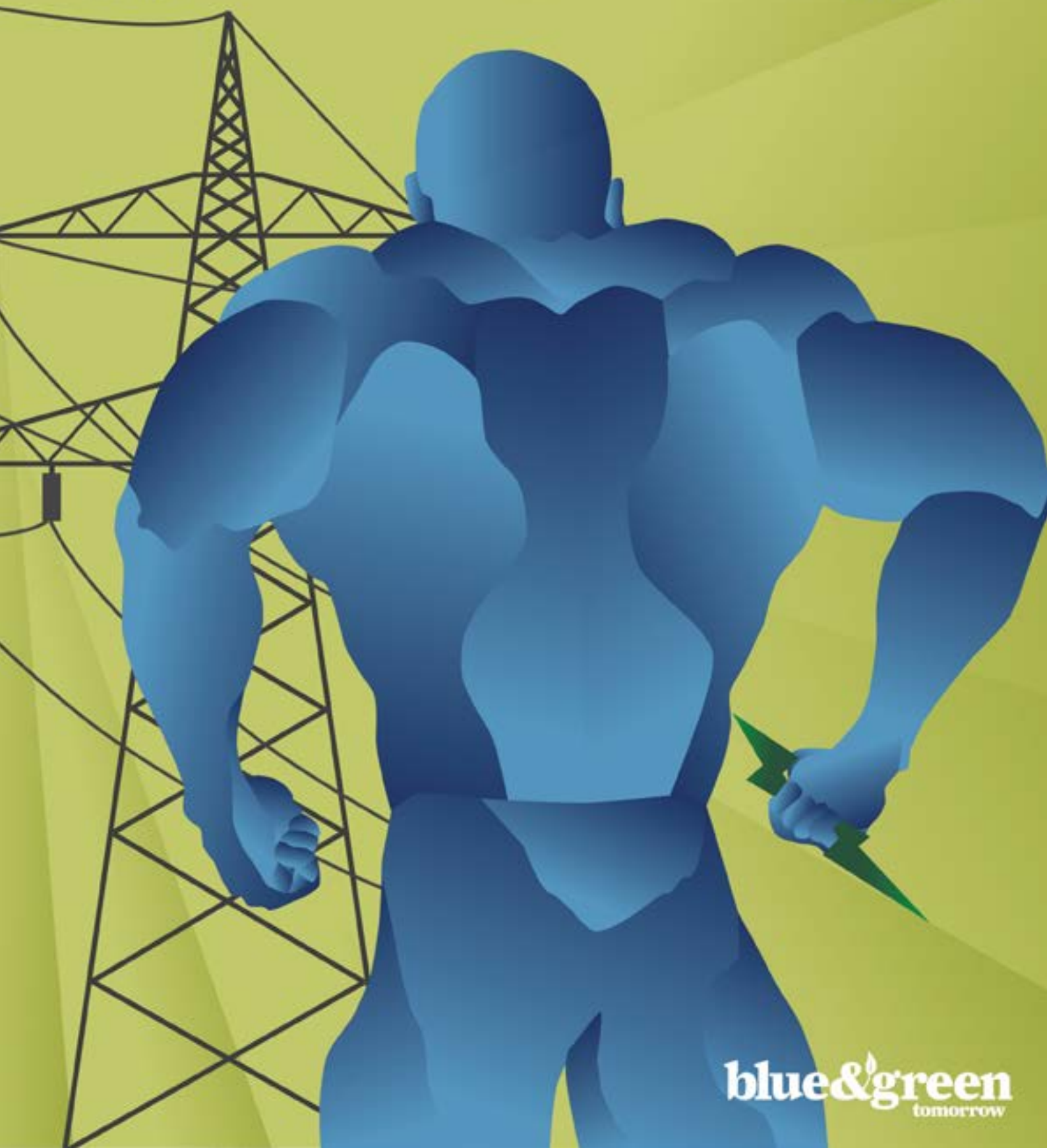
SUSTAINABLE CLEAN ENERGY

JULY 2014

3RD EDITION



blue&green tomorrow

PUBLISHER'S LETTER

"Every percentage point increase in homegrown renewable energy makes us that much more energy secure."
- Nina Skorupska, chief executive of the REA

In 1860, then-US president Abraham Lincoln described the wind *"an untamed and unharnessed force"*. He continued, *"Quite possibly one of the greatest discoveries hereafter to be made will be the taming, and harnessing of it."*

In 1931 – before solar power became commercially viable – the inventor Thomas Edison said, *"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."*

If these quotes from two of history's most influential figures are anything to go by, we are long overdue in making the most of the vast potential renewable energy has to offer. The UK specifically – a wet, windy island surrounded by miles and miles of coastline – is perfectly placed to harness the Earth's natural power. What's clear is that the biggest stumbling block is political. Countless studies have outlined just how feasible – and financially sensible – it would be to vastly ramp up our clean energy output. The economy would benefit, society would thrive and the environment would be cleaner.

But the debate all too often comes back to aesthetics – and whether something spoils the landscape. Nimbyism ('not in my back yard') is quickly turning into bananaism ('build absolutely nothing anywhere near anyone') – my favourite acronym of the year.

We ran a poll on blueandgreentomorrow.com asking people which energy sources they'd be happiest having next to their home. No prizes for guessing the most popular choice, but I'm still baffled at the three people who chose a coal mineshaft and the five who opted for an opencast coal pit. See page 38 for the full results of the poll.

This guide, now in its third annual edition, takes you on a journey; starting with a look back at the current generation of renewable technologies – likely dating back further than you think – and ending with a glimpse of what the future might hold. Along the way, you'll meet some of the leaders going to great lengths to bring about the low-carbon transition. Prepare to be utterly inspired.



Simon Leadbetter
Publisher, Blue & Green Tomorrow



19th Century Windmill, Geneva IL.
Photo by BRAD PERKINS via Flickr

CONTENTS



2 **EDITOR'S LETTER**
Alex Blackburne

8 **RENEWABLE ENERGY THROUGH THE AGES**
Ilaria Bertini

14 **ENERGY FROM RENEWABLE SOURCES**
A six-year table on the share of renewable energy in all 28 EU countries

16 **THE WINDS OF CHANGE**
Alex Blackburne with Siemens

23 **20 QUESTIONS WITH...**
Jeremy Leggett

26 **FINANCING THE FUTURE OF RENEWABLE ENERGY**
Alex Blackburne with the Renewable Energy Association

31 **SWITCHING ENERGY SUPPLIERS IS GETTING EASIER**
Charlotte Malone

34 **A DAY AT SOLAR FARM**
Richard Heasman

39 **20 QUESTIONS WITH...**
Bruce Davis

45 **THE STORY OF THE UNBURNABLE CARBON**
Alex Blackburne with the Carbon Tracker Initiative

50 **THE MASTERING OF THE TIDE**
Tom Revell with Tidal Lagoon Power

56 **20 QUESTIONS WITH...**
Sarah Butler-Sloss

60 **RENEWABLE ENERGY OF THE FUTURE**
Tom Revell

69 **WHAT DO I DO NEXT?**

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RENEWABLE ENERGY THROUGH THE AGES

By ILARIA BERTINI

By adopting clean, renewable energy sources like wind, solar and hydro, mankind is reverting to its roots as an energy producer.



Photo by JOSEPH HART via freeimages.com

"We are like tenant farmers chopping down the fence around our house for fuel when we should be using nature's inexhaustible sources of energy — sun, wind and tide..."

Photo by STEPHEN ONEIL via freeimages.com

The wind, the sun, steam, waves and organic materials were the first forms of energy that humans ever knew. The power of nature has accompanied mankind through the centuries but was cast aside as an energy source when fossil fuels – oil, gas and coal – started to prosper. Yet today, renewable energy is recognised as essential for the Earth and the future survival of our species.

Before coal became widely available and convenient in the 19th century, the majority of energy came from cleaner sources: firewood for heating, wind to drive ships and water and wind to power mills. It is often said that we have to 'move on' and make room for progress. Oil and gas-powered ships and machines might have replaced those fuelled by the wind or water, but looking at the enormous technological leaps forward – turning a simple windmill into a wind turbine, for example – it is impossible not to be grateful for what nature gives to us for free.

Do we already have the answer to our energy needs and are pretending not to see it? This potted history of renewable energy suggests we may do.

"We are like tenant farmers chopping down the fence around our house for fuel when we should be using nature's inexhaustible sources of energy — sun, wind and tide... I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." - Thomas Edison, US inventor, 1931.

BIOMASS

Biological material from living organisms is probably the most ancient source of energy, dating back to 400,000 BC. Despite being clean and accessible, biomass energy has changed significantly over the years, as our energy needs changed. Humans went from burning wood and straw in stoves to growing crops and forests and using them for fuel, which many argue is unsustainable. However, some other forms of biomass, such as getting power from organic waste from food or crops through anaerobic digestion are rapidly becoming popular among energy firms and are seen as an effective way to send less waste to landfill.

HYDRO

Used in ancient Egypt and later by the Romans, water has historically been used to power watermills. Such activity was said to have boosted local economies, with major economic centres developed around water sources throughout history. Humanity quickly understood that water could be used in many forms, whether this was streams, tides or waves. The world's first hydroelectric facility appeared in Appleton, Wisconsin, in 1881 and shortly after, hydro energy became economically viable in the US and the first dams were built. Today, hydropower, including wave and tidal energy, accounts for about 16% of global electricity consumption.

WIND

The power of the wind is what has allowed humans to cover long distances and discover previously unexplored land on ships. Greek engineer Heron of Alexandria is said to have been the first to build a wheel powered by the wind to run a machine, back in the 1st century AD. In the Middle Ages, windmills appeared all over Europe and Asia, proving to be more effective than watermills at times, as they could stay functioning throughout the winter, whilst watermills would stop if the water froze over. The construction of the first windmill to generate electricity dates back to 1887, when Glasgow professor James Blyth installed a small turbine in the garden of his holiday cottage, but it wasn't until the early 1900s that the technology started to become economically viable. Development in Denmark and the US allowed the concept to grow and improve, and in 1941, the first megawatt-size wind turbine was built in Vermont. In the 70s, when the oil crisis hit, wind power started to become seen as central to a new energy system – one not based exclusively

"Turning a simple windmill into a wind turbine, for example - it is impossible not to be grateful for what nature gives to us for free."

