

The Practical Journal of Sustainable Living

Clean Slate

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Zero Carbon Britain - new report

Powering up offshore wind

Gardening on the wild side



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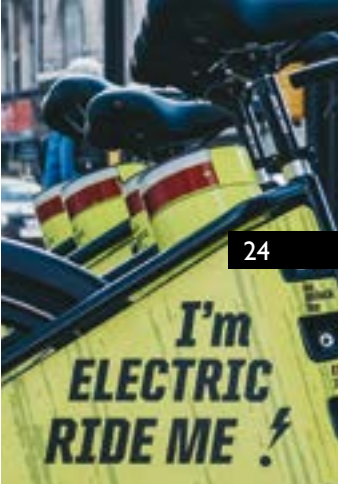
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Contact Penny Rowland at CAT for more information 01654 705988.



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From emergency to action

Bushfires in Australia. Typhoons in Japan. Hurricanes in the Bahamas. Floods in Yorkshire. Lives lost, homes devastated, livelihoods ruined, crops destroyed. It's becoming all too familiar a story.

This is what an emergency looks like. This is what the UK Parliament meant when, following a huge upsurge in public demand for action, they declared a climate and environmental emergency. It's the reason that well over half of local authorities in the UK have now declared, why arts organisations, universities, museums and professional bodies across the world are joining the call.

And it's the reason why we need to act fast to turn these climate emergency declarations into urgent, effective action.

CAT has a huge role to play in helping build the zero carbon society that we all know is needed, and I'm honoured and excited to be joining such a visionary organisation at this crucial time. For 45 years CAT has focused on environmental solutions, and has been working specifically on how to get to net zero greenhouse gas emissions for the past 12 of these.

In this issue, we introduce the latest phase of this research, *Zero Carbon Britain: Rising to the Climate Emergency*. We explore the changes needed to building, transport, industry, energy, food and land-use that could help the UK reach net zero greenhouse gas emissions. You can read some of the key findings on pages 18-21.

There are no easy fixes – climate change is what Paul Allen

describes as a 'wicked problem', requiring 'wicked solutions' (pages 16-17). But – crucially – these solutions already exist. We don't have to, and we *must not*, wait for new technologies to solve our problems.

Many areas in the UK are recognising this and are beginning to develop Zero Carbon Action Plans that will allow them to map out what actions they can take at a local level. For example, on page 7 you can read about some of the work we have been doing to help inform the Isle of Man's planning process. In other areas community groups are using CAT's work to create the changes needed. For example, the inspiring contribution of Cumbria Action for Sustainability is outlined on pages 30-31.

CAT has big plans to scale up this work. Over the next three years, our Zero Carbon Britain Hub and Innovation Lab will provide training, support, advice and information to help local authorities, businesses and community groups to develop Zero Carbon Action Plans to suit their areas.

By inspiring, informing and enabling people to do what's necessary at a local level, we can build a real movement for change as others see what's possible and follow their lead.

Thank you so much for your support – we could not do any of this without you.

Peter Tyldesley
Chief Executive Officer

Keep in touch



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Meet Peter Tyldesley, CAT's new CEO

This September we welcomed our new Chief Executive Officer, Peter Tyldesley, to the CAT team. We caught up with him to find out a bit about his background and motivations, as well as his aspirations for CAT and the planet.



Tell us a bit about your background – what were you doing pre-CAT?

I qualified as a Chartered Surveyor in 1993, which means that I have a longstanding interest in both buildings and land use, which are two of the areas in which the greatest opportunities exist to reduce greenhouse gas emissions.

This is the third time I have worked in Mid Wales, having worked for the Brecon Beacons National Park Authority as Director of Countryside and Land Management from 2004 to 2007, and for the Ministry of Defence as a surveyor/land agent in the early 1990s.

In my last job I was Director (CEO) of the Bradgate Park Trust, a charity in Leicestershire that operates Bradgate Park, a historic deer park with a visitor centre, two cafes, a gift shop and a wide range of events from craft workshops to concerts. We used to welcome around 500,000 visitors each year,

What brought you to CAT?

I first visited CAT in 2005, which inspired me to start thinking seriously about climate change.

Apart from that, it was just a case of the right opportunity presenting itself at the right time – after seven years at Bradgate Park, during which time I turned the charity around, I was ready for a new challenge, preferably one with a stronger focus on tackling the big issues such as climate change and biodiversity loss. CAT was looking for a new CEO and the rest, as they say, is history.

What drives you?

The feeling that I am making a difference and that what I spend my time doing all day is in some way important and meaningful.

The world needs to get to zero carbon as fast as possible to avert climate catastrophe – how can CAT help make this happen?

CAT is uniquely placed to inspire, inform and enable an incredibly wide range of people on a variety of levels to take action on climate change because we are not simply a visitor attraction, an academic institution or a think tank but a remarkable mix of all these and more.

Beyond this, CAT's reputation as a centre of excellence and honest broker gives us access to politicians and decision makers looking for evidenced-based information and advice on what actions are needed to rise to the challenge of climate change.

Where do you see CAT in three years?

It would be great to think we would be seeking a new role because all the current pressing environmental challenges had been solved.

On the assumption that we won't quite have managed that within three years, I see a financially strong CAT that is clear about its purpose and contribution, that is widely known and respected as a Welsh organisation with global influence through a network of members, supporters, alumni and opinion formers, and which is recognised and valued as a source of knowledge, expertise and inspiration by professionals, governments and members of the public around the world.

Tell us a bit about what you do in your spare time.

I have been married to Nicola for 29 years and we have four grown-up children aged 21-27 (I know – I don't look old enough!).

Looking back, I seem to change my hobbies every 10 years or so: I spent my twenties playing rugby, in my thirties I got into endurance sport, and in my forties I "accidentally" took up karate because two of my sons wanted to do it and I didn't want to just sit and watch. Nowadays I am happy to get my exercise through walking and gardening.

I am a trustee of an educational charity in Northamptonshire and am on the Board of Wellcome Trust Trading Limited, which operates the retail, catering and conferencing activities at the Wellcome Collection's premises in central London. [CS](#)



Global climate strike

Did you join the Global Climate Strike in September? If so, you were one of an estimated 7 million people who joined the world's biggest ever climate mobilisation.

From Delhi to Denver and from Sydney to Stavanger, millions of us left our homes, workplaces and universities to stand with the school strikers and demand climate action.

Those who couldn't join marches were encouraged to use their lunch hour to show solidarity, post support on social media, or spend the day working on solutions.

As well as encouraging our supporters to join their local actions, CAT took part by throwing open its doors, with free entry all day on 20th September, providing a space for anyone who wanted to explore ways of getting to zero carbon.

Staff, students, volunteers and visitors also staged a solidarity protest, reading out inspiring and often heartbreaking words from young climate strikers from around the world, and using phones and alarms to signal that time's up for action on climate.

Want to get involved? Find a school climate strike near you via the UK Student Climate Network: <https://ukscn.org/>



Inspiring action at the CAT Conference



With inspiring conversations, great speakers, highly engaged participants and our biggest ever attendance, this year's CAT Conference was a real source of hope and motivation for all involved.

Despite being one of the stormiest weekends of the year, with floods leading to train cancellations and road closures, more than 100 determined people made their way to Mid Wales on 27th September for a weekend of talks, seminars, workshops, discussions, film showings and a bit of a Saturday night knees-up.

Inspiring action and creating change

This year's theme was 'Inspiring Action', with a range of expert

speakers and committed campaigners exploring ways to bring about the radical changes that we know are necessary to tackle the climate and environmental emergency.

Kicking things off on Saturday morning, Paul Allen gave a preview of our new Zero Carbon Britain report, with the clear message that we can't wait for a technological magic bullet: we have the technology now to rapidly reduce our emissions, and there are many other benefits of taking urgent action, including improved health and housing.

Seminars and workshops ranged from the technical, such as Trystan Lea showcasing the modelling behind our Zero Carbon Britain project, to the political, with Andy Rowland and Machynlleth town councillor Ann MacGarry exploring the role of councils.

Looking at lessons from psychology, Rosemary Randall explored how we can find our voice and talk more effectively about climate change, whilst other sessions explored activism, migration, buildings and much, much more, including an inspiring session led by local youth climate activists Bea and Lexi.

What next for CAT?

On Sunday Paul Allen and CAT CEO Peter Tyldesley ran a session allowing the conference to input ideas and feedback on plans for CAT's new Zero Carbon Britain Hub and Innovation Lab, which we will use to help provide support to communities, councils and governments in creating Zero Carbon Action Plans and in developing innovative solutions. The session was very interactive and provided us with a lot of food for thought.

Huge thanks to everyone who attended, and to the speakers and workshop leaders who gave their time and expertise. Plans are now underway for next year's big event – watch this space!

Remembering Roger Kelly

We're sorry to report that Roger Kelly, Director of CAT from 1987 to 1997, has died from a rare form of cancer at the age of 72. We would like to offer our deepest sympathies to Roger's family.

An architect by training, Roger spent a lifetime working on environmental solutions. His time at CAT covered our 'Gear Change' years, when several substantial developments transformed the site, including the building of our iconic water-balanced cliff railway, which has been loved by visitors young and old ever since.

Also during this time links were made with the University of East London, beginning a relationship that would eventually lead to CAT offering Masters degrees in a wide range of topics related to sustainability.

Fondly remembered with great affection by all who worked with him, Roger was known as someone who would happily turn his hand to anything that was needed, whether that was helping out in the gardens, doing a bit of admin, or working in the visitor centre.

He was also an active member of CAT's on-site community, and said that the ten years he spent at CAT with his young family were some of the most enjoyable years of his working life.

Thank you, Roger, for all that you did, for CAT and for the world that you loved.



CATkins capers

This September saw the launch of CATkins, our new weekly club for nature-loving pre-schoolers and their adults.

All-weather activities have been taking place every Tuesday morning, including building, crafting, wildlife rambles and more, to help connect children and their families with nature and the great outdoors, whilst supporting early years' learning and wellbeing.

From pre-school to postgraduate level – we really do aim to teach sustainability for all!

Find out more at www.cat.org.uk/catkins



CAT Stories

Have you taken something you learned from CAT and used it to make a real difference? We're collecting 'CAT Stories' to help us see and share the impact our work is having.

Maybe you started a zero carbon community group after reading Zero Carbon Britain, or set up a green building business after a series of short courses. Perhaps you studied one of our postgraduate degrees and are now involved in community energy, or read an article in *Clean Slate* that helped with your local food waste campaign.

These are all real-life examples of things people have told us that CAT helped them to achieve – and we've heard many more over the years.

If you have a CAT story you'd like to share, please email us at media@cat.org.uk - we'd love to hear from you.

Winter in the woods – festive fun at CAT

Join us at CAT on 14th December for a special day of wintery woodland rambles, natural decoration making, tree dressing, greenwood crafts and more as we celebrate the magic of the season.

Learn how to make your own simple gifts with wood carving, wood turning, wreath making and felt workshops, or join a seasonal nature walk to identify key species and learn how to help wildlife

survive and thrive during the lean winter months.

Warm yourself up with some seasonal festive fare in our vegetarian café, and take advantage of a special discount in the CAT shop.

Find out more at www.cat.org.uk/whats-on

Zero Carbon Britain presented in Manx Parliament

In October, Paul Allen was invited to present CAT's Zero Carbon Britain research in the Tynwald – the Isle of Man Parliament – to an audience that included Manx Environment Minister Geoffrey Boot and other elected officials.

Having declared climate emergency earlier this year, the Tynwald established a team of over 25 experts from across a range of sectors, led by Professor James Curran, to develop an action plan. Paul gave a detailed presentation to this team, exploring how CAT's research can feed into their planning.

Paul says, "As the Tynwald has direct governance over their own coastal waters, energy and energy services, water utility, ferry company and a lot of buildings, they are in an ideal position to become a leading live-lab for how islands can transition to net zero."

The Tynwald talk was part of a week-long programme of events exploring the island's response to the climate emergency. Other

events included a Zero Carbon Britain presentation to 150 of the island's young people at Ballakermeen High School and an evening talk at a packed public meeting in Douglas, the island's capital.

The week was well covered by Manx media, including interviews with Paul on radio and TV and features in local newspapers.

Our thanks to CAT graduate and Isle of Man resident Alice Quayle for inviting us to be part of an inspiring week.

Big growth in visitor numbers

Summer saw a huge spike in visitors to the CAT site, with July up by nearly 60% compared to the same time last year, and visits to the end of August up by 35% for the year as a whole.

Whilst there are lots of factors behind the increase – including more holidaymakers in the area, CAT allowing dogs in for the first time, and a new programme of family events – there's also clearly been a huge upsurge in interest in environmental solutions. It's been great seeing families exploring solutions together, with many intergenerational conversations about the changes we need to see.

John Challen, CAT's Eco Centre head, said: "CAT's core message of climate and environmental solutions is more important now than ever, so it's great to see the visitor centre so busy."

