Reduce, Reuse, Store, and Recycle

Energy trends for 2020 and beyond

The future is becoming clear

For decades, the global energy sector has been in a state of flux, but the direction in which investment is surging has become increasingly clear; electrification, the switchover to renewables and accelerating innovation in clean energy technologies.

Sustainability – given the trans-national imperative to curb climate change – is the overriding force propelling the trends discussed in this review of the energy sector. While fossil fuels will be consumed for decades to come. But crucially, the economic tide is turning in favor of sustainability and low-carbon energy. Waves of renewable energy are swelling in the wake of the oil and coal super-tankers that have fuelled development since the industrial revolution.

After years of public subsidy and support for alternatives to fossil fuels, renewables producers are scaling up, their technologies are improving, and costs of production are falling. It is this bottom line that will power the accelerating transition of energy systems in both developed and developing countries.

Established wind and solar energy providers have already begun providing cheaper energy than fossil fuel power stations. Within a few years the investment case will tilt decisively as new-build wind and solar farms become cost-competitive with the incumbent power plants in many countries. The world's electricity system will move from two-thirds fossil fuels in 2018 to two-thirds zero-carbon energy by 2050. Of the $13.3trn to be invested in new power generation over these coming three decades, 77% will go into renewables.

That global prediction agglomerates a multitude of local trends and varying speeds of transition in different territories. Coal will continue growing in Asia – notably China, India and Southeast Asia – beyond this fuel's global peak in 2026. Cheap natural gas will drive coal out of the energy mix in the US, as global gas generating capacity doubles by 2050. In the UK, coal-to-gas conversion will also accelerate its phase-out ahead of the official 2030 target, before offshore and onshore wind, and solar, backed up by batteries, dominate the electricity market – rising from two-thirds to some 87% in the two decades to 2050. The transformation of energy systems goes furthest and fastest in Europe. **"By 2040 renewables make up 90% of the electricity mix in Europe, with wind and solar accounting for 80%,"** according to New Energy Outlook.[1]

Other powerful forces are also at work, shaping energy markets and determining how we power our industries, heat our buildings, and fuel our vehicles.

[1] New Energy Outlook 2019, BloombergNEF - https://bnef.turtl.co/story/neo2019?teaser=true

Rising demand

Both economic and population growth are energy-hungry. Global energy demand picked up in 2017 to 2.2% from its 10-year average of 1.7% as OECD (the Organisation for Economic Co-operation and Development) economies grew more quickly. Yet the developing world accounted for nearly 80% of the extra energy consumed[2]. Cheap coal and oil, where it's available, will continue to fuel these countries' growth up until the point they develop and refine the required technology or access to the West's clean energy technologies is provided.

Investing in efficiency

Energy efficiency will continue to be a major focus of investment and innovation. Since the 1970s, the International Energy Agency estimates that 11 of its member states had saved 1.4bn tons of oil, worth $743bn. Annual investment worldwide in all kinds of efficiency measures exceeds $220bn and is growing.

Decoupling energy and growth

The hope is that reducing the energy intensity of economies can more than offset the demand from growing populations and rising income levels. The shift in consumption from goods to services, which are less energy-intensive, is a major factor.

Digitalization

Digitalization and smart technologies are already starting to streamline energy use. Corporate investment in new energy technology companies is growing strongly, reaching $6bn, its highest level ever, in 2017. More generally, smart meters and grids, connectivity through the Internet of Things, and other digital solutions need to contribute.

Electrifying speed

The shift to electric vehicles will accelerate electrification of energy systems. In the UK, charging the road fleet will consume almost a quarter of all electricity used by 2050. Cooling and heating buildings will also contribute to a doubling of global electricity demand by 2050. For only the second year running, the electricity sector attracted more investment in 2017 than oil and gas.[3]

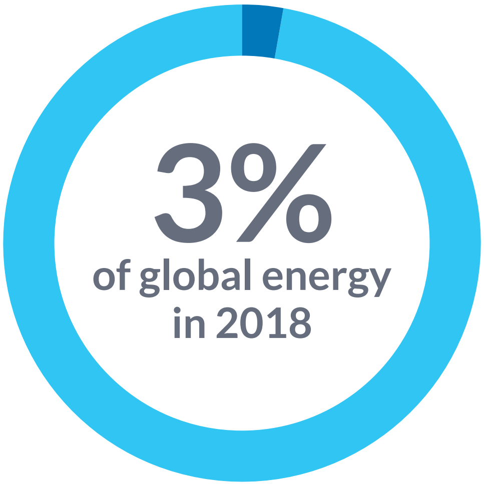
[2]https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf

