

Spotlight

ENERGY AND CLIMATE CHANGE: FUEL'S GOLD

Ada Colau / Emma Howard Boyd / James Heapey MP

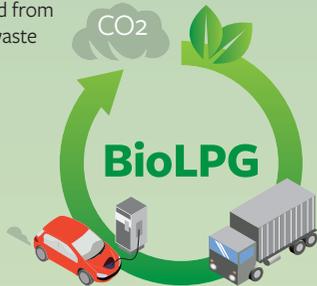


Clean Growth Strategy: how can we decarbonise the countryside?

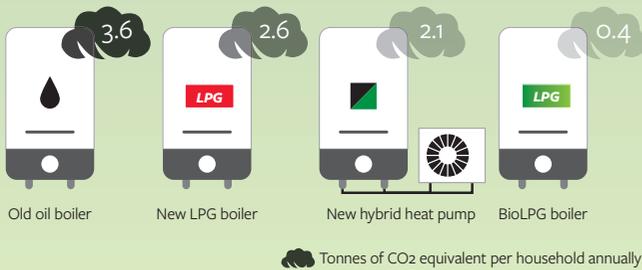


BioLPG is a low carbon, drop-in alternative

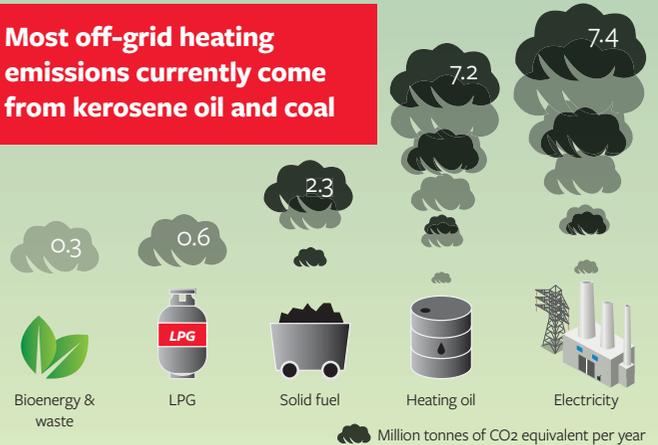
BioLPG is created from renewable and waste materials...



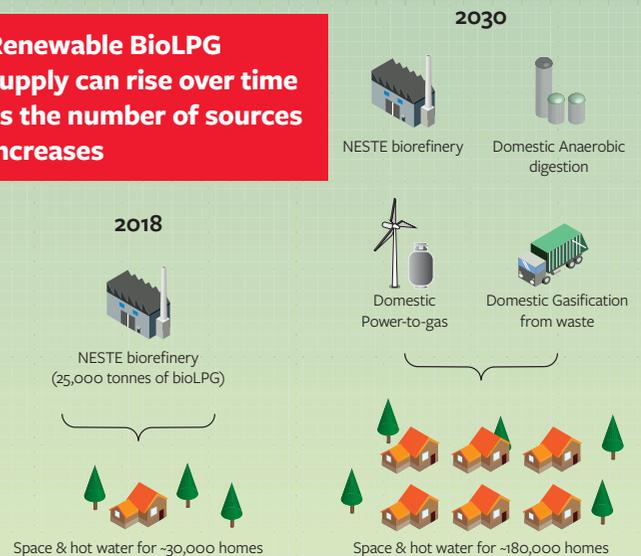
...and can help off-grid households move away from traditional fossil fuels



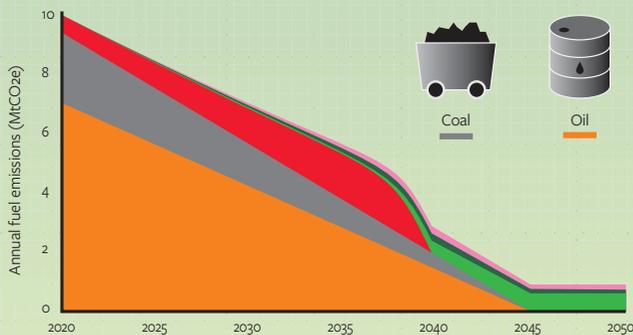
Most off-grid heating emissions currently come from kerosene oil and coal



Renewable BioLPG supply can rise over time as the number of sources increases



BioLPG and gas heating technologies can drastically cut emissions from rural properties in the long term without breaking the bank



What should the Government do?



Continue with plans to phase out the use of high carbon fossil fuels used in off-gas grid Britain during the 2020s i.e. heating oil and coal



Promote the role of clean gas and explore opportunities with industry for domestic production sources for biogases such as BioLPG



Reform EPCs to ensure rural property owners are no longer disadvantaged by government energy efficiency policy

Figures: Ecuity Consulting calculation based on data from BEIS (2017) and EU Commission (2016)

The dangers of greenwash



Opposition parties around the world are putting climate change at the centre of their policy. In the US, the Democrats’ new congresswoman Alexandria Ocasio-Cortez has become the most vocal proponent of a “Green New Deal” that would create massive investment in renewable energy. In Australia, opposition leader Bill Shorten has declared climate change a “disaster” that can only begin to be tackled with a \$15bn programme of investment in energy production, transmission and use. Labour’s 2017 manifesto promised to almost triple the amount of solar power generation, to almost double the amount of onshore wind generation and to add four times the amount of offshore wind capacity to take the UK to 60 per cent renewable zero-carbon energy production by 2030, creating more than 410,000 jobs.

But how often are the energy promises of opposition realised in government? In 2001, Labour promised to put “an obligation on electricity companies to deliver ten per cent of the UK’s electricity from renewable sources by 2010” (a requirement set as a minimum by the EU) and failed. In 2010 the Conservatives offered to “unleash... a wave of low carbon innovation” but since 2011, what David Cameron said would be the “greenest government ever” has never raised fuel duty, a measure that amounts to a £9bn-a-year subsidy on petrol and diesel. The 2015 Conservative manifesto, in a lengthy section devoted to the party’s mission to “protect our planet for our children”, gave no intimation that the government would go on to sell the Green Investment Bank to a major fossil fuel investor or force through fracking in the UK against the protests of local people and local government.

It is not surprising, then, that public discourse around climate change is becoming more angry, disillusioned and fearful. The gains made by businesses and policymakers are overshadowed by the empty promises of previous years. There is great political and economic capital to be made, but the time for platitudes is at an end.

6 / Ada Colau, Giuseppe Sala and Giorgos Kaminis

The mayors of Barcelona, Milan and Athens discuss climate change’s unequal effects on cities and their populations

8 / Emma Howard Boyd

The chair of the Environment Agency on managing the effects of climate change

11 / Oil and the next crisis

David King and Bob McNally debate the risk that fossil fuels pose to the global economy

16 / Powered by plastic

Could chemical recycling enable cars to run on rubbish?

22 / James Heappey MP

The MP for Wells explains why fracking is a waste of time

26 / Nuclear fusion

A futuristic technology increasingly appeals to the private sector

NewStatesman

Standard House
12-13 Essex Street
London, WC2R 3AA
Subscription inquiries:
sbrasher@
newstatesman.co.uk

Account Managers
Jugal Lalsodagar
Dominic Rae

Commercial Director
Peter Coombs
+44 (0)20 3096 2268

Special Projects Editor
Will Dunn

Special Projects Writers
Rohan Banerjee
Augusta Riddy

Design and Production
Leon Parks

Cover illustration
Sam Falconer



Spotlight is the British Society of Magazine Editors’ 2017 Launch of the Year. First published as a supplement to the *New Statesman* of 30 Nov 2018. ©New Statesman Ltd. All

rights reserved. Registered as a newspaper in the UK and US. The paper in this magazine is sourced from sustainable forests, responsibly managed to strict environmental, social and economic standards. The manufacturing mills have both FSC and PEFC certification and also ISO9001 and ISO14001 accreditation.

This supplement can be downloaded from:
newstatesman.com/page/supplements

News



MARIO TAMMA/GETTY IMAGES

Greenhouse gases highest for 5m years

Will Dunn

Carbon dioxide is now at 146 per cent and methane is at 257 per cent of pre-industrial levels, according to the World Meteorological Organisation's yearly *Greenhouse Gas Bulletin*. These gases have contributed to a 41 per cent increase in "total radiative forcing" – the means by which these gases warm the climate.

The Secretary-General of the WMO, Petteri Taalas, commented that "the last time the Earth experienced a comparable concentration of CO₂ was 3-5 million years ago, when the temperature was 2-3°C warmer and sea level was 10-20 meters higher than [it is] now" on the release of the bulletin.

The bulletin was led by a report on what the WMO called an "unexpected" resurgence in CFC-11 emissions, which did extensive damage to the ozone layer and were banned under the Montreal Protocol in 1987. While the amount of CFC-11 in the atmosphere continues to decline, this rate has slowed by a third; the WMO's investigation drew the "robust conclusion that these changes are predominately related to increased CFC-11 emissions", and that "these increases originate from emissions in eastern Asia".

Provider of BEIS scheme goes under

Augusta Riddy

A company delivering the government's Green Deal energy scheme has gone into administration, leaving thousands of Scottish customers in debt.

Home Energy and Lifestyle Management Systems (HELMS) was installing home features as part of the government's scheme to help "make

Coast Guard orders stop to 14-year spill

Augusta Riddy

The US Coast Guard has ordered Taylor Energy to clean up a 14 year-old oil spill or face \$40,000 a day in fines.

The company's rig, off the coast of Louisiana, was destroyed by Hurricane Ivan in 2004, and since then has leaked up to 700 barrels of oil a day, and over a million barrels of oil since it began.

The Washington Post reported that the spillage was likely to be far more severe than Interior Department estimates, which was basing its data on Taylor Energy information. The day after the *Post* story was published, the

Coast Guard said the company must "institute a ... system to capture, contain, or remove oil" or pay the fines.

Taylor Energy has challenged the accusations, insisting that its wells are not to blame for the spillage: "The Coast Guard issued its order relying on deeply-flawed analysis and inflated volumes." *The Post* claims that as the spill has emitted somewhere between 1.5m barrels and 3.5m barrels, it is up there with the 2010 BP Deep Water Horizon spill, when four million barrels were leaked into the Gulf of Mexico.

energy-saving improvements to your home”, including solar panels and loft insulation. Customers believed that HELMS would provide these improvements, which would see a drop in their bills, at no extra cost.

Instead, many customers have been lumbered with loans for thousands of pounds for the improvements. Citizens Advice Scotland has called for the government to step in, but the Department for Business, Energy and Industrial Strategy has advised customers to take their complaints directly to the Green Deal Finance Company.