Sustainability in the classroom

CAT's schools programme is at the heart of our education work. Every year, we welcome thousands of schoolchildren to our visitor centre, with some joining us for a day and others staying in our on-site accommodation for an immersive learning experience.

We offer a range of tours, workshops, talks and other activities, and the site itself offers the chance for children to get out into nature as they learn about environmental issues and solutions.

But did you know that we also go out into schools and offer sustainability workshops in the classroom? This is an area that we are keen to develop further, as we are seeing that schools increasingly struggle to cover the costs of school trips.

This summer, for example, we were invited to Short Wood Primary School in Wellington, a large school in an area of social and economic deprivation.

The teachers had organised a family event with an engineering theme for pupils and their families – a great way to spark young minds and develop their interests and aspirations. As part of the day, CAT's schools team ran an earth-building workshop with approximately 2,000 children and their families, giving them a chance to get hands-on experience of sustainable building.

This kind of 'learning by doing' is a fun and memorable way to talk about people's impact on the environment and how we can do things better.

You can find out more about CAT's work with schools on our website at www.cat.org.uk/schools - do get in touch if you would like to arrange a workshop or a visit.



New Zero Carbon Britain report launched

As this issue of *Clean Slate* hits your doormat, a new report will be hot off the presses. *Zero Carbon Britain: Rising to the Climate Emergency* looks at how we can get to net zero greenhouse gas emissions without relying on unproven future technology.

Aimed at helping communities, campaigners and policymakers in the development of Zero Carbon Action Plans, the new report will provide CAT's new Zero Carbon Britain Hub and Innovation Lab with the baseline data to help people make evidence-based choices about where to focus their efforts.

Exploring energy, buildings, industry, transport and land-use, the report looks at an end point, detailing what the UK might look like once it has made the radical changes needed if we are to have a chance of keeping climate change within 1.5°C or even 2°C. Take a look at pages 18-21 to find out what changes could help.

Building on our 2013 report *Zero Carbon Britain: Rethinking the Future*, we have updated the baseline figures and adjusted the numbers to take account of new information and developments in technology. You can read more about how we went about this on pages 24-25.

Zero Carbon Britain: Rising to the Climate Emergency is available to download free of charge on our website and printed copies can be ordered through our online shop.

Please share it far and wide, and do get in touch if you are working on local Zero Carbon Action Plans and would like copies for your local policymakers.

www.cat.org.uk

**ZERO
CARBON
BRITAIN**

**RIISING TO THE
CLIMATE
EMERGENCY**



Record intake for CAT's Graduate School

This September saw us welcome our biggest ever cohort of students to the CAT Graduate School. The surge in interest in climate solutions over the past year combined with a number of new degrees being offered saw our numbers spike to more than 200 students.

CAT students come from a wide range of different backgrounds, with many of them returning to education part way through their career. Part-time and distance learning options are designed to offer real flexibility so that students can choose to continue with their career whilst studying, or fit their learning around family life.

What this means is that we attract students who can use their learning to create change almost immediately upon starting the course. Whether they're working in industry, government or civil society, they can apply their learning to their work and start making a real difference in implementing sustainable solutions.

Of course, we also get students straight out of university, having just completed their undergraduate degrees, who really benefit from the contacts and networks they can make with their fellow students.

It's an inspiring and effective mix of backgrounds and experience.

New courses offered this year

have helped add to that mix: MSc Sustainability and Ecology offers a biological sciences perspective; MSc Green Building allows people to really focus on sustainable building materials and methods; and our most popular new course, MSc Sustainability and Behaviour Change, allows people to study how best to create the changes the world needs. We've also added a part-time version of MArch Sustainable Architecture, allowing more people to access our unique Part II course for people training to be architects.

A huge warm welcome to all of our new students, and if you're inspired to get started on a CAT Masters course yourself then do get in touch. Visit www.cat.org.uk/gse or call us on 01654 705953.



Cotmore Trust - inspiring changemakers

In August, we were delighted to welcome Charlotte Semlyen and her family to CAT, and to give them a tour of the WISE education and conference centre. Charlotte is a Trustee of the Cotmore Trust who donated towards the building of WISE, helping enable a generation of changemakers to be educated in climate solutions. It was inspiring to hear that the next generation of the Semlyen family are continuing the family interest in sustainability.





CAT Fundraising Walk along 52° North

Over the summer, CAT supporter Richard Smith walked across Britain in aid of three environmental charities, including CAT. CAT fundraiser **Tanya Hawkes** caught up with him to find out about his motivations for the expedition and his experiences along the way.



Tanya: Richard, thank you – to date, you’ve raised an amazing £1,734 for CAT. What made you decide to do a sponsored walk across the 52nd parallel?

Richard: The walk was an excuse to get outdoors for some fresh air and exercise really. Plus, I wanted to do something significant to remember my wife, aunt and parents who have all died in the last five years.

Once I’d had the idea of walking across the country along the line of 52° North, I became really excited about visiting a different place each day as well as seeing such a variety of wonderful countryside.

TH: What are the environmental issues you care most about?

RS: The most extreme predictions now anticipate near-term social collapse due to global food shortages, not in 2100, but in the 2030s, or even the 2020s. But even if you don’t accept those extremes, experts all agree climate breakdown will pose significant problems for humanity in the remainder of the 21st century.

And if human civilisation is indeed coming to an end (which perhaps we deserve), don’t we owe other species a chance of survival?

TH: What drew you to want to walk for CAT?

RS: I’d never heard of CAT but stumbled across it by accident on a walk north from Machynlleth to Cadair Idris in 2017. My 52°N walk went right through a solar park in Hertfordshire and a wind farm in Wales so CAT’s focus on a broad range of sustainability issues made it an obvious charity choice for me.

I’m particularly excited by CAT’s new Zero Carbon Britain Hub.

TH: What were the highlights of the walk?

RS: The variety of places I visited every day, and the people I met,

on this random cross-section of Britain were what made the walk really special.

Writing up each day’s walk and visit on my daily blog and making weekly highlights videos were also great fun. You can read and watch them at 52inBritain.co.uk.

BBC local radio stations were really supportive: I was interviewed by seven stations as I crossed the country.

And what a joy to traverse such a variety of beautiful countryside and landscapes as I crossed 16 counties from Suffolk to Pembrokeshire.

Monday 5 August was a particularly fabulous day: visiting two wind farms, high up in a Welsh forest.

Walking with my lovely niece Hannah, we climbed up from Llansawel into Brechfa Forest, over the hill towards Pencader. Then, emerging in clearings like gentle giants, we started to see the turbines.

These were majestic machines. Neither of us had ever been so close to so many wind turbines – it was awe-inspiring. Statkraft’s Alltwalis Wind Farm has 10 turbines and opened a decade ago. innogy’s 28 turbine Brechfa Forest West Wind Farm is much more recent.

I’d arranged to meet innogy’s Bethan Edwards, who led the development of their farm, together with her public relations colleague Ffion Davies, and Statkraft’s Rhodri Jones who maintains the Alltwalis turbines. We were also incredibly lucky that CAT’s Head of Development, Eileen Kinsman, had come down to meet with us as well.

Up on the windy, and slightly wet, hillside, this was the most inspiring group of people! I was left feeling, if only people like Bethan, Eileen, Ffion and Rhodri were running the world, everything would be ok.

A spooky coincidence as we went our different ways: Bethan announced she was due to start a part-time Masters course at CAT the next month!

TH: Would you recommend this type of fundraising activity to others?

RS: I’d definitely recommend undertaking some sort of activity like this, if your life and schedule allow. It was great fun and gave me a sense of achievement (the blogs and videos maybe even more than the walk itself).

As well as raising funds, it can also raise the profile of the charities you’re supporting, in this case CAT. As I walked across the country, I found folk had often heard of CAT but weren’t completely sure what it does. Spreading the word on that, especially about the new Zero Carbon Britain Hub, with the folk I met and on BBC local radio, hopefully helps. [52inBritainCat](https://www.justgiving.com/fundraising/52inbritaincat)

If you’d like to support Richard, there’s still time to donate. Visit <https://www.justgiving.com/fundraising/52inbritaincat> to make a donation.

And if you’ve been inspired by Richard’s story and would like to do a sponsored event for CAT, or help us to raise funds in other ways, please get in touch! Email tanya.hawkes@cat.org.uk or call us on 01654 705988.

Fledgling farmers

One year into the innovative Pathways to Farming training project, **Katie Hastings** gives us an update on how the new horticultural businesses are faring.



Katie Hastings (left) and Jodie Griffiths, Pathways to Farming project coordinators.

We have reached the end of our first year training new commercial food producers to grow and sell food into our local food economy. It's been a year of wintery classroom sessions, agonising over crop plans, frantically fixing fences, stressful spring feelings, the joy of summer harvests, grappling with packaging and delivery to actually get these crops into local mouths. All of this has been undertaken by our part time trainees while they waded through the thick mud that is the first year of producing food to sell in the face of a myriad of barriers such as low food prices, lack of access to land and lack of support for new farmers.

When we designed the Pathways to Farming project, we felt like we were shooting for the stars. We wanted to train people to grow not just for themselves but for their wider community. We wanted to increase the local food being sold into the local economy, and the only way to really do that was to get more local food in the shops and on the menus of local businesses. But underneath it all we always wondered if we were resting far too much hope on the shoulders of trainees new

to food production. How would they navigate soil health, pests and weather fluctuations while also trying to balance the need to grow what is profitable, in demand and sellable?

Then there was the familiar elephant in our room – despite producing nutritious crops in efficient ways, would these new farmers ever be able to actually earn a living from their crops in a food economy that pays them so little for what is so labour intensive?

Taking stock

On Monday 9th September we sat around a table at the Centre for Alternative Technology (our supporters in this project) to assess how much of their ambitious business plans our 12 fledgling farmers had managed to achieve this year. Reflecting back on our first lessons together a year ago, we remembered the dreams set out by the trainees for selling fruit juice, foraged goods, pizza ingredients, children's dips, gourmet salads, fresh herbs and veg boxes. With support from our tutor Emma Maxwell, these plans had been nurtured



through financial forecasts, germination and year-round graft. Our trainees had really jumped head first into making their new local food businesses a reality.

Hearing the results was amazing. Out of 12 trainees, nine had managed to bring food from seed all the way to local sale. The three that didn't sell products succeeded in producing food and taking steps towards selling in the future. This far exceeded our expectations and blew us away with what can be achieved with hard work and a commitment to producing food.

Meet the growers

Jane Baker of Rye and Roses Bakery undertook our training to be able to produce ingredients for her business pop-up events. Over this season Jane has managed to grow Mediterranean ingredients including



aubergines, tomatoes and peppers in our Welsh climate, and has sold them at several pizza events over the year to her enthusiastic customers.

Gareth Fysh Foskett planned to develop healthy dips for children made from his locally grown root veg, and he has done just that! Now being sold in the CAT café and soon in another local shop, the Calon Dyfi dips are proving tasty to local children in

need of a quick snack and are grown only minutes away.

Kait Leonard has been foraging local ingredients and selling them at the market as added value products. Her pestos and blueberries have been flying off the stall, with plans afoot for more RealRoots delicacies to come.

Sadie Maund has taken her previous knowledge of salad production to another level to supply high quality gourmet salads to several local shops. The Many Hands Market Garden salads include edible flowers and colourful herbs and are grown without chemical input.

Four of our trainees in Newtown joined together to form the Veg2Table Veg Box Scheme and succeeded in bringing their precision crop plans to fruition, supplying an astounding 20 houses per week with an array of fresh vegetables from their four different growing sites. Liz, Maryline, Maxwell and Michelle managed the feat of working cooperatively to harvest a consistent supply of vegetables and get them out to local drop-off points for their customers to take back to their kitchens.

Of our remaining trainees: Tammi Dallaston delivered fresh herbs to festival kitchens across the summer;

John Williamson scaled up his family food production while refining his plans to take on a land-based business in the future; Sarah Everitt produced tasty radishes destined for local pickles; and Julie Ashton negotiated the use of part of her family farm for vegetable production.


To those who have not grown food before, these steps might seem small. They are not. They are mammoth. Each crop sold only exists because of hours of work. Our trainees are laying the foundations for a more resilient food system for us all.

The coming year

Moving into year two of our training programme we will continue to support these trainees as they move onto bigger pieces of land and scale up. In these times



of low food prices and potential food scarcity, small local farmers need your support more than ever. Buy their produce, and for a fair price. Thank them for being here, and maybe even offer to help them on their land. We need them if we want good food in our future.

We are beyond excited to welcome a new intake of 12 more trainees this autumn. We have high hopes resting on their shoulders too. They are already poised to jump into the same difficult food system we are all struggling in, with the anticipation of being able to feed people good food and earn a living. We are hopeful that things are changing, that local food is becoming more appreciated and valued. While we designed our project on the assumption that demand for local food was lacking, we have found the opposite to be true with overwhelming demand for local produce from businesses in the Dyfi Valley. We want to meet this demand with new crops and new food businesses, and our trainees are already working to deliver on this. 

