of ten years of hard work by a dedicated team of residents from Killington, an upland farming village of about 150 people, spread over 20 square miles in the Lune Valley, south-east Cumbria.

Coming together as RainePower, a community benefit society with 181 members, the team developed a 35kW Archimedes screw hydroelectric turbine, situated on the weir of the old Broad Raine flour mill on the River Lune. The turbine was commissioned and started generating electricity in February 2018.

The turbine house, screw housing and fish pass

Key Statistics

- **35kW Archimedes screw turbine by Spaans Babcock**
- **8 years from conception to completion**
- **130,000 kWh of electricity is expected to be generated annually – equivalent to the annual demand of 39 homes**
- **39 tonnes CO_2 anticipated to be off set per year***
- **Local design and construction**
- **181 shareholders**
- **£580,000 total spend**

*Based on the current carbon content of grid electricity 0.3kg CO_2/kWh

Timeline

2008/9

A small group of individuals in Killington came together in 2008 to see what they could do in the village to help address climate change. In March 2009 Killington Sustainable Energy Trust (K-SET) was registered as a company limited by guarantee.

A carbon footprint report of Killington village was produced, based on house-to-house surveys undertaken in August 2009. This was produced by a local expert at no cost to K-SET and provided a useful blueprint for the organisation in the early years. The report recommended that the most effective measures to reduce the carbon footprint of the village were: loft insulation, solar thermal panels for hot water and heating, and biomass boilers. It also examined hydro and anaerobic digestion systems and wind power. Wind power was discounted as there had been opposition to some schemes. Anaerobic digestion systems were considered possible for individual farms. A number of streams were identified as possible sites for high-head hydro systems and Broad Raine weir on the River Lune as a potential site for a low-head scheme.

2009/10

K-SET commissioned two studies to investigate the potential of hydro systems on the streams and Broad Raine weir. Both recommended that further feasibility studies should be carried out on the potential high-head sites identified on a number of streams and one recommended that a low-head system at Broad Raine weir should also be explored further.

A preliminary feasibility study was produced and discussed with statutory agencies: Environment Agency (EA), Natural England (NE), South Lakeland District Council (SLDC) and the Yorkshire Dales National Park Authority (YDNPA).

2011-13

To save money, the K-SET Board decided to pull together the feasibility study themselves for a hydro system at Broad Raine weir, based on information already gathered. Project costs were estimated at £400,000 for a 50kWh system. Spaans Babcock produced a site survey and designs for the system.

Problems were encountered due to policy changes at the EA and confusion over ownership of the weir. K-SET acquired the site of the fish trap from the EA, which included the fish ladder.

2014-15

A community benefit society, RainePower, was set up to raise the funding for the scheme, manage the construction works and then the operation of the scheme for 22 years. After further investigations, the size of the system was reduced to 35kW.

Planning consent was given in February 2015, following a unanimous vote of support by SLDC councillors. Negotiations progressed with landowners on a lease for access to the site, registration for the feed-in tariff (FIT) was approved and Energy4All issued a share offer for the scheme on behalf of the K-SET Board, raising £440,690.

2016-18

Following some revisions to the design that required planning and EA approval and delays in getting the right-of-access agreement in place, construction work started in July 2016. RainePower appointed a project manager to oversee delivery. Due to delays in starting the construction works, it was not possible to complete them by the date required by the EA, which was set to allow migrating sea trout to swim up river, so the works had to stop.

The cost of the delay was approximately £100,000 as some of the unfinished construction works had to be demolished and rebuilt the following year. Energy4All raised the additional funds from shareholders, loans and grants. Work re-started in April 2017. The screw and turbine arrived in September 2017, with the system finally commissioned in February 2018.

2018 onwards

There is an ongoing requirement to maintain the hydro system, including clearing debris from the inlet, which sometimes needs to happen every day. It's undertaken by members of the RainePower Board, K-SET and other residents. Due to the increased costs as a result of delays, it is likely that the return for shareholders will be reduced.

The hydro scheme is delivering on its original intention of generating low-carbon electricity – or 'carbon-free energy', as RainePower and K-SET prefer to describe the electricity their hydro produces.