Smart meters criticised by auditor

Will Dunn

The scheme to install smart energy meters in every home and business in the UK has been criticised by the National Audit Office (NAO) for cost overruns and delays.

The NAO also found that in order to create a faster roll-out of smart meters, BEIS advised energy suppliers to deliver older “SMETS1” meters to households. However, the majority (70 per cent) of SMETS1 meters have been found to stop working properly if the customer changes their energy supplier; 12.5 million SMETS1 meters have now been installed. The NAO also highlighted that millions

of households “do not recall being offered advice on how to save energy when their smart meter was installed”. The NAO says a “conservative estimate” of the cost of each smart meter is now £391 per home, which all consumers will pay through energy bills. BEIS has said it still expects households to save around £18 a year from using the meters. Smart thermostats, which offer consumers automated and remote control of their heating, can be bought for around £150.

Six energy firms go bust in 2018

Rohan Banerjee

Ofgem, the regulator for UK gas and electricity markets, will introduce new “fit and proper” tests for suppliers after several smaller companies went into administration.

Extra Energy, which collapsed last week, became the sixth small firm to go out of business since the start of 2018. The company, which blamed its collapse on the government’s new price cap on energy bills, will have its 108,000 domestic and 21,000 business customers transferred to a new supplier by Ofgem. A spokesman for Extra Energy said the price cap had “made the market unviable”.

Ofgem’s new tests will come into effect next year, requiring companies to demonstrate that they have sufficient financial resources and can meet their customer service obligations before being awarded an energy supplier’s licence.

Around 25 per cent of UK customers are supplied by small-to-medium-sized energy firms, after switching to get better deals. But according to a report from Citizens Advice, many firms have been guilty of poor customer service.

Ofgem will require prospective suppliers to demonstrate adequate financial reserves to manage their business for at least after 12 months after entering the market, and that they can deal with customer complaints and queries to regulator’s standards.



Subsidy blow to offshore wind

Rohan Banerjee

The government has announced that just £60m will be made available to support offshore wind projects through next year’s contracts for difference (CfD) auctions – less than a third of the amount spent on subsidies in 2017.

The CfD scheme forms agreements in which the government pays the difference between the “strike price”, a price for electricity reflecting the cost of investing in a low-carbon technology, and the average market price of electricity in the UK.

Greenpeace UK’s head of energy, Kate Blagojevic, called the £60m figure “a pitiful sum”, while others said the government’s lack of commitment would do little to stimulate the renewable energy industry. The allocation, which comes from a £557m pot to fund the next three CfD auctions, has raised questions as to how the remaining £497m will be spent.

The government set a total capacity cap of 6GW for “less established” technologies to provide power. Offshore wind contract prices have been set at £56/MWh for 2023-24 and £53/MWh for 2024-25, a rate around 40 per cent less than the strike price offered for the Hinkley Point C nuclear power station.

Climate change is unfair. Our response must not be

Ada Colau, Mayor of Barcelona, Giuseppe Sala, Mayor of Milan, and Giorgos Kaminis, Mayor of Athens, say that climate change will deepen the divisions already present in societies around the world

Climate change affects us all. The recent Intergovernmental Panel on Climate Change *Special Report on Global Warming of 1.5°C* could not have been clearer on the scale of the threat we face. Limiting global warming to 1.5°C, compared to 2°C, could reduce the number of people exposed to climate disasters and at risk of poverty by hundreds of millions. Yet, without profound and urgent change in every part of the economy, society and our daily lives, the world will exceed the 1.5°C target within just 12 years.

We also know that climate change is unfair. A very small percentage of the global population are responsible for the vast majority of greenhouse gas emissions, which cause climate change. Yet it is the poorest, most vulnerable members of society and those who have contributed least to emissions who feel the greatest impact of a warming planet.

It is in cities that the impacts of climate change and growing inequality are being felt most severely. Hurricanes, heatwaves, flooding and droughts are becoming an

annual reality for cities around the world. Too often, it is the old, the young, the disenfranchised and the marginalised citizens who are most at risk of losing their homes, their jobs or even their lives when these disasters strike.

That is why we, as the mayors of Barcelona, Milan and Athens, are so committed to delivering urgent climate action, which also benefits all citizens equitably. As leading members of the C40 Cities network, we are working to rapidly bring down greenhouse gas emissions consistent with limiting the global temperature rise to 1.5°C. We are equally clear that cities cannot live up to the promise of the Paris Agreement unless our actions also reduce inequality and deliver social justice for all citizens.

Here in Barcelona, we have published the Climate Plan 2018–2030, which will ensure we deliver on our fair share of the Paris Agreement targets. Our plan recognises that climate mitigation and adaptation are key, but also gives equal weight to climate justice, with a zero-



Ada Colau with Paris mayor and C40 chair Anne Hidalgo



effects of climate change. We have been prioritising the protection of our most vulnerable citizens from extreme weather events as well as the participation of all those affected in all relevant decision making. By enhancing nature-based solutions and blue/green infrastructures in the most disadvantaged areas of the city, our goal is to better prepare everyone for the inevitable impact of climate change.

Our commitment to bold and just climate action is clear. A total of 31 cities globally, representing 100m people, have now committed to increase community-led development and inclusive climate action. This C40 equity pledge will help achieve social and economic benefits for low-income groups in cities worldwide. But we cannot deliver the sustainable, equitable and prosperous cities of the future alone.

We call on the European Union to step up their climate ambition. First, the European Commission must adopt the 1.5°C and net-zero emissions objectives of the Paris Agreement as goals for their long-term European strategy. This vision can only be delivered with consistent social, economic and energy policies, a coherent post-2020 EU budget for climate action – including measures to phase out fossil fuels – and an enhanced 2030 emissions reduction target.

We also call on EU member states to enhance their climate targets and take all the necessary measures to ensure their implementation for a full and rapid achievement of the Paris Agreement.

Finally, we ask every citizen of the European Union to recognise this unique moment in our history. The decisions we take in the coming months and years about the energy we use, the way we travel, the food we eat and the types of cities we create, will determine the world that our children will inherit. Ideas on how to accelerate climate action and keep global warming to below 1.5°C should be central in the forthcoming European elections. Let none of us who aspire to a more sustainable, equitable and healthier future for all miss this opportunity to create the future we want.

energy poverty target by 2030, and to shared citizen responsibility and co-creation, allocating €1.2m in subsidies for collaborative citizen projects. A network of 1,000+ organisations and signatories of the Barcelona Citizen Commitment to Sustainability 2012 - 2022 is involved in drafting and implementing this city-wide climate plan.

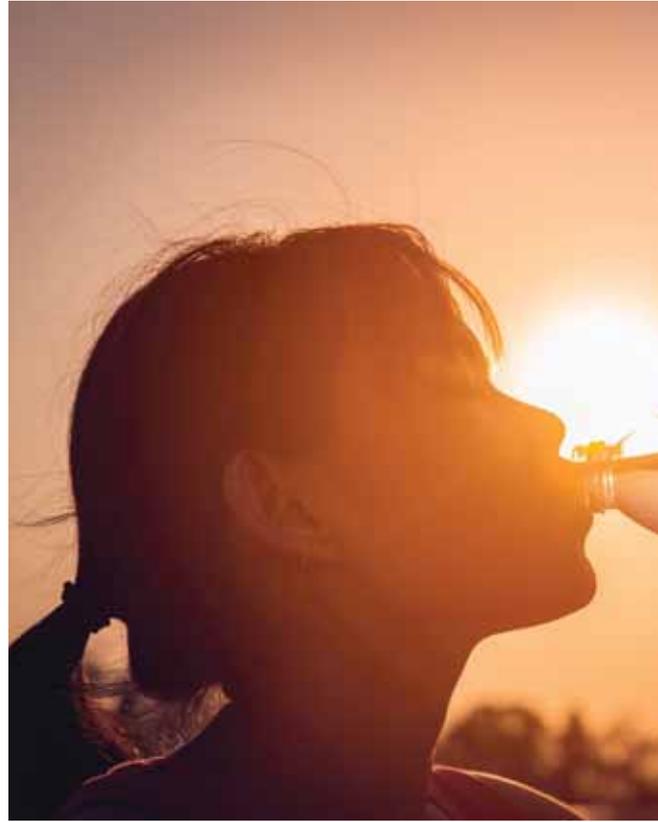
In Milan, we have introduced policies to tackle food waste, procure electric buses, and improve energy efficiency, whilst also improving the quality of life of our most vulnerable citizens. For example, restaurants and shops which donate their unused food to charities pay 20 per cent less waste tax. Working hand in hand with businesses, civil society and communities is key to delivering bold and equitable climate action in our cities.

In Athens, we have pledged to update our Climate Action Plan in order to meet the Paris Agreement goals by 2020, as part of our 2030 resilience strategy, setting actionable goals for both mitigating as well as adapting to the

Barcelona has a zero energy poverty target by 2030

Emma Howard Boyd,
 chair of the Environment
 Agency and UK
 commissioner for the
 Global Commission on
 Adaptation, says the world
 needs green infrastructure

Adjusting to the new normal



“THE WORLD’S ON FIRE” said *The Sun*’s front page on 25 July. “BRITAIN’S IN MELTDOWN!” said the *Daily Mail*’s. It was the UK’s joint hottest summer on record and the driest since 1921. The Environment Agency responded to a 330 per cent increase in drought-related incidents. The problems were not unfamiliar to us, there were just a lot more of them. All at once.

Such summers are soon expected to become the norm here, which we will have to adapt to. But, if that’s the new normal, what of the new extremes?

The Paris Agreement shows that the international community – with regrettable exceptions – realises we must reduce carbon emissions, but this year’s Intergovernmental Panel on Climate Change report said even if we limit the global temperature rise to 1.5°C above pre-industrial levels (which is unlikely),

the dangers will continue to conflagrate.

Around the world people’s ability to cope with hotter days, fiercer fires, bigger storms, rising and more acidic seas, shifting crop patterns, and the spread of tropical diseases into uplands and formerly temperate zones, will vary hugely depending on the strength of their existing regional systems.

Is a common, global understanding of “resilience” possible when people live in so many different circumstances and experience so many different threats at different times? Maybe, maybe not, but because of those differences, people have diverse strengths in managing risks.

Whether we live in developed economies or emerging markets, we are all failing to adequately pool our knowledge – in terms of managing nature, building infrastructure, and organising logistics – to prepare for dangers that, in many cases, someone is



already dealing with somewhere else.