*For more information on Pathways to Farming and Mach Maethlon: www.machmaethlon.org, katie@machmaethlon.org
Pathways to Farming is funded by Arwain Rural Development Fund, part of the European Social Fund.*



Opinions expressed are not necessarily those held by CAT.
We reserve the right to edit letters where necessary.

Fair shares

Dear CAT

I was especially taken with 'Counting carbon' by Martin Burgess (CS111), because it encapsulated ideas which I had over 30 years ago, when I suggested that a form of rationing of fossil fuels was a means of fairly sharing what oil remained after 'peak oil'. Now it's much more urgent, in view of global warming, to reduce burning of fossil fuels to zero, but the way to do it must include some sort of rationing like the points system Martin refers to.

Rod Sykes

Focus on fossil fuel subsidies

Dear CAT

Further to the correspondence in *Clean Slate* 113 on Mike Berners-Lee's article in CS112, he makes no mention of fossil fuel subsidies (variously estimated at £305bn to £4tn a year). Surely this is the place to start, and you put it at the top of your Emergency Climate Action Plan. Even the threat of phasing out these subsidies, which take the form of tax credits, production subsidies and support for oil and gas exploration, would discourage investment in fossil fuel industries. Transferring just some of these subsidies to renewables would have a massive impact on their development and implementation.

The Jevons Paradox, or 'rebound effect' of energy efficiency measures does not appear to be well-supported by evidence. In fact, measures that actively involve the user such as domestic solar, smart meters and electric

vehicles probably have the opposite effect, encouraging further efficiency because the results can be seen immediately.

Nick Ward

Ed: The article from Prof Mike Berners-Lee was an edited extract from his new book 'There is No Planet B: A Handbook for the Make or Break Years'.

The book covers a wide range of issues in a succinct and accessible way, and covers both the need to scrap fossil fuel subsidies and an examination of the criticisms of the Jevons Paradox. Unfortunately we did not have space to include these in the article. The book is available from the CAT Ecostore for anyone who would like to read more - www.cat.org.uk/shop 01654 705959.

Fossil fuel subsidies were addressed in the article by Andrew Simms and Peter Newell in CS113, which highlighted a breathtaking \$10m per minute given by the world's governments in fossil fuel subsidies.

Labelling impacts

Dear CAT

Neil Kermode writes in *Clean Slate* 113 about the impact of shopping.

It wouldn't be difficult for stores to provide impact details on till receipts, which people could then total should they wish.

Even better would be impact information on the shelves as well, so that choices could be informed.

I see the problem is working out what the impact of most goods is in the first place - the



debates over disposable nappies and painted wooden window frames are good examples. But just because it's difficult isn't a reason for not trying.

John Heathcote

Share your thoughts

We'd love to hear your thoughts on CAT's Zero Carbon Britain research or anything else that has got you thinking in this issue of *Clean Slate*. If you'd like your views published in *Clean Slate* just mark the message 'For publication'. We may edit letters for clarity or for reasons of space.

Email us at members@cat.org.uk

Call us on 01654 705988

Write to us at CAT, Llwyngwern Quarry, Machynlleth, SY20 9AZ

Dynamoland



It's time for governments around the world to stop subsidising the fossil fuel industry. Image shows a brown coal mine in the Czech Republic.

Fauna & Flora International appeal: help protect the Sunda pangolin

Photo: Zahari Dzhalily



Your support is needed now to help save the Critically Endangered Sunda pangolin - cut the coupon or go to www.protectpangolins.org and you could help keep them out of the hands of traffickers.

Hunted down, trapped and killed, pangolins like the one in the picture above are being slaughtered at a phenomenal level. Hundreds are being snatched from the wild every day and unless we act now, this enchanting mammal could soon be lost forever.

You can't help but find pangolins endearing. Looking like a cross between an anteater and an armadillo and completely toothless, they are about as aggressive as their waddle makes them look. Their young ride around on their mothers' backs and their main defence against predators is to roll into a ball and wait until the danger goes away. But these innocent creatures are now being plucked from their native habitat, shipped around the world by ruthless traffickers and cruelly killed.

Tragically, the pangolin has now become the world's most trafficked mammal, and populations are dropping dramatically. Pangolin meat is seen as a delicacy or a status symbol in a number of countries. Their scales are also used for medicine, despite the fact they have no proven medicinal value whatsoever. Now, the international trade in animal parts is driving the pangolin to extinction, which is why a campaign to save them has been launched.

Fauna & Flora International (FFI) has put out a call to help protect the last remaining Sunda pangolins in the Sumatran forest, a remaining stronghold of this Critically Endangered mammal. If you believe that the Sunda pangolins should be protected, then the time to act is now.

FFI is determined to step up a crucial conservation programme in Kerinci Seblat National Park in Sumatra, Indonesia, employing rangers to patrol deep in the forest where they can deter illegal collection and carry out intelligence-led investigations to stop the trafficking.

By collecting evidence, their work will put key figures of the illegal wildlife trade behind bars and help save Sunda pangolins.

FFI's investigators are gathering evidence and building watertight cases for prosecution so that the police have the evidence they need to put these

offenders behind bars.

Every piece of evidence and testimony is vital to build stronger cases to get pangolin traffickers arrested and prosecuted. Once these offenders face justice, there is a chance that the Sunda pangolin can be saved.

There is no time to waste.

Evidence shows that one local trader was routinely trading 25 or more pangolins every single month. At the higher levels of the trafficking networks, trading is taking place on an even greater, almost industrial scale – and their ruthlessness knows no bounds. As Debbie Martyr, FFI Team Leader of the Kerinci Project in Sumatra, says: "Immoral, greedy villains are driving the illegal trade in pangolins. We urgently need to get these offenders behind bars."

That's why FFI is raising funds which could help pay for investigations and evidence gathering that will help put key traffickers behind bars. To do so they are asking Clean Slate readers to make an urgent contribution today.

Photo: Gary Morris/FFI



"If you value the natural world – if you think it should be protected for its own sake as well as humanity's – then please support Fauna & Flora International."

**Sir David Attenborough
Fauna & Flora International
vice-president**

These funds are sought because FFI needs help to strike at the very heart of the trafficking chain, bringing the key facilitators to the courts.

By taking the traffickers out of the equation, FFI can make sure that the grisly market for pangolins is dismantled, and there is no chance for opportunists to make easy profits from these

Worldwide, over 1 million pangolins have been slaughtered since 2000. We must act now to save the Critically Endangered Sunda pangolin from extinction.

defenceless animals. This is the only effective way to stop this deadly and vile industry.

FFI's approach is already producing some very encouraging results. Thanks to their work gathering evidence, a trader was arrested in early 2018 with 30 dead pangolins and he subsequently received a substantial jail term – striking fear into other traffickers.

There is not a moment to waste. We urgently need to stop the senseless killing, before the numbers of pangolins drop so dramatically that they simply cannot survive.

Please, cut the coupon now and return it to FFI - and you could help save the Sunda pangolin.

If the coupon is missing, please send your cheque (payable to FFI) to: Freepost RTTH-TXTL-AJRK, Fauna & Flora International, The David Attenborough Building, Pembroke Street, Cambridge, CB2 3QZ by 1 January.

Cut the coupon and return it with your gift to FFI, and you could help save the Critically Endangered Sunda pangolin. Alternatively go to www.protectpangolins.org or call 01223 749019. Thank you.

YES! I want to give £ _____, which could help save the Sunda Pangolin

Title Forename

Surname

Address

Postcode

☐ I enclose a cheque to **Fauna & Flora International**

OR ☐ I wish to pay by credit/debit card

Card No:

Expiry Date:

Security code:

Issue Number:

(Maestro only)

See the difference you are making

To show how your support is helping, we will keep you informed of the progress on this and other important work by post. We will also send you carefully selected projects where you could help make a vital difference and invite you to events to see what your support has achieved.

If you don't want these updates by post, just tick here ☐

Your personal details are kept secure and are never sold, traded or rented. See full details at www.fauna-flora.org/privacy or call for more information.

YES! Please also keep in touch via

email at:

phone on:



Return to: Freepost RTTH-TXTL-AJRK, Fauna & Flora International, The David Attenborough Building, Pembroke Street, CAMBRIDGE, CB2 3QZ or go to www.protectpangolins.org to donate online.

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January 2020

6 – 10	Low Energy Buildings – Part B
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22 – 24	Introduction to Permaculture
22 – 25	Introduction to Rewilding
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March 2020

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2 – 5	Build a Tiny House (Sold out – next available 24-27 July)
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7	Introduction to Horse Logging
7 – 8	Intro to Solar P.V. & Off Grid Solar P.V.
7 – 8	Growing Fruit
8	Introduction to Horse Logging
9 – 13	Energy Provision: including Renewable Energy
9 – 13	Energy Generation from Wind
14	Spoon Carving
14 – 15	Build a small wind turbine
21	Build a Lapsteel Guitar
21	Making Frame Baskets
23 – 27	Build a Natural House (Sold out – next available 5-9 May)
28	Traditional Timber Frame Joints
31 – 3 April	Social Forestry OCN

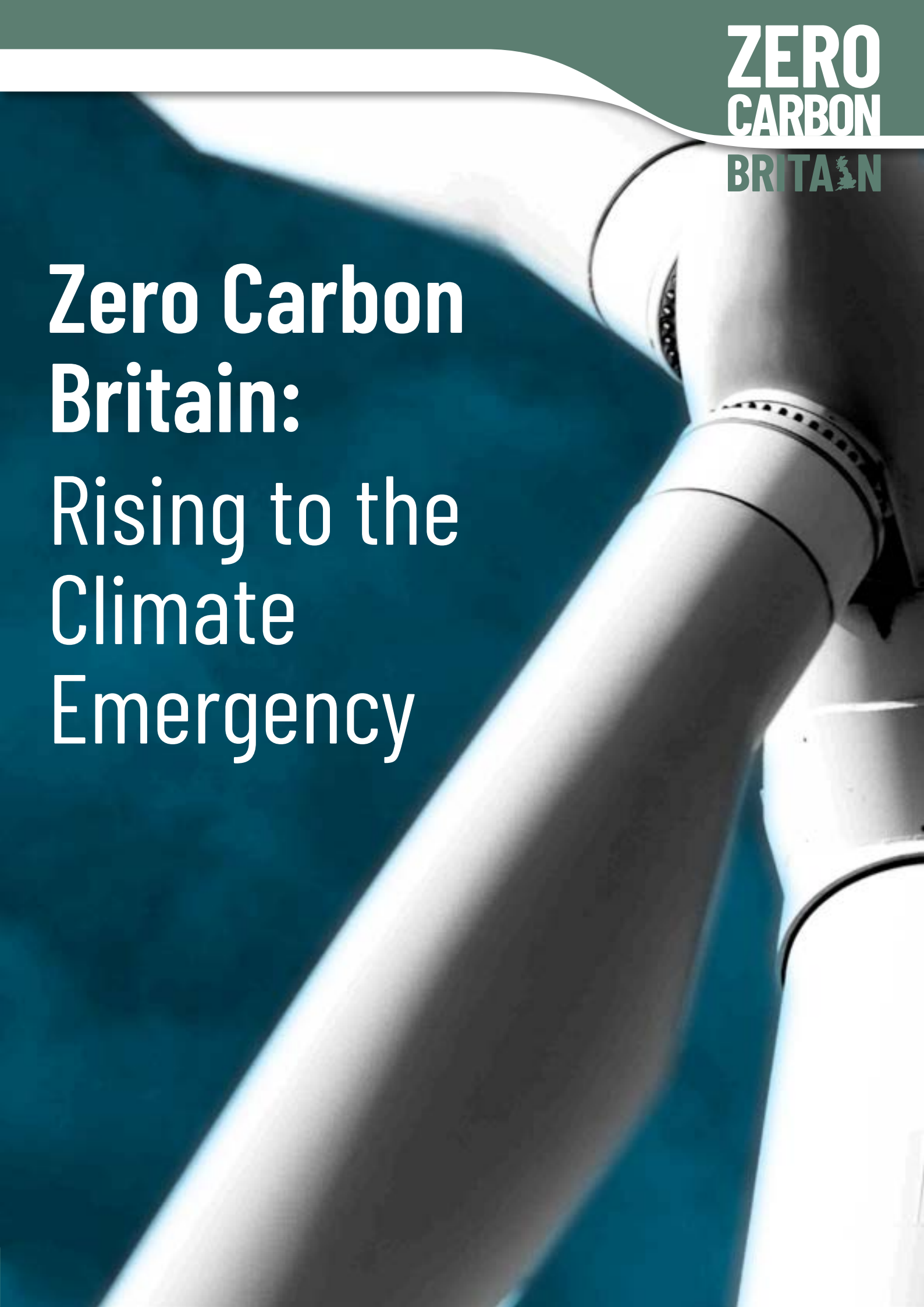
April 2020

4 – 5	Self-Build Project Management
6 – 10	Energy Generation from Solar
11	DIY Furniture: Upcycling with Pallets
17 – 20	Eco Refurbishment
18	Earth Oven Building
20 – 24	Ecosystem services: Land use, Water and Waste Management
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Zero Carbon Britain: Rising to the Climate Emergency



Time for **wicked** solutions

Paul Allen introduces CAT's new report, and explores how we can meet the complex challenges of climate change with ingenuity and collective determination.