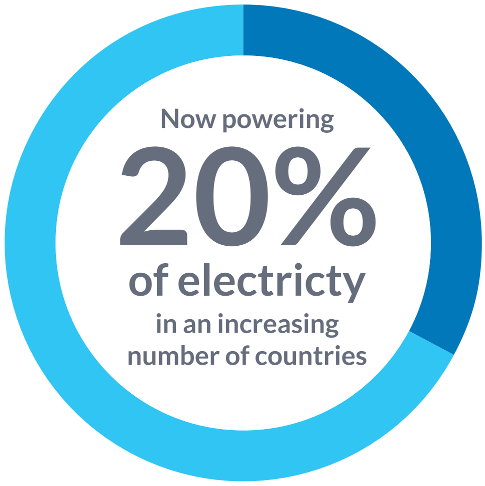
[3]International Energy Agency – Investment report 2018: https://www.iea.org/wei2018/

However, if even the most optimistic predictions for decarbonizing the energy system are achieved, along with de-intensifying demand, all this may not be enough. Carbon emissions from energy are expected to peak in the mid-2020s before beginning to take a downward trajectory. The continuing build-up in the atmosphere looks set to push global temperatures beyond the 1.5/2-degree thresholds set by the 2015 Paris Agreement. The environmental and social costs are expected to be colossal, as will the financial impacts on countries around the world. Therefore, there is an increased interest in how technological trends will play a significant role. So the stakes could not be higher as we transition to decarbonized energy systems, and these technology trends play a growing and vital part.

Into the mix

Wind & solar energy:





The changes that clean energy will demand from in the world's power and distribution systems over the coming decade will be truly transformative. Not only the terms of the debate, but also the foundations for investment decisions have shifted. This needs to be tectonic given the massive scale advantage and vested interests in oil, which supplied 33% of global energy in 2018 versus just 3% for wind and solar. However, these renewables now power more than 20% of electricity in an increasing number of countries.[4]

Previously, the question of 'peak oil' focused on supply and the planet's dwindling economically-viable reserves. Now it's about demand, given the increasingly keen competition from renewables and the pressing need to surmount the peak in carbon emissions. Investment bank BNP Paribas described this trade-off in the most stark terms for road transportation. It concluded: **"the economics of oil for gasoline and diesel vehicles versus wind- and solar-powered EVs are now in relentless and irreversible decline, with far-reaching implications for both policymakers and the oil majors".** [5]

Comparing a $100bn outlay on the oil spot market today and the same investment in new renewables projects, the latter returns 3.4-3.9 times more net energy, depending on whether it's from on - or offshore wind, or solar.

As costs of production for oil and renewables travel in opposite directions, the fossil fuel would need to trade at $9-10 a barrel to be competitive. The report concluded: **"If all this sounds far-fetched, then the speed with which the competitive landscape of the European utility industry has been reshaped over the last decade by the rollout of wind and solar power – and the billions of euros of fossil-fuel generation assets that has stranded – should be a flashing red light on the oil industry's dashboard."**

Powerful lobbying is still blocking the reversal of subsidies for fossil fuels, said to have risen globally by 11% in 2018. But the great replacement of oil, coal and (eventually) gas, is an inexorable trend, and we see further developments accelerating it.

In the power sector, renewable energy has made its greatest inroads, and is increasingly competitive with thermal generation. It accounted for more than 26% of global electricity production by the end of 2018. Lloyd's Register expects decentralized renewable energy to be cheaper than power from the grid by 2025. However, the UK government may have to drop its block on onshore wind farms to lower costs to energy consumers while decarbonizing the grid.[6]

[4] REN21 – 2019 Global Report

[5] Wells, Wires and Wheels – BNP Paribas

[6] https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/1454/145402.htm

Solar has inspired eye-catching, large-scale commercial projects worldwide.[7] In the UK, most growth will come from single-building and community-level installations, though its rate depends on the take-up for the new Smart Export Guarantee scheme.

Business and commerce can propel faster change through procurement as well as investment. Corporate sourcing of renewables more than doubled in 2018 and the pace picked up in the first half of 2019 with power purchase agreements signed for 8.6GW of clean energy.[8] Bloomberg NEF reported 12% growth with US companies leading the way and China poised for 'game-changing' corporate procurements policies.

City municipalities, whose citizens are deeply affected by toxic air quality, are adopting some of the most ambitious targets for renewables, outdoing national and state governments. There's also a case for bringing forward national deadlines for phasing out combustion engines – 2040 in the UK – as manufacturers make more ambitious commitments.