Lessons learned

There were many challenges experienced in developing the hydro project. Here are some of the main lessons learned:

- **Having a group of committed individuals to drive the project forward is essential.**
- **Learning from other community hydro projects was very important from the early stages of project development. This included site visits.**
- **Getting access agreements in place early in the process is essential or it can lead to delays.**
- **Delays in project delivery may lead to increased costs.**
- **Increased project costs may mean that there are reduced returns for shareholders and reduced funding to deliver other projects.**
- **Despite the delays and challenges experienced, the K-SET and Raine Power Boards would do it all again.**

If you'd like to learn more about the RainePower hydro, please contact Maureen Lamb maureenlamb@broadraine.plus.com or visit www.rainepower.coop

Community Energy Cumbria hydro scheme
Killington Reservoir

Hydro #2

This 30kW hydroelectric power plant at Killington Reservoir in south-east Cumbria is the first community-owned hydro scheme in the county. Owned by Community Energy Cumbria, it has been generating electricity since January 2017. The electricity is sold to the National Grid, generating revenue via the Government's feed-in-tariff (FIT). This income benefits CEC's one hundred shareholders and the local community, while reducing carbon emissions.

Members of Community Energy Cumbria celebrating the turbine's official launch

Key Statistics

- **30kW turbine**
- **4 years from conception to completion**
- **152,000 kWh of electricity will be generated annually – equivalent to the annual demand of 46 homes**
- **45.6 tonnes of CO_2 offset each year***
- **Local design & construction**
- **100 shareholders**
- **£280,000 total spend**
- **15m gross head**
- **8.25km² catchment area**
- **34kVA 6-pole induction generator**
- **30kW maximum output**
- **300 l/s maximum turbine flow**

*based on the current carbon content of grid electricity 0.3 $kgCO_2$/kWh

Timeline

2013

The project to develop the hydro scheme was initiated by Cumbria Action for Sustainability (CAFS). Killington Reservoir was chosen as the site primarily because there was an existing drawdown pipe from the reservoir. A turbine was eventually retrofitted to this drawdown pipe, which greatly reduced the technical and construction challenges.

Once the site was chosen and before reaching out to the community, feasibility studies were conducted, including water-flow calculations and environmental-impact assessments. A forty-year lease was agreed with the Canal & River Trust, which owns the reservoir.

A planning application was made in the summer of 2013 and the scheme did not face any objections – largely because much of the infrastructure was already in place, there would be no abstraction from the waterway and due to the positive community aspect of the project. Planning permission was received in September 2013.

£30,000 was spent during this initial period, with funding and administrative support from CAfS and technical studies and outline designs produced by Ellergreen Hydro Ltd.

2014-2015

Detailed design of the system and specialist works were carried out after planning consent. As an example of these works, professional divers were employed to install a fish pass to prevent bottom-feeding fish descending to the outflow pipe during stormy weather.

Community Energy Cumbria (CEC), a community benefit society, was established in early 2015. CEC launched a share offer in July 2015 to raise funds for the hydro scheme, resulting in around one hundred shareholders, many of whom benefited from tax relief on their investment.

2016

Construction began in 2016. The community ethos of the project extending beyond its shareholders; the team encouraged a circular economy by procuring design work, construction materials, technical equipment, labour and maintenance support as locally as possible. Eighty-six per cent of labour and materials were procured locally!

The total cost for the design and construction was £240,000.

The new hydro turbine installed and commissioned

The new turbine house

Lessons learned

- **A tenacious individual or group is essential to keep driving things forward.**
- **Communicate with the Environmental Agency, Land owners and the Power Distribution Network Operator early in the feasibility process and under what is expected by them.**
- **Review the eligibility criteria and rates of the current government incentives such as the Feed-In-Tariffs and Renewable Heat Incentive, you may find your project is driven by meeting a cut-off deadline that will determine the return-on-investment of your scheme.**
- **Be aware that specialist surveys, such as a diving survey, may be necessary and potentially costly.**
- **There is an abundance of local expertise, materials and labour that can be exploited and enhanced through developing hydroelectric plants in Cumbria.**
- **A period of at least a year should be expected after completion for seasonal commissioning & dealing with teething problems.**
- **Consider preferential ownership and how this might be defined for your scheme, e.g. is the community defined by some catchment area or maybe a school?**
- **Engaging motivated volunteers to monitor and promote the project can help to make the most out of the project and encourage new schemes to develop.**