That's a problem, but it also allows us to be optimistic. Last month, the Global Commission on Adaptation was launched to accelerate preparations for the physical risks of climate change. I was asked to be the UK commissioner because of my 25 years working in finance, and because I am chair of the Environment Agency, where I regularly meet world-class experts in the business

Prepare for the next storm, not the last

SHUTTERSTOCK/FOCUSSTOCKER

of protecting people from nature and protecting nature from people.

The Global Commission, which is led by Ban Ki-moon (eighth secretary-general of the UN), Kristalina Georgieva (CEO of the World Bank), and Bill Gates, is an opportunity to show how adapting to climate change can improve people's wellbeing and drive action on food security, rural livelihoods, infrastructure, and urban resilience, among other things. It will demonstrate, through economic analysis and case studies, that the costs of adapting are often less than the costs of business as usual, and the benefits many times larger.

There are huge benefits to preparing for the physical risks of climate change and these go beyond governments' basic responsibilities towards citizens. The governor of the Bank of England, Mark Carney, said in April: "Financing the transition to a low-carbon economy is a major opportunity for investors and creditors. It implies a sweeping technological revolution, including investments in long-term infrastructure at roughly quadruple the current rate."

For New York City, watershed management has saved \$5bn in capital costs and \$300m annually. On the border of Brazil and Paraguay, returns on investment in soil conservation have significantly extended the life expectancy of the Itaipu Dam, paving the way for greater energy security. In China, improved land management and watershed restoration on the Loess Plateau has eliminated the need for drought-related emergency food aid to a region that is home to 50m people. Restoring mangroves in Vietnam for storm defence has enhanced sea defences and improved the livelihoods of people using local resources.

In England, there are currently around 5.2m homes at risk of flooding – roughly one in six. On 5 December 2015, 341.4mm of rain fell in 24 hours at Honister Pass in the Lake District. As record rainfall events increase, international partnership with countries that already experience such extremes is important for helping us improve our

own resilience and for developing skills in the national economy.

We also have a lot to offer. We improve defences like the Thames Barrier by exchanging expertise with professionals who operate such structures all over the world as part of The International Network for Storm Surge Barriers. We work with the Bureau of Meteorology in Australia to stay on the cutting edge of flood forecasting and warning. We share information on our emergency response capability with Rijkswaterstaat in the Netherlands.

No man is an island, and no island can hold back the sea forever with concrete walls. Green infrastructure complements grey infrastructure by creating a buffer, prolonging the lifespan of traditional defences, something else we are learning about together with the Dutch.

Of course, preparing for the new normal requires much more than collaboration between government agencies. Everyone needs to act: from individuals who need to adapt their homes so they can return home quickly after a storm, to global corporations who must reduce their carbon emissions and protect supply chains.

Climate resilience means preparing for the next storm, not the last one; recovery must always be aiming at a better version of normal. In Bangladesh, deaths from tropical cyclones declined more than 100-fold in 40 years, from 500,000 deaths in 1970 to just over 4,000 in 2007. This was achieved by developments in early warning systems, cyclone shelters, evacuation plans, coastal embankments, reforestation schemes, increased awareness and communication.

The Global Commission will present its report and recommendations in September 2019. Earlier this year, more than a million people were displaced by floods in northeast India and Bangladesh. Internationally, people have a lot to learn in order to adapt and be more climate resilient, but there's no time to lose: the physical risks of climate change are already here.

Creating a smarter energy future

James Graham,
vice president of
asset optimisation
at SmartestEnergy,
answers questions
about making
energy work harder,
for customers and
the environment

How is SmartestEnergy a “next generation energy company”?

We are the original asset-lite energy company, a model being adopted by many other leading energy players. We believe the future energy customer is a hybrid of: a producer of renewable energy, a consumer of grid back-up electricity and a provider of balancing services, and our role is to provide a simple service for customers to access this new reality. Our new Managed Flexibility platform does just that!

What does the platform do?

It is a technology platform which connects into assets that customers own, such as battery storage, and into consumption assets, such as a piece of equipment that uses a great deal of energy. By connecting into these systems, the platform can control variable factors, making adjustments to the power consumed, or changing the times of day at which it is used, or deploying alternative sources of generation. It might mean slowing down an industrial production process for short periods of time without impacting overall production.

How can it save customers money?

By optimising a customer’s energy usage, making adjustments that streamline it and make it more efficient, a considerable amount of money can be saved. For example, a hypothetical company is spending £1m on electricity a year; by changing how much energy they use and when, we think that our platform could reduce that expenditure

by five to eight per cent.

What sustainable impact can it have?

The UK energy mix continues to change, reflecting an influx of renewable energy and a reduction in traditional thermal generation. This provides a very different challenge to the Grid as it struggles to balance supply and demand around changeable weather and other factors. Our platform helps companies support the Grid in balancing power at the lowest cost, consuming power in a more sustainable way, and freeing up electricity at peak times.

How is it encouraging leadership in energy?

At SmartestEnergy, as do many commentators, we believe that companies should take a lead when it comes to achieving sustainable goals. Our platform allows companies to take an active role in their energy; what they use, when they use it and where they source it from.

How does it reflect the changing nature of energy?

The traditional utility model of big power stations which sell to many customers is becoming less and less economically viable. In this new age of energy, customers want to take control and build their own sustainable sources, such as solar panels on their own sites. This brings control but needs managing. Energy efficiency is reducing demand but new demands are growing as well, for example through the growth of electric vehicles.

That’s why we are developing this Managed Flexibility platform. It started despatching real life energy assets at the start of this winter, and supports customers who want to embrace this smarter, greener age of energy. We have never built power stations – we have a service-led approach and are proud to be at the forefront of this energy transformation.

For more information, please visit:
www.smartestenergy.com

IN ASSOCIATION WITH



Will oil cause the next global recession?

Could changes in energy use and geopolitics make oil a dangerous bet for banks? **Augusta Riddy** talks to leading energy figures to understand the risks

In February, David King travelled to Dallas, Texas, to address a group of oil barons on the future of energy. During his trip, the scientist was concerned to observe temperatures drop to well below zero, something that very rarely happens. He was further concerned to hear that the temperature in the North Pole was hovering around the zero degrees mark – warmer than Texas. In 2004, during his tenure as chief scientific adviser to the government, King famously declared climate change to be the greatest threat facing the world, greater even than terrorism. Fast forward 14 years, as the Northern Hemisphere reels from one of the strangest summers in living memory, and that statement no longer seems dramatic at all, and – evidently – King has not stopped worrying.

“I believe, just to put my position clearly,” he tells *Spotlight*, “that globally we have about ten years to make all the right decisions on emissions, and in that ten years we will be taking decisions for the future of civilisation over the next 10,000 years.”

Luckily, King is an optimist – “I have to be, in this game” – and he believes that a transition from fossil to renewable fuel is already underway, and will quickly escalate. But this necessary energy transition, he warns, poses a different global risk: recession. “The big risk for the global economy,” he explains, “is all the continued investment by the fossil fuel industry in new fossil fuel industry infrastructure, because they’re

borrowing from banks to do it, and the debt won’t be repaid because those industries will not be able to function in that way.”

Historically, King explains, banks have always loaned great sums of money to oil companies because they tend to be very good at paying it back, due to the sheer size of the industry: “they have such an enormous marketplace.” King believes that when the world inevitably switches completely to green energy and cuts out dangerous sources such as oil, the industry will be hit with a shock unlike ever before, default on its enormous debts, and bring down a number of banks. When it comes to bank loans, he claims, energy companies are the greatest corporate borrowers. “There is no global industry that matches up to the oil industry ... clearly companies like Google and so on are pretty big, but they are not engaged in borrowing money in this way.”

In 2014, the price of oil did crash. It plummeted from \$100 a barrel, to just \$27 by 2016. Between 2004 and 2014, when the price was rising steadily, the amount of debt owed by junk-rated energy producers grew by 11 times, to \$112.5bn. In 2016, oil and gas loans accounted for 2.4 per cent of Bank of America’s total lending, at \$21.3bn, and Morgan Stanley was the most exposed of the big banks, at five per cent of its red book. As a result of the crash, energy companies defaulted on over \$13.1bn of debt. It was caused by a sudden drop in demand, but the crisis King is predicting is of a far greater scale; one he believes has the potential to tank the global economy. “I’m not talking about oil price volatility. I am talking about the end of the road for the oil industry.”

Bob McNally has a different take on things. The former energy adviser to President George W. Bush – an administration King once accused of “failing” to tackle climate change – and former adviser to Republican hopefuls Mitt Romney and Mark Rubio “in no way” sees a transition to fossil fuels taking place in his area of expertise, transport, in the coming decades.

“Recent return of boom-bust... risk to balance sheets”



Transport, McNally points out, has always considered electricity. “The first vehicles that graduated from horse and buggy were electric, and in 1900 or so I think data shows about a third of cars were electric.” But oil rose to the top because it was cheaper, easier to store, and it’s not as high in demand in other sectors: “oil won out for largely commercial reasons.” In the UK, the government is budgeted to spend £124m on electric vehicle grants from 2018-19, and in the US, the government hands out \$2,500 – \$7,500 in tax credits on each EV bought, part of what McNally calls “a rich history of wasting a lot of money in unsuccessful attempts to make electricity commercially viable”. But if someone can

find out how to make the electric car battery compete with the internal combustion engine – not just commercially viable, but profitable – then that, he says, would be a “goldmine”.

In McNally’s view, if/when a meaningful transition from fossil to renewables takes place, it will be the private sector leading the way, and it will be doing so because it makes commercial sense. In the US and the UK, when it comes to major investment decisions, “the oil industry does not take orders from policy officials”.

So, bank exposure in the context of an abrupt switch to green energy is not something that keeps McNally up at night – “I don’t think it’s a big problem”

– but that’s not to say he isn’t concerned about bank exposure in general. “Were there to be a shock to the oil industry of the type [King] is describing, absolutely the banks that are exposed through contagion could easily cause a global financial crisis and economic slowdown.” It’s for the precise reason that the banks are so vulnerable to oil downturn, he says, that “governments will not induce that shock” by imposing a wholesale transition. “They will not forcibly bankrupt the oil industry.”

McNally describes how, for the last 15 years, the world has been living through an era of boom-bust oil prices, in which supply and demand has been peaking and plummeting in far shorter cycles,



creating shocks like the one seen in 2014. He views the recent return of “authentic” boom-bust oil cycles as “a much bigger risk to the bank balance sheets” than any transition to green energy, and to the global economy in general. King calls oil price volatility “infamous” because “it has so many ramifications”. A glance at the news will tell you that we are living in through an age of geopolitical flux, which presents a serious risk to oil stability.