Still lacking, however, are ambitious and sustained policies to decarbonize heating and cooling. Heating in particular is open to technological disruption. The UK ban on fossil fuel heating systems in new buildings from 2025 should spawn supply chains for low-carbon heating technologies.

We expect greater investment in heat pumps, and in the medium term, development of hydrogen boilers, subject to large-scale demonstration trials. A U-turn is also likely to re-boot two policies ditched in 2015 – the zero-carbon standard for new builds and Green Deal scheme for retrofitting energy efficiency measures.

Hydrogen is expected to play a major role powering industry and heavy transport as well as the home. BloombergNEF predicts that renewable hydrogen costs could be competitive by 2030 – ideally produced by electrolysers, which extract the clean gas from water, powered by solar and wind, rather than from natural gas and coal, as with current industrial uses.

Other changes in the energy mix can be expected to come from the expansion of proven technologies as well as new breakthroughs, as the quest for the Holy Grail of energy – nuclear fusion – goes on. The International Thermonuclear Experimental Reactor (ITER) now being assembled in southern France aims to be the first to produce net energy in 2025, paving the way for commercial plants producing limitless clean electricity.[9]

Harnessing wind energy from high-flying kites may seem pie-in-the-sky, though UK Research and Innovation is funding work by a Glasgow-based company, aiming to bring kite energy to market by 2025.[10]

[7]https://www.popularmechanics.com/technology/infrastructure/g2936/11-impressive-solar-projects/

[8]https://www.businessgreen.com/bg/news/3080388/report-corporate-renewables-demand-keeps-on-rising

[9]https://www.iter.org/

[10]https://www.ukri.org/news/kites-could-create-clean-energy/

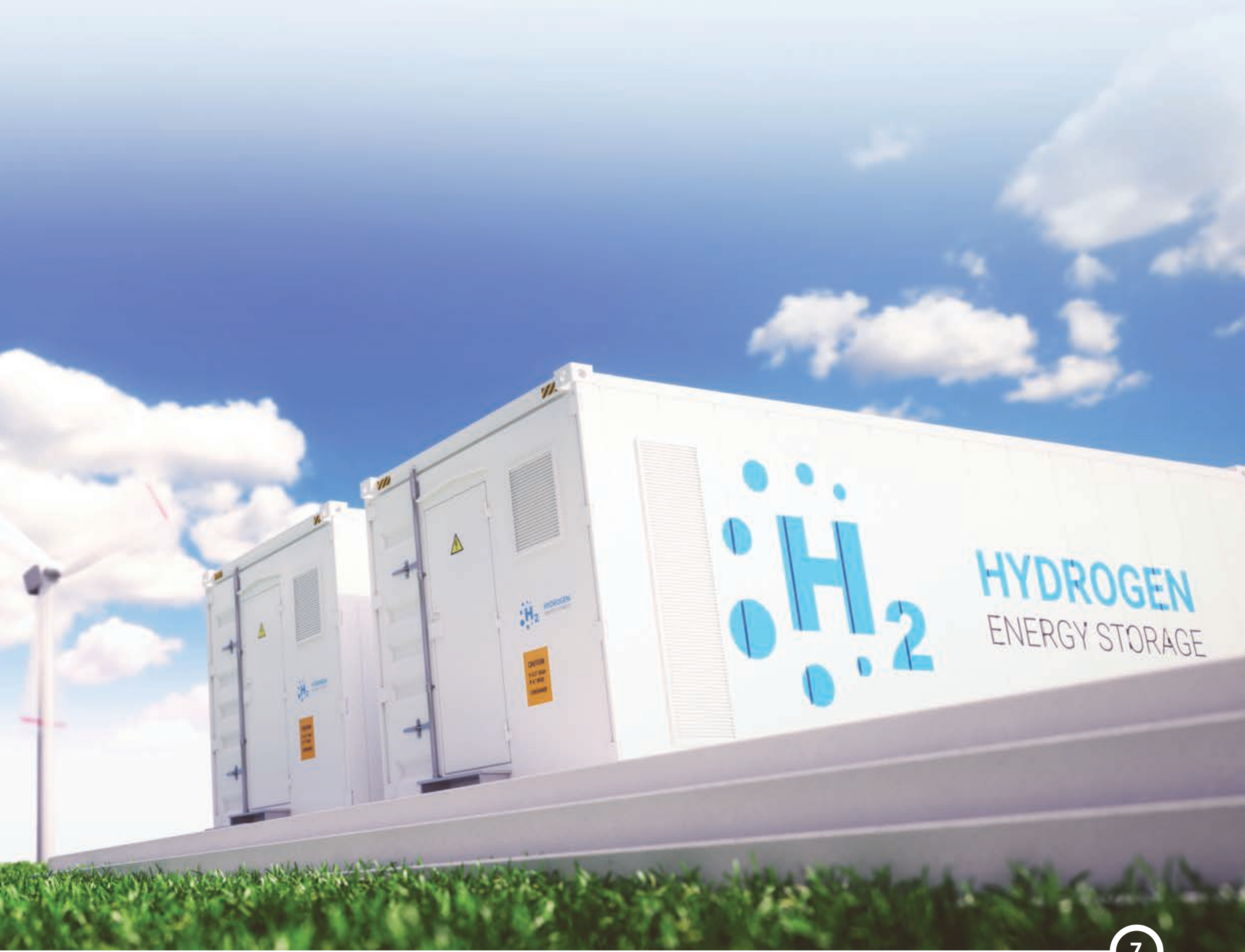
The UK government believes wave and tidal energy together can deliver around 20% of the nation's electricity needs, though it has shied away from backing tidal lagoon megaprojects. MPs have backed the industry's call for market support for developing and commercializing various innovative marine energy technologies.