There is no time to spare. In order to deliver the necessary solutions at the scale and speed required, we must fully understand the true nature of the climate problem.

Back in 1973, design theorists Horst Rittel and Melvin Webber developed the term 'wicked problem' to help us recognise really complex, challenging problems, particularly those with many feedbacks and no single solution.

The Centre for Alternative Technology acknowledges the climate emergency as a wicked problem, and is launching a major programme of increasing action to help society develop the wicked solutions it so urgently demands – the first phase of which is the release of our new report *Zero Carbon Britain: Rising to the Climate Emergency*.

Feedback loops and climate breakdown

The first reason to see climate change as a wicked problem is that it contains many feedbacks that make it non-linear. As the Earth's climate

systems break down, the resulting changes feed back on each other and accelerate change. For example, loss of sea ice means the earth absorbs more of the sun's heat and warms faster, which causes more ice to melt. There are many others.

In addition, the root causes of climate breakdown are deeply intertwined, spanning many disciplines. All across our living systems, humanity has become locked into high carbon ways of doing things; these exert a powerful influence, shaping the choices that define our lives. Despite the serious climate impacts being known, and despite the existence of cost-effective alternatives, the self-perpetuating inertia of high carbon energy, housing, transport, agriculture and economics creates persistent systemic forces that are highly resistant to change.

The reason we now face an 'emergency' is that, despite the climate problem being recognised by science for decades, governments and industries have not acted fast enough. A systemic bias against low carbon technologies and practices is a result of the historical development of the

fossil fuel system. We could have – and should have – accelerated this shift to net zero carbon decades ago, avoiding many mistaken investments in fossil fuel assets that we simply cannot burn.

Accelerating emergency

We have, at last, collectively acknowledged that the science tells us we must go to net zero.

The UK government has now signed into law a new target to 'cut greenhouse gas emissions to net zero by 2050'. This was approved by both the Commons and Lords in June 2019, strengthening the target of the 2008 Climate Change Act. But many believe that for a long-industrialised country like the UK, net zero by 2050 is simply not fast enough.

Speaking to the BBC in September, former Chief Scientific Adviser to the government Professor Sir David King said he's been scared by the number of extreme events, and called for the UK to advance its climate targets by 10 years. "It's appropriate to be scared. We predicted temperatures would rise, but we didn't foresee these sorts of extreme events we're getting so soon."

Feedback loops add to the complexity of climate change - loss of sea ice, for example, means the earth absorbs more of the sun's heat and warms faster, which causes more ice to melt.

Finding solutions

Thankfully, our human response embodies some 'wicked solutions' that can also accelerate change.

For over 12 years, CAT's Zero Carbon Britain project has been demonstrating with increasing detail how we can connect up the currently available, well-proven technologies to achieve net zero greenhouse gas emissions.

What makes these zero carbon technology solutions wicked is, firstly, the fact they are also non-linear and are now revealing an emerging array of feedbacks, which accelerate both the scale and speed of their deployment.

Investment in research means production costs fall and the scale of deployment increases; this triggers further research and investments in manufacturing and costs fall even faster.

For example, the falls in the cost of solar panels (solar photovoltaic or solar PV) has been faster than experts predicted. Massachusetts Institute of Technology have identified research and development and improvements in cell efficiency as the major factors contributing to a 99 percent reduction in module costs since 1980.

Offshore wind has plummeted below the cost of fossil fuels in just over half a decade. In September, *The Guardian* revealed that as recently as 2015 UK offshore windfarms received contracts costing around £120 per megawatt hour (/MWh); by 2019 this had fallen to around £40/MWh – less than the price of electricity in the wholesale market.

When the shift to these new technologies is also combined with a 'just transition' that offers a more socially just and equitable deal for workers, energy customers and citizens, the process begins to engage more and more people. That is the point of wicked systems thinking – not just looking at one feedback loop, but many.

Grassroots leadership

Fortunately, yet another important wicked solution feedback is now emerging across many countries: new grassroots leadership is calling for climate emergency declarations, backed by action plans for town, city, regional and national levels.

This is now accelerating, as one town sees its neighbour declare it then also joins the call. We are now witnessing a seismic shift in the collective action to prevent climate breakdown, it is becoming the new normal. And this shift is being documented: UK declarations are listed on the website climateemergency.uk and global declarations can be found on cedamia.org.

Schoolchildren have gone on strike; many deeply committed people across the country have taken to the streets; even the UK parliament has declared a climate emergency. And there is more in the pipeline, so much so that this is now transforming national, political and cultural narratives in a deep way.

Multiplying the benefits


But perhaps the most powerful element of these 'wicked solutions' is that delivering a zero carbon future also holds the potential to be one of the most exciting opportunities in human history, offering us the chance to simultaneously resolve many other problems.

Acting on climate breakdown with a multi-solving, interdisciplinary mindset can

help us also deliver benefits across many sectors. The trick is to identify synergies between investments in the changes needed to reach net zero and investments to improve health and wellbeing, enhance biodiversity, create jobs, reduce poverty, stabilise our economy, and increase our resilience and ability to adapt to climate change.

Maximising the benefits beyond carbon can help empower diverse constituencies, building the necessary engagement and a coalition of support across society.

Inspiring action

CAT is now exploring key collaborations and scaling up its ability to provide people with the knowledge, skills and resources needed to take action at the speed and scale required. We hope this new 2019 report will support the emerging 'climate emergency response team' of active citizens and local groups who are working hard to bring to life the wicked net zero solutions needed. And, in the process, help us foster a stronger, more resilient society, united in a new sense of collective purpose! 

Read the report

You can download Zero Carbon Britain: Rising to the Climate Emergency *from the CAT website or order a printed copy from our online shop. You'll also find a range of resources on our website, including summaries, videos and graphics for sharing.* www.cat.org.uk

"This new report is essential reading for politicians, business leaders and anyone interested in developing effective solutions to the climate emergency. Importantly, it comes at a time when grassroots pressure has opened up space for honest politicians to play their part in instigating a low-carbon revolution. With the CAT report as a guide, we can yet bequeath our children, future generations, and other species a sustainable and prosperous future."

Kevin Anderson, Professor of Energy and Climate Change, Tyndall Centre, University of Manchester (UK) and Uppsala (Sweden)

Zero Carbon Britain: Rising to the Climate Emergency

CAT's new report looks at how the UK can reach net zero greenhouse gas emissions using only proven technologies, helping prevent dangerous climate breakdown. Project Coordinator **Paul Allen** outlines the key changes needed.

Zero Carbon Britain: Rising to the Climate Emergency models a technically robust endpoint where we have achieved net zero greenhouse gas emissions – let's call this 'zero carbon'. CAT's work clearly demonstrates that we already have the tools and technology needed to efficiently power the UK with 100% renewable energy, to feed ourselves sustainably and so to play our part in leaving a safe and habitable climate for our children and future generations.

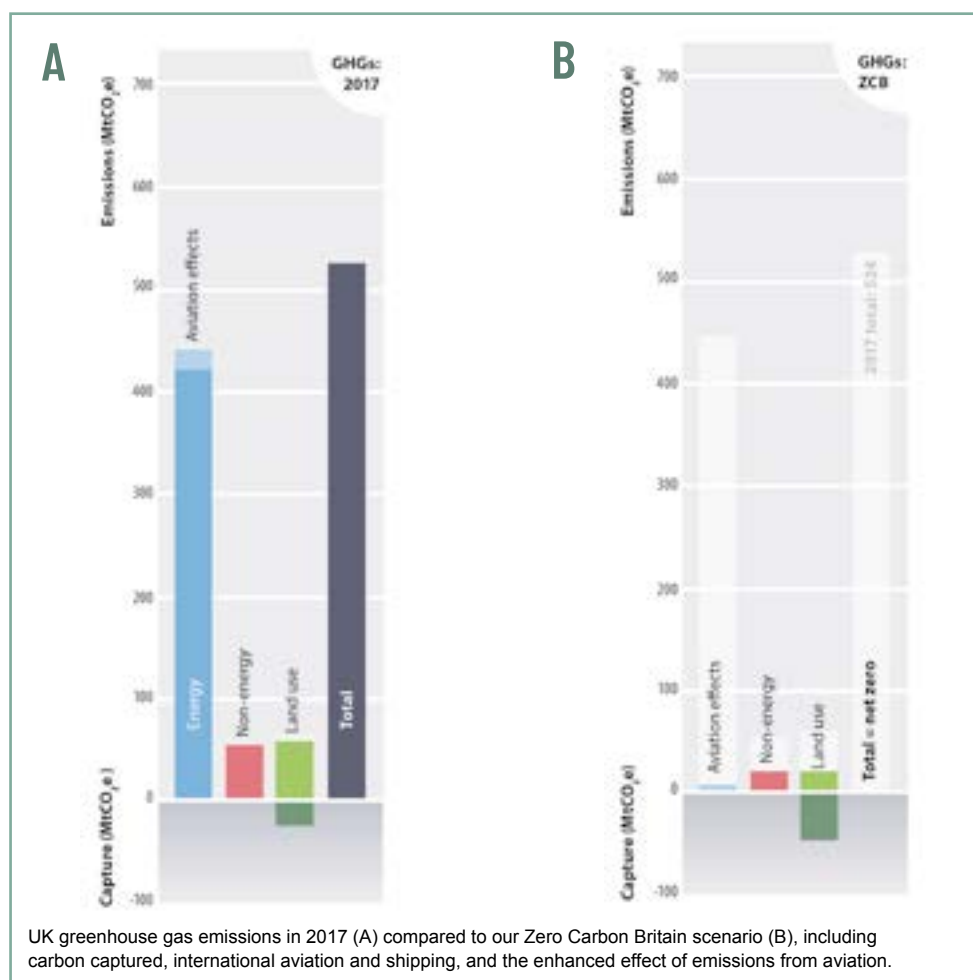
A blueprint for change

People all over the world are feeling the effects of climate breakdown, from unprecedented heatwaves, droughts and massive wildfires to some of the most damaging floods and storms ever seen. The warnings from the scientific community are now becoming real life experiences.

The current UK greenhouse gas emissions target of net zero by 2050, though ambitious in comparison to some other countries, does not offer rapid enough reductions to provide a good chance of avoiding extremely dangerous climate breakdown. Neither does it adhere to what might be termed the UK's 'fair share' of the remaining global carbon budget.

Zero Carbon Britain: Rising to the Climate Emergency explores how we can do what we know is necessary, clearly demonstrating that we can achieve net zero emissions without relying on unproven promises of future technology. By making changes to our buildings, transport systems, land use and behaviour, and by investing in a variety of renewable energy technologies, we can achieve a zero carbon transition while building in a wide range of additional benefits.

The report provides a blueprint to open new conversations around the scale and speed of change we need to deliver if we are to rise to the climate emergency. It can be used as a template to help citizens and local and national policymakers develop and deliver zero carbon action plans.



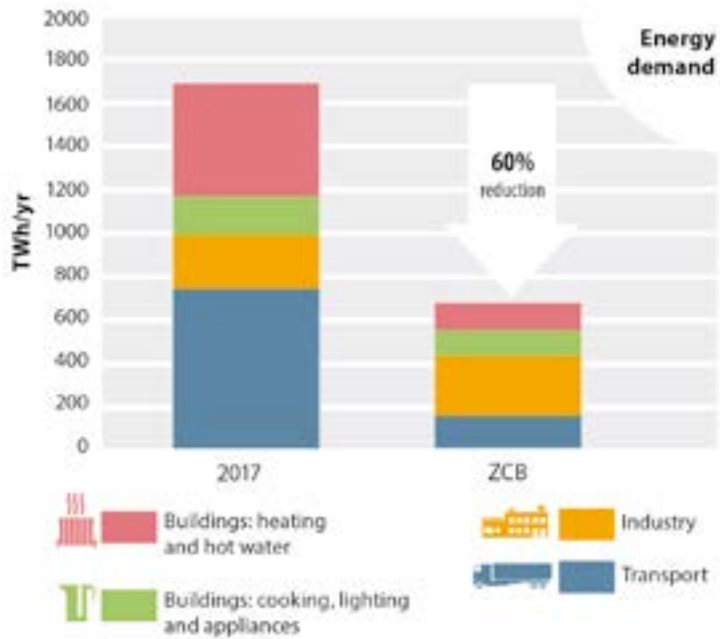
How can we reach net zero?