In Venezuela, which in 2016 was the tenth-largest producer of oil, the economy has crumbled. The country faces 1,000,000 per cent inflation. Iran, the fifth-largest producer of oil, has just been hit with a fresh round of economic sanctions by Donald

Trump’s administration. These and other developments caused alarm in oil markets and sharply increased demand. Until a few weeks ago, the price of oil had risen by over 25 per cent in 2018, creating the possibility of hitting \$100 a barrel before the end of the year. This run-up in the price of oil sent jitters through the market that the price could once again tumble.

Compounding this, the journalist Jamal Khashoggi was murdered in the Saudi consulate in Istanbul on 2 October, triggering an international diplomatic crisis. “There’s no question,” says McNally, “that the Khashoggi affair poses a grave threat to the US-Saudi relationship, and everyone ought to

be concerned about that ... It’s a big problem.” Saudi Arabia, until it was recently overtaken by America, was the biggest producer of oil in the world, and has been acting as “swing producer” – cutting or increasing its oil production to stabilise oil prices.

Recently, observers have become concerned by the ruling House of Saud’s reluctance to play this role, but McNally thinks that both Saudi Arabia and Russia – another oil-producing giant – have now been “scared straight” by the events of 2014-16. During the crash, the Saudis declined to cut production until OPEC (the Organization of the Petroleum Exporting Countries) was eventually forced to do so, and Saudi Arabia had to take a “big hit”, according to its oil minister, to prevent a full-blown crisis. “They have been burned by experience; we’ve all been reminded about how extremely volatile oil prices can be when supply and demand is unbalanced and there’s no swing producer,” McNally concludes. As a result, he is predicting that the Saudis and Russia will unite to become joint swing producers, and bear the responsibility together. “I think the Saudis are still determined not to be the only swing producer ... they want to build on this temporary relationship they’ve had with Russia, and say: ‘Look – we’re back to balancing the market. We’re going to ensure stability; we’re working with Russia this time.’”

In recent weeks, the price of oil has dropped considerably – Brent crude has dropped by \$20 a barrel since the start of October – partly due to the US issuing waivers to its sanctions against Iran, meaning less oil is being removed from the market than expected. McNally wonders whether, in the face of this price drop, Saudi Arabia might avoid implementing “big, high-profile production cuts” in order to drive the price up once again “for fear of angering the United States” over the Khashoggi affair; the US wants the price of oil to come down so as to please American motorists. But despite Khashoggi, the Saudis have pledged to cut production

In 2017 bank support for fossil fuels increased

in 2019, and the announcement has sent prices rising once again. The power of oil to define international events is evident. “Oil is the livelihood of modern civilisation,” says McNally. “It is the tail that wagged the dog of the global economy and global geopolitics, and when that is volatile, it threatens to destabilise everything else – including the banks that are exposed to it.”

Some banks have taken steps to cut ties with the industry. HSBC has committed to ending its funding of new oil sands projects, the World Bank – 1-2 per cent of whose \$280bn lending portfolio was allocated to oil and gas projects – will end its support for extraction within the next two years, and BNP Paribas made a similar pledge last year. And this time around, McNally thinks the banks that do invest are being more careful when it comes to committing money. “Oil prices recently rose to \$80 a barrel, and oil companies haven’t done as well, because investors and banks are like, ‘wait a minute, we’ve seen this movie before!’ You’re starting to see some caution and discipline.”

A report entitled *Banking on Climate Change*, produced by a group of six American climate pressure groups, found that of the top lenders to non-renewable producers, 21 banks reduced (often marginally) their lending to producers in 2017, but 14 increased their support. According to the report, the Royal Bank of Canada (the second-largest lender) increased its lending from \$4.173bn in 2016, to \$13.011bn in 2017, and JPMorgan Chase (the third-largest lender) from \$7.598bn to \$11.645bn. In fact, bank support overall for the “largest extreme fossil fuel companies” in 2017 came to \$115bn, which was 11 per cent higher than in 2016, fuelled largely by a huge increase in bank lending to tar sands oil extraction projects. The report found that in 2017, “financing levels went in the wrong direction”, making it a year of “backsliding for banks”. *Bloomberg* reported at the start of 2018 that “speculative-grade debt” from junk-rated energy companies was experiencing a rapid increase in value

due to the rise in the price of oil; bonds from companies nearly wiped out by the 2014 crash were reporting returns of nearly 50 per cent.

The road to a fossil-free future seems long, but as hard as it may be to envisage a switch to green energy, King’s confidence is understandable; will governments really stand back and watch as the world descends into climate chaos, and their citizens die? “What’s happening to the global weather systems is a big wake-up call,” he asserts. “Fossil fuels have actually been very bad for our health over all these years – I certainly remember smogs in London ... the drive towards clean energy is also a health-driven issue.” Nevertheless, he admits that “the demand for oil and gas around the world is increasing all the time ... we’re now approaching two billion cars on the planet” and producers are still heavily investing in new extraction infrastructure. The recent green light for fracking to take place in the UK is just one example.

As for the next recession, if he doesn’t think it will be caused by energy transition, would McNally care to throw his hat in the ring? His is the “unified theory”, which is the theory that the next recession is not far away because “the usual suspects at the scene of a recession are starting to show up.” By the “usual suspects”, McNally is referring to interest rate hikes by the Federal Reserve – “the rise in short-term rates or tightening of monetary policy; that’s the first suspect” – large trade disputes, especially the one currently raging between America and China, “a rapid fall” in emerging market currencies such as the drop recently experienced by Turkey, and last but not least: a big run-up in oil prices.

Over-exposure of the banks to such an unreliable and fluctuating – not to mention environmentally damaging – commodity can only serve to produce yet more insecurity in the global financial system, as it prepares itself for the next inevitable beating, whenever it arrives. “The stars are aligning,” warns McNally. “In a bad way.”

Energy markets are lacking an equal playing field

Jonathan Ainley, head of public affairs and UK programme manager at KiWi Power, explains the importance of competition in energy transition

We are living in a time of unprecedented change in the energy sector. The UK has started to undertake the largest transition in the energy sector since market liberalisation, but we have a long way to go to ensure that we unlock the maximum amount of flexibility in our existing energy infrastructure, so that we run the most efficient system possible for consumers.

Currently, when it comes to flexible markets, the UK is in a state of transition. Available prices for flexibility have proved to be volatile over the last couple of years, as can be seen through the dramatic decline in the market prices in firm frequency response from over £20/MW/hour in 2017 to less than £10/MW/hour in recent months. Clearly, this market is not going to support the deployment of flexible new infrastructure or technology that UK energy desperately needs as we increase our reliance on intermittent renewable generation. Furthermore, the “capacity crunch” that was forecast five years ago has not materialised, and may not do so until the mid-2020s when the old coal power stations finally close. The ability of these outdated, inefficient thermal power stations to stay open has largely been due to subsidies offered to them by the National Grid, which are not available to market innovators such as KiWi Power, and the UK government’s Capacity Market, which was recently suspended by the European Courts. Due to this inequality, the markets for flexibility have been suppressed,

resulting in an unfair playing field for disrupters.

There are several barriers to entry which must be overcome to effectively compete in the GB energy market, due either due to regulation or lack of government direction. In January 2018, Parliament approved the latest set of environmental permitting regulations, placing more stringent requirements on UK generators than anywhere else in Europe. The government decided to exempt diesel farms which run for thousands of hours each year, whilst requiring backup generators operators, including NHS trusts, universities and the emergency services to immediately fit abatement equipment costing several hundred thousand pounds, distorting the playing field. All forms of fossil-fuelled generation should be subject to the same emissions requirements.

Furthermore, government must take steps to improve the market conditions for flexibility, starting with ensuring transparency in grid-balancing markets. The old days of murky bilateral contracts between the National Grid and large market incumbents must end, and all contracts must be let following a clear, transparent process with low barriers to entry. The government is blinkered to this and is unaware of how these markets work, but without reform policy objectives will not be met. Reforming these crucial markets will enable all consumers to make rational financial decisions about their electricity usage. Currently, most domestic customers pay the same price for their power whenever it is consumed, when we have the technology to ensure consumers can respond to prices, as in other markets.

All the talk in the sector is about a move towards a “smart” system, but unless policy and regulation enables all market participants to interact with their energy in the same way they would with any other product, and compete effectively, we risk not realising the full potential offered through the transition to a smart energy future. We have some way to go.

IN ASSOCIATION WITH



How a rubbish idea could be a great one



Advanced chemistry technologies are making it possible to convert plastic waste into fuel. Rohan Banerjee investigates this emerging trend

In the 1985 sci-fi film *Back to the Future*, Emmett “Doc” Brown drives a time-traveling, flying DeLorean that uses garbage for fuel. And although the majority of that scene will likely remain confined to Hollywood, in 2018, given the sheer amount of it, the idea of using plastic waste to generate power is perhaps not a bad one.

Plastic is the collective term given to a large family of synthetic materials derived from organic polymers, such as oil, coal or natural gas, that are able to be moulded into different shapes, usually by being exposed to extreme heat and pressure. As plastics are strong yet flexible and cheap to produce, they make effective cases and containers. Plastics have established themselves as a mainstay of the modern human

experience, but their widespread use – in food packaging and electronic equipment, for example – has paved the way for the problem of plastic pollution.

A study published by the academic journal *Science Advances* found that of the roughly 8.3bn metric tonnes of plastic that had been produced since the material’s introduction into the manufacturing mainstream in the 1950s up to 2015, 6.3bn had become plastic waste. Nearly 80 per cent of all plastic, the report added, winds up as debris in landfills or in the world’s oceans.

The Spanish chemical recycling company Plastic Energy, which has plants in Seville and Almeria, as well as a newly opened technology HQ in London, is trying to address the problem of plastic pollution while creating a



Almost 80% of plastic ends up in landfills or the sea

renewable energy resource that can do something good with the vast supply of plastic waste that humans continue to produce.

The company, its head of PR Richard Peel says, receives “raw end-of-life plastic waste from sorting facilities and recycling factories [in Spain]” before applying a patented “thermal anaerobic technology [TAC] process” to turn the “rubbish that would otherwise end up being incinerated, in a landfill or in the sea, into an oil that we call TACOIL”.

Via the TAC process, Peel explains, plastics are “heated in an oxygen-free environment”, where the vapour is then distilled to form TACOIL, which can be used to “produce new plastics or as an alternative fuel source” following condensation and refining.