Efforts to build a circular economy are driving innovation in the re-use of waste products. Waste oils are already used on a commercial basis to manufacture biofuels. Even fatbergs that form in sewers can be processed to produce biodiesel. A 130 ton fatberg under Whitechapel in London yielded around 10,000 liters of biodiesel, towards Thames Water's goal of self-generating a third of its electricity usage from renewable sources by 2020.

Waste plastics are another problem, for which hydrogen could be a smart solution. Advanced thermal treatment technology developed at the University of Chester will have its first commercial application in a £7m plant at Ellesmere Port. It will treat up to 25 tons of non-recyclable plastics daily, producing hydrogen for trucks and buses, and electricity for local businesses.

Turning waste directly into energy – through incineration – is a large and growing part of the UK's waste management industry. There are approaching 50 energy-from-waste plants in the UK. As recycling plateaus, there are still infrastructure gaps. Not only are large volumes of recyclables exported for processing, so are the majority of alternative fuels made from waste. The industry's trade body says it costs the UK £280m to export some 3.5m tons of refuse-derived fuels each year for other countries to generate energy for their own benefit, while Britain buys electricity back. Reshoring this waste would power an additional 620,000 homes here in the UK. More waste-fueled combined heat and power plants can help fill the gaps in energy and waste infrastructure.

A wider mix of sustainable energy technologies is fast emerging to take the place of fossil fuels.



[11]https://www.renewableuk.com/news/466734/MPs-call-for-Ministers-to-unblock-onshore-wind-and-champion-marine-power-to-reach-net-zero.htm

[12]hhttps://corporate.thameswater.co.uk/Media/News-releases/Monster-Whitechapel-fatberg-given-new-lease-of-biodiesel-life

[13]https://www.peelenvironmental.co.uk/news-blog/2019/4/10/uk-first-waste-plastic-to-hydrogen-project-to-be-delivered-at-protos

[14]Environmental Services Organisation – Energy for the circular economy
http://www.esauk.org/application/files/7715/3589/6450/20180606_Energy_for_the_circular_economy_an_overview_of_EfW_in_the_UK.pdf

Extra storage

Any lingering concerns about the intermittent nature of renewable energy may soon be blown away as investment in storage technologies surges.

Worldwide, energy storage capacity will multiply exponentially by 2040 to more than 1,200GW on the back of an investment of more than $660bn, according to BNEF estimates.[15]

Further falls in the cost of lithium-ion batteries will be a major factor; 2010-2018 saw an 85% reduction. A further halving in the cost per kilowatt-hour is predicted by 2030, driven by demand for electric vehicles as well as stationary storage.

Ten countries lead the way. South Korea will cede its top spot to China and the US, while in Europe, France and Germany outpace the UK. But even here, with more than 300 companies active in the sector, planning applications indicate battery storage capacity will soar. From just 2MW in 2012, applications (normally approved first time) were made for a total of 6,874MW in 2018.[16] This would be enough to power nearly half a million electric vehicles. Government support for more technically challenging large-scale inter-seasonal storage projects, along with trials involving low-carbon heating, can provide further impetus.