By using energy more efficiently we can power down demand by 60%. At the same time, we can power up the UK's renewable energy resources to replace fossil fuels. And by making changes to our agricultural systems and diets, these combined actions could reduce the UK's annual greenhouse gas emissions by 92%. We could then balance out the remaining 8% of emissions from non-energy processes (such as cement production or methane from livestock) by removing greenhouse gases from the atmosphere through natural carbon capture from forests and restored peatlands. This would take us to net zero emissions overall.

Powering down our energy demand

Our current lifestyles use far more energy than we actually need. CAT's research shows that we could reduce our energy demand by around 60%, with particularly large savings in heating buildings and in transport.

- Buildings: having high 'Passivhaus' standards for new buildings, retrofitting all existing buildings, and improving internal temperature control could reduce energy demand for heating by around 50%.
- Transport: reducing how much we



Total annual energy demand by sector in the UK in 2017 and in our scenario in terawatt-hours per year (TWh/yr).

travel, and changing how we travel – with more use of public transport, walking, cycling, switching to efficient electric vehicles and two thirds less flying – could reduce energy demand for transport by 78%.

Powering up renewable energy

It is possible to supply 100% of the UK's 'powered-down' energy demand with renewable and carbon neutral energy sources, without fossil fuels and without nuclear. In the Zero Carbon Britain energy scenario:

- Many different renewable energy sources suited to the UK – solar, geothermal, hydro, tidal and others – are used to produce electricity and heat.
- Wind energy – both offshore and onshore – plays a central role, providing around half of the energy.
- Most of the energy in this scenario (around 66%) is produced in the form of electricity.
- Carbon neutral synthetic fuels play an important role where it is not possible to use electricity – for example, in some areas of industry and transport, and as back up for our energy system.

Balancing supply and demand

The important question for a 100% renewable energy system is not if we can produce enough energy but whether we can produce enough energy at all times – even when the wind isn't blowing, the sun isn't shining and our energy demand is high.

The Zero Carbon Britain energy model uses hourly weather data (sunlight, wind speeds, temperatures, etc.) from over the ten-year period of 2002 to the end of 2011 – a total of almost 88,000 hours – to test renewable energy mixes under real life conditions.

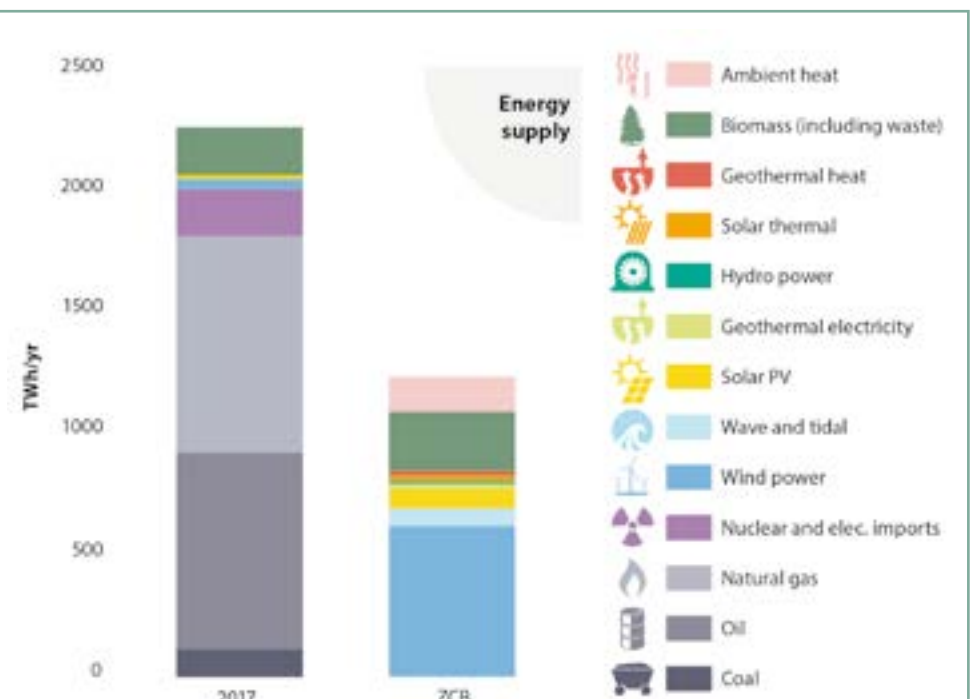
Hourly modelling of the renewables mix in the Zero Carbon Britain scenario shows a surplus of energy 74% of the time. We ensure there is enough energy at other times by:

- Shifting energy demand using 'smart' appliances and using batteries, pumped storage, heat storage and hydrogen for short-term energy storage over hours or days.
- Using carbon neutral synthetic gas for long-term energy storage over weeks or months. These have the same chemical make up as fossil fuel oil and gas but can be created by combining hydrogen (produced by electrolysis using surplus renewable electricity) with carbon from sustainable UK grown biomass, making them carbon neutral.

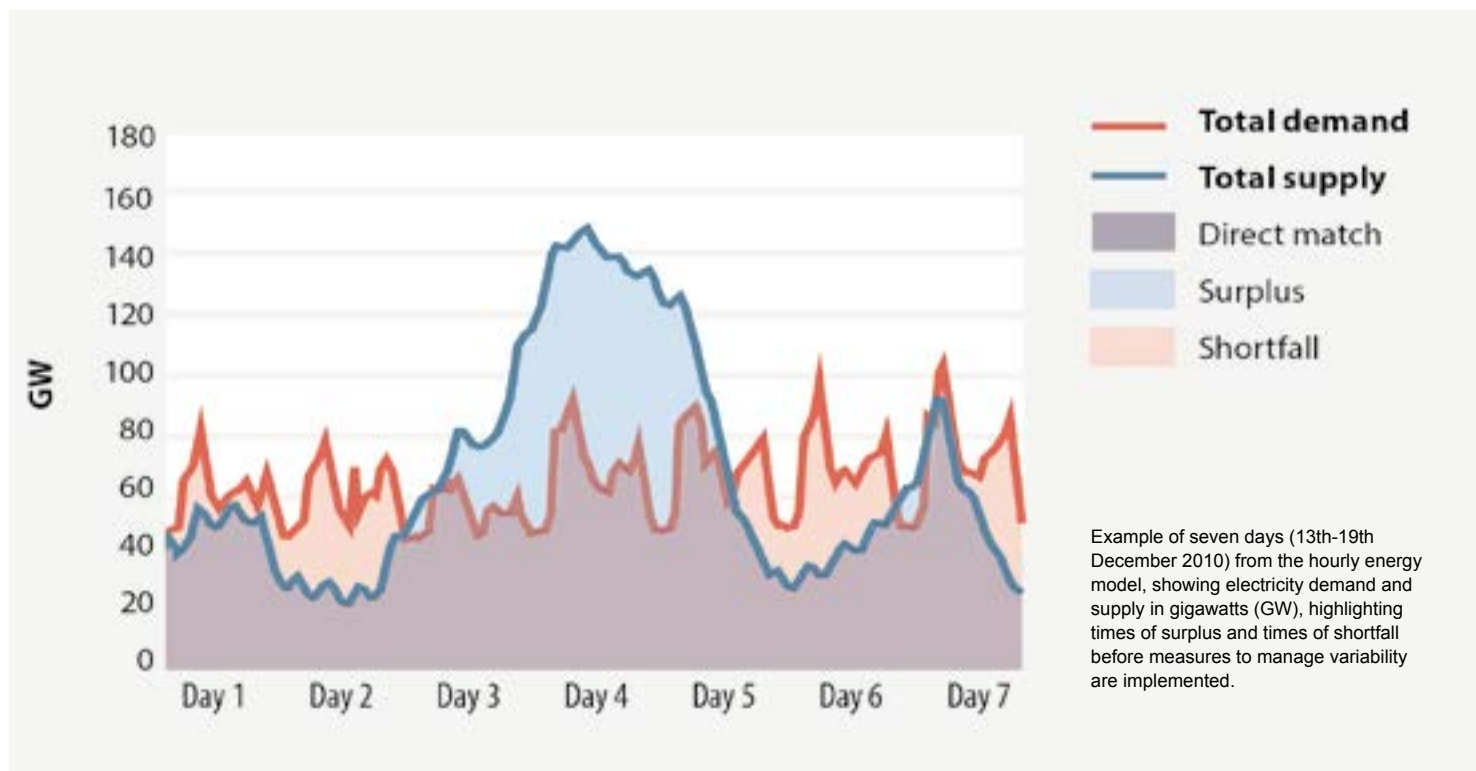
This research suggests 'baseload' power that provides a continuous supply of electricity but can only respond slowly (nuclear power, for example) doesn't work well with a highly variable renewable energy system, as it leads to further overproduction when renewables already exceed demand.

Land use – a vital piece in the net zero carbon jigsaw

Through 'powering down' demand and 'powering up' renewable supply, the UK's emissions can be significantly



Energy mix 2017 compared with our scenario, showing the amount of energy supplied by each renewable source.



reduced save a few industrial and waste management processes that still emit residual greenhouse gases. However, there are also emissions associated with the agricultural use of land, and land use changes associated with it, accounting for around 10% of current UK emissions.

Agricultural systems are threatened with reduced productivity due to a decline in the numbers and variety of plants and animals necessary for efficient food production. Therefore, our land management practice must include restoring essential biodiversity.

Our model explores how we can achieve this whilst also reducing agricultural emissions, providing a healthier mix of foods, reducing unnecessary food imports, producing sustainable building materials, providing UK sourced biomass, and increasing natural carbon capture to 'balance' our residual emissions. In doing this, the UK will become more self-reliant and can clean up its own mess within its own territory.

The use of land explored in the Zero Carbon Britain model will offer a healthier mix of food, plus backup energy supply and will provide natural carbon capture, which allows the UK to be truly net zero carbon.

A healthy low carbon diet

Through dietary change, food waste reduction and improved agricultural practices we could provide a healthy, sustainable diet for the whole UK population. These changes would mean that:

- Our health would be improved by eating a better and more balanced diet with significantly less protein from meat and dairy (which have high emissions and use a lot of land) and more protein from plant-based sources like beans, nuts, cereals and vegetables.
- Greenhouse gas emissions from agriculture would be reduced by 57% from 2017 levels. This represents only emissions produced 'on the farm', as food processing and distribution are taken into account in 'powering down' and 'powering up'.
- The UK could become much more self-reliant in food, reducing imports from 42% to 17%, and so reducing the impacts elsewhere in the world of food production for our consumption.
- 75% of the land currently used for grazing livestock could be repurposed,

freeing up space for a range of other uses, which could also offer new income streams to farmers.

Diversifying our land use

As well as being used directly as a fuel, UK sourced biomass can be combined with hydrogen from surplus renewables to make carbon neutral synthetic gas and liquid fuels, which increases the amount of fuel produced per acre of land. These are 'carbon neutral' as the greenhouse gases they contain were initially captured by the biomass as it grew, resulting in no net increase in the atmosphere.

In our scenario forest area is doubled to 24% of the land area of the UK – with roughly one third unharvested and two-thirds harvested for timber. These forests, the wood products they produce and the restoration of 50% of UK peatlands, would result in the capture of around 47 million tonnes of carbon dioxide equivalent (MtCO₂e) on average every year. This is required to balance the residual emissions in the scenario and so make the UK net zero carbon. There is also more room for biodiversity in wild, restored, conserved or protected areas.

So how quickly can we get there?

When we launched our original Zero Carbon Britain scenario in 2007, we estimated that the net zero end point would take around 20 years to deliver, focusing on paths that minimised disruption. However, during the intervening 12 years the UK government has been working to an underestimated '80% by 2050' target. Without national-scale systemic transition in place, time is now very tight.

2030 remains a valid target from the perspective of climate science, but we must recognise that this is now becoming a hugely challenging delivery timeline. It is vital that we focus on ambitious, large-scale, near-term emission reductions.

Developing a UK zero timeline requires a cross-sectoral team with expertise in policy and financing frameworks as well as technology deployment timescales. Development of such a plan is an urgent task, and one which should be a key priority for UK and devolved governments. CAT would be happy to work with policymakers and industry associations to explore such timelines.

Using Zero Carbon Britain

A great many people and organisations across the UK are working alongside their local governments to explore zero carbon transitions in transport, energy, buildings, food, land use and waste.

Not only can we deliver this through collective action plans, we can also make the individual changes which directly reduce our own emissions, and so transform how we relate to climate breakdown personally. While the impacts of individual changes are, of course, relatively small, as more and more of us scale these up they normalise emission reduction behaviours, empower people, help change social and political norms and so increase ambition for policy shifts.

Sharing Zero Carbon Britain can inform ambitious practical actions and policy shifts by clearly demonstrating that:

- All the technologies needed to power down demand and power up clean energy are ready and waiting.
- Changes in land use, reduced food imports and healthier diets are an integral part of the plan.
- Action on climate change can provide many additional benefits, including improved health and wellbeing, better housing and enhanced biodiversity.