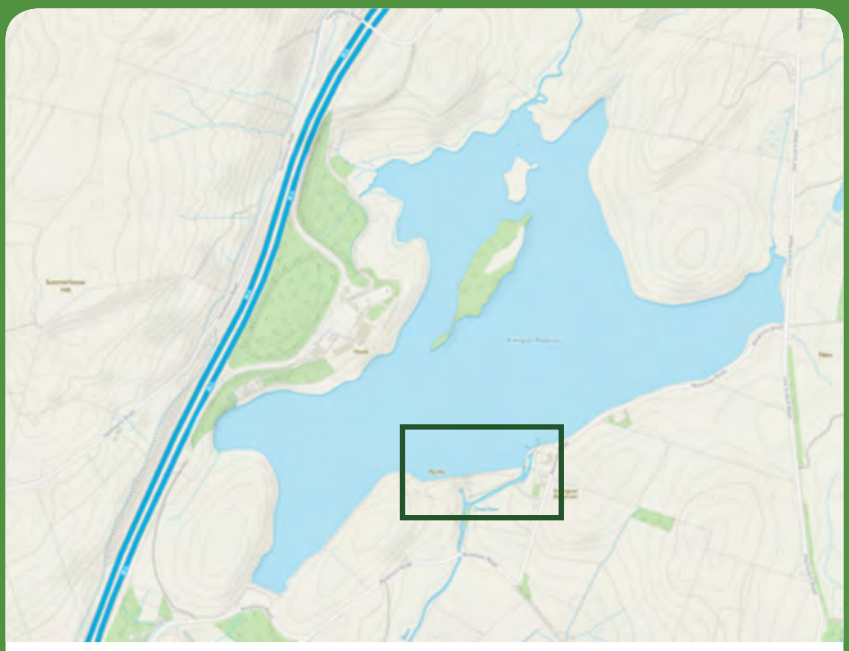
2017

Once operating, aquatic debris began to build up in the turbine so there were some remedial works to install an additional mesh.