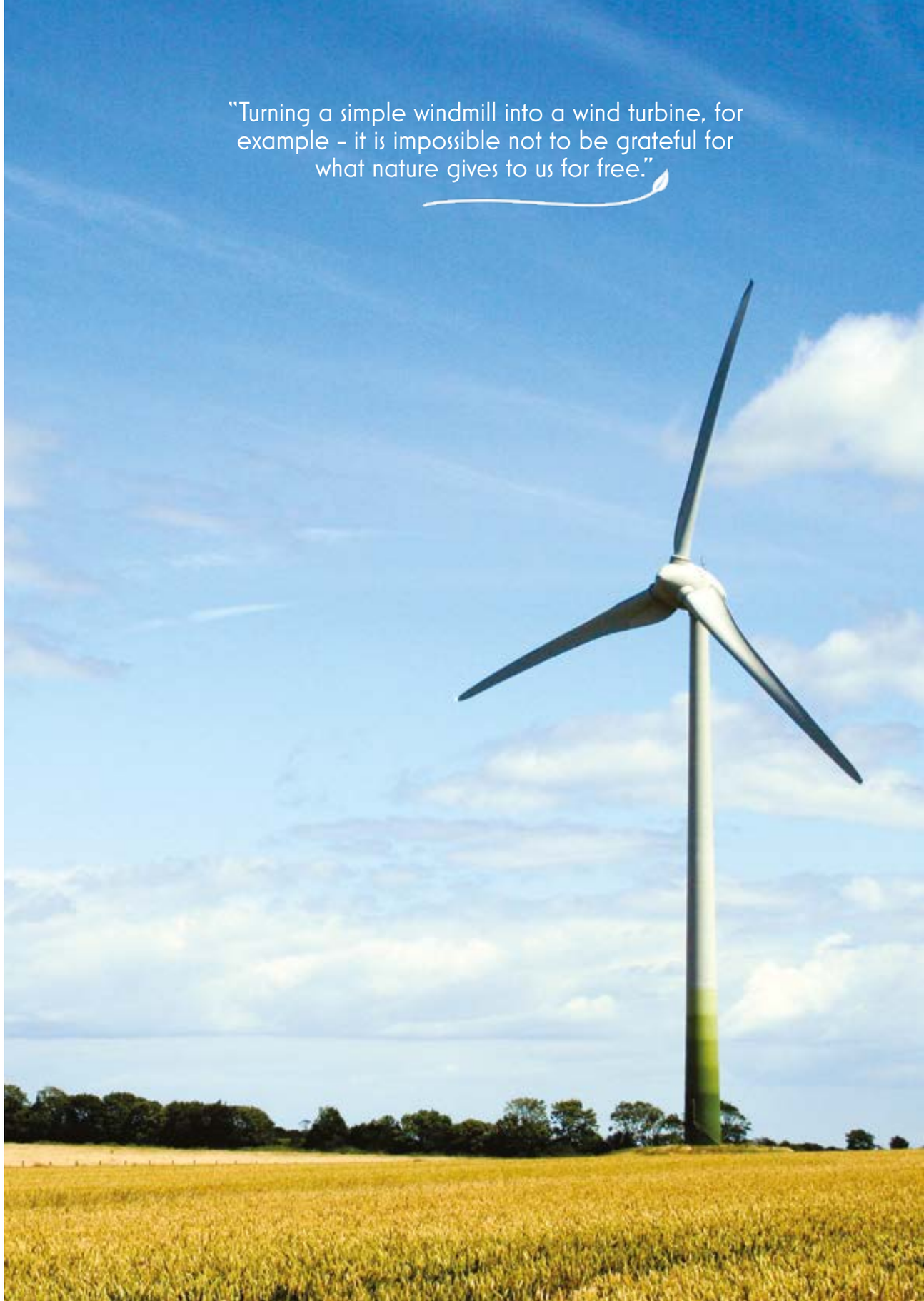




Photo by CBLEHM via freeimages.com

on fossil fuels. In 2010, wind energy accounted for 2.5% of worldwide electricity usage and this figure is expected to rise to 8% by 2018, according to the World Wind Energy Association.

SOLAR

The first solar or photovoltaic (PV) cell was invented by Charles Fritts in the 1880s. Two decades earlier in 1860, French inventor Augustine Mouchot had already seen the enormous energy potential of the sun, testing a solar-powered steam generation system to power industrial machinery. Solar technology suffered a period of cooling-off as fossil fuels, especially coal and oil, thrived in the 20th century and its use on private properties was rare. However, the oil embargo and energy crisis in the 70s gave a boost to research and new development. PV installations have grown around 50% per year since 2000, also thanks to the falling cost of the technology. Solar farms and solar rooftops are now being supported in most places around the world, promoted for their relative competitiveness and the crucial role they play in providing energy security and reducing dependence on fossil fuels.

GEOTHERMAL

Geothermal energy is generated from the heat that lies beneath the Earth's surface. Its use to warm places or baths dates back to the Palaeolithic era, but it wasn't until 1892 that the first geothermal heating district opened in Boise, Idaho. Within a few years, the facility was able to power 200 homes and 40 local businesses. In 1904, the first geothermal power generator was tested in Larderello, Italy, and was successfully used to light four bulbs. The US later passed the Geothermal Steam Act in 1970, to encourage the production of geothermal power on a large scale and is currently in fact the world's largest producer. This form of energy has been proved clean, cost-effective and profitable in many countries – particularly volcanic ones such as New Zealand, Iceland and the Philippines. Despite being limited to certain areas where extraction of geothermal power is viable, the share of electricity coming from this source has increased notably since the late-1990s, especially in developing countries, according to the International Geothermal Association.

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"Growth in tourism is undesirable: it is rarely economically, socially or environmentally 'good'."

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10th September 2014

"Free trade trumps fair trade in helping developing economies."

Sustainable Energy Debate
Siemens Crystal
16th September 2014

"Shale gas and nuclear power will address carbon emissions in the immediate term, far more effectively than renewables"

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23rd September 2014

"The purpose of investment is maximising financial return and nothing else."

Sustainable September: The Event Full-Day Conference
Central Hall, Westminster
30th September 2014

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SHARE OF ENERGY FROM RENEWABLE SOURCES

(in % of gross final energy consumption)

0-5 6-10 11-15 16-20 21+

	2004	2007	2010	2011	2012	2020 target[5]	% increase between 2004-2012
EU28							5.8%
BELGIUM							4.9%
BULGARIA							6.7%
CZECH REPUBLIC							5.3%
DENMARK							11.5%
GERMANY							6.6%
ESTONIA							6.8%
IRELAND							4.5%
GREECE*							7.9%
SPAIN							6%
FRANCE							4.1%
CROATIA							3.6%
ITALY							7.8%
CYPRUS							3.7%
LATVIA*							3%
LITHUANIA							4.5%
LUXEMBOURG							2.2%
HUNGARY*							5.2%
MALTA*							1.1%
NETHERLANDS							2.6%
AUSTRIA							9.4%
POLAND							4%
PORTUGAL							5.4%
ROMANIA							6.1%
SLOVENIA							4.1%
SLOVAKIA							5.1%
FINLAND							5.1%
SWEDEN							12.3%
UNITED KINGDOM							3%
NORWAY							6.4%

** Eurostat estimates based on the national data transmission under Regulation (EC) No 1099/2008 on energy statistics.*

THE WINDS OF CHANGE

By ALEX BLACKBURNE

Roland Aurich, the outgoing chef executive of Siemens UK, on sustainability, renewable energy and why the northern city of Hull is central to its future plans.

Photo of London Array by SIEMENS AG

"There is a bit of envy from other countries like Germany and others, which are probably watching pretty closely at what the UK has been doing."

The people of Hull had spent two years playing 'will-they, won't-they' when they were finally given the answer they had longed for. German manufacturing giant Siemens announced on March 25 that it was choosing this emerging northern city, along with neighbouring Paull in the East Riding of Yorkshire, as the location for two offshore wind turbine manufacturing plants.

Despite fierce competition from a range of coastal locations across Europe, the game went in Hull's favour because of the UK's place as an offshore wind leader and its own location at the heart of the Humber estuary. The decision confirmed that the city really was the subject of a sea change – after it was named city of culture for 2017 just four months earlier.

Photo of ROLAND AURICH



For Siemens – a firm with a global market capitalisation of over €82 billion – the deal reaffirmed its offshore wind leadership. Hull, once a thriving fishing port, sits 25 miles inland from the North Sea. Some 1,000 direct jobs are expected to be created as part of the deal, which – it is hoped – will help create a renewable energy hub in the Humber region.

The early signs are certainly promising. Just two weeks after the deal was announced, the Hull Daily Mail reported that a *"major renewable company"* was in talks to move to a business park right next to the Siemens site in the city.

The long deliberation process may have made Hull sweat. But Roland Aurich, UK chief executive at Siemens until July, is certain that the decision is an informed one – being that it is carefully based on a range of economic and geographical factors. *"We really wanted to make sure that the industry has the certainty, because we would never make investments like this unless we saw a stable market trend going forward"*, he says.

"I would say that the UK has one of the more stable regimes when it comes to making sure we meet our decarbonisation targets and at the same time making sure that capacity is there to avoid the blackouts. It is almost an impossible equation, but I think the UK has come a long way to establish that framework. There is a bit of envy from other countries like Germany and others, which are probably watching pretty closely at what the UK has been doing."

The positive market conditions for offshore wind that Aurich speaks of have led to the UK being described as the *"most attractive"* country in the world for investing in the technology. As a windy island with over 11,000 miles of coastline, it is not difficult to see why this may be the case.



Photo of London Array by SIEMENS AG

David Cameron joined the energy secretary Ed Davey in July last year in cutting the ribbon on London Array – the world's largest offshore wind farm, which has capacity to power Hull's 100,000 or so homes four times over. Meanwhile, the government's long-term strategy, unveiled in August, hopes to boost the UK's position at the forefront of the industry.

It is a different story for onshore wind, which continues to divide opinion among voters and businesses alike on both value for money and aesthetics. The Conservative party is even reportedly including measures to curb development of onshore turbines in its manifesto for the 2015 general election. *"I think they need to be extremely careful in proposing things like that"*, says Aurich, who concedes that debate around onshore wind is a *"never ending story"*. He adds that wind conditions are more attractive and reliable offshore – added to the fact there are fewer dissenting locals about to stall the planning process.

Aurich himself is Siemens through and through, having first joined the firm in 1986. He has been chief executive of its operations in Canada and his native Sweden, before moving to head the UK business in 2012. After nearly three decades of service, he hands his role as UK chief executive over to Juergen Maier from July 1.

Aurich explains how innovation and technology have always been core to what the company does. But in the last decade, it has become increasingly cautious about the bigger picture – namely, its impact on society and the environment. It has reshuffled its portfolio, moving away from less sustainable industries and into smart grid, energy efficiency and making cities more sustainable.

The location for our interview, the Crystal, is a prime example of its future ambitions. Situated on Royal Victoria Dock in east London, it is an interactive showcase for what sustainability might look like in our cities. The building itself has meticulous architecture, with a natural cooling and self-shading design, insulation, solar panels and ground source heat pumps. Its roof harvests rainwater which is then treated and used throughout the buildings for taps, showers and in the kitchen.

"Urbanisation, demographic shifts, climate change – these are the megatrends that Siemens has been focusing on for years now."



Photo of Siemens Crystal Building by SIEMENS AG

Meanwhile, its immediate surroundings have been landscaped in a way that maximises conservation and green space. The result is one of the world's most sustainable buildings.

But does Siemens's vision for its own future – to be a sustainable technological leader – include the fossil fuels that we know do serious harm to the environment? Yes – but only ones that emit the least possible carbon, Aurich says.

He adds, *"We still need to acknowledge that at least 60% of the world's global power generation is based on fossil fuels. We won't be able to switch that off from one day to another, but what we can do is have a much higher efficiency in the power plants that are based on fossil fuels.*

"In the last 10 years, we have been focusing more on how to make sure that we add value to our customers, and how to make things more sustainable."

Some of his peers in the business world may think sustainability is a passing fad – a view that Aurich is determined to fight against. It's a myth, he explains, that there is a trade-off between going green and making a profit.

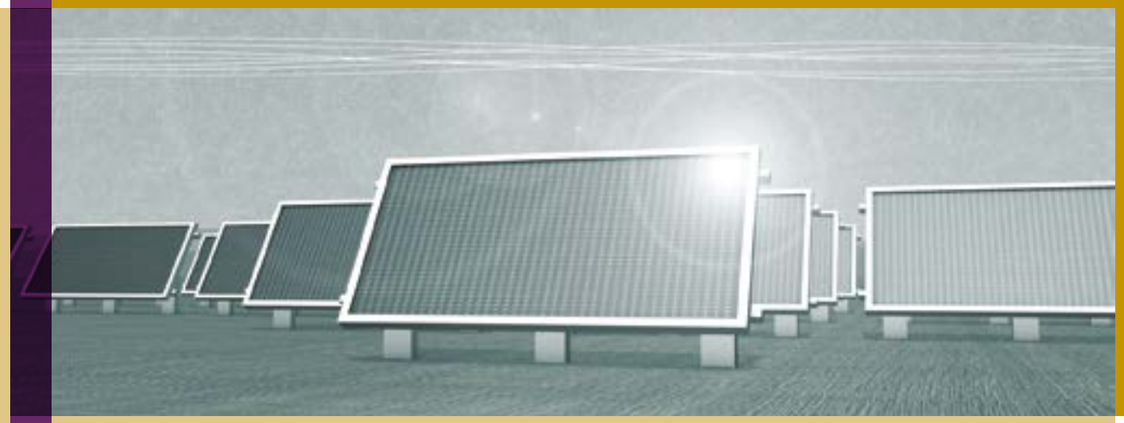
He points to the latest series of reports from the Intergovernmental Panel on Climate Change (IPCC), which expertly and alarmingly outlines what is in store for our climate in the coming decades – including impacts on food prices, national security and the environment – if we don't act soon.