Clearly, there is no single technology, policy or action that can prevent climate breakdown. It will require many people, from all walks of life, working together to bring about the change we need to see. So let's come together at individual, local,

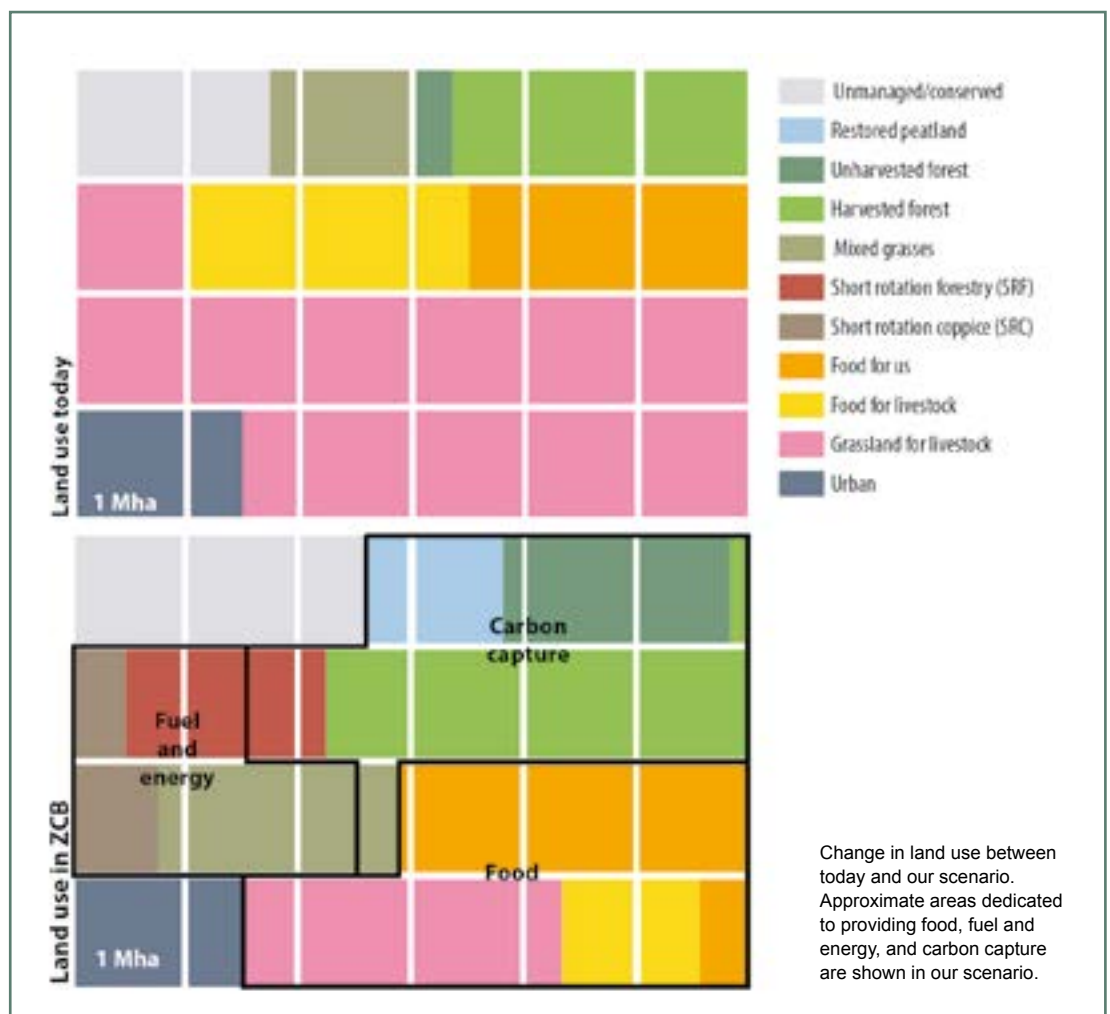
national and international levels – and collectively rise to the climate emergency! [CS](#)

About the author

Paul is project coordinator for Zero Carbon Britain. He has been a member of the Wales Science Advisory Council (2010), board member of the International Forum for Sustainable Energy (2008) and a Climate Change Commissioner for Wales (2007). He holds an Honours degree in Electronic and Electrical Engineering and has been at CAT since 1988.

Additional research updates by Chloe Ward, Philip James and Trystan Lea.

You can download the full report and find shareable videos and infographics on the CAT website: www.cat.org.uk





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ZCB and the CCC: how the models measure up

How does CAT's Zero Carbon Britain scenario compare to other models for getting to net zero?

Philip James compares the key changes, choices and technologies from Zero Carbon Britain with the Committee on Climate Change's 'Further Ambition' scenario.

Issue	CAT's Zero Carbon Britain	CCC's Further Ambition
Target date for a net zero greenhouse gas UK	• 2030, or as soon as possible thereafter	• 2050
Electricity generation	<ul style="list-style-type: none"> • 790 TWh/year • 100% renewable energy, biogas/synthetic methane power stations provide backup (which meets 2% of demand) 	<ul style="list-style-type: none"> • 645 TWh/year • Renewables (59%), nuclear (11%), bioenergy with Carbon Capture and Storage (BECCS) (6%), natural gas with CCS (23%), backup provided by hydrogen/ammonia produced from methane reforming with CCS (1%)
Electricity use	• 578 TWh/year	• 594 TWh/year
Bioenergy	• 230 TWh/year, all from UK energy crops or waste. Some used in buildings and industry but most used for synthetic methane and synthetic liquid fuel production.	• 200 TWh/year (of which 17% is imported). Over 85% is used with BECCS, either in power generation or biofuel production, generating negative emissions.
Hydrogen	• 100 TWh/year, produced by electrolysis. Used mainly for synthetic methane and liquid fuels, small amount used in transport (10 TWh).	• 270 TWh/year, produced by methane reforming with CCS and a limited role for electrolysis. Used mainly in shipping (70 TWh), industry (120 TWh), HGVs and buses (25 TWh) and heating in buildings at times of peak demand (53 TWh).
Buildings	<ul style="list-style-type: none"> • Around 50% reduction in heating demand. • Buildings mainly heated with heat pumps, some biomass, direct electric, solar thermal and geothermal where feasible. 	<ul style="list-style-type: none"> • Around 25% reduction in heating demand. • Majority of homes heated with heat pumps, some with hybrid systems using hydrogen or biogas for heating at times of peak demand. Hydrogen boilers also considered.
Industry	• High levels of electrification. Some solid biomass, biogas/synthetic methane and synthetic liquid fuel.	• High levels of hydrogen, as well as electrification, solid biomass, biomethane, and CCS for industry with high process emissions.
Transport	<ul style="list-style-type: none"> • Switching to walking, cycling and public transport reduces car mileage by a third. • Cars, vans and trains nearly all electric. • HGVs and ships run on mixture of electric, synthetic liquid fuel and some hydrogen. • Significant (two-thirds) reduction in aviation. Planes fuelled with synthetic liquid fuel. 	<ul style="list-style-type: none"> • Switching to walking, cycling and public transport reduces car mileage by 10%. • Cars, vans nearly all electric. Trains, HGVs and ships are electric and hydrogen/ammonia. • Growth in aviation is 'constrained' by limiting demand growth to 60% above 2005 levels. • Biofuels meet 10% of energy demand.
Agriculture and land use	<ul style="list-style-type: none"> • Emissions reduced to 20 MtCO₂e. • Over 90% reduction in beef and lamb. • Food waste halved. • Around half of agricultural land freed up for other uses. • Woodland area increases to 24% of UK land. Around 1 million hectares of peatland restored. 	<ul style="list-style-type: none"> • Emissions reduced to 26 MtCO₂e. • A 20% reduction in the consumption of beef, lamb and dairy by 2050. • 20% reduction in food waste. • A fifth of agricultural land freed up for other use. • Woodland area increases to 17% of UK land. Around 1 million hectares of peatland restored.
Net emissions balance	• The equivalent of 47 MtCO ₂ e/year of residual emissions remain from industrial processes, waste, agriculture/land use and aviation impacts. These are fully offset by an equivalent amount of negative emissions from natural climate solutions including increased forests, timber products, peatland restoration and biochar.	• Around 90 MtCO ₂ e/year of residual emissions remain from fossil fuel use - particularly in aviation, industrial processes, waste and agriculture/land use. 55 MtCO ₂ e/year of negative emission are generated, mainly from BECCS. This leaves 35 MtCO ₂ e/year of remaining emissions. The CCC identifies further 'speculative measures' to bridge the gap to net zero. These include further dietary change and greater reductions in aviation.

Key: TWh = terawatt-hours / MtCO₂e = million tonnes of carbon dioxide equivalent / CCS = Carbon Capture and Storage

Energy updates

The new Zero Carbon Britain report includes an updated energy scenario that takes into account changes in technology and progress in renewables as well as refinements to the hourly modelling that underpins the research. **Philip James** explains the key updates.



Changes since our 2013 research include a big increase in the use of electric bicycles and scooters.

Since the publication of *Zero Carbon Britain: Rethinking the Future* in 2013, there have been significant changes and developments in the UK energy system. There has been impressive deployment of some technologies and better than expected reductions in their costs. Some technologies have moved from potential options to inevitable parts of the energy transition. Meanwhile new technologies have emerged as realistic possibilities.

Therefore, for our new updated report, *Zero Carbon Britain: Rising to the Climate Emergency*, we have updated the energy scenario by:

- Updating the baselines in the report in order to reflect progress to date and to give an accurate picture of the challenge that remains.
- Incorporating the latest technological changes, either by changing the proportions or deployment of some technologies (such as battery storage), or introducing new technologies that weren't previously considered realistic (such as electric shipping).
- Continuing to refine the hourly modelling that underpins the energy scenario. The scenario is developed with hourly modelling of the UK energy system using ten years of weather data to simulate our renewable electricity supply and the demand for electricity. The modelling helps us better understand how energy storage and demand management can allow us to balance energy supply and demand, and we have further developed our understanding in this area.

Developments in renewable energy

Since 2013, there has been significant deployment of renewable energy systems in the UK. Solar photovoltaic (PV) power has increased from 3 gigawatts (GW) to 13 GW by 2018. Costs have reduced such that solar PV farms are competitive and systems on buildings can be a good investment without subsidy. Onshore wind has increased from 8 to 14 GW and it is planning permission and electricity grid issues rather than the cost of generation that is holding back further deployment. Offshore wind has increased from 4 to 8 GW. Planned new offshore wind farms have recently won contracts at less than the wholesale price for electricity! Floating offshore wind turbines have also been installed off Scotland.

The last few years has also seen a

dramatic increase in the amount of bioenergy in the UK energy system. Bioenergy and waste has increased from around 110 Terawatt-hours (TWh) in 2013 to around 200 TWh in 2018 (increasing from 5% to 9% of total primary energy supply). This has been driven by big increases in burning biomass and biodegradable waste for electricity and heat, as well as increases in anaerobic digestion. Currently, around a quarter of bioenergy is imported but there have still been large increases in generation and utilisation of UK bioenergy.

Buildings and transport

In other areas, less change has occurred in recent years.

In buildings, whilst there have been great exemplar eco-home projects and some significant progress in the social housing sector, overall progress is sluggish and there is no national programme for improving the energy efficiency of buildings.

In transport, cycling is increasing slowly but the car remains dominant. Miles driven by car are starting to increase once again following a dip in the years after the financial crash, as is distance flown. 'Flygskam' or 'flight shame' is a growing trend but one that is yet to have a major impact.

Changes in technology

In terms of technology development, recent years have seen some technologies go from potential or peripheral to central and mainstream. For example, renewable energy sources such as solar PV and on- and offshore wind are now widely accepted as a cornerstone of future energy supply. Likewise the shift to electric vehicles is now a question of when, rather than if. Other technologies, for example heat pumps for heating and hot water, are accepted as being required but deployment remains low and technical, economic and social barriers remain. All of these technologies were central to our previous scenario and remain so in the latest iteration.

Some technologies that we did not previously include, or only at low levels, have developed in recent years. For example, battery storage for electricity has emerged as a mainstream technology due to reductions in cost and the development of markets for 'grid services', therefore,

we have significantly increased the amount we include in our scenario. The electrification of large vehicles such as Heavy Goods Vehicles (HGVs) and shorter range ships has also emerged as a reality. We have increased the proportion of these technologies in our scenario. Electric bicycles and scooters have taken off in a big way and this is reflected to some degree in our latest scenario. The prospect of electric aviation, for short haul flights at least, is also on the horizon but since we wish to focus our scenario on technologies available today, we only include this at a low level.

Bringing it all together

As stated above, we have also improved the hourly modelling of our energy scenario. This helps us better understand how energy storage and demand management will allow us to balance energy supply and demand. It gives us even greater confidence that a 100% renewable energy system can deliver a secure and sufficient supply of energy at all times, if we 'power down' and manage energy demand correctly. Our hourly modelling can be explored at <https://openenergymonitor.org/zcem>.