Multinational energy business Centrica has delivered battery storage projects in Europe including the 49MW Roosecote battery in Cumbria, one of the continent's largest. It also partnered with battery supplier Tesla and the Belgian Transmission System Operator to deliver a pioneering multi-asset 'virtual power plant' to stabilise the European power grid. Its energy distribution business, Centrica Business Solutions, is now teaming up with the US Department of Energy's National Renewable Energy Laboratory on a trial to explore the integration of multiple energy storage technologies, including second-life batteries from electric vehicles.[17]

[15] https://www.renewableenergyworld.com/articles/2019/07/bnef-energy-storage-increase-122x-by-2040.html

[16] https://www.renewableuk.com/news/425522/Energy-storage-capacity-set-to-soar-300-UK-based-companies-involved-in-new-sector.htm

[17] https://www.centrica.com/news/centrica-business-solutions-partners-us-department-energy-battery-storage-trial

[18] https://www.theverge.com/2017/12/1/16723186/elon-musk-battery-launched-south-australia

[19] https://www.tesla.com/en_GB/blog/introducing-megapack-utility-scale-energy-storage

A 100MW battery farm, said to form the world's largest lithium-ion battery, went live in South Australia at the end of 2017.[18] Tesla's installation, covering 10,000 square meters, takes power from a nearby wind farm and connects to the national grid. The storage was commissioned after a state-wide blackout in 2016. Tesla claims its Powerpacks saved nearly $40m in the first year and stabilized the region's unreliable grid. In summer 2019, Tesla followed up with a new Megapack solution with 60% higher energy density. It claims a system of Megapacks is faster and more cost-effective to install than a fossil-fuel plant. [19]

Millions of homes will have batteries too. A solar battery boom has taken hold in Germany, and is set to accelerate across Italy and Spain. Energy consultancy Wood MacKenzie predicts that Europe's home battery capacity could climb fivefold in the next five years as more households plug rooftop solar panels into battery packs.[20] By 2024, more than 500MW would be installed, the equivalent of building a new gas-fired power plant every year. A lag is expected in the UK, however, due to a recent VAT increase on solar battery packs and other unfavorable policies, despite a government pledge of £264m to develop battery technology.

Lithium is leading but not the only rider in the storage stampede. The array of technologies being tapped ranges from solid-state and flow batteries, via mechanical flywheels and compressed air energy, to thermal and pumped hydro-power.

A Swiss start-up also uses a gravity-based system, which lifts 35-ton composite bricks to the top of purpose-built towers when power from wind and solar is abundant. Lowering the weight releases the stored power when required by the grid. In August 2019, Japan's SoftBank Vision Fund put $110m into Energy Vault, which claims it will ensure that renewables are cheaper than fossil fuel power at any hour of day or night.[21]

The International Energy Agency believes that hydrogen produced using energy from solar and wind can create regional powerhouses. Hydrogen and hydrogen-based fuels could transport energy from renewables over long distances – from regions with abundant solar and wind resources, such as Australia or Latin America, to energy-hungry cities thousands of kilometers away.[22]

The expansion of storage is fundamental to the transition underway in the power system, and also transportation. As the proportion of variable generation in the electricity system rises, so does the need for storage to balance the grid. Batteries can take the place of natural gas 'peaker' power plants. So not only will batteries be used instead to manage this dynamic supply and demand, sector experts predict that energy storage will become a viable alternative to building new electricity generation capacity or network reinforcement.

[20]https://www.theguardian.com/environment/2019/aug/06/uk-risks-losing-out-europe-home-battery-boom-report-warns

[21]https://www.businessgreen.com/bg/news/3080502/softbank-makes-first-energy-storage-play-with-usd110m-investment-in-energy-vault

[22]https://www.iea.org/hydrogen2019/

Grid unlocked

National grids are powered by big plants generating electricity from coal, nuclear and gas, which is then delivered across hundreds of miles of national power networks. As renewables progressively replace these centralized stations, that grid model has to change. But it becomes obsolete with the advent of thousands of small and nimble producers, local grids and other decentralized players.

What was a grid becomes a highly complex patchwork of moving parts and players using and trading power. Electricity ceases to be a utility and becomes a commodity and the traditional suppliers and distributors have to adapt like the highly flexible grid itself.

Apart from accommodating low-carbon, intermittent supplies, a decentralized grid can increase competition and drive down prices as more providers join the market. Above all, a smarter grid can help meet the increased demand for electricity without building new power plants and grid networks.[23]

The UK's National Grid Electricity System Operator (NGSEO) aims to be able to manage a 'zero carbon' electricity grid by 2025 – in advance of the Government's 2032 projection for renewable power.

The challenges are immense and highly complex. As the proportion of power coming from the synchronous generation of fossil-fuel power plants reduces, the grid becomes less stable. As a conventional power station goes down, generation usually continues long enough for another plant to start up. With renewables, there is less inertia in the system and more, small generators are needed to spread the risk. The spectrum of providers range from energy-from-waste, combined heat-and-power, and biomass plants to community schemes and individual homes.