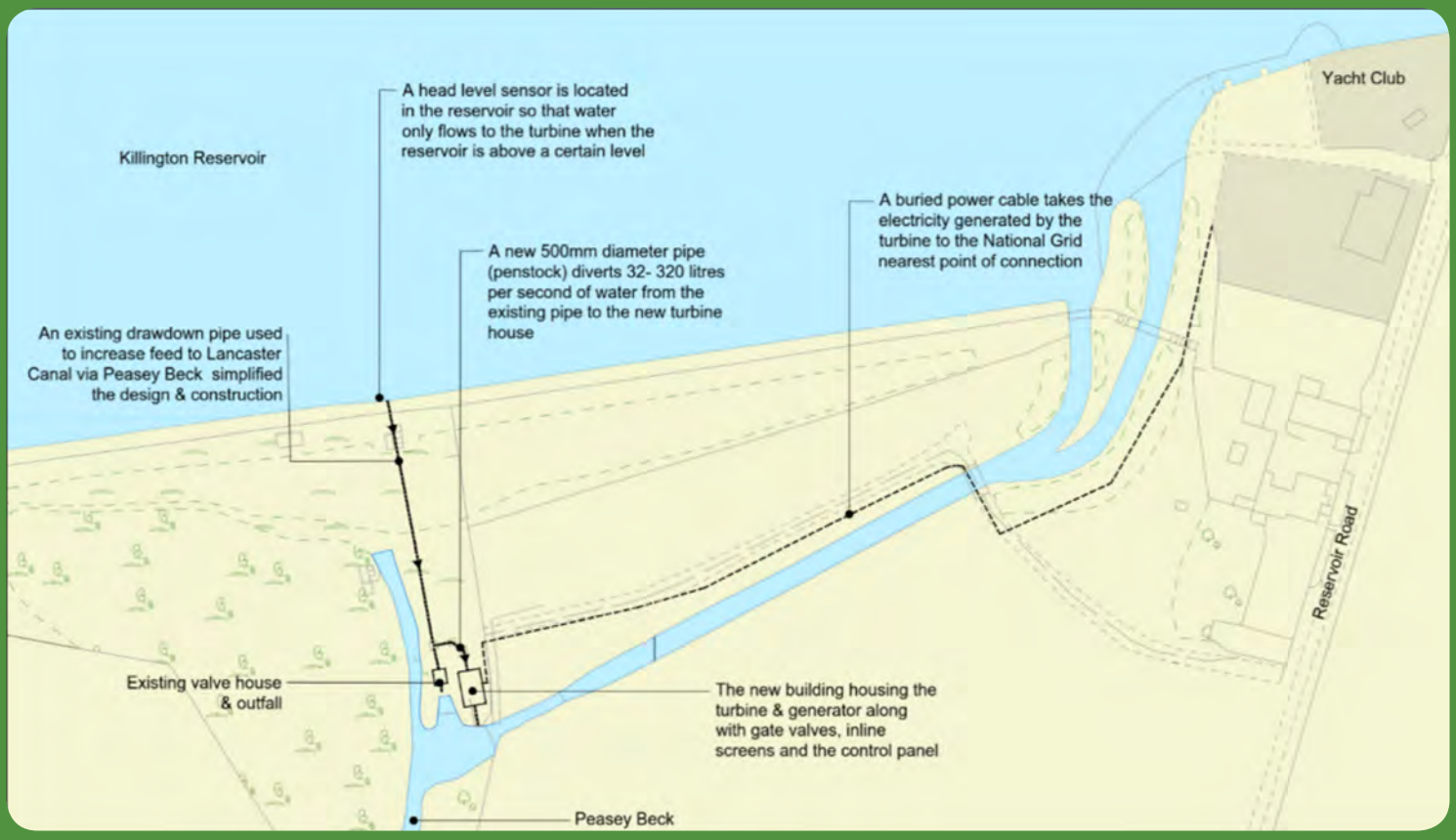
A part-time caretaker has been hired to regularly inspect the equipment, ensuring smooth, unbroken generating capacity.

2018 & beyond

The scheme generated an income of £33,500 over the first year, with £21,500 available to distribute between interest payments, capital repayments and community benefit. Investors should receive five per cent interest a year and have their capital returned, while the community benefit dividend is expected to be £50,000 over 20 years.



Killington Reservoir with the M6 running alongside



South Lakes MP Tim Farron officially launches the hydro scheme in January 2017

Project Team

Project management & administration: Cumbria Action for Sustainability (project lead: Phil Davies)
Scheme funders & owners: 100 shareholders living within Cumbria
Solicitor: Bond Dickson
Hydrological assessment: Ellergreen Hydro Ltd
System design: Ellergreen Hydro
Main contractor: Ellergreen Hydro
Monitoring: Ellergreen Hydro
Commissioning: Ellergreen Hydro
Maintenance contractor: Ellergreen Hydro
Turbine: 30kW, CINK turbine
Materials & labour: 86% procured locally

COMMUNITY ENERGY CUMBRIA

The two Killington hydro schemes at a glance

	RainePower hydro scheme	Killington Reservoir scheme
Lead organisation	The development of the RainePower scheme was led initially by Killington and District Sustainable Energy (K-SET), which then set up RainePower Community Energy Society Limited (a community benefit society). RainePower managed the development, delivery and ongoing operation of the hydro scheme.	Ellergreen Hydro Ltd originally developed the concept of the Killington overspill hydro project and went on to manage the project through to installation and commissioning, on behalf of Community Energy Cumbria (CEC). CEC owns and manages the scheme on behalf of its shareholders.
Timescale	Delivered in 8 years from inception to launch	Delivered in 4 years from inception to launch
Cost	£580,000	£240,000
Funding	£440,690 was raised in 2015 through a share offer managed by Energy4All. Costs increased by £100,000 due to delays and Energy4All raised the additional funds needed from shareholders, loans and grants.	CEC raised £240,000 through a share offer.
Maximum generating capacity	35kW	30kW
Expected annual electricity generation	152,000 kWh	130,000 kWh
Anuual carbon savings*	39 tonnes of CO_2	£41,215
Other benefits	Production of locally owned carbon-free energy.	Shareholders should receive 5% interest per annum and have their capital returned, while the community benefit dividend is expected to be £50,000 over 20 years.