How effective is TACOIL as a fuel source? Plastic Energy has already achieved proof of concept, in part, Peel says, by supplying some of the fuel used in the On Wings of Waste research project, which involved the British pilot and environmentalist Jeremy Rowsell flying a light aircraft across Australia in 2017. Rowsell flew a Vans RV9a plane the 500 miles from Sydney to Melbourne, using a blend of fuel of which ten per cent was made up of TACOIL. While at first glance this might appear to be a “modest figure”, Peel says that if scaled up this could have a “significant effect on the aviation industry”.

Consider, for context, that a typical Boeing 747 plane on a 10,000-mile flight burns through about 36,000 gallons of fuel and, according to the International Air Transportation Association, a fifth of most airlines’ operational costs are spent on fuel supply. Were ten per cent (3,600 gallons) of plane fuel to be sourced from TACOIL, that would equate to about 16 tonnes of plastic waste, in theory at least, being saved from landfills or the ocean on every 10,000-mile flight.

Could TACOIL eventually represent more than ten per cent of a fuel blend? Could it replace fuel entirely? Peel says: “I’m confident that this has the potential for upscale, yes. But in the early days, as

with any innovation, there will always be some initial scepticism. We had to use ten per cent [for On Wings of Waste], because at the end of the day, we were sending a human being up in a plane and it’s someone’s life we were talking about. Thankfully, it worked, but it’s best to start small and then scale up. In the future, yes, I think we could be seeing more TACOIL-led fuel solutions but just as important is our ability to turn waste plastic back into plastic.”

Currently, Peel says, Plastic Energy has “arrangements with Spanish recycling and waste management companies” to supply it with plastic waste, with the firm’s biggest market being “mainly fuel for transport in Spain”. More than six million litres of TACOIL output has been produced to date. He adds that Plastic Energy’s long-term aim, towards which the London technology HQ is a “giant step”, is to “expand the product globally”. Peel envisages a plant in the United Kingdom “hopefully sometime very soon”.

Will the UK’s decision to leave the European Union affect this ambition? “Of course Brexit will be a consideration,” he says, “but I’d hope that an innovation like this would be something that attracts investment, independent of politics.”

At Swansea University, a team of scientists led by Dr Moritz Kuehnel is working on a chemical process to convert plastic waste into hydrogen. The process, “photoreforming”, involves adding a light-absorbing material to plastic waste before placing it in an alkaline solution, which is then exposed to solar energy. “We have developed a special coating made from cadmium sulfide,” Kuehnel explains, “that makes the [plastic] very robust and highly active for photoreforming when placed into alkaline water, which is water containing sodium hydroxide.”

The Plastic waste, Kuehnel says, is cut up into more manageable-size strips. The “photocatalyst” is then applied before sunlight or a simulator lamp is shone onto the solution. “Upon irradiation with sunlight, the quantum

Could a car really run on carrier bags?

dots form a charge-separated state characterised by excited electrons and holes, similar to a solar cell, where excited electrons and holes are used to generate electricity. The excited electrons convert water to hydrogen. The hydrogen gas forms as bubbles and evolves from the solution.”

As traditional mechanical recycling plants use “expensive and time-consuming” cleaning and sorting processes to separate plastic waste by quality and type, Kuehnel claims that chemical methods of recycling can avoid this issue altogether. He points out that the residue of whatever a plastic container used to hold, “for example grease or oil”, can cause complications for recycling. “The sorting and cleaning of plastics is very costly, and the actual recycling process requires energy, namely heating. In contrast, photoreforming only uses sunlight as an energy source, so it does not actually need additional heating. Photoreforming always produces hydrogen, so the type of plastic doesn’t matter so much, although certain types of plastic are more readily degraded than others. Contamination on the plastics is not a problem, because the contaminants are similarly photoreformed to hydrogen. In a previous study, we have demonstrated photoreforming of other types of waste, meaning that this method is suitable for mixed waste.”

Kuehnel clarifies that his team’s aim is “not to replace conventional recycling”. Instead, they think of photoreforming as “an ideal complementary method” to deal with mixed waste, which is too difficult to separate and therefore ends up in landfills or the oceans.

So, could cars eventually run on carrier bags? “All plastics are energy-rich materials,” Kuehnel says. “They are mostly produced from petrochemicals, and common plastics such as polyethylene and polypropylene are hydrocarbons with a chemical structure similar to petrol. The problem is that we need better means to extract the contained energy from the plastic. Our work currently is at the proof of

concept stage, meaning we can generate only small amounts of hydrogen. For polyethylene terephthalate [PET], we are producing 10mg hydrogen from 1g PET, so for filling the tank of a hydrogen car, which is around 5kg, we would need 500kg of plastic waste.”

Kuehnel adds: “We are working on the scale-up at the moment with good results, but it will take some time, perhaps five to ten years, for this to be a commercial process that can compete with cheap hydrogen produced from fossil fuel reforming. We are also developing new materials with better performance and lower toxicity than cadmium sulfide, which is a very important step for a large-scale implementation. The Austrian petrochemical company OMV is supporting our scale-up activities.”

While a time-traveling, flying DeLorean might be a bridge too far, then, it seems *Back to the Future’s* foresight of energy from rubbish was not so far-fetched. But, as Peel and Kuehnel recognise, an innovation can’t be adopted overnight. Both policymakers and the public have a part to play in the future of recycling. “We need to drive the circular economy for plastics,” Peel says, “which means that we only need resources once to generate plastic products and then plastic waste, the end-of-life product, is converted back into materials to be fed back into the process.”

The issue of plastic pollution has caught the public’s attention with harrowing documentaries such as David Attenborough’s *Blue Planet* putting the spotlight on the scale of the problem for the planet’s oceans and wildlife. “Any government policy,” Peel recommends, “should reflect these environmental concerns” with investment in chemical recycling and changes to the infrastructure so that there is better separation and sorting of plastic waste. “Plastic Energy has proved the concept with its plants in Spain, so those responsible for regulation and infrastructure [elsewhere] now need to catch up.”

Harnessing the power of renewable energy

Nick Brown, head of sustainability at Coca-Cola European Partners, explains what the company is doing to reduce its footprint, and be part of a greener future

IN ASSOCIATION WITH



At Coca-Cola European Partners (CCEP), sustainability has been at the heart of our business for many years. We understand that climate change is one of the most serious and complex challenges facing the world today and we're committed to playing our part in tackling the issue.

In line with this commitment, we launched our pan-European Sustainability Action Plan *This is Forward* in 2017 – setting out how the Coca-Cola system is taking action on climate change, amongst other key areas such as packaging waste and water scarcity. This is a critical part of our long-term business strategy and provides clear direction on how we intend to use our business and our brands to build a better future.

As part of our “Action on Climate” commitment, *This is Forward* sets out ambitious new carbon reduction targets, whereby we aim to cut greenhouse gas emissions from our core business by 50 per cent, and by 35 per cent across our entire value chain by 2025. In Great Britain we are making good progress, having already reached a reduction of 54 per cent and 34 per cent respectively this year. This is the result of many actions across our supply chain, including investment in renewable energy, more efficient coolers and vending machines, and increasing our use of recycled materials, which themselves have a lower carbon footprint. Behaviour change is also a key factor so we are ensuring energy efficiency remains

front of mind for all colleagues.

In Great Britain, 100 per cent of the electricity we purchase now comes from renewable sources, an important milestone that we reached in early 2017. One example of this is an eight-hectare solar farm that directly supplies our site in Wakefield, Yorkshire – the largest soft drinks factory in Europe – as part of a long-term power purchase agreement (PPA). Last year, it generated 3,719 MWh of electricity, covering 13 per cent of the site's total electricity use, and cutting the factory's carbon footprint by approximately eight per cent.

More recently, we installed a heat recovery system at our Edmonton site which has already led to a ten per cent reduction in gas use at the factory. While ensuring that our manufacturing operations are as sustainable as possible, we make it our priority to continue these measures throughout our supply chain – including the way our products are stored and distributed. The introduction of automated warehouses has allowed us to store more products on-site, reducing transportation to third parties, significantly reducing road miles. Our latest of these facilities – opening in 2019 – will help to reduce our Sidcup site's carbon footprint by nearly 4,000 tonnes of CO₂ per year.

In light of our strong decarbonisation programme and continued work to minimise the environmental impact of our operations, we're proud to have been listed on the Dow Jones Sustainability Index (DJSI) in 2018 for the third year running.

While we're pleased with the progress that's been made to date across our operations, we understand that there is much more to do in addressing the key sustainability issues facing our business, wider industry and society as a whole. We therefore look forward to working long term with suppliers, partners and stakeholders to continue innovating in this area and building towards a lower-carbon future.

Imagine more energy

Shell is looking to the future of energy and making a habit of thinking big, but significant barriers to energy reform remain in place

IN ASSOCIATION WITH



Central to any discussion on the future of vehicles is energy and how it is stored. Many of the conversations centre around existing technology for battery power, and are based on “known knowns” in 2018. To make any sensible progress it’s important to base assumptions on reality but before embarking on any energy project it’s worth considering how much battery power has developed in recent years compared to that which might have been anticipated. There are laws of physics that dictate there will be no short-cuts available when it comes to moving parts transporting a certain weight along a given surface but there may be mitigating variables.

For example, as futurist and CEO of think tank Fast Future Rohit Talwar points out, there are alternatives. Wireless charging happens with phones and it’s entirely possible that it could apply to the world of vehicles. Solar roads may become a reality and more important, and then there are the energy and resources that go into making a car,

but when people bring these subjects up they can be stifled. “We’re so imprisoned in the old ways of doing things that when someone suggests something disruptive we start thinking, how can we incorporate this into the old systems.” His view is that we need to get beyond that and start embracing the idea that things will indeed change.

This is part of the backdrop against which Shell is working on future emerging technologies. Its *Sky Scenario* publication is dedicated to describing a technically possible but challenging pathway for society to achieve the Paris Agreement goals, and concerns some of the more challenging elements of energy production in future. It outlines tough objectives for society including making carbon emissions decline after 2035 faster than the rate of growth in the century so far, an ambition the company describes as “eye-watering” whilst acknowledging that it has to be achieved. It involves numerous drivers and they are not all technical; first the mindset of the entire society has to





change so that people want low-carbon, low-emission fuel; it requires a step change in the efficiency of fuel consumption and governments acting in concert to embed the true cost of CO₂ within products. Rates of electrification of final energy will need to more than triple, new energy sources will need to grow fifty-fold, and there will be a need for 1000 new carbon capture and storage facilities and net zero deforestation.