The full details of our latest scenario can be explored in the *Zero Carbon Britain: Rising to the Climate Emergency* report available to download on the CAT website. As always, the scenario is presented as a viable net zero scenario but not the only possible scenario. Other choices in terms of technologies used, the extent of their deployment and the level of lifestyle and behavioural changes that can occur are all matters for healthy debate. However, we do feel that the core combination of ambitious 'powering down' of energy demand, 100% renewable energy supply and natural climate solutions to drawdown carbon whilst enhancing the natural environment is a powerful one. A comparison is made on page 23 of the key choices and technologies in the Zero Carbon Britain scenario with those assumed by the Committee on Climate Change in its recent report on net zero. [CS](#)

About the author

Phil is currently working at Nottingham Council helping to develop a plan to achieve a carbon neutral Nottingham by 2028. He worked as a researcher on the latest update of the Zero Carbon Britain scenario.

Further research

As can be expected, our research for the latest report has raised numerous questions and areas for further research. These include:

1. There is a great deal of interest from local councils and other local groups in developing zero carbon energy plans for their regions. How the research and modelling conducted for Zero Carbon Britain can be adapted for use at different scales and geographic regions is a key area for future work.
2. The role for hydrogen in the heating of buildings, in industry and as a backup fuel for electricity generation should be explored. It may be possible for its role to be larger than in the scenario presented here.
3. The electrification of large vehicles such as lorries, ships and even aeroplanes has emerged as a possibility. Some electrification of these vehicles is included in our scenario but further investigation is needed into the feasibility and energy system implications of even higher levels of electrification as an alternative to liquid fuels.
4. Industrial energy use is dealt with at a high level in our research and a cautious approach is taken to industrial energy demand reductions. More research is needed to further explore how changes to what is manufactured, the materials used and processes involved could impact on industrial energy use and emissions.
5. The manufacture of synthetic gas and liquid fuels using biomass and hydrogen (made with surplus electricity from renewables) is a key part of our scenario. Developments in this area mean that the cost and efficiencies of these processes, as well as the potential to use CO₂ captured directly from the air as the source of carbon, should be monitored.

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Powering up the UK's offshore wind industry

Offshore wind has a crucial part to play in getting to net zero greenhouse gas emissions. **Sally Shenton** explores the promise and practicalities of a growing industry, and looks at what needs to be done to unlock its huge potential.

The first two offshore turbines were installed off the coast at Blyth in 2000. Over the 19 years since, a new industry has developed, with turbines increasing in size and power output, plus a revolution in the ways they are operated.

The first commercial offshore turbines installed at Scroby Sands and North Hoyle were 2 MegaWatt (MW) machines based on onshore models with additional marinisation to protect them against salt water and the harsher environment. The

latest turbines being planned for offshore sites are between 10 and 12 MW.

Financial support and falling costs

In the early days of the offshore wind industry, the cost of building and operating offshore wind farms was high. However, through a planned programme of financial support and a great deal of innovation and enthusiasm, offshore wind is now lower in cost than most other forms of energy.

Financial support initially took the form of the Non-Fossil Fuel Obligation, which was used to part-fund the original Blyth turbines. This was soon followed by the Renewable Obligation (RO), which required electricity suppliers to include renewables in their mix, with the RO Certificate (or ROC) acting as evidence that suppliers met their renewable generation targets (the 'obligation'). Offshore wind generators could sell ROCs to electricity supply companies to provide income in addition

to the revenue received for the power they produced.

More recently, the RO regime has been replaced by a competitive auction to win 'Contracts for Difference' (CFD), which provide a way for power prices to be guaranteed in the long-term. Offshore wind developers can use the certainty of the CFD to borrow large amounts of money – often several billion pounds – which are needed to build an offshore wind farm.

This competitive approach coupled with larger turbines and growing experience has delivered the dramatic cost savings seen over the last few years: the cost of energy produced peaked around £150/MWh while in the next auction they are expected to be below £52/MWh.

Developing technology

The importance of offshore wind in the future energy mix has been recognised by many, including governments and climate change activists, and it has been a real privilege to see the industry develop.

The world of offshore wind is full of amazing things. We have built electricity substations in the middle of the sea, used some of the largest crane ships in the world, we have created special boats to allow maintenance workers to safely transfer onto turbines and, for larger sites further from shore, we now use specially designed ships that allow technicians to live on-board for several weeks.

Once planning consent and finance is in place, offshore wind can be built quickly and used at scale. The UK is currently home to the world's largest offshore wind farm at the Walney wind farm site off the coast of Cumbria. Yet this record is set to be beaten soon by another UK site, the Hornsea 1 construction, which is due to be finished in 2020; at 1.2GW its output is comparable to the large thermal power plants it will inevitably replace.

Rising to the Climate Emergency

Being in this industry at this time is exciting and it's easy to get swept along in the wave of enthusiasm. We must celebrate our successes, but we should also remember the bigger picture. We are in a climate emergency and we need to move over to using zero carbon forms of energy production as soon as possible.

The current UK Industrial Strategy is aiming to bring a total of 30 GW into operation by 2030, which is one quarter of the capacity needed under CAT's Zero Carbon Britain plan. So why are we not accelerating the number of wind turbines installed offshore? Despite installing nearly 3,000 offshore turbines, why are none manufactured in the UK? Why aren't all communities close to offshore wind farm installations prospering? Why is the installation rate of offshore wind turbines falling? And why did the government introduce a cap on the amount of offshore wind that can be developed in the 2019 CFD auction no matter how cheap it is?

We are facing a Climate Emergency. Renewable energy offers a solution that is proven, quick to build and low cost compared with other new power plants. The Zero Carbon Britain energy model estimates that we will need to install around 9,000 more turbines around the coast of the UK. We will only do this quickly if we have a stable pipeline of projects with some form of income guarantee in place to ensure we can raise the finance needed – whether this is from banks, pension funds, local authorities or direct funding from government.

It is not easy to criticise the industry I love being a part of, especially when I know how many individual engineers, offshore workers, designers, environmental specialists, planners, vessel skippers and many others have worked so hard to bring us to where we are today. It has not been an easy ride to get to this point – early offshore wind workers were ridiculed for moving out of the fossil fuel sector, worked long hours and kept going through periods where the industry faltered and struggled. We owe it to all these people and to the youth to accelerate our plans.

Speeding the transition to zero carbon

If we install at the fastest rate achieved in any year, it will take 24 years to install the 9,000 turbines needed in the Zero Carbon Britain model. If we go at twice this rate, then we could do it in 12 years – but it is not quite that simple.


We need to ensure the planning and development of projects keeps pace – it currently takes around 10 years to find

sites, gain planning permission, then plan and build projects; the actual physical installation of the turbines, offshore substations and cables takes up only 2-3 years of this.

We will also be building in increasingly challenging areas – challenging due to water depth, weather conditions, wildlife or visual impact. We need to make sure we place turbines in the right places, but we must make these decisions quickly and ensure that the pipeline of projects is secure so that we can give manufacturers the confidence to build factories in the UK. We need to improve our understanding of the impacts on wildlife – especially birds – and seek ways to protect populations as we build and install more turbines.

We also need to urgently accelerate the commercialisation of floating wind technology – an area in which the UK is currently a leader – so that we can build in deeper water that is further offshore. And we need to make sure improvements to the electricity grid do not hold us up.

There is a huge role for government to support the enabling work that underpins the growth of a new clean energy sector. There is more work to do to improve understanding of the underlying natural environment and set the right signals for investment in a new electricity grid infrastructure. We need to recruit and train more environmental and consenting experts if we are to avoid delays in bringing projects forward. We need to invest in our ports and manufacturing facilities to deliver jobs as well as turbines.

Challenges surround us, but I am filled with hope that these kinds of conversations are now happening and we are gaining so much support from around the UK and the world. Take heart from the words of Mahatma Gandhi: "The difference between what we are doing and what we are capable of doing would solve most of the world's problems." 

About the author

Sally is Director of Generating Better Limited. She has worked in the offshore wind industry for over 12 years and has been in the electricity supply industry for her entire career. She now runs a consultancy that advises offshore wind investors, owners and operators, whilst supporting suppliers, industry bodies and universities.

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Gearing up to support community level change

How can Zero Carbon Britain help with on-the-ground action? **Hazel Graham** introduces a pioneering project that's having real impact at a local level and providing a template for others to follow.



A pilot 'carbon literacy' training course run by CAfS in September 2019 helps people to better understand climate change and its solutions.

Cumbria Action for Sustainability (CAfS) is a registered charity and company that's been operating for 20 years. Its vision is a zero carbon Cumbria that brings about a better way of life in balance with the environment. Its 12 paid part-time staff and a small pool of volunteers run projects in the county to motivate, inspire, enable, advise and support people and organisations to reduce their greenhouse gas emissions and live in a more sustainable way.

CAfS has consciously aligned its mission to CAT's Zero Carbon Britain project, distilled down to a local level, and is guided by the Zero Carbon Britain principle that we already have the technology we need to transition to net zero. Its projects aim to normalise these solutions.

With no 'core' government funding, projects are often influenced by the availability of grants and contracts. But CAfS has a clear vision, a five-year business plan and prioritises the highest impact sources of emissions that it can

realistically have an impact on. It also factors in its strengths and skills, and the actions that others are taking in the county, so as to support and not duplicate effort.

CAfS' projects have touched on virtually all main sources of local carbon emissions, from food and transport to buildings, waste and energy production – many of the Zero Carbon Britain topics in 'powering down' and 'powering up'.

The scale has ranged from one-off talks, workshops or film screenings through to a £1 million 'whole-place' approach to transform the long-term sustainability of a community. CAfS is perhaps best known for its work in a few key areas of emissions: the built environment and community energy.

Buildings

As Zero Carbon Britain shows, retrofitting existing buildings for energy efficiency and tightening the regulations for building energy use are central to the UK's path to net zero.

Achieving this demands action from individual property owners as well as within the construction industry and the planning and building control frameworks. Recognising this, and recognising that there is a need for low carbon skills and knowledge to be shared as widely as possible, CAfS has supported and upskilled people at all these levels through its projects and services, including:

- Its annual Cumbria Green Build & Sustainable Living Festival (the first in the country, in its 14th year in 2019), offering a month-long programme of green open homes, site visits, workshops and training courses showcasing low carbon technologies and lifestyles.
- Technical training for construction professionals and homeowners in low energy new builds and retrofits, including CPD-certified courses up to Level 4.
- Thermal imaging.
- Energy audits for buildings.
- Schemes to install draughtproofing measures and offer energy advice.

Some of these are free via funding, while others are paid for by the client. CAfS contracts out some services to trusted local partners, with others carried out in-house by specialist staff.

Community energy

Zero Carbon Britain spells out the need to shift away from fossil fuels and shows that local generation of power from renewables must be a significant part of the UK's energy mix. CAfS has strived to develop community owned renewable energy in Cumbria to harness its many benefits for the area – from generating income for community projects, to bringing people together and making it possible for schemes to go ahead that may not have done with private investment.

CAfS used its charity reserves to seed fund Community Energy Cumbria,

supporting this new organisation to set up community owned renewable energy schemes, including hydro and solar power. CAfS has used its expertise to manage share offers for several community groups, raising almost £1 million.

Integrating small-scale generators into the electricity distribution network is a big challenge for network operators, along with enabling the shift to electric vehicles. CAfS has built a strong partnership with its local operator, Electricity North West, by sitting on its sustainability advisory board and co-hosting several events looking at electricity distribution in a low carbon future.

Influence and reach

Community organisations can be the bridge that brings others together on a theme like climate change – something that will be crucial for local areas striving to reach net zero. CAfS is increasingly influencing development across the county, as an enabler of change as well as a visionary body and delivery organisation.

For example, in 2019, CAfS chaired Cumbria's first summit on climate change for leaders in the private, public and third sectors and is helping to drive high-level partnership working to rapidly decarbonise the county.

Keys to success

CAfS has managed to survive, thrive and stay true to its vision through periods of funding cuts and reduced interest in climate change.

This has been possible for three main reasons, which are linked:

- The clarity of purpose and ability to articulate a clear, long-term, positive vision for a zero carbon Cumbria, using Zero Carbon Britain to influence priorities for work and fundraising.
- The organisation's success in sourcing grants and contracts for paid services, based on its reputation.
- Having paid staff to lead the organisation, communicate its work effectively and deliver projects, and competitive recruitment for strong trustees.



A 'Cold to Cosy' scheme run by CAfS includes home visits to advise on energy improvements.

Lessons for local groups from CAfS' experience

- Use Zero Carbon Britain to influence what you do on a local level.
- Work out the priorities for your area. This will be a mix of opportunism and strategy, balancing what needs doing, what you can get funding for and the skills available.
- Tackle the sources of carbon emissions that individuals, local businesses, communities or local authorities have direct control over.
- Share your expertise as widely as possible – train others and build a strong base of local knowledge. Support people to bring about the changes they want to see.
- Capitalise on current interest in climate change to engage local experts who weren't involved before.
- Consider the co-benefits of carbon reduction actions, as these can open up more funding (e.g. fuel poverty), but stay true to your purpose.
- Identify your gatekeepers – organisations that hold the funds, or with whom you need to partner.
- Understand that there will be limits to what you can achieve operating on a local basis, but maximise your impact within these limits.