*based on the current carbon content of grid electricity 0.3 $kgCO_2$/kWh

Other options for community energy

Low-carbon community energy isn't just about hydro power. Hydro power plants like the ones in this case study are suited to Cumbria's landscape and weather, but they may not work for every community. There are many other technologies with the potential to profit and empower communities, while reducing their carbon footprint. Here are some examples from elsewhere in Cumbria.

Technology	Application	Pros	Cons
Solar photovoltaics (PV)	Solar photovoltaic panels convert sunlight into electricity via the photoelectric effect	• Proven technology • Little maintenance • No moving parts • Low visual impact • Clean energy that's relatively cheap	• Requires a large, mostly south-facing, unshaded roof, or a landscape where they can be ground mounted
Examples: A 29.7 kW PV array is sited on the courtyard roofs of the Lake District National Park Authority's headquarters in Kendal. See the CAfS website for more information: **www.cafs.org.uk/community-energy**			
Wind turbines	Wind turbines convert the wind's kinetic energy into electricity	• Clean energy that is relatively cheap • Can be eligible for the feed-in tariff (FIT)	• The siting of wind turbines is controversial because they have a visual impact on the landscape • There are restrictions and it can be difficult obtaining planning permission in Cumbria, particularly in the National Park
Examples: High Winds is a successful community-energy society that owns and operates two 2.3MW Enercon Wind Turbines at Harlock Hill near Ulverston, Cumbria. The wind turbines began generating electricity in June 2016. For more information visit **www.highwinds.coop**			
Tidal	Turbines submerged in the sea transform the energy of the tides into electricity	• Tides are predictable and therefore so is the energy production	• Tidal power can have a high ecological impact, which requires due consideration and assessment • High cost in comparison to other technologies (but potential very good pay back)
Currently, there are no working tidal power projects in Cumbria but the Solway Firth and Morecambe Bay were ranked second and third among UK estuaries for tidal potential. It is estimated that a 30km tidal barrage across the mouth of the Solway could produce 5.5 to 8GW of power, which is only slightly less than a major Severn scheme. A barrage across Morecambe Bay could yield 3GW and a Duddon estuary barrage perhaps 500MW.For more information, visit: • **www.tidallagoonpower.com/projects/west-cumbria** • **www.cumbrianenergyrevolution.org.uk/renewables/tidal** • **www.solwayenergygateway.co.uk**			
Anaerobic digestion (AD)	Organic matter such as sewage sludge, farm slurry or food waste is left to break down (digest)without oxygen to generate biogas which could be used for onsite combined heat and power (CHP), gas grid injection and vehicle fuel.	• Diverts a bio-product into a useful fuel, which otherwise would result in more methane being released into the atmosphere • Produces a digestate that could be sold as fertilizer • Prevents contaminants entering water supplies	• Can be time-consuming in operation and maintenance
Stanley Renewable Energy operate a 250kW AD plant at Ponsonby Old Hall Farm in Cumbria. The farm supplies the feedstock for the AD from farm wastes, such as manure and slurry, supplemented with energy crops. Renewable electricity is generated from the anaerobic digestion process, and income is received from the feed-in tariff scheme. The electricity is used on the farm or sold to the National Grid. The farm will have the benefit of free heat from the plant and the use of the digestate bi-product on the land as a bio-fertilizer.			

Fuel cells and **biomass boilers** are two further examples of renewable energy technology that could be adopted in a community sense. For more information, visit the CAfS website and www.gov.uk.

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CAfS, Eden Rural Foyer, Penrith, Cumbria, CA11 8ET • Charity No. 1123155 • Company No. 06492907 • (01768) 210276 • office@cafs.org.uk • www.cafs.org.uk