Perhaps “eye-watering” was an understatement, but this is what Shell believes the world needs to achieve against a backdrop of increasing energy demands and consumers wanting the latest and best of everything, always, with £1000 phones regarded as disposable after a couple of years. The dichotomy is obvious and damaging.

The company is also investigating uses of carbon dioxide, derided in the popular imagination as the source of all greenhouse gas (this is a simplification as water vapour and methane also play their part). CO₂, however, can be captured and deployed in industry; it is

used in beer, food production and in agriculture in combination with other things; work out how it can be captured before reaching the ozone layer and a great many issues will be addressed. Methane also has potential as a fuel.

The *Sky Scenario* calls for a different approach to car use as well. Sharing vehicles would allow a reduction not only in petrol and emissions but in the manufacture of batteries and other components. Other vehicle innovations may become possible. Cars spend 90 per cent of their time parked, so the resources involved in manufacturing them are substantially wasted on something ornamental in people’s driveways; while it is not an alternative to reducing the numbers of vehicles, Talwar points to 3D printing processes which – once they have been refined to the Nth degree, and this is a process rather than an end point – they could become cheaper to make and the raw materials more easily recyclable into new models than they are now. Variables such as the power required to make this happen will need

to be assessed as the technology becomes available. Again, allowing for the notion of disruptors rather than evolutionary nudges in the development of better fuels and processes.

The forecasts and targets (for example the government targets to end new diesel and petrol car sales) in the motor industry at the moment point mostly towards the year 2040, with a number of commentators and industry participants saying they are in fact aiming for 2030. This is laudable and nobody should criticise – but they are in the future and technology can take some unexpected turns. Talwar believes the approach needs to be as flexible as possible – the idea of a motorway with an induction rail or some sort of solar capture technology, a car park with a cable-free charging station, hydrogen, an as-yet unpredicted way of harnessing marine power or methane – none of it should be discounted immediately.

For the foreseeable future the research continues on battery power, spreading access to it and improving battery life. The thing is, the future may not be as foreseeable as we think. “If we take all this into account we could be starting with a very different mindset,” says Talwar. “It’s really difficult to think about the choices people who haven’t been born will make about technologies that haven’t been invented, working in jobs that don’t yet exist – let alone how they will transport themselves to work.”

But that’s what the forecasters have to do. Shell and its competitors appear to have shown a lot of willing in terms of reinventing themselves as energy companies rather than oil giants; the next few years will be testing in terms of how profound that move will need to be; a lot will depend on society reaching the Paris Agreement’s global warming target which is proving politically as well as technically difficult.

It should be understood that Shell’s Sky scenario is not intended as a forecast of future events but as an aim; investors should not rely on the document when making investment decisions with regard to Royal Dutch Shell plc securities.

Why fracking needn't be in anyone's back yard

James Heappey MP, chair of the APPG on renewable and sustainable energy, says the North Sea can provide the UK with a suitable gas stopgap as the full transition to renewables is completed

In Somerset, where my Wells constituency resides, we've been wrestling with the threat of non-conventional gas extraction. Early license areas were on the Mendip Hills, where the old coalfields possibly offered opportunities for gasification of coalbed methane. The licenses were held for a while, a few rumours of exploratory wells circulated but nothing was ever drilled, and then the licenses were given up. The geology wasn't suitable and locals breathed a big sigh of relief.

More recently, licenses have been offered over on the Somerset coast. Most were never taken up but a few have been bought by Southwestern Energy, a small gas company based in South Wales. The geology of the Somerset coast doesn't look to be the most profitable place for gas extraction and – even if the seismological impact of fracking is as low as claimed – that sort of activity in close proximity to a nuclear power station doesn't seem like the most sensible thing either. Needless to say it is strongly opposed in our county.

Many of my Conservative colleagues are similarly challenged by the possibility

of fracking arriving in their area. This might be dismissed as nimbyism by some but our job is to stand up for our community and to reflect the opinion of local residents. Besides, there is a very legitimate question over whether the economic juice is really worth the political squeeze.

The proposal to allow exploratory drilling as permitted development must be decided against. I often draw parallels between the onshore wind industry and fracking as there is a clear inconsistency in the government's position. They both excite opposition in the areas where they are proposed, although it may well be that there are some areas where communities can be persuaded that there is a benefit in having them. To say that we're squashing one industry because people don't like it whilst making it much easier for another, equally disliked, industry is horribly inconsistent, and undermines the argument that we're making decisions based on facts rather than emotion.

I've made the case for rehabilitating onshore wind by insisting that the planning process must be robustly



**The Cheddar Gorge,
Mendip Hills, Somerset**



stacked in favour of the communities that might host it. If they don't want it, they don't have to have it, end of. We certainly can't allow a return to the days of smirking planning agents fiddling with their phones whilst district council planning committees said "no" because they knew that direction from DECC would almost certainly mean that the decision was overturned by the planning inspector. We should apply exactly the same logic to applications to frack. If developers can make the case, fine. If they can't, then they can't.

Yet fracking is not just a planning decision. There are also concerns over the long-term value of the industry to the UK as we seek to decarbonise. Make no mistake, we need gas for the foreseeable future as a fuel for heating and to generate electricity, but that should not be conflated with the entirely separate issue of where the gas comes from.

Current geopolitical tensions might suggest that we're better to have an entirely sovereign gas supply, although for my money it's hard to see our relationships with our most likely suppliers materially changing anytime soon. Others might argue that gas extraction elsewhere in the world might be done to lower environmental standards and so any satisfaction we might feel over fending off fracking here should be offset by guilt over the way the gas industry operates elsewhere. The Treasury would also argue that tax revenues from gas extraction are very helpful too.

There will be some who say that the simplest answer is to transition immediately to renewables and other zero-carbon technologies so that our gas demand falls to zero. Most serious policymakers know, however, that even the fastest of transitions requires gas as a bridging fuel for the next 20 years or more and so we must be realistic about the need to guarantee our gas supply for some time yet.

The solution I propose is that we continue to incentivise late-field exploitation in the North Sea, where there are already communities that

depend on and support the industry. The Chancellor announced a welcome change to tax liabilities for decommissioning last year and there is arguably more that we could do to re-grow the gas industry. That also brings the welcome outcome of shifting decommissioning costs to the right, realising a significant saving for the government in the meantime. For those who fret about the security of our gas supply, the lower environmental standards applied by the industry overseas, or diminishing tax revenues for oil and gas, those problems are solved or at least mitigated.

More importantly, it means we're not wasting political capital and policymaking bandwidth on fracking when there are so many other things that we could be doing to expedite our transition away from oil and gas altogether.

Electrifying our heat and transport networks will significantly reduce our dependency on hydrocarbons. Moreover, all the clean tech that would then be on our roads or in our homes and businesses as a result of that transition would deliver a huge amount of flexibility – both storage and demand response – that changes the current argument over the need for dispatchable gas-fired power.

We must also be looking at the opportunity to deliver a hydrogen economy in the UK too. Many argue, and I tend to agree, that we can't electrify everything and that we have a very valuable piece of national infrastructure in our gas network that we'd be mad to throw away. I'm certain that electrification technologies will win out no matter what the government does – particularly EVs but also generation, storage and smart-enabled demand shifting behind the meter. However, hydrogen will require quite a lot of political will to get it going.

The rewards are huge. There's a big industrial opportunity, it answers the thorny issue of inter-seasonal storage and it catalyses the arrival of carbon capture and storage. I'd strongly argue that is a better place for us to be focusing our political and policy making efforts rather than wrestling with voters over the fracking debate.

Electrification is a gradual process

SHUTTERSTOCK/LORENA TEMPERA

The UK is ready for the Sweden energy effect

Danielle Lane, country manager at Vattenfall UK, explains why UK customers are crying out for credible low-carbon suppliers

When I joined Vattenfall in spring this year, three things jumped out at me.

First was our UK growth story. The second was our determination to forge a future free from fossil fuels within a generation, and how that is transforming our business. And thirdly, being a state-owned Swedish energy company, there is a definite Swedish way of doing things.

Like many others, Vattenfall has been encouraged to invest in UK wind power – on and offshore – because of the determination of successive UK, Scottish and Welsh governments to take carbon out of the economy and people's lives as quickly as possible. Over the last decade we have invested £3.5bn and built 11 wind farms. Collectively, they can produce enough power, in an average year, to meet the equivalent electricity demand of around 700,000 UK households. Our inward investment has led to the creation of thousands of jobs in the UK and supported thousands of UK businesses.

Looking ahead, we will continue to grow our renewable power capacity – we have a significant pipeline in the UK and seek innovative solutions for large-scale solar power farms and battery storage co-located with wind farms. If we build all this pipeline Vattenfall will be able to meet the electricity needs – based on current consumption – of 3.6m UK households.

And our leadership and expertise in Northern Europe in district heating, electric vehicle charging, and smart grids has now been brought to Britain.

We believe our commitment to large-scale, fossil-free district heating has the potential to bring to Britain what is quite normal in many cities on the continent. We set up Vattenfall UK Heat earlier this year and we are already actively seeking partners around the British Isles to help deliver on the district heating sector's potential.

Similarly, with transport, we are using our European expertise to expand our InCharge electric vehicle business in a very exciting UK market. After launching InCharge in early summer this year, we expect to announce our first partnerships and public charging station roll-out very soon.

In power distribution, we want to deliver smart, independent networks which will help businesses to reduce cost by helping manage their networks better. Late last year we set up Vattenfall Networks Limited, after Ofgem, the regulator, granted us a licence to own and operate independent distribution networks.

Looking further ahead, we hope the research we are conducting in Sweden with our partners on the electrification and cleaning-up of the steel production process could be used by UK steelmakers. The HYBRIT partnership is world leading and hopefully will provide fossil-free solutions for what seemed an intractable problem a few years ago for much of heavy industry.

If we look right across our British businesses, it is clear that in the past 12 months, standing on the shoulders of our ten-year-old wind business, Vattenfall has made a significant commitment to grow in Britain.

That's where our Swedish way of doing business is the key to success; there is an openness here, a real desire to be inclusive, for consensus, for partnerships because we know we don't have all the answers, to be responsive to customer and societal need, and to have a clear purpose and long-term vision. These traits are not exclusive to Sweden, but these are the qualities I have found in the past six months at Vattenfall.

IN ASSOCIATION WITH

VATTENFALL 



Fossil-free in a generation

Vattenfall is a leading European energy company that for more than 100 years has electrified industries, supplied energy to people's homes and modernised our way of living through innovation and cooperation.