"Urbanisation, demographic shifts, climate change – these are the megatrends that Siemens has been focusing on for years now. For us, it's just evidence again that we are going in the right direction."

Roland Aurich is chief executive of Siemens UK. He is retiring on June 30 and will be replaced by Juergen Maier.
www.energy.siemens.com

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"In the developed world, insulate your home. In the developing world, replace your kerosene lantern with a solar lantern."

WE WANT THE WORLD TO BE AS BLUE AND GREEN TOMORROW AS IT WAS YESTERDAY. WHAT'S YOUR MISSION?
To make as big a difference as I can in combatting climate change. That breaks into three sub-missions across the organisations I chair. First, with Solarcentury, to create the most respected solar solutions company in the world. Then with SolarAid, to rid Africa of kerosene lanterns by 2020. And third, with Carbon Tracker, to align the capital markets with climate policymaking.

WHEN YOU WERE A CHILD, WHAT DID YOU WANT TO BE WHEN YOU GREW UP?
Er, I rather regret to say, a professional golfer.

HOW WOULD YOUR FRIENDS DESCRIBE YOU?
Driven, fun on occasion.

WHAT WAS YOUR 'ROAD TO DAMASCUS MOMENT' IN TERMS OF SUSTAINABILITY?
A talk on climate change, long before it was ashionable to worry about it. It was at a Pugwash conference during the Cold War, in a room full of retired and active Soviet and American nuclear weapons scientists.

WHO OR WHAT INSPIRES YOU?
The brave.

Photo of JEREMY LEGGETT



WHAT REALLY GRINDS YOUR GEARS?
Politicians who think they can frack their way to cheap gas in the UK. Or even any gas, worth speaking of.

DESCRIBE YOUR PERFECT DAY.
Sun in the garden, the prospect of a day working from my office at home, lunch and dinner with the wife, a long run with the dog, fine wine at six.

WHAT DO YOU SEE WHEN YOU LOOK OUT YOUR WINDOW AT HOME?
A pond, a bank of huge oak trees around it, fields beyond and a ridge of Wealden sandstone on the skyline. On occasion, a kingfisher surveying the pond from a tree 20ft away from me.

WHAT DO YOU LIKE SPENDING YOUR MONEY ON?
Good food and wine, in various Kentish pubs, as host to friends and family.

WHAT'S YOUR FAVOURITE HOLIDAY DESTINATION?
Kent.

WHAT'S YOUR FAVOURITE BOOK?
The Road.



"Routine recognition in the capital markets that carbon fuel 'assets' are at risk of stranding."

WHAT'S YOUR FAVOURITE FILM?
Avatar.

YOU'RE MADE PRIME MINISTER. WHAT'S THE FIRST THING YOU DO?
Employ a Carbon Army to retrofit the nation with energy efficiency and microgeneration, starting with the government estate. So saving the national combined account a tonne of money. Oh, and becoming the greenest government ever.

WHAT WAS THE BEST PIECE OF ADVICE YOU HAVE EVER BEEN GIVEN? AND THE WORST?
The best piece of advice: raise capital when you can, not when you need to. The worst: looks to me like you need a nightcap.

IF YOU WERE STUCK ON A DESERT ISLAND, WHICH FAMOUS PERSON WOULD YOU LIKE TO BE STUCK WITH AND WHY?
Haddy N'jie, for her singing.

WHAT WOULD YOU LIKE TO BE DOING FIVE YEARS FROM NOW?
Writing.

WHAT'S YOUR BIGGEST REGRET?
You really want me to commit that irrevocably to the entire online universe?

ONE THING WOULD YOU ENCOURAGE READERS TO DO TO MAKE THEIR LIFE MORE SUSTAINABLE.
In the developed world, insulate your home. In the developing world, replace your kerosene lantern with a solar lantern.

WHAT'S THE ONE IDEA THAT YOU THINK COULD CHANGE THE WORLD FOR THE BETTER?
Routine recognition in the capital markets that carbon fuel 'assets' are at risk of stranding.

WHAT'S YOUR FAVOURITE QUOTE?
It's more fun to be a pirate than to join the navy.

Photo by RICKETYUS via Flickr

FINANCING THE FUTURE OF RENEWABLE ENERGY



By ALEX BLACKBURNE

Top Photo by MARTIN VMORRIS via Flickr

Right Photo of NINA SKORUPSKA

Being the voice of over 1,000 different companies is no easy task – as Nina Skorupska, chief executive of the Renewable Energy Association (REA) has learnt during her first year in the job. She tells Blue & Green Tomorrow why she is optimistic about the future of clean energy.

YOU'VE BEEN IN THE JOB AT THE REA FOR ALMOST A YEAR. HAS IT BEEN HOW YOU EXPECTED?

My expectations about the importance and enormity of this job have been well met! One thing that has been a new adjustment is being responsible for so many different businesses at once. It's a very different kind of responsibility to the kind I lived with in the private sector. We're trying to help a whole industry be profitable and sustainable, not just one company. I have a responsibility to each and every REA member. That means a lot of listening and a very open mind, whilst also being firm and practical to deliver results.



"The low-carbon transition will not be easy, but it is important for the long-term success of our industry"

WHAT HAS SURPRISED YOU MOST ABOUT THE JOB?

The polarisation of the renewables debate. It seems that battle lines were drawn long before I arrived on the UK scene and positions are now well entrenched. Some politicians and stakeholders will always have time for the REA, while others have slammed the door in our face. That surprised me. But I'm tenacious, and I will open those doors!

YOU TOLD BLUE & GREEN TOMORROW LAST NOVEMBER THAT THE REA HAS GOT TO BE ABLE TO SAY THINGS IN A VOICE THAT APPEALS TO ALL ITS MEMBERS. HOW DIFFICULT HAS THIS PROVEN TO BE?

It has been challenging. We came up with a good plan though and we stuck with it. We changed the way the REA board is structured. The previous board was trying to do lots of things at once, and while the people in the room were brilliant, the structure did not enable us to move forward efficiently. Now we have two boards with tightly defined responsibilities: a policy board, which gives direct representation to every sector we represent and shapes the REA's lobbying positions and priorities, and a governance board, which is smaller, enabling more efficient decision making on matters such as the REA's membership, budget, finances and so on. I must pay testament to all our directors past and present, who have really helped make this transition a success.

YOU SAID YOUR 90-DAY VISION WHEN YOU STARTED WAS TO DO LOTS OF LISTENING. PRESUMABLY YOU HAVE DONE THAT, SO WHAT WERE THE MAIN NOISES YOU HEARD?

Access to finance came up again and again. At one end of the scale, we have early stage technologies like marine, geothermal, and gasification and pyrolysis. The stage between concept and commercialisation is often called the 'valley of death' as investment risk is seen as being very high. At the other end of the spectrum, mature technologies like biomass, solar and wind are being unsettled by the 'shifting sands' of government policy. This is why we've set up the Finance Forum, to cut through all the noise and put renewable energy developers and the finance community directly in touch with each other. The plan is that these new relationships and the exchange of information will lead to more and more successful investments in renewable energy at all scales and across all technologies.

TELL US ABOUT SOME OF THE MAJOR DEVELOPMENTS THAT HAVE TAKEN PLACE IN RENEWABLES SINCE YOU TOOK OVER?

It's very encouraging that the policy fog for renewable transport at EU level is beginning to clear. Now the focus shifts back to the UK government, which could unlock substantial investment in current and advanced renewable fuels by mapping its green transport policies out to 2020.

The launch of the domestic renewable heat incentive (RHI) and the expansion of the commercial RHI are also very welcome. The policy framework is more or less sorted for green heat now, so the next step is to raise awareness about the opportunities that are out there for homes and businesses across the full range of technologies.

We've also seen steady progress on electricity market reform (EMR), but there is still work to do to ensure it supports all different scales and applications of large scale renewable power, and especially independent generators. Finally, the community energy strategy will fundamentally reshape the way communities engage with renewables, especially the commitment to increasing the shared ownership of new projects, which is shared by government, industry and community groups alike. The transition will not be easy, but it is important for the long-term success of our industry.

WHAT STATE WOULD YOU SAY THE RENEWABLE ENERGY INDUSTRY IS IN COMPARED TO THIS TIME LAST YEAR?

We've grown! The latest data shows that almost a fifth of UK electricity was renewable over the last quarter.



"Investors are the lifeblood of the renewable energy economy."

Photo by PATRICK MOORE via freeimages.com

That's some achievement. Things are improving for heat and transport too, but not as fast as required to meet government's targets. However, individual successes must be contrasted with the scale of the overall challenge. The need to rebuild consensus for renewable energy and energy efficiency as solutions to energy security and climate change is stronger than ever in a world where politicians are now so fixated on nuclear power and shale gas. We must bust the myth that 'technology neutral' policy delivers technology neutral results.

THE REA RECENTLY UNVEILED THE LAUNCH OF ITS FINANCE FORUM, WHICH AIMS TO CONNECT THE FINANCE WORLD WITH THE THRIVING RENEWABLES INDUSTRY. HOW IMPORTANT ARE INVESTORS IN THE LOW-CARBON TRANSITION?

Investors are the lifeblood of the renewable energy economy. No investment means no new business. I'm really excited to see what lessons the finance community and the renewables community can take from each other. As Greg Barker said at our Awards Gala Dinner in June, *"No-one does financial innovation better than us. The City of London leads the world in low-carbon finance. Our industry must innovate with finance as well as technology."*

WHERE NEXT FOR THE REA AND UK RENEWABLE ENERGY?

The general election is our next major focus. With our policy board in place we plan to deliver a coherent manifesto, with each sector singing its own piece in harmony with the overall tune: which is that clear, stable policy will deliver investment, jobs and cost reductions in renewable energy, so it can make an increasing, and increasingly cost effective contribution to reducing the energy security and climate change risks of an energy system dependent on fossil fuels.

Nina Skorupska is chief executive of the Renewable Energy Association (REA).
www.r-e-a.net

" The need to rebuild consensus for renewable energy and energy efficiency as solutions to energy security and climate change is stronger than ever"

Photo by JAN FLASKA via freeimages.com

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Journalism is changing rapidly through a digital and social media revolution. It is no longer the preserve of press barons and elite groups; journalism is now democratic and everyone has a voice.

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So, if you blog, tweet or write about sustainability we want to hear from you. You don't need to be an experienced or aspiring writer or worry about article length, spelling or grammar—we'll tidy that up for you.

We can't publish everything, but if it's likely to resonate with our readers or challenge them in some way, you'll fly to the top of our list.

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blue&green tomorrow



SWITCHING ENERGY SUPPLIERS IS GETTING EASIER

By CHARLOTTE MALONE

"Select a supplier that has a reputation for good customer service or matches their ethical values.."

New rules from the energy regulator mean it's now even faster and simpler to get the most sustainable deal – both for the planet and your back pocket.

Energy regulator Ofgem recently implemented plans to make switching energy suppliers faster and simpler for consumers, dispelling the myth that switching is difficult and opening the door for households to find a supplier that suits their needs.

By the end of this year, people will be able to switch suppliers in just three days, following a two-week cooling off period, with the aim of reducing this to just one day by the end of 2018. Switching currently take around five weeks, including a two-week cooling off period, so the new rules significantly reduces the timescale. The regulator explained the plans aim to improve the reliability of the switching process and *"improve consumer confidence to shop around for a better energy deal"*.

Survey results from Ofgem, published earlier this year, found that whilst energy bills were a concern for many British households, 43% of Brits admit they don't prioritise 'energy shopping' to find the best deal. Switching suppliers can allow consumers to save money on their bills, select a supplier that has a reputation for good customer service or matches their ethical values.