Not only are new decentralized energy resources connecting to distribution networks, smart technologies also mean many consumers will no longer be passive users of power and become active players of the system. NGESO is consulting the industry and collaborating with technology partners to find innovative ways of designing and operating transmission and distribution networks.
Various forces are driving this trend towards greater localization.

Some companies that are heavy users of energy already generate their own or develop mini-grids whether it's for security of supply, financial savings or sustainability objectives. They may export their surplus energy or choose to remain off-grid.

UPS has developed a smart grid to service its London fleet as it switches to electric vans. Supermarket and retail chains such as Sainsbury's and Marks & Spencer have off-the-grid sources, M&S owning one of the UK's largest solar rooftop plants.[24]

Centrica with hopes to provide a foretaste of a future decentralized energy landscape. Said to be a world first, its Cornwall local energy market project involves installing self-generation and storage technology in homes and businesses across the county, and making that storage available to the market as a single source of flexibility, or 'virtual power plant'.[25] The aim is to serve the needs of generators, customers and networks by responding to price signals, reducing the strain on the grid at peak times, and maximizing renewables' productivity.

[23]https://www.nationalgrideso.com/

[24]https://www.raconteur.net/sustainability/decentralized-energy-grid

[25]https://www.businessgreen.com/bg/sponsored/3079926/energy-independence-key-to-thriving-communities

Again, advances in energy storage and other smart technologies are changing the economics of energy and the terms of trade.

Innovative storage units such as Tesla's Powerwall will allow homeowners and communities to retain the intermittent power they generate from renewable resources, and release it to the grid when it is most needed – for a higher price. Just as smart appliances will curtail their electricity use at peak periods and take advantage of cheaper power at other times of day.

As in other sectors, digital transformation of the energy sector comes with many challenges, not least a huge increase in data with the proliferation of market players. New decentralized assets are also often inherently unpredictable. NGESO recognizes that its legacy systems and processes will struggle to cope with this rapid increase in participants, data from the Internet of Things and other technological advancements. It will need to harness power of big data, and explore the potential for applying artificial intelligence, machine learning, cloud computing and even blockchain.

Embedding AI in business models could reduce global carbon emissions by an additional 4%, according to research by the tech giant Microsoft. The energy sector offered the greatest scope, with reductions of up to 2.2%.[26]

A smart decentralized grid will depend on an ecosystem of providers of digital technology and infrastructure upgrades across all areas of the electricity system, from generation to transmission, distribution, supply and demand.

Some of these technologies could allow small energy providers to trade electricity with each other. For example, blockchain's capacity for recording, verifying and securing transactions could facilitate a peer-to-peer market, completely independent of utilities and other third parties.

Funded by UK Research and Innovation, computer scientists at three UK universities are researching the scope for this kind of 'free trade' between micro-generators.[27] They would no longer have to sell excess energy back to the national grid, or store it. In this 'democratized' market, householders could even donate it free of charge to a local charity, or choose whose energy to buy and at what price. Their trading platform would use blockchain-based distributed ledger technology. Industrial partner EDF Energy is testing the P2P trading concept in a London block of flats.

Australia's power system is on track to become the most decentralized in the world with consumer solar panels and 'behind-the-meter' batteries making up 38% of all capacity. It's driven by a highly competitive market for small-scale solar and high retail tariffs.[28]

Prospects in the UK are not so sunny, not just because of the weather. The roll-out of smart meters is faltering. Withdrawal of the feed-in tariff has disrupted the smart energy and micro-generation market. Almost 70 community energy projects in the UK stalled in 2018. Several hundred groups between them own 250WM of capacity, but investment and new capacity were down by around 80%.[29]

The feed-in tariff's delayed successor, the Smart Export Guarantee Scheme, along with market price controls for network operators must facilitate greater flexibility and innovation as the energy networks undergo significant change, according to Parliament's Science and Technology Committee.

A hundred years ago, before nationalization, Britain had a decentralized electricity supply industry that was fragmented and inefficient. Now the challenge is to re-engineer the national grid not only so that it is resilient but also to ensure it meets the burgeoning demand for green electricity. Innovation is also required to ensure it is smart and flexible enough for homes and businesses to generate, consume and trade this clean energy efficiently.

[26] https://www.edie.net/news/8/PWC-AI-study-carbon-emissions-reduction-4-percent--/

[27] https://www.ukri.org/news/new-project-could-help-you-decide-where-your-renewable-energy-ends-up/

[28] New Energy Outlook: BloombergNEF - https://bnef.turtl.co/story/neo2019?teaser=true

[29] https://communityenergyengland.org/pages/state-of-the-sector-report-2019

Capturing carbon

Even with rapid advances in decarbonization, climate change cannot be effectively curbed without sequestering carbon as it is emitted in the industrial sector and in power generation too.