We now want to make fossil-free living possible within one generation. Therefore we are driving the transition to a more sustainable energy system through growth in renewable production and climate smart energy solutions for our customers.

Vattenfall is present across most of Northern Europe and one of the leading companies in renewable energy production. We see things in a broader perspective - the need to power the change to fossil free fuels beyond our own production

- and are committed to act on it on a much broader scale. We take our responsibility to find new and innovative ways to not only power the lives of our customers free from fossil fuels, but also, together with partners, electrifying core industrial manufacturing processes, transportation and other areas where we can eliminate or reduce the use of fossil fuels significantly, outside our own industry.

Climate change is a global challenge which requires broader solutions. Using our engineering capabilities

across all parts of the value chain, from production, distribution and retail, we are well positioned to develop solutions and innovations that take us toward our goal. That's why we can help our customers be more energy efficient, adopt smarter technologies to create their own electricity or heat and switch to cleaner alternatives that are affordable and easy to use.

The new industry of building stars

Nuclear fusion could offer the world clean and effectively limitless power. Will Dunn meets a new breed of British businesses trying to crack energy's hardest problem

The Culham Centre for Fusion Energy in Oxfordshire is a set of large buildings with the unshowy, municipal appearance of a university or a hospital. But while hundreds of doctors – their PhDs mostly in physics, maths or engineering – walk the squeaking lino of its corridors, there are only two patients. Called MAST and JET, they appear as massive, roughly cylindrical assemblies of metal plates, wires and pipes. The larger of the two, JET, sits behind a pair of concrete doors that weigh 800 tonnes apiece. They are experimental reactors for testing nuclear fusion, the process by which stars release their energy.

Almost all human history has been powered by fusion, indirectly. Every plant that has ever been eaten, burned or fed to an animal used sunlight to make its energy, and all fossil fuels were once plants or animals. Fusion is arguably the

universe's most fundamental process. If it can be created and controlled on Earth, it will offer humanity an effectively limitless supply of clean energy.

For the last 50 years, the investigation of controlled fusion has been done almost exclusively in large, government-funded projects such as the Culham laboratory. There are good reasons for this; a working fusion power station is still a long way off, and the science is extremely difficult. For one thing, it requires a vessel that is capable of holding a substance hotter than the core of the Sun.

This substance is called plasma. There is no material that can survive contact with plasma heated to millions of degrees, so the JET and MAST reactors contain it with very powerful magnetic fields. Both are “tokamak” reactors – the word is shortened from a Russian phrase, and the design is Russian in origin – which





means they hold plasma in a toroidal, or ring-shaped, magnetic field.

Tony Donné, the programme manager of Eurofusion, says that the research being done on the larger JET (Joint European Torus) reactor has two aims. “The first is to improve the plasma performance inside the machine” to make the fusion happening inside more powerful, and more controlled. “The second [problem] is the heat exhaust, which is one of the larger problems in

“You could lie these plates on the Sun”

fusion.” Even after cooling within the reactor, Donné explains, the heat exhaust in a tokamak can be “of the order of 10MW per square metre; it’s roughly the power flux that you have at the surface of the Sun. So these materials here” – he gestures to a series of metal plates, inches thick – “you can lie them on the Sun”.

Lorne Horton, head of the JET Exploitation Unit, says that JET is “the only operating device in the world at this scale. We can get conditions in the plasma that are closer to where we need to be” – hot enough that more power comes out of the reactor than is put into it – “than anywhere else”. For the moment this is true, but as Culham’s scientists – of which there are around 1,500 working on fusion – branch out, a number of private companies are starting to speed up the race for the energy source of the future.

Great balls of plasma

In a warehouse a few miles from Culham, a smaller but still formidable reactor – it stands around 15 feet high and fills most of a large room – has been built by a company called Tokamak Energy.

“Innovation comes from diversity,” explains David Kingham, Tokamak Energy’s co-founder and executive vice chairman, “and if one approach is not challenged at all, progress is going to be slower than if there’s a bit of rivalry and challenge, collaboration and competition.”

Kingham says the company was born from a shared frustration with the slow pace of fusion development. In the 1980s Kingham’s co-founder at Tokamak, Alan Sykes, showed that in theory a “spherical tokamak” – a reactor in which the plasma is held in a ball-like shape, which Kingham describes as a “cored apple”, rather than a the doughnut-like ring of the standard toroidal reactor – could be a more efficient design. Sykes worked at Culham at the time, and when he could not raise the means for a fully funded experiment to prove his theory, Kingham says Sykes “ferreted around the laboratory, found spare parts, and built the START spherical tokamak.”

Sykes and Mikhail Gryaznevich, “an expert in the physics of small tokamaks” who was recruited from the former Soviet Union, spent years working on the START reactor, setting records for important factors in fusion research such as plasma pressure. “Plasma”, Kingham explains, “is a squashy, awkward sort of thing” that “wriggles” under pressure, but massive pressure is crucial to creating the conditions necessary for fusion.

As in the large reactors at the Culham laboratory, this pressure is exerted using huge electromagnets. Some of these magnets – copper bars the size of railway sleepers – can be seen on the sides of the latest Tokamak Energy reactor. But these magnets present an engineering problem, in that copper, while it is a very good conductor of electricity, does provide some resistance. After less than a second at the power needed for fusion, copper magnets begin to get very hot indeed.

In 2012, Kingham, Sykes and

↳ Gryaznevich realised they could build magnets from another material. “A new superconductor was just coming onto the market in usable quantities,” remembers Kingham. Producing a strip of light, silvery metal tape, he explains that a single strip can hold thousands of amps of current, “if you cool it to around 20 degrees above absolute zero”. In terms of superconductors, “high temperature” is still very cold.

These magnets are now the company’s “particular expertise”. The longest any large, government-funded tokamak has maintained plasma is six and a half minutes, but using superconducting magnets, Tokamak Energy was able to get its spherical reactor to hold plasma for 29 hours. “It wasn’t wonderful plasma physics,” Kingham concedes, “but it did demonstrate that the magnets worked”.

Kingham sees the smaller, spherical reactor as a more realistic proposition. At eight to ten metres across, Kingham says a spherical tokamak could produce 150MW of power; Ofgem estimates that 1MW is enough to power 2,000 homes, which would enable a “small” reactor to power a city the size of Plymouth or Derby. He also thinks a reactor this size would be a better fit for the power grids of the future. “As increased amounts of wind and solar are added,” he explains, “you’ll need controllable power sources at the 100-megawatt, rather than gigawatt, level.”

“Plus, there’s the economics of it. These huge, Hinkley Point-scale devices are a huge expense, so they’re very challenging to get private finance into. Someone has to pay a premium, somewhere.” In the case of the Hinkley Point C power station, this someone is the consumer, who will pay the plant’s pre-agreed “strike price” for 35 years. The National Audit Office has estimated the extra cost of this policy at £50bn over the market price of the electricity.

While the government supports fusion research, Kingham says that “the publicly funded fusion projects think that they are in the 1960s, and someone has to get to the Moon... their view is that a lot more science needs to be done

before it’s time for industry to get involved. We think fusion should be in the 2010s, and it should be like the space race is today. We’d like to see that transition to a more dynamic environment of innovation.”

The shrimp and the supernova

Though barely prawn-sized, at about 5cm long, the pistol shrimp is one of the loudest animals in the ocean. It has one large claw, half as long as its body, that it snaps at its prey, creating a shockwave that can stun or even kill small fish or other shrimp. In 2000, Dutch scientists discovered that the very loud snapping noise this creates – it is so loud that colonies of pistol shrimp can disrupt military sonar – was created not by the animal’s claw, but by what it does to the water around it. When the shrimp’s claw moves through the water it creates cavities – bubbles of air and water vapour – in the liquid. At the same time, the moving part of the shrimp’s claw displaces a jet of water that smashes into the expanding bubble at more than 30 metres per second. This causes sudden compression of the gas inside the bubble, creating a tiny spark of hot plasma.

Within the cavity, though it is minuscule and lasts a thousandth of a second, the gas reaches more than 4,700°C.

For Nicholas Hawker, co-founder and CEO of First Light Fusion, the pistol shrimp is an inspiration. It is one of only two examples of “inertial confinement” known in nature. The other happens within a supernova, the explosion with which some stars end their lives. In both cases, he explains, “there’s nothing holding the plasma together – no big magnets, or external forces”. Instead they are “transient phenomena, these very high-pressure, high-temperature, high-density states of matter, and they’re held together for a very short amount of time, simply by their own inertia. Once assembled, it just takes a certain amount of time for it to disassemble.” First Light Fusion is Hawker’s attempt to make fusion happen in the same way – momentarily, in bubbles.

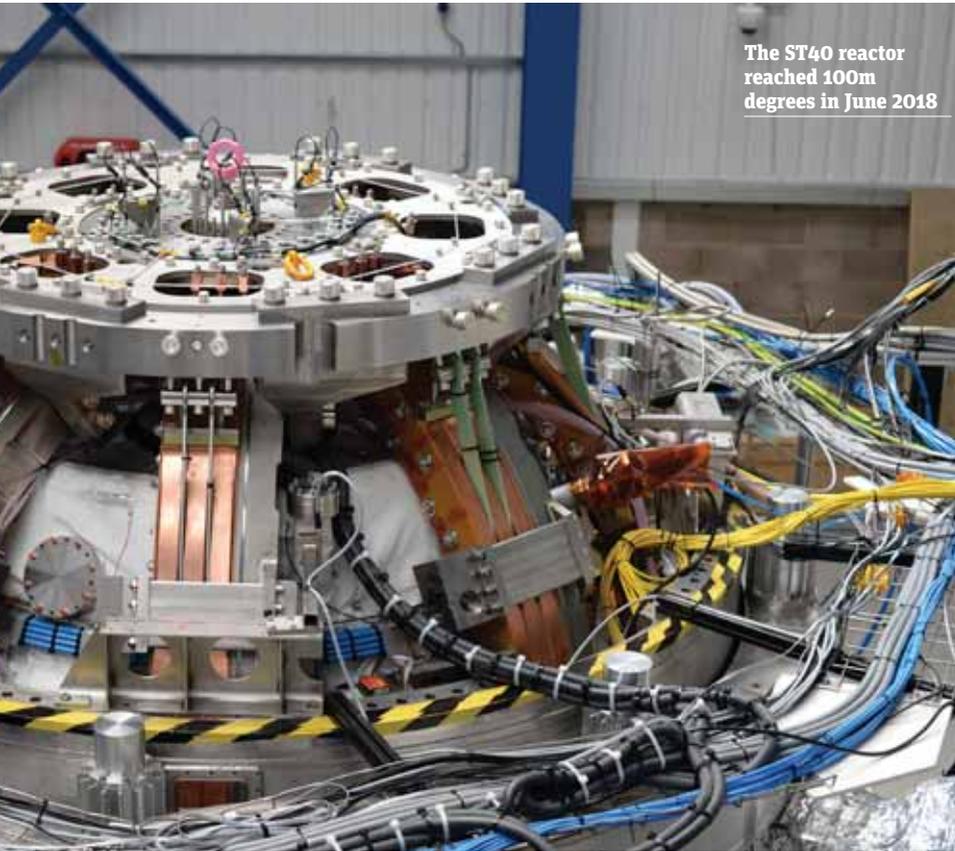
In layman’s terms, Hawker’s plan is



that rather than creating a large chamber, like the JET reactor, in which hydrogen is held and heated to 200,000,000°C, he will take a tiny bubble of hydrogen and, like the pistol shrimp, he will shoot it. Except, instead of a claw, he will use an enormous gun made of magnets.