In addition to speeding up the switching process, new rules come into force in August and will mean suppliers could face investigation and fines if they cannot meet the timescales set out. Ofgem said, *"These changes represent a significant modernisation of infrastructure, which will help consumers take full advantage of the benefits of smart meters, and pave the way for reliable, fast and easy switching for all."*

Even with faster switching times, some consumers may be daunted at the prospect of changing supplier. Survey results revealed that over half of the public have been confused by energy tariffs. Ofgem's Be An Energy Shopper campaign includes an independent advice site – www.goenergyshopping.co.uk – that offers consumers guidance on how to compare energy tariffs and links to approved price

Photo by GAVIN FORDHAM via freeimages.com



"The energy industry certainly lags behind other sectors in terms of the ease of customer switching."
– Dale Vince, Ecotricity

Photo by JON DOC via freeimages.com

comparison websites. Trade association Energy UK added, *"Switching is already simple: just pop in your postcode; pop in how much gas and electricity you use – which is on every bill; and Bob's your uncle. It's as simple as that."*

The reforms follow the 'big six' suppliers hiking prices last year and facing criticism over the profits they made. Whilst some claimed the increases were due to rises in wholesale energy costs and environmental regulation, the figures from Ofgem suggests that, on average, the suppliers saw their profits increase by 77% in 2013.

Since the hikes, wholesale energy costs have decreased significantly. During June, gas prices were around 38% lower than they were in the same month in 2012, whilst electricity prices have fallen 23%. This has led to the regulator calling on the big six – Npower, British Gas, E.ON, EDF Energy, SSE and Scottish Power – to justify their prices to customers and inform them how falling wholesale costs will impact on their household bills.

By reducing switching times, it also hoped that smaller suppliers will see their customer bases rise, boosting competition across the industry. Many smaller companies, such as renewable energy specialists Ecotricity and Good Energy, rank highly in customer satisfaction surveys but are overlooked by customers who are more familiar with the big six.

Competition in the industry has come under fire in recent months. New measures bought in earlier this year aimed to address that and create a fairer and more transparent market that would benefit independent suppliers. The measures, coupled with faster switching times, could provide some welcome diversity to the industry, whilst better meeting the needs of the consumer. Ofgem's CEO Dermot Nolan pointed out the consumers can now change a variety of services quickly, from banks to mobile phones, and that the energy industry's plans bring the energy industry in line with this.

Ecotricity founder Dale Vince commented, *"The energy industry certainly lags behind other sectors in terms of the ease of customer switching. Ecotricity make it easier than most, not least through a five minute online switch journey, and quick access to people on the phone in the UK, with no automated options. However, if there can be industry wide solutions for a quicker all-round switch journey, they would only be good for consumers – and would bring the energy industry further into the 21st century."*

Meanwhile Juliet Davenport, CEO and founder of Good Energy, also noted that the changes should make it easier for consumer to engage with energy suppliers and represent *"another step in the right direction"*.

Switch to 100% renewable energy provider Good Energy and quote "Blue & Green Tomorrow". We get £50 for every person that switches – which helps us fund our intern and researcher programme.

www.goodenergy.co.uk/affiliates/blue-green

"Many smaller companies, such as renewable energy specialists Ecotricity and Good Energy, rank highly in customer satisfaction surveys"

Photo by ANDREAS DAHL via freeimages.com

A DAY AT A SOLAR FARM

By RICHARD HEASMAN

Hidden away in the flat Lincolnshire countryside, there is a solar farm near the village of Stow. Richard Heasman trekked down a long and winding road on an overcast afternoon in June to pay it a visit.

Established seven years ago and providing 1.1 megawatts (MW) of clean electricity to the local grid network, Freewatt is fast becoming one of the UK's leading solar power developers. Its facility in Stow, Lincolnshire, is spread over land owned by Julian Patrick – the firm's founder – encompassing three smallholder fields and a converted residential property and office. The development will be entirely carbon-free when a biomass boiler is installed later this year.

The impressive array of solar panels at the site, located in two fields, sit silently as they convert UV rays into usable electricity – irrespective of the grim weather conditions and lack of noticeable sunlight. A solar panel, Patrick explains, is made up of *"wafer thin silicon crystal squares, cut from a brick. The little silver buzz bars are put on with a screen print process, which collect the really small voltages and connected end on end – like a battery, increasing the voltage. Then, on the back end, you have two cables, a plus and a minus – essentially like a big battery."*

The panels themselves are surprisingly hollow and incredibly thin. Positioned in rows and following the land back like a metallic wave, they are discrete, only coming up to shoulder height and sitting well below the surrounding hedges. Their low height means the only blots on the landscape are the two power stations in the distance – which serve as a fitting juxtaposition to the futuristic solar panels.

Though discrete, there are still some who object to solar parks on aesthetic grounds. An article in the Daily Mail last year about a 30-acre Hampshire development raged how the site "blighted" the local countryside, *"creating a massive eyesore in the centre of an otherwise picturesque view"*. The article came complete with a range of aerial photographs. Not all agreed with this view, though, with one reader commenting, *"I live less than a mile from this site and didn't even know it was there until I read this."*

Patrick goes on to say that the solar current is then converted by the installation's transformer, before being sent to the national grid. The only noise that can be heard throughout this whole process is the flapping of Bill and Percy in the wind – Freewatt's resident plastic bird-scarers. While comical, Bill and Percy play an important role. Patrick says Freewatt has an ongoing problem with pigeons and their faeces – which can impact on the total output of the panels as the precious UV receptive squares are physically covered by the falling sunblock. A similar, though less fecal, natural problem is impacting the productivity of panels in the Middle East – where solar farms get covered in a layer of dust from the frequent sandstorms and can lose output by as much as 40% as a result.

Patrick is keen that the Freewatt site benefits the surrounding environment – if only for its own long-term sustainability. Aside from the physical placement of the solar panels, which are raised off the ground so as not to disturb the local ecology, the impact on the environment is very minimal. The grass that the panels sit on is maintained by the farm's resident flock of sheep – which keep it noticeably tidy.

Meanwhile, the utilisation of smallholder pieces of land for solar developments is a big selling point for the industry. The land that cannot be used for farming or development, Patrick explains, *"located in a multitude of settings, like the unused portion of farm land the owner cannot grow anything on, can be, for the same price as a combine harvester, converted into a solar farm that will generate revenue while maintaining its environment"*.

While talking to Patrick, a strong sense of excitement around the emerging market clearly comes across – especially as we dissected where the industry is expected to go. *"The industry has been a victim of its own success. The governmental incentive [known as the feed-in tariff], although was very nice, was originally placed too high. Now prices have dropped, people suddenly thought it was wasn't worth investing in anymore"*, he says.

"A big issue also came from the negative publicity in the press – people have this attitude that sustainable technology is costing us excessive amounts of money.

Photo by KATE AUSBURN via Flickr





"The solar industry has been a victim of its own success."
– Julian Patrick, Freewatt

But if you look at the finances, renewable incentives make up a tiny amount, less than 2% - a greater proportion of that is profitability of the company."

Financial incentives in the domestic market, from installations on people's homes, are an exciting prospect. Patrick adds, *"Even the government intends to hit huge renewable energy targets by 2050."*

But the biggest need of change is the attitude people take towards renewables, something Freewatt is also engaged in progressing. While working on solar developments for schools and community-based projects, the firm also undertakes sessions to educate people in sustainable energy and technology.

It is clear that the conversation needs to change around renewable energy. Showcasing the many benefits – for the environment, the economy and people – rather than the much-talked-about aesthetic issues is crucial.
The long and winding Lincolnshire road that leads to the Freewatt solar park in Stow could quite easily be a metaphor for the journey the renewables industry still has ahead of it. But the solutions are far closer to home than they might seem.

www.freewatt.co.uk

freewatt
renewable energy

Photos kindly provided by Freewatt Ltd.

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20 QUESTIONS WITH BRUCE DAVIS

"Invest in renewable energy and start the process of opening your eyes to reality."

WE WANT THE WORLD TO BE AS BLUE AND GREEN TOMORROW AS IT WAS YESTERDAY. WHAT'S YOUR MISSION?
To create investments that pay a good return now, without borrowing from all our futures.

WHEN YOU WERE A CHILD, WHAT DID YOU WANT TO BE WHEN YOU GREW UP?
Weirdly, a civil servant or a politician. Too much Yes, Minister at a young age.

HOW WOULD YOUR FRIENDS DESCRIBE YOU?
A non-self identifying leftie.



Photo of BRUCE DAVIS

WHAT WAS YOUR 'ROAD TO DAMASCUS MOMENT' IN TERMS OF SUSTAINABILITY?
Coffee with my co-founder Karl in the British Library.

WHO OR WHAT INSPIRES YOU?
Richard Duvall, founder of Egg and Zopa. Zygmunt Bauman, the globally reknowned sociologist you haven't heard of.

WHAT REALLY GRINDS YOUR GEARS?
Vested interests and lazy capitalism dressed up as enterprise.

DESCRIBE YOUR PERFECT DAY.
A PR frenzy – I like a good crisis.

WHAT DO YOU SEE WHEN YOU LOOK OUT YOUR WINDOW AT HOME?
The weather – I try to cycle the 9 miles to work every day and need to dress accordingly.

WHAT DO YOU LIKE SPENDING YOUR MONEY ON?
See above – bikes and Rapha kit.

WHAT'S YOUR FAVOURITE HOLIDAY DESTINATION?
I run a start-up, therefore don't understand the question being asked.

WHAT'S YOUR FAVOURITE BOOK?
Anything by Spike Milligan.

DESCRIBE YOUR PERFECT DAY.
A PR frenzy – I like a good crisis.

WHAT'S YOUR FAVOURITE FILM?
300. I studied ancient Greek and they made it sexy.

YOU'RE MADE PRIME MINISTER. WHAT'S THE FIRST THING YOU DO?
Break up the energy companies, then the big banks.

IF YOU WERE STUCK ON A DESERT ISLAND, WHICH FAMOUS PERSON WOULD YOU LIKE TO BE STUCK WITH AND WHY?
Alive, Kristin Scott Thomas. Dead, Richard Feynman.

WHAT WAS THE BEST PIECE OF ADVICE YOU HAVE EVER BEEN GIVEN? AND THE WORST?
The best: take the red pill. The worst: take the red pill.

WHAT WOULD YOU LIKE TO BE DOING FIVE YEARS FROM NOW?
Writing more, talking less.

WHAT'S YOUR BIGGEST REGRET?
I don't believe in them.

ONE THING WOULD YOU ENCOURAGE READERS TO DO TO MAKE THEIR LIFE MORE SUSTAINABLE.
Invest in renewable energy and start the process of opening your eyes to reality.

WHAT'S THE ONE IDEA THAT YOU THINK COULD CHANGE THE WORLD FOR THE BETTER?
We make the markets we deserve.

WHAT'S YOUR FAVOURITE QUOTE?
"If you want to learn how the lion hunts, go to the jungle not to the zoo" – the CEO of Procter & Gamble describing the value of ethnographic research, which was a lot of the inspiration for Zopa and Abundance.