Carbon capture and storage (CCS) technologies involve trapping the carbon dioxide (CO_2) in factory flues and power plants burning fossil fuel, compressing and then transporting it by ship or pipeline for permanent storage deep underground in geological formations.

Environmentalists may worry that the technology perpetuates the fossil fuel status quo, but scientists consider it essential to take out accumulated emissions in the atmosphere, as well as residual sources such as power plants and heavy industry. Concrete production, for example, is responsible for at least 5% of humanity's carbon footprint. While the cement and concrete sector could feasibly cut emissions by 80% by 2050, to get to net zero, producers would require carbon capture and storage, according to Swiss research.[30]

The International Energy Authority (IEA) estimates that the technology needs to provide 7% of the global emissions reductions required to 2040. This would mean a rapid scale-up, from around 30 million tons of CO_2 currently captured each year to 2,300 million tons per year by 2040.[31]

However, investment has fallen well behind that of other clean energy solutions, and only 15% of $28bn in public funds earmarked for such projects over the last decade was spent. There are 18 large-scale facilities operating globally, but few in the pipeline.

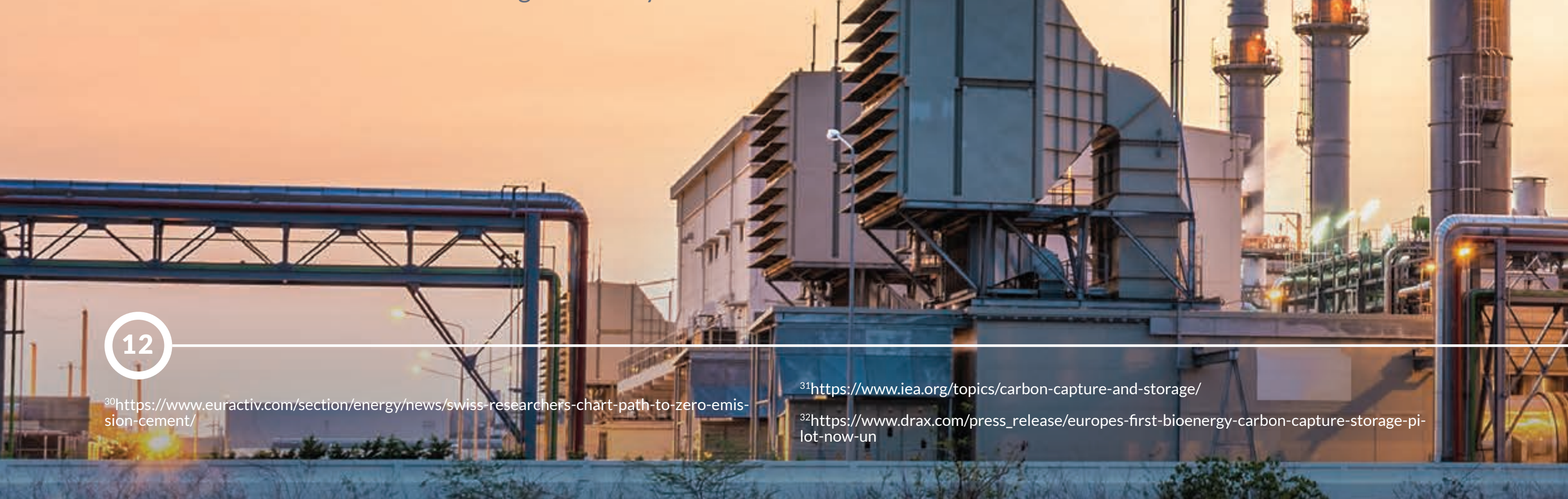
Yet there are some positive signs. In 2018, the US introduced a significant stimulus for investment with an enhanced tax credit. Called 45Q, it provides up to $50 per ton of CO_2 for permanent storage and $35 for use in enhanced oil recovery (the US oil and gas sector accounts for 70% of global carbon capture capacity). The IEA reckons this could trigger more than $1bn of investment over the next six years, adding up to 30 million tons of capacity.

In the UK, which has no large-scale CCS despite its transferable expertise from North Sea oil, momentum was also lost over the last decade, but there's a new urgency. Gas-fired power plants with carbon capture and storage are seen as essential to meet rising electricity demand. Achieving the new net-zero target will probably require active removal of at least 130 million tons of carbon dioxide from the atmosphere annually by 2050. This is a step-change and at the limit of what is expected to be deliverable for the UK.