Perhaps most importantly, do not give up. The science is crystal clear, the solutions are available and local groups have the potential to play a pivotal role in bringing people together and guiding action, as local authorities and others begin turning to them. Groups have weathered the storm through periods of low public interest but the clouds are breaking.

Now is the time for environmental groups to gear up, keep climate change on the agenda, and ensure that they can respond when their moment comes. [CS](#)

About the author

Hazel is Chief Executive of Cumbria Action for Sustainability and a climate jobs campaigner with 20 years' professional experience of transformative emissions reduction and social justice programmes.

About Cumbria Action for Sustainability

CAfS is a registered charity and company based in Penrith, striving towards its vision of a zero carbon Cumbria with a better way of life in balance with the environment. Formed in 1998, it empowers people, communities and organisations by managing and delivering projects and sharing knowledge, practice, skills, networks and practical experience. www.cafs.org.uk.

Gardening on the wild side

CAT gardener **Petra Weinmann** explores how to make any patch of earth or community greenspace more sustainable and biodiverse.

With ever increasing loss of species and biodiversity worldwide, how can we look to our own gardens, allotments and shared spaces to try and make a difference? Here are my top tips for a wildlife-friendly plot.



There's no need for chemical warfare

Any herbicides and pesticides we add to the environment may not stay where we put them and often have unintended consequences. Let's keep things in perspective. Is it end of the world if our roses suffer an aphid attack or our patio sprouts the odd weed? Resorting to a brightly packaged spray bottle full of promises is a short-term solution that has no place at all in a non-commercial setting. It is far more effective to put our efforts towards good husbandry and fostering a balance of prey and predator insect species. So grow flowers, berries, seeds, make compost, have unkempt corners and brush piles! These are the things that bring a natural harmony to the garden.



Practise selective weeding

While in the throes of weeding let's remind ourselves that many of our most demonised weeds are important native food plants for wildlife. Nettles feed ladybirds and butterflies (and people!). Ivy's autumn flowers and winter berries make a great food source for pollinators and birds in times of scarcity. Brambles provide shelter, nectar, berries. Common ragwort attracts moths and butterflies and supports over 200 species of invertebrates. Dandelions... I could go on! Suffice to say weeds have a place in the 'wild' garden and in a gardener's affections. See their qualities and values. Find ways to incorporate them into your schemes. Some, like teasel or hemp agrimony, do not look out of place in an herbaceous border. Nettles and the mighty bramble could ramble around the compost bin. And what's wrong with some early dandelions in the lawn?

Feed the living soil

A huge part of a garden's biodiversity is underground in the form of worms, nematodes, insects, fungi and microbes. Caring for the soil is the heart of sustainable gardening. If the subterranean wildlife is happy, the soil will be healthy, plants will thrive, and positive effects will ripple through the food chain to birds and small mammals.

Compost, manure, leaf mould and organic mulches are all great ways to feed the soil and all the creatures in it. Synthetic fertilisers boost plant growth spectacularly, but they bypass this living ecosystem, leading to the soil's depletion, so compost all you can. If you have space and time, all waste from the garden can be composted - weeds, leaves, grass cuttings or woody prunings. In my opinion, there is space for a compost bin in the smallest of gardens. Even a balcony has room for a worm bin. It's important; it's the heart of the matter!



Coatesy

Don't rush into tidying

Wild things need places to hide and hibernate over winter. Mouldering vegetation is perhaps not the height of beauty, but it does provide shelter and nourishment for all sorts of animals and fungi. Skip the traditional autumn tidy altogether, or keep within reason. Leaves can be left on the borders over winter to form a protective mulch. If, like me, you need some areas (or pots) to look less dishevelled, add an extra step here by taking leaves off to make leaf mould and return this to the soil as mulch (it takes a couple of years to get going, but then you'll have a regular supply).

I also leave most herbaceous plants untouched until the spring, but if you really want to cut them back tie your cuttings into bundles. These can be used as mulch around trees and shrubs, where the hollow stems continue to provide shelter for overwintering insects.

Grow your own bird food

Bringing birds into the garden is all about providing food and shelter. We can buy imported bird seed as a treat, but it's not difficult to provide local produce all year round.

Leave some wind fallen apples for the blackbirds. Grow sunflowers for the seed heads. Don't prune your summer flowering shrubs until the birds have had a chance to pick off the seeds. And, if you have room, leave teasel standing for the pleasure of watching goldfinches feed in the dead of winter.

Make a pond

A pond, no matter how big or small, adds a whole new habitat to any garden. Send out an open invitation to frogs, toads, newts, pond skaters and dragonflies. Importantly, ponds also provide a place to drink. Watching a wasp bring its tiny mouth to drink from the surface of an urban pond was an eye opening moment for me. Bees, birds, hedgehogs – they all need to drink!

A lawn need not be a mono crop of rye grass mown to within an inch of its life!

Take a relaxed approach to lawn care, let it grow a bit longer and have some flowering 'weeds' in it. Just banish sprays and fertiliser and a habitat will develop amongst the moist roots and nectar laden daisies. If you don't need the open space for children's games or deckchairs, you could consider going the whole hog towards a wildflower meadow.



Trees for the bees

When choosing a tree or shrub to plant, pay attention to the pollen and nectar sources you have already in your garden and neighbourhood. Are there any hungry gaps when bees would travel further afield? This kind of observation takes time, so you could just focus on extending the flowering season. Willows, for example, provide essential nourishment in March when groggy, hungry bees are just emerging. Early flowering fruit trees are good too.

Minimise hard landscaping

If you are lucky enough to be choosing the elements of a new garden, take wildlife habitat and flow into account. Is there freedom of movement at the boundaries? Is there room for a hedge instead of a fence or wall? How much paving does one garden really need? These elements make a big difference to how welcoming our gardens are, and whether back gardens can connect up to become a bigger haven.




Venture into seed saving

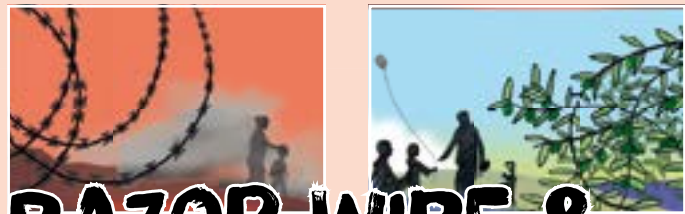
As well as being highly nutritious to wildlife, seeds contain the genetic code for future generations. They are the store house for plant diversity, and this store house needs to be well stocked to cope with an uncertain future. Genetic variety makes plants resilient – who knows what forgotten traits may turn out to be useful in a changing climate? If you don't already, you could continue the age old gardening tradition of seed saving and help bring heritage varieties back from the brink of extinction. I am a beginner myself, and I am finding it an exciting way to learn more about plants I thought I knew. Sue Stickland's *Back Garden Seed Saving* book has been an invaluable guide.

About the author

Petra has been managing the garden displays and helping the biodiversity flourish in the CAT gardens since 2015. When she's not pruning the apple trees and experimenting with chickpea and lentil crops, Petra can be found improving and planning new interpretation for the gardens, and leading university and school groups on garden tours and volunteering days.

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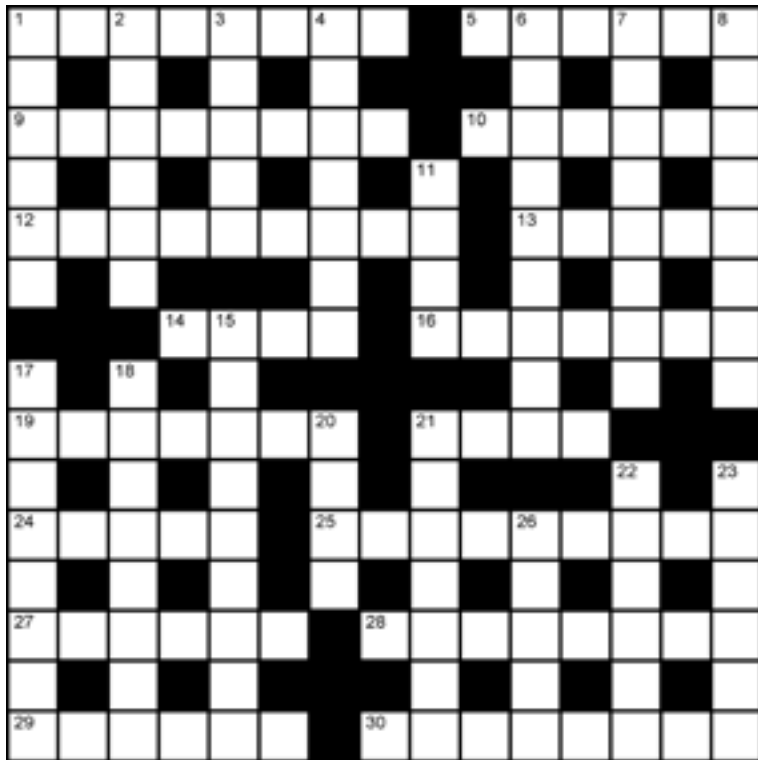
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The first correct entry pulled from a hat on 13th January 2020, wins a £20 voucher for the CAT EcoStore – store.cat.org.uk.

Please send your completed crossword entry to *Clean Slate* Crossword, Centre for Alternative Technology, Machynlleth, Powys, SY20 9AZ.

Solution will be published in the next issue of *Clean Slate*.

Across

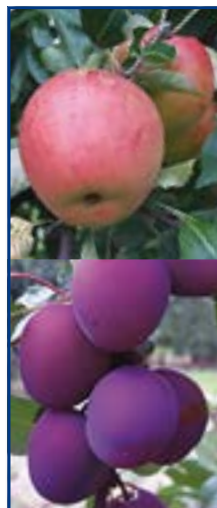
- 1 Professional actor captures sailor returning to battle? (8)
- 5 Puzzles regularly upset befuddled members (6)
- 9 Become less stupid and stop losing head (8)
- 10 Heartless boss throws out Christmas decoration (6)
- 12 A strong drink required before bar fight (9)
- 13 Salesman plugging collagen tablets (5)
- 14 Man heard in passageway? (4)
- 16 Tackle such fraudulent behaviour (7)
- 19 Consummate pain that is very interfering (7)
- 21 Annoyed with twenty out of one hundred? Quite the opposite! (4)
- 24 Bank on getting a B in elementary Italian course (5)
- 25 Encounter fizz from Welsh town outside the Lamb's Head (9)
- 27 Church put back live broadcast by seconds? (6)
- 28 Fight rogue later, in court (8)
- 29 Party backs providing Spain with reserves (6)
- 30 Pay Barça with small change for great South American (8)

- 4 Very upset about book on medicine turning out incomprehensible. (7)
- 6 Wind up near the Algarve, pulling off victory against Spain, here (9)
- 7 Not the first to mismanage ill-considered confrontation with the Romans (8)
- 8 Fight with girl against Roman outfit (8)
- 11 One's found outside cheap hotel, half-naked (4)
- 15 Weapon and loads of money discovered in the garden? (9)
- 17/18 Fight against heavyweight? (6,2,3,5)
- 20 Sort of bee you'll find around large flower (4)
- 21 Fruitcake's content; content to consult analyst (7)
- 22 Gangster bound over and serving in Spain (6)
- 23 Battle with Austria after small commotion (6)
- 26 Scrap plastic recycling bags (5)

Down

- 1 Naval encounter like one in 471BC? (6)
- 2 Marine recollected an unsuccessful campaign? (6)
- 3 Clothing a home for previously unknown parasite, according to Spooner (5)

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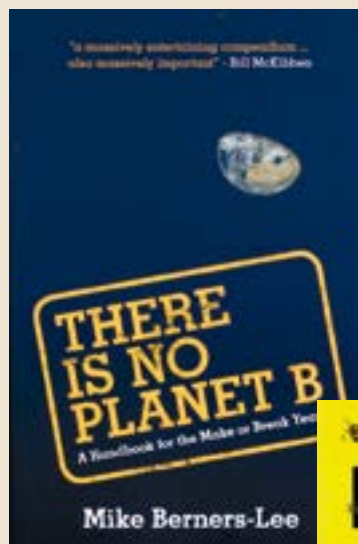
Contact Alison:

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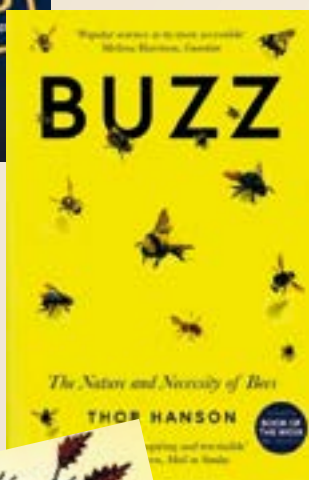
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