Bruce Davis is the founder and retail director of Abundance Generation, a fellow at the Finance Lab and a research fellow at the Bauman Institute. www.abundancegeneration.com

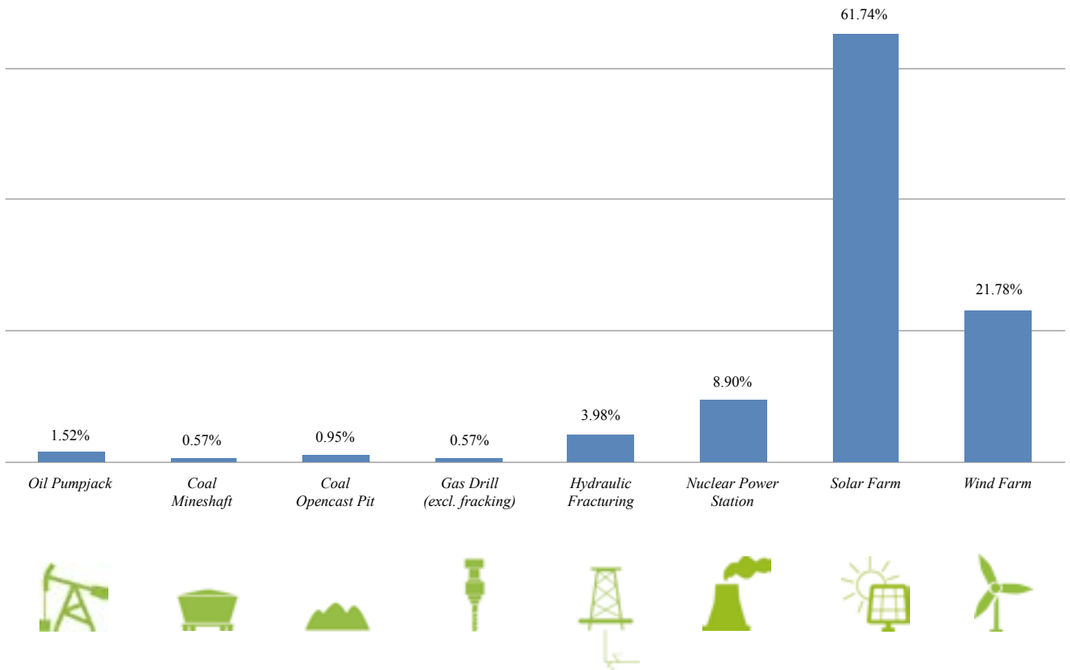
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MIKE LEWINSKI
via Flickr

BLUE & GREEN TOMORROW READERS' POLL

WHICH ONE OF THESE SOURCES OF ENERGY WOULD YOU BE HAPPIEST TO HAVE NEXT TO YOUR HOME?

Throughout June, we ran a poll on blueandgreentomorrow.com asking readers to tell us which energy source they would be most happy to have next to their home. This what they said.

Monthly readership of 84,000



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QUILTER CHEVIOT

INVESTMENT MANAGEMENT

QUILTER CHEVIOT WELCOMES ETHICAL INVESTORS

We are one of the UK's largest independently owned private client investment management firms with a heritage dating back to 1771. In recent years, we have seen an increasing number of clients becoming more interested in sustainable investment, wanting to invest their wealth in companies delivering a cleaner and more efficient economy – the 'New Economy'.

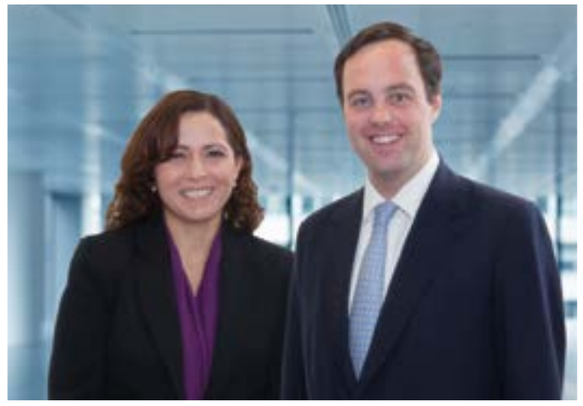
Providing a sustainable investment strategy that does not compromise performance is a priority for Quilter Cheviot. Claudia Quiroz and William Buckhurst are responsible for the delivery of this proposition. Our clients benefit from the wealth of experience the team has in managing sustainable investments.

Our global multi-asset Climate Assets Fund invests in established leaders and emerging winners that stand to benefit from the convergence of climate change, population growth and resource scarcity. The Fund seeks to invest in companies providing the products and technologies to deliver the 'New Economy'. Climate Assets is designed to meet the needs of many individual investors, through diversification across asset classes and seeking to provide a balance between income and growth which combine to smooth market volatility.

OUR INVESTMENT PROCESS

Quilter Cheviot's investment process combines strong disciplines with bespoke, flexible asset allocation and stock selection. Our approach is a combination of 'bottom-up' and 'top-down' analysis. We are not constrained by one particular investment style (such as growth, value etc.) and believe the best returns come from a flexible approach during different economic cycles.

We aim to reflect our views on asset class and geographical allocation through the portfolio and support these with conviction ideas within our five investment themes: Low Carbon Energy, Food, Health, Resource Management and Water. To select our holdings we use a combination of quantitative analysis, in-house fundamental research, brokers' research notes and management meetings.



"We are very proud of the Climate Assets Fund. I joined Quilter Cheviot 5 years ago particularly to develop this investment strategy. Today, we have a dedicated team with 4-years' performance track record and an established investment process. The Fund has returned +40.50%*, since launch in March 2010, compared to the VMA Stock Market Balanced Index rising +38.98%."

CLAUDIA QUIROZ
INVESTMENT DIRECTOR

"Too many ethical funds have been overly volatile and not delivered on performance. At Quilter Cheviot, we are passionate about delivering a sustainable investment solution that is both multi-asset and offers an attractive dividend yield. The Climate Assets Fund benefits from the considerable depth of analytical resource that Quilter Cheviot can draw on."

WILLIAM BUCKHURST
INVESTMENT DIRECTOR

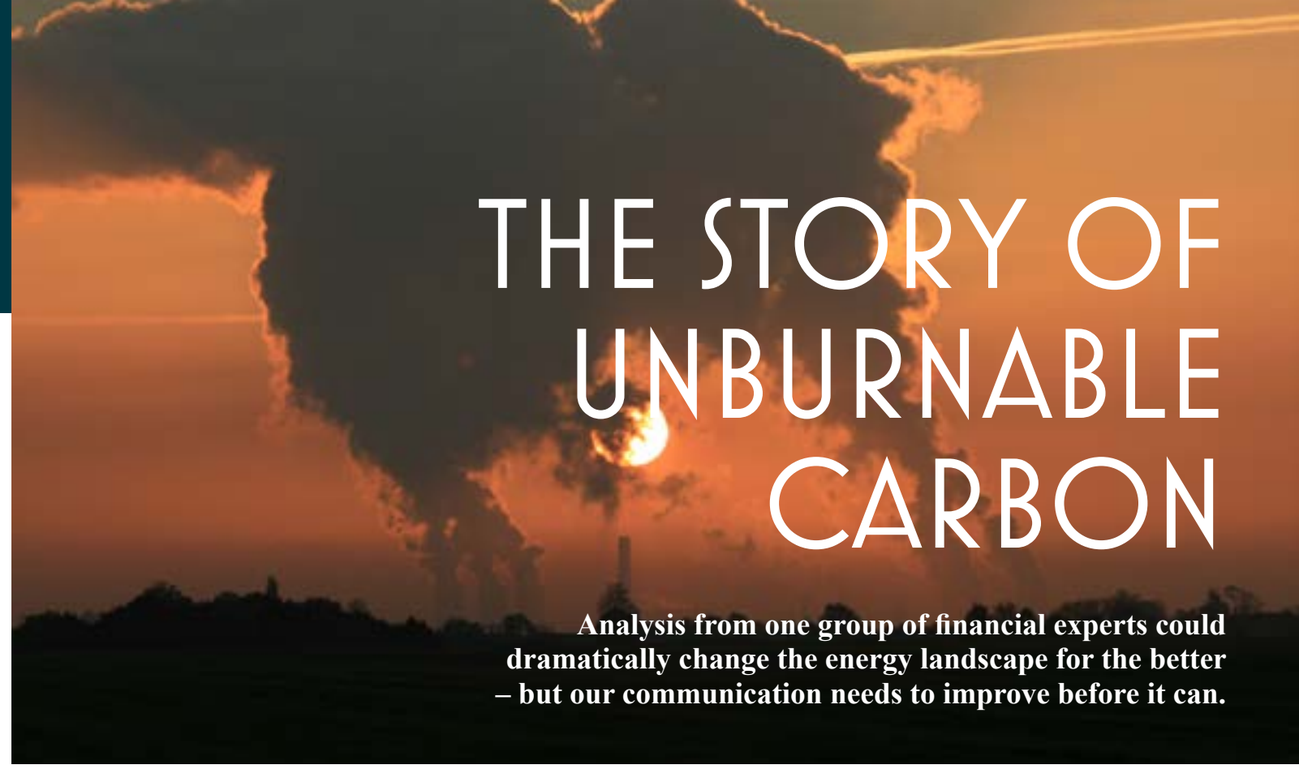
*Source: Financial Express, performance to 28 February 2014. A Accumulation share class performance, inclusive of charges, in GBP with net income reinvested. Past performance is not a guarantee of future results.

INVESTING IN THE NEW ECONOMY CLIMATE ASSETS FUND

Contact Claudia Quiroz on +44 (0)20 7150 4749
or William Buckhurst on +44 (0)20 7150 4160 or visit quiltercheviot.com

The value of investments, and the income from them, can go down as well as up.
You may not recover what you invest. Past performance is no guarantee of future returns.

There are risks involved with this type of investment. It is always recommended that potential investors seek independent advice before placing an investment. Please refer to the Prospectus, Key Investor Information and Supplementary Information documents for further details, available free of charge from the Authorised Company Director Thesis Unit Trust Management Ltd, Exchange Building, St Johns Street, Chichester, West Sussex, PO19 1UP. These documents are only available in English. The Climate Assets Fund is a sub-fund of the Sun Portfolio Fund which is an open ended investment company authorised and regulated by the Financial Conduct Authority. Quilter Cheviot Limited is registered in England with number 01923571, registered office at One Kingsway, London WC2B 6AN. Quilter Cheviot Limited is a member of the London Stock Exchange and authorised and regulated by the UK Financial Conduct Authority.



THE STORY OF UNBURNABLE CARBON

Analysis from one group of financial experts could dramatically change the energy landscape for the better – but our communication needs to improve before it can.

By ALEX BLACKBURNE

Top Photo by BUGDOG via freeimages.com

Left Photo of ANTHONY HOBLEY

On August 28, 1963, Martin Luther King Jr stood on the steps of Washington's Lincoln Memorial and told 250,000 people about his dream of a more equal society. His speech is considered one of the most powerful in human history and his visions of black children joining hands with white children in unity inspired an entire generation.



A key factor in its influence was that people knew first-hand about the alternative. King was telling them his dream; but they already knew the nightmare – the segregation, the oppression. When it comes to climate change – the 21st century's defining challenge – this couldn't be further from the truth.

This is something Anthony Hobley knows all too well. Chief executive of the London-based thinktank the Carbon Tracker Initiative since February, he and his colleagues work to translate the complex climate science into something tangible and understandable for the financial world. Their ground-breaking 2011 report, Unburnable Carbon, estimated that as much as 80% of known fossil fuel reserves cannot be burned if we want to tackle climate change. Suddenly, they had investors' attention.

"If you just tell people there is a massive, complex problem, the psychology is to switch off to protect yourself from the stress", Hobley says, sitting in a London café at the foot of the Shard.

"We've done the climate nightmare and that doesn't work. We've done the green dream and that doesn't work. We need some great leaders, great communicators, who find a powerful way to combine the two in language that people understand."

Bill McKibben, the environmentalist and author, communicated Carbon Tracker's concept to the



Photo by SETH ANDERSON via Flickr

"If you just tell people there is a massive, complex problem, the psychology is to switch off to protect yourself from the stress."
– Anthony Hobley, Carbon Tracker

Bill McKibben, the environmentalist and author, communicated Carbon Tracker's concept to the masses in his 2012 Rolling Stone article – Global Warming's Terrifying New Math – that really gave rise to the divestment movement. Since then, universities, pension funds and other major investors have pledged to take their money out of oil, gas and coal – most of them with Carbon Tracker's analysis as their motivation to do so.

For Hobley, while this is clearly useful in furthering the conversation, divestment is not the sole answer. *"You cannot practically divest from energy overnight. We're more about a mainstream discussion, which is about managing the climate risk and allowing for a managed deflation of the carbon bubble."*

Hobley himself spent 25 years as an environmental lawyer. The skills he had picked up in this time were described as the *"perfect amplifier"* to Carbon Tracker's existing talent pool when he was unveiled as chief executive last December. He has come a long way and jumped many hurdles in his career.

He couldn't read or write until he was nine. But he is proudly dyslexic. Like the Bransons, Da Vincis and Einsteins of this world before him, Hobley sees the condition as a gift. His dyslexia thrust him down a very academic route, including postgraduate chemistry research at Cambridge. Despite holding a first-class honours degree he realised his future was in another "more meaningful" field.