“We separate the fusion process into two parts,” he explains. “One is the target, and the other is the driver. So our target is inspired by shock-driven cavity collapse, and then the way we want to cause that collapse to happen, and the way to create that shock wave in the target is with a high-velocity projectile.”

The “target” Hawker describes is a one-centimetre cube of plastic, a bit like a dice, that contains a bubble two or three millimetres across. The “projectile” is a one-centimetre disc of metal, a bit like a penny. Hawker’s machine will use a huge electrical pulse to launch the penny at the dice at 20-30 kilometres per second. When the penny hits the target,



The ST40 reactor reached 100m degrees in June 2018

A single “shot” releases energy equivalent to a barrel of oil

it “creates a high-pressure shockwave, and that drives the cavity inside the target to collapse”, even faster than the projectile was travelling. As in the bubble created by the shrimp, the contents of the bubble are compressed to a superheated plasma. Except this time the bubble is much hotter, and it contains deuterium gas. As the deuterium nuclei are forced together, they fuse, releasing a burst of neutrons that can be used to generate electricity.

This may sound like a tremendous effort to go through for a waft of subatomic particles, but the energy released from fusion is so great that it could, Hawker believes, represent a serious power source. By First Light’s calculations, “each target would produce the same amount of energy as a barrel of oil.” In a power station, a target would be loaded into a chamber every ten seconds and shot, generating enough electricity to power thousands of homes. “You are

going to get through a lot of targets - but think of the engineering effort that goes into producing a barrel of oil, and that’s still economically worthwhile.”

“We think there are some really interesting advantages of doing this, what sounds like quite an esoteric, thing”, says Hawker. “We’ve dodged two of the biggest engineering challenges for the tokamak – the heat flux, and the neutron damage to the sensitive parts. It’s super simple in comparison to what you have to have for a tokamak.”

All the same, Hawker says he will leave building the power station itself to “established engineering firms, who have decades of experience in managing huge projects. We’re going to be the team tackling the hard physics – which is all in the target. Our business plan is that we would manufacture the targets on-site, for the operator of the plant.”

This approach offers what everyone working in fusion craves – speed. Because First Light’s engineering is simpler, Hawker thinks a “first-of-a-kind” reactor, one that generates more power than it consumes, could be ready in as little as 12-15 years. While Hawker admits the “physics risk” of First Light’s technology is greater – meaning the risk that fusion will be harder to reliably produce or control – it’s an approach that, if it does work, could be much quicker to develop into a new form of clean energy.

Back at the Culham laboratory, teams of scientists and engineers are running tests that will inform the design of a new internationally-funded reactor, ITER, now being built in France. More than physics papers, engineering solutions or even neutrinos, however, the Culham laboratory is producing something it has produced in great quality for half a century: people with the knowledge and the desire to bring clean power to the world. As these people move out into other facilities and businesses, they are gradually building something more than a reactor. “What’s interesting,” observes Nick Harker, “is that there are actually startups, whereas 15 years ago there weren’t. Now, there’s a community.”

ENERGY

The latest contracts, jobs and ratings

THESE CONTRACTS ARE NOW OPEN FOR TENDERS

Crown Commercial Service

Heat networks and electricity generation assets

Contract value: £800m

Bid deadline: 12th November 2022

The CCS is looking for partners to provide electricity, heating, solar and nuclear energy across a range of UK locations on a four-year contract.

Contact: helgadps@crowcommercial.gov.uk

Greater London Authority

Technical assistance team for the London Homes Energy Efficiency Programme

Contract value: £3.4m

Bid deadline: 4th December 2018

The GLA seeks private partners to assist a project to develop energy efficiency products for newly built homes and to retrofit existing London architecture with smarter equipment.

Contact: claudianewman.cpt@tfl.gov.uk

Department for Business, Energy and Industrial Strategy

Clean Growth Fund

Contract value: £10k-£3m

Bid deadline: 18th December 2018

BEIS is inviting innovative energy-related startups to bid for a stake in the £20m's worth of equity funding for the government's Clean Growth Strategy.

Contact: cgf@beis.gov.uk

Total value: £823.4m

Tender and framework data supplied by



THE LARGEST CONTRACTS OPEN FOR BIDS SOON

"Pre-Information Notices" give advance warning of contracts that will soon be open for tenders.

Efficiency East Midlands

EEM will enter a framework with multiple contractors for the production and installation of electric vehicle charging infrastructure across Leicestershire, Derbyshire and Nottinghamshire.

PIN value: £50m

Department for Business, Energy and Industrial Strategy

The offshore renewables decommissioning team within BEIS will seek to appoint specialist support to advise on industry proposals for safe decommissioning a range of offshore renewable infrastructure, including windfarms and tidal energy technologies.

PIN value: £73,000

Department for Business, Energy and Industrial Strategy

BEIS are creating a new innovation competition that will fund the development of new business models

that scale up the delivery of energy efficiency building or retrofitting/ refurbishment projects in the non-domestic sector.

PIN value: TBC

Total value: £50.073m

ENERGY JOBS NOW OPEN FOR APPLICATIONS

Greater Manchester Strategic Area Lead, Department for Business Energy and Industrial Strategy

Salary: £46,800-£55,116

Location: Manchester

Closing date: 5th December 2018

BEIS is looking to recruit an experienced civil servant to oversee energy-related policymaking related to regional growth in the North West. The post-holder will work closely with the Northern Powerhouse, HS2 and local businesses.

Energy Pricing Analyst (British Gas), Centrica

Salary: £30,000-£45,000

Location: Staines

Closing date: Ongoing

The post-holder will be responsible for helping to design pricing tariffs for British Gas, sensitive to market competition, and work on renewal offers.

THE BEST ENERGY SUPPLIERS FOR CUSTOMER SERVICE

According to the latest survey by Citizens Advice, these are the top ten energy companies for customer service, rated on a scale of one to five, measuring criteria such as dealing with complaints, easiness to switch to, and delivering clear bills on time.

1. SO ENERGY	NNNNN	4.7
2. BULB ENERGY	NNNNI	4.35
3. OCTOPUS	NNNNI	4.3
4. BRITISH GAS	NNNNI	4.25
5. EDF ENERGY	NNNNI	4.05
6. GREEN NETWORK ENERGY	NNNNI	4.05
7. SSE	NNNN	3.95
8. TONIK ENERGY	NNNN	3.95
9. BRISTOL ENERGY	NNNN	3.85
10. UTILITY WAREHOUSE	NNNN	3.8

Plastic straws are easy; saving the world is hard

At the 2018 Commonwealth Heads of Government Summit, Theresa May declared plastic waste to be “one of the greatest environmental challenges facing the world”. Since mass plastic production began in the 1950s, scientists believe 6.3bn metric tonnes of plastic waste has accumulated, which will rot away for the next 400 years, or more, until it eventually biodegrades.

May is right; it’s an almost incalculably huge problem. “The UK government is a world leader on this issue,” she continued. “Today we have put forward ambitious plans to further reduce plastic waste from straws, stirrers and cotton buds.”

Any reduction in plastic waste is an important step in the right direction, as is any reduction in one’s carbon footprint. So, despite the fact that paper straws seem to get soggy within three slurps (also aren’t the rainforests in short supply?), fewer plastic straws is a good thing. But of the eight million tonnes of plastic that end up in the sea each year, plastic straws only make up 0.025 per cent, and this straw backlash is at risk of being a massive distraction from the monumental amount of banning that needs to take place to protect Mother Earth.

You may have a little collection of plastic bottles on your desk which you patiently refill, or even a posh metal one, but worldwide the amount bought per year is expected to jump by 20 per cent by 2021. Since Theresa May’s announcement, McDonald’s has pledged to get rid of plastic straws – the company uses 1.8m a day in the UK –



To reverse environmental disaster, change needs to be more extreme, writes Augusta Riddy

but the company serves millions of beef burgers a day; beef production can produce as much as ten times the amount of greenhouse gas as plastic production.

In August, a group of scientists told the UN that “self-sustained low-emission [energy] production and consumption runs contrary to the currently dominant world political order”. Essentially, the global capitalist system in its current form will not deliver the transformation so desperately needed to prevent the appalling effects of climate change, and eventual climate catastrophe.

Diligently padding out to the bins every week with a pile of clean plastic does not mean it’s guaranteed a new life (but don’t stop doing that); only nine per cent of all plastic has ever been recycled. What’s more important is that a product like plastic that takes (minimum) 400 years to break down shouldn’t be being produced at the intense rate it is. Scientists believe it is now even forming its own geological sediment.

The climate change non-profit CDP Worldwide published a report last year which claimed that just 100 companies are responsible for 71 per cent of all global emissions; it’s clear that an unprecedented level of state intervention at source, which ignores the interests of private companies and individual consumers, is needed. Jeremy Corbyn declared in February that in order to take the fight to climate change, the next Labour government would need to be “at least as radical” as the post-war Attlee government. Can capitalism be radical enough to save the world?



equinor

How do we keep the lights on in the UK?

1



We operate offshore wind farms, invest in the UK continental shelf and maintain a reliable supply of natural gas.

We have a broad range of activities in the UK, helping meet the country's day-to-day needs. From providing half of the UK's gas needs through Norwegian pipelines, heating and powering 8 million UK homes,

and generating renewable energy for 650,000.

We are a committed energy partner of the UK, and will be for decades to come.

Statoil has changed its name to Equinor. Learn more at equinor.com/ukenergy