He became interested in law and started going to some of the early lectures on modelling climate change. Putting the two together – a *"powerful combination"*, he says – he embarked on a new career in environmental law.

Much of his work for the next few years focused on issues like mergers and acquisitions liability, waste and contaminated land, but his passion was always with climate change. He spent the following two decades working at a range of leading law firms – Nabarro, CMS Cameron McKenna and Baker & McKenzie – and with his mentor James Cameron at Climate Change Capital.

In 2007, he moved to Norton Rose Fulbright – based in London and then Sydney – with a mandate to build a global climate change practice, and in 2009 worked with the Lithuanian government at the now infamous Copenhagen climate change negotiations, when world leaders tried, and failed, to agree on a global deal on cutting back greenhouse gas emissions. Hobley says, *"Like many people, I went into extreme 'counselling' and soul searching after Copenhagen. We all went in with such optimism and such hope – and that was obviously so cruelly dashed against the rocks that it took a bit of time to recover."*

He started at Carbon Tracker in February. Of his decision to move away from law, he says, *"I realised that this was one of those critical times. If you really understand what's at stake with climate change and the fact that we have fortuitously been given a second bite of the cherry with [the Paris climate negotiations, the follow-up to Copenhagen] in 2015, you kind of felt you want to be somewhere to make a difference."*

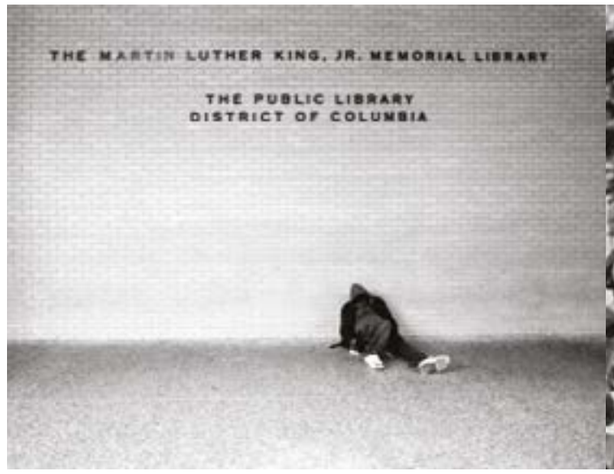
He maintains that the climate change movement's *"biggest failure"* is its communication of the science. It hasn't made it understandable in everyday language or relevant now for most people, he argues.

"Most people's brains are wired to deal with life as it is now over the next 12 months or at most two years, whereas I think many of us in the climate movement have a longer horizon, we're weird to most people. In evolutionary terms, we're the human canaries I guess.

"What I saw that was so exciting about Carbon Tracker is they had found a way to make this relevant to their community – the financial community – in their language. They had used basic financial analysis in a way that I hadn't really seen done in the climate movement before."

The way investors react to Carbon Tracker's analysis will likely shape how the threat that is climate change

"You cannot practically divest from energy overnight"
– Anthony Hobley, Carbon Tracker





Left Photo by ALEX BARTH via Flickr

Right Photo by MINNESOTA HISTORICAL SOCIETY via Flickr

plays out. Many are divesting; many others are actively engaging with fossil fuel firms to get them to consider these climate risks – but most, so far, are not.

As for Paris next year and what the world's response to climate change will look like after that, Hobley says there are only three scenarios. The first is the goldilocks scenario, whereby strong policy allows for an orderly low-carbon transition at relatively low-cost. There would be few 'stranded assets' – stocks that are essentially worthless – in this scenario, like Carbon Tracker is currently forecasting, because investors would see the risks in advance and act upon them.

The second outcome is the nightmare – a world 3-6C warmer, and rising, which Hobley says is *"catastrophic, existential, game over"*. He adds, *"If we allow that to happen, this will be the most hated generation that ever lived."*

The third scenario – which is most likely in Hobley's eyes – sees the world leaving climate action until the last possible moment and then throwing everything at it as we did in the financial crisis. Whether this will be spawned by some severe weather event, disruptive technological change or a financial shock, he is unsure, but this scenario will be massively more expensive than the first. This is where stranded assets and systemic risk raise their ugly heads.

Carbon Tracker's analysis helps connect these three scenarios with the people with the most power to do something about it – the investors. But it cannot stop there. We need similar translations into industries like retail, tourism, advertising, education, engineering and medicine. We need films about climate change – and not just disaster movies – and we need people to write fiction and songs about it.

Martin Luther King's place in history is assured because he made the issue of civil rights relevant to everyone. And crucial to our future is making climate change relevant to everyone. Creating a new dream is in everyone's best interest.

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WHEB

THE MASTERING OF THE TIDE

By TOM REVELL

Utterly predictable and with huge potential, could tidal lagoons provide the impetus that UK marine renewables need to thrive?



"We know that the tides are going to happen. You don't need the sun to shine or the wind to blow."
– Eva Bishop, Tidal Lagoon Swansea Bay

Photos kindly provided by TIDAL LAGOON (SWANSEA BAY) PLC.

Photo of EVA BISHOP

At Swansea Bay, there are sandy beaches, surfers and dog walkers. Sometimes, porpoises glide through the surf. Once, there were oysters. In a former life, the bay was the hub of a booming Victorian-era oyster fishing industry, but the molluscs were fished until there were no more.

But most of all, there is the tide. Swansea Bay has one of the highest tidal ranges in the world, with a maximum range of around 10 metres. It is why the bay, sitting on the upper reaches of the Bristol Channel, has been chosen as the site of an unprecedented renewable energy development.

The £850m Swansea Bay Tidal Lagoon, now in a phase of public examination, will be the world's first tidal lagoon power plant. These plants are quite simply a manmade enclosure of the sea. In Swansea's case, a six-mile horseshoe shaped sea wall will enclose 11.5 sq km of water, between the estuaries of the river Tawe and the river Neath.



One section of the wall will house submerged hydroturbines. As the tide comes in, the lagoon fills, and releases the water through the turbines, which turn and generate electricity. As the tide starts to ebb, the lagoon is emptied, again driving the turbines. The lagoon would predictably produce power in four periods each day, totaling 14 hours of generation in every 24.

Swansea Bay is expected to generate 495 gigawatt hours (GWh) of clean, green electricity for every year of its 120-year lifetime. That is enough for 155,000 homes – or about 11% of Wales' domestic use.

Tidal Lagoon Power Limited, the firm hoping to bring this pioneering technology into the world, hopes to follow Swansea Bay with five full-scale tidal power plants on Britain's coasts within the next decade.

The firm believes this new wave of renewables could meet 5-10% of the entire country's electricity demand at a relatively low cost. A recent report from Pöyry Management Consulting concluded that a series of three lagoons, including Swansea, would have a weighted average contract for difference strike price of £111 per megawatt hour (MWh). This compares to the £155 per MWh that are currently offered to offshore wind projects.

However, as development director Eva Bishop explains, the potential advantages don't end there. *"One of the fundamental advantages is that there is no guesswork. We know that the tides are going to happen. You don't need the sun to shine or the wind to blow"*, she says.

"Although it's not baseload, it is an entirely predictable, reliable supply – so the National Grid can take that into account."



"This new wave of renewables could meet 5-10% of Wales's entire energy demand at a relatively low cost."

The technology is reliable, too. Though the method is new, the component parts are all proven. *"The wall has been used in construction around the world, the hydroturbines have been in use for decades. As far as investors or the public are concerned, it is lower risk than some other technologies"*, Bishop adds.

Then there is the speed of construction. If all goes well in the examination stage, Tidal Lagoon Power hopes that the Swansea Bay plant will be operational by 2018. With five more penciled in within a decade, the speed of delivery for such a large-scale renewable project is remarkable. Most of the fleet could be completed before any new nuclear plant powers a single lightbulb.

But it is with Tidal Lagoon Power's plans for Swansea that, Bishop says, it gets exciting: *"The Swansea Bay lagoon will be much more than a power plant. We're going to provide a unique amenity to the people of Swansea Bay. For starters, they'll be able to walk, run and cycle around the seawall and participate in water sports in the lagoon. We'll be building a visitor centre and hosting international sporting and cultural events, attracting 100,000 tourists per year."*

It's been suggested the lagoon could provide a huge boost to the local economy in an area hit hard by the recession. An independent report from the Cardiff Business School estimates that the project will directly invest close to £300m of regional spending spread over its three-year development period, while creating the equivalent of around 1,850 full-time jobs.

An education programme is also already underway, engaging with students from primary school to university, hoping to build a passion for their seafront and inspire new renewable energy enthusiasts.

Of course there are concerns, as well there would be when a company wishes to build a six-mile wall in the sea. Though consultation work reveals that the project has over 85% of local support, some fear the environmental impact. Construction is subject to an extensive environmental assessment, and must accommodate the surfers and the porpoises.

The project has the blessing of numerous environmental groups, however, including Friends of the Earth Cymru and the RSPB. Bishop hopes that, through partnerships with various organisations, including Swansea University, the lagoon can make a positive contribution to the bay's ecology.

The oysters may even be returning, symbolically – the offshore visitor centre will take the form of a 3,500 sq metre shell – and perhaps literally. Almost a century after they disappeared, plans are afoot to reintroduce the missing moluscs.

"We hope that in time the wall will be used as an artificial reef structure. We hope to see colonisation of the marine wall structure, as a rocky habitat which could support various species", Bishop adds.

There is a way to go yet. There are assessments to pass, a minority of locals yet to convince, and the small matter of building the thing. But if Swansea Bay can achieve each of its ambitious aims and generate growth, jobs, biodiversity and local pride alongside limitless clean energy, its impact could be huge.

"I think tidal lagoons have an enormous role to play in transforming the public perception of what renewable energy can achieve", Bishop says.

"When you deliver renewable energy at scale, with reliability, low costs and a positive local impact and with the ability to supply up to 10% of the UK's electricity, you start to show that we do have the capacity to deliver on our low-carbon goals. We want to make renewable energy an accepted technology and an accepted option. I think that tidal lagoons certainly have the ability to do that."

Eva Bishop is development director at Tidal Lagoon Swansea Bay.
www.tidallagoonswanseabay.com

"If Swansea Bay can acheive each of its ambitious aims and generate growth, jobs, biodiversity and local pridealongside limitless clean energy, its impact could be huge."



SARAH BUTLER-SLOSS

Sarah Butler-Sloss, founder-director of Ashden, answers 20 questions on life, sustainability and everything.

WE WANT THE WORLD TO BE AS BLUE AND GREEN TOMORROW AS IT WAS YESTERDAY. WHAT'S YOUR MISSION?
To help bring sustainable energy to a billion more people across the globe by 2020.

WHEN YOU WERE A CHILD, WHAT DID YOU WANT TO BE WHEN YOU GREW UP?
An intrepid explorer of the natural world!

HOW WOULD YOUR FRIENDS DESCRIBE YOU?
Passionate and thoughtful.

WHAT WAS YOUR 'ROAD TO DAMASCUS MOMENT' IN TERMS OF SUSTAINABILITY?
In 2000, I was visiting homes and schools across Kenya and saw the appalling conditions that women were cooking in. The rooms they called kitchens were filled with smoke as they cooked on open fires. The smoke was choking the women, and they complained of terrible coughs and eye problems. A straightforward, fuel efficient smoke-free stove could change all this, saving lives and trees. I couldn't understand why they weren't everywhere!



Photo of SARAH BUTLER-SLOSS

WHO OR WHAT INSPIRES YOU?
David Attenborough, Jonathon Porritt, Amory Lovins and all of Ashden's inspirational winners – they are all amazing people doing amazing work to make the world a better place.

WHAT REALLY GRINDS YOUR GEARS?
Climate change deniers.

DESCRIBE YOUR PERFECT DAY.
Being in a beautiful place on a sunny day with my family and some close friends with good food, good wine and the sea very nearby.

WHAT DO YOU SEE WHEN YOU LOOK OUT YOUR WINDOW AT HOME?
A big beautiful ash tree and the back of some flats.

WHAT DO YOU LIKE SPENDING YOUR MONEY ON?
Holidays with my family in beautiful places, and clean energy.

WHAT'S YOUR FAVOURITE HOLIDAY DESTINATION?
The Greek Islands.

WHAT'S YOUR FAVOURITE BOOK?
I love beautiful landscape and books of photos so I'm going to choose The Earth from the Air by Yann Arthus Bertrand.

WHAT'S YOUR FAVOURITE FILM?
So difficult to choose – The World of Apu, Gandhi, Witness, Out of Africa, Breakfast at Tiffany's. It depends on my mood.

YOU'RE MADE PRIME MINISTER. WHAT'S THE FIRST THING YOU DO?
I'd make every home in the UK energy efficient with insulation and energy efficient boilers. It would eradicate fuel poverty, reduce people's energy bills and dramatically cut UK carbon emissions, as well as creating lots of jobs.



"Insulate your home as much as possible and enjoy walking and cycling."

IF YOU WERE STUCK ON A DESERT ISLAND, WHICH FAMOUS PERSON WOULD YOU LIKE TO BE STUCK WITH AND WHY?
David Attenborough. We could explore the island and he could tell me about all the fascinating wildlife.

WHAT WAS THE BEST PIECE OF ADVICE YOU HAVE EVER BEEN GIVEN? AND THE WORST?
The best advice I had was never be afraid to question the status quo. I don't remember the worst advice.

WHAT WOULD YOU LIKE TO BE DOING FIVE YEARS FROM NOW?
To do more of the doing rather than the rewarding and the talking.

WHAT'S YOUR BIGGEST REGRET?
Not to have had more time with my gorgeous children.

ONE THING WOULD YOU ENCOURAGE READERS TO DO TO MAKE THEIR LIFE MORE SUSTAINABLE.
Insulate your home as much as possible and enjoy walking and cycling.

WHAT'S THE ONE IDEA THAT YOU THINK COULD CHANGE THE WORLD FOR THE BETTER?
Cheap solar photovoltaic (PV), combined with cheap energy storage.

WHAT'S YOUR FAVOURITE QUOTE?
"I find hope in the darkest of days and focus on the brightest" – Dalai Lama.

Sarah Butler-Sloss is founder-director of Ashden, a London-based charity that works in the field of sustainable energy and development and hosts the Ashden Awards annually.
www.ashden.org

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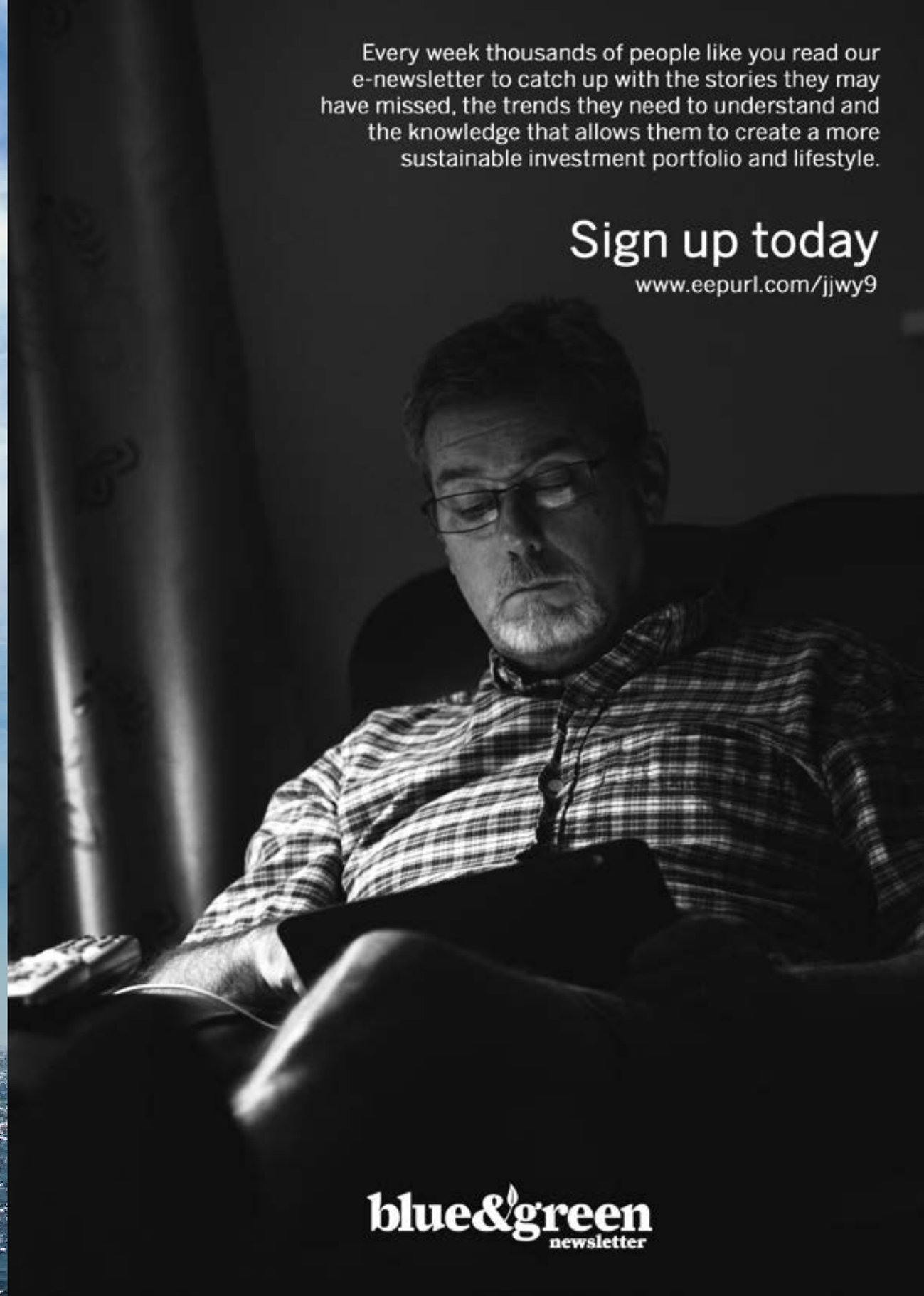
"I'd make every home in the UK energy efficient with insulation and energy efficient boilers. It would eradicate fuel poverty, reduce people's energy bills and dramatically cut UK carbon emissions."

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RENEWABLE ENERGY OF THE FUTURE

By TOM REVELL

Going beyond wind turbines and solar panels, what are the clean energy technologies of the next generation?

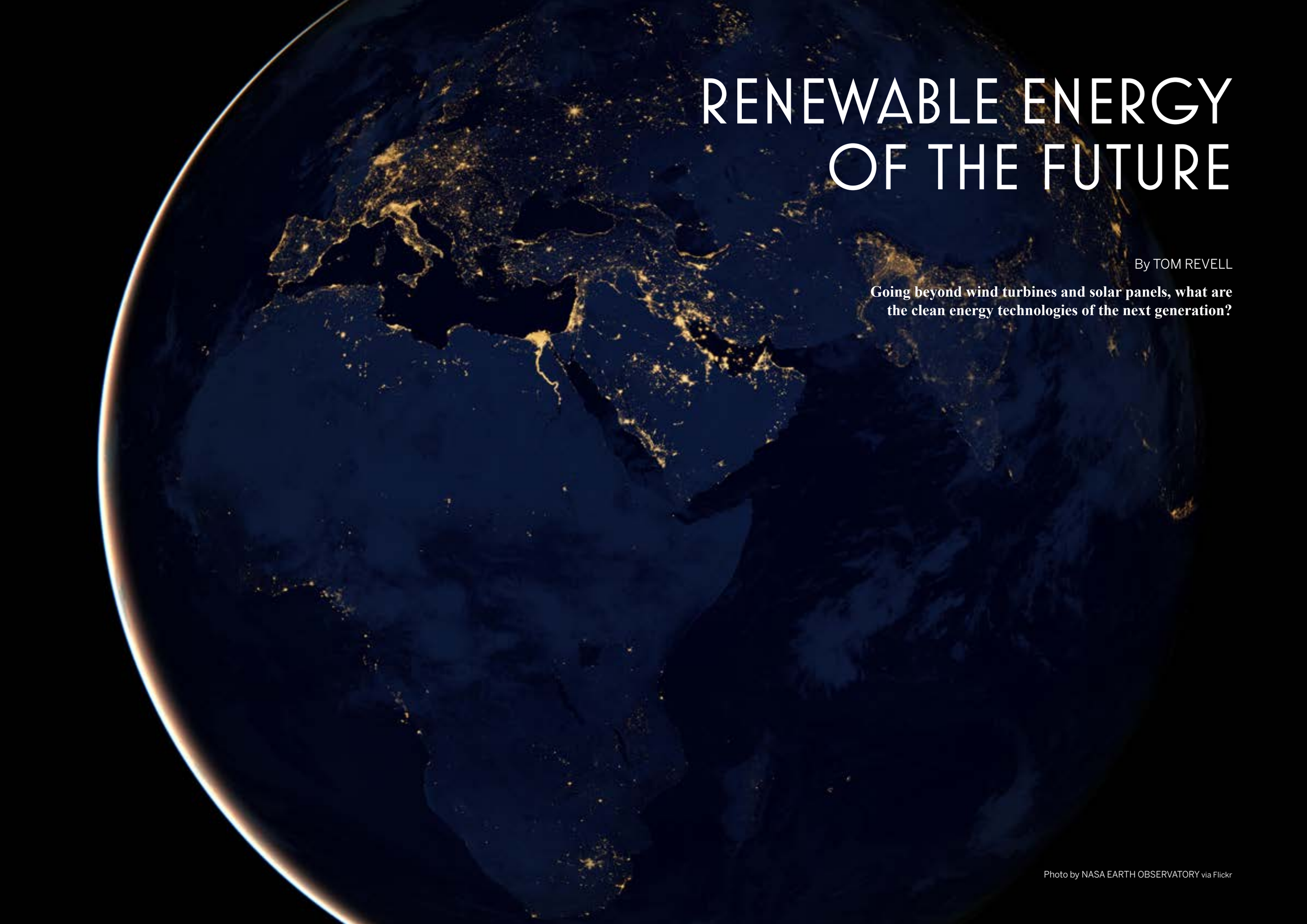


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"Scientists believe the magical material grapheme can revolutionise renewable energy."



The phrase renewable energy is synonymous with wind farms, solar panels, hydroelectric damns and – increasingly – bioenergy plants. But these are far from the only sources of clean power. In fact, some believe that it is not these familiar forms that will deliver the world to its low-carbon salvation, but the next generation.

This may be missing the point – the most important solutions to climate change and resource exhaustion are surely the ones we have, the ones that work now, the ones that might not turn out to be pie in the sky pursuits. Nonetheless, the appeal of some renewable energy pipedreams has endured through the decades, and it is easy to see why.

The loosely defined next generation of renewables includes things like geothermal sources, advanced energy storage technology but also more weird and wonderful ideas, ranging from mind-bogglingly small hydroelectric systems to colossal space stations. The question is, how realistic are these ideas and could they actually change the world?

GRAPHENE

Graphene. What can't it do? The wonder material continues to fascinate scientists around the world, having only been discovered in 2004 at the University of Manchester. It is the strongest material known to exist, though it is only one atom thick. It is remarkably pliable, almost transparent and an excellent conductor of electricity and heat.

In 2013, the EU made available a €1 billion grant to researchers investigating the potential uses of graphene, saying it could become as important as steel or plastics. Much of the excitement has focused on the possibility of making advanced, lightweight and superfast electronics, but other potential applications are many. Bill Gates's philanthropic foundation has paid for the development of a graphene-based condom.

Now, scientists believe the magical material can also revolutionise renewable energy. Researchers from the Nanjing University of Aeronautics and Astronautics in China recently revealed that dragging small droplets of salt water along strips of graphene generates electricity. The faster they dragged the droplet across the graphene strip, the higher the voltage they generated. Scaling up the experiment, the scientists found that placing a droplet of copper chloride on a tilted graphene surface generated a voltage of approximately 30 millivolts (mV) – a millivolt being one thousandth of a volt.

Though much more research is needed, the scientists say these nano-sized generators could power small devices. It is also believed that graphene could make batteries far more suitable for high capacity energy storage, potentially solving renewable energy's biggest dilemma and helping sustainable power sources finally rival fossil fuel plants for stability and reliability.

NUCLEAR FUSION

Its status as a renewable energy source may be contentious, but nuclear fusion theoretically offers carbon-free and, most significantly, risk-free clean energy for the world.

Modern day nuclear reactors are powered by nuclear fission, where the nuclei of atoms split into smaller parts. Nuclear fusion, the same process that takes place in the hearts of the stars, occurs when two atomic nuclei fuse to form a heavier nucleus.

"One kilogram of nuclear fusion fuel could provide as much energy as 10 million kilograms of today's fossil fuels."

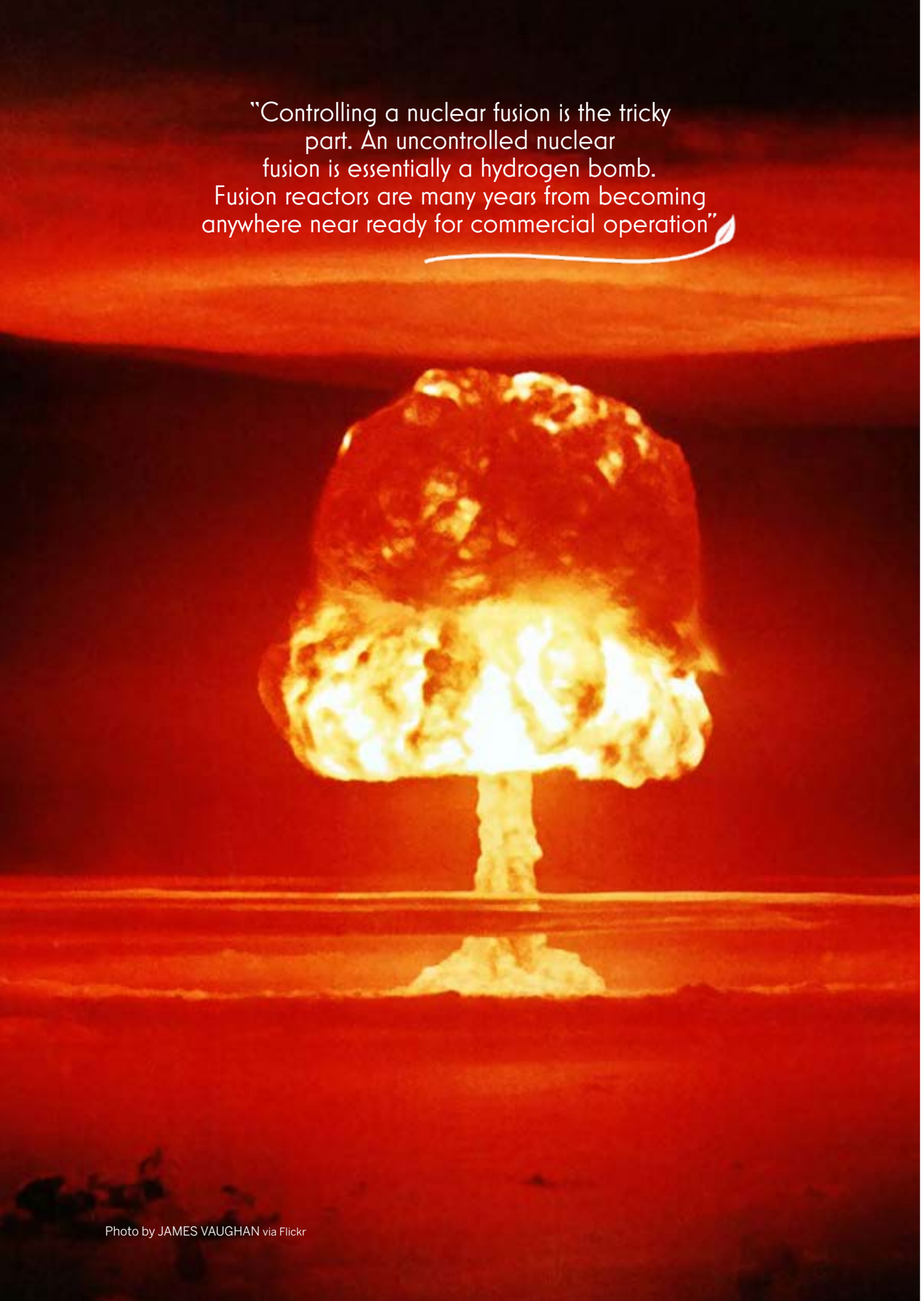
Controlling a nuclear fusion is the tricky part. An uncontrolled nuclear fusion is essentially a hydrogen bomb. Fusion reactors are many years from becoming anywhere near ready for commercial operation, but their promise is such that researchers around the world have dedicated their lives to the cause.

A fusion reactor would enjoy many advantages over conventional alternatives. While technically not limitless, fusion fuel – primarily the abundant deuterium – supplies would last for millions of years, and likely longer than civilisation itself. They would also be incredibly efficient, generating more energy for a given weight of fuel than any modern day technology. It has been estimated that one kilogram of fusion fuel could provide as much energy as 10 million kilograms of today's fossil fuels.

Unlike fission reactors, with fusion reactors there would be no possibility of a devastating leak of radioactivity. Fusion only takes place in very specific circumstances, at a precise temperature and pressure and only within certain magnetic field parameters. This means that if a fusion reactor were to lose control, reactions would cease before any leak could occur.

However, some experts are concerned that the billions spent on researching nuclear fusion could be poured into more tangible renewables instead, bringing guaranteed benefits in the short-term. By the time nuclear fusion is ready to save the world, it may already be too late.

Photo by JAMES VAUGHAN via Flickr



"Controlling a nuclear fusion is the tricky part. An uncontrolled nuclear fusion is essentially a hydrogen bomb. Fusion reactors are many years from becoming anywhere near ready for commercial operation"

Photo by JAMES VAUGHAN via Flickr



"Japan's space agency recently announced its ambitions to make the space-based solar panels a reality within 25 years."

Photo by NASA via Flickr

SPACE-BASED SOLAR POWER

There are some weird and wonderful ideas in the world of clean technology, but none are quite so out of this world as the concept of space-based solar power.

It sounds like the domain of science fiction, and indeed, it is. Though the idea was not discussed academically for another two decades, in 1941, the iconic sci-fi writer Isaac Asimov set his short story Reason aboard a space station that beamed power to Earth in the form of microwaves. Since then, however, many governments and researchers have given the concept of space-based solar power installations serious thought.

Theoretically, the system would be composed of three parts: a geostationary satellite colleting solar energy in space, some form of technology that could beam the energy down to Earth – a microwave or laser – and an antenna to gather the energy on the planet's surface. All of the required technology does not yet exist, but some experts are optimistic.

Such projects would bring many advantages. In space, the sun's energy is uninterrupted by obstacles such as the atmosphere and clouds, and would be available 24 hours a day. It's always sunny in space. Space-based solar panels would be able to harness substantially more energy than their equivalents on Earth.

Serious progress has been thwarted by a number of difficulties, however, and many studies across the decades have concluded that while space-based solar power is technically possible, it remains economically impossible. The cost of such a mission would be huge, requiring many space launches and a terrestrial receiver many kilometres in diameter. There are also safety concerns – such a large satellite would be vulnerable to impacts from the manmade space debris that litters the heavens and would be incredibly difficult to repair.

But the fascination with space-based solar power refuses to die. Japan's space agency recently shared a roadmap for space-based solar power, announcing its ambitions to make the fantastical concept a reality within 25 years. The country now seems to be the leader in the space (pun not intended), motivated by a desperate need for clean energy alternatives in the wake of the Fukushima Daiichi nuclear disaster of 2011. The scale of investment required means no one nation can achieve space-based solar alone, but perhaps Japan can be the catalyst – the leader to finally realise the mad ambitions of so many scientists and the outlandish dreams of Isaac Asimov.



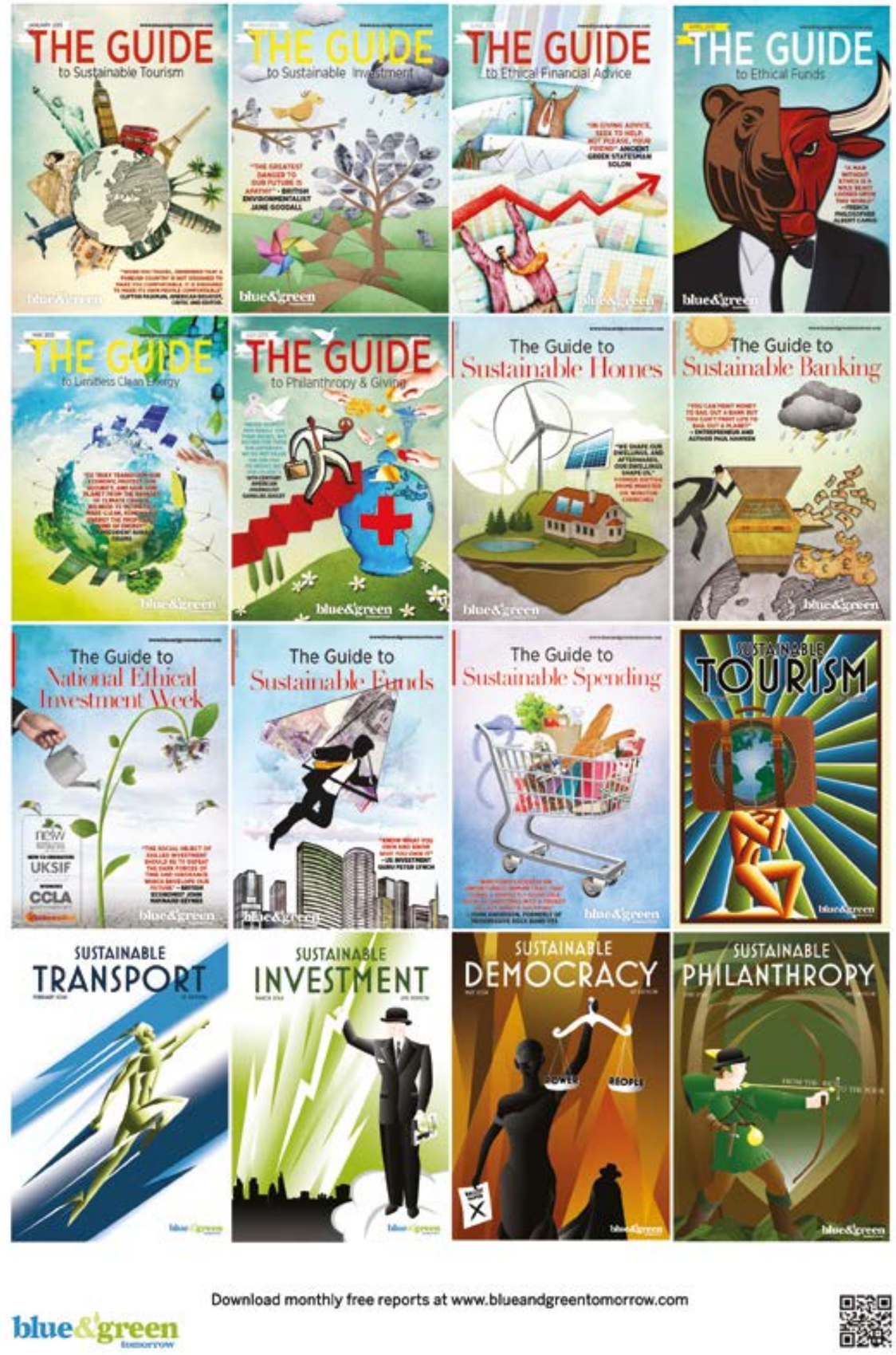
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Pg 70

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Pg 72

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