In November 2018 the government published an action plan for developing a first carbon capture project by the mid-2020s and regional clusters to scale up applications of the technology. It followed up with a consultation in summer 2019 on the business models needed to underpin investment in CO_2 transport and storage, and carbon capture in intensive industries, as well as clean electricity and low-carbon hydrogen and bio-energy.

Capturing carbon when burning biomass for energy has an added advantage. Emissions are negative due to the carbon absorbed in growing the fuel. A pilot project at Drax Power station is testing whether it can capture a ton of carbon per day, on its way to becoming the world's first carbon-negative power station.[32]

Having upgraded two thirds of its generating units to burn wood pellets instead of coal, Drax is using a carbon-absorbing solvent, C-Capture, developed by a spin-out from the University of Leeds. Drax reports that the technology could capture 50 million tons of CO_2 per year by 2050, some of which might be used by the drinks industry to inject fizz into beverages.



[30] https://www.euractiv.com/section/energy/news/swiss-researchers-chart-path-to-zero-emission-cement/

[31] https://www.iea.org/topics/carbon-capture-and-storage/

[32] https://www.drax.com/press_release/europes-first-bioenergy-carbon-capture-storage-pilot-now-un

Britain's first industrial-scale carbon capture and utilization (CCU) demonstration plant is being built by Tata Chemicals Europe at Northwich in Cheshire. The £16.7m plant could keep 40,000 tons of carbon out of the air every year, starting from 2021. Extracted from its 96MW gas-fired combined heat and power plant, the carbon will be used on site, in manufacturing sodium bicarbonate for medicines and the food industry.

Both projects are supported by innovation grants. Governments around the world will need to get behind CCU. It could be the planet's last chance to pluck a solution to a global temperature increase of over 2°C out of thin air.

There are contenders out there, but they are expensive and have not yet been proven at scale.

California's Blue Planet has developed a machine that extracts CO_2 from the open air and stores it in construction materials as a carbonate substitute for aggregate or in a synthetic limestone coating. It believes humans could build their way out of the climate crisis.[33] Carbon8 in the UK is doing something similar.[34]

Other pioneers are also vying to cut the cost of carbon capture by storing it in marketable products rather than underground. The applications range from the beverage industry to fuel and fertilizers.

Founded in 2009, Canada's Carbon Engineering is testing production of clean fuel in British Columbia ahead of commercialization in 2021.[35] Climeworks is also developing carbon-neutral fuels. The Swiss company, which claims to have built the world's first commercial-scale direct air capture plant, has backing from Audi and several European governments.[36] Backed by Exxon Mobil, Global Thermostat was formed in 2010 in New York, and is commercializing a process for industrial customers using modular carbon extraction plants.[37]

Synthesizing fuels from captured carbon is itself energy-intensive, and may only be viable in places where there's cheap and abundant low-carbon electricity. They could find a place in markets with few green alternatives, such as aviation and long-haul transport. Another potential application, according to the IEA, is in supercritical power cycles as a working fluid to increase the efficiency of electricity generation. Every application will require a rigorous whole-lifecycle assessment of climate impact.

The strong economic case for carbon capture is now even more powerful. Before the UK's net-zero emissions commitment, the Energy Technologies Institute estimated that meeting the original 80% reduction target by 2050 would cost an additional £30bn without the use of carbon capture and storage.

[33] http://www.blueplanet-ltd.com/#services
[34] http://c8s.co.uk/
[35] https://carbonengineering.com/history-and-trajectory/
[36] https://www.climeworks.com/about/
[37] https://globalthermostat.com/

Investment & innovation are key to success

The countries that pioneer and perfect clean energy technologies can grow new industries and exports. This could offset at least some of the financial cost of decarbonizing the economy. For the UK, the Committee on Climate Change has estimated that achieving net-zero emissions could cost around 1–2% of GDP by 2050. Runaway global heating will exact a far heavier price – in economic, environmental and social impacts.

Investment and innovation in the emerging clean energy mix, efficient storage technologies, a smarter decentralized power grid, and carbon capture and utilization are hugely significant. As things stand, these trends alone may not prevent a global temperature increase of over 2°C, but they offer the greatest hope of mitigating climate catastrophe and define the sustainable energy revolution that will end the era of fossil fuels.

Innovation that can help drive the bottom line

The following are examples of client projects that Ayming's energy team has identified as qualifying for R&D incentives:

- Increasing energy plant production using the same or fewer input materials or resources
- Development of an alternative fuel mix to reduce emissions of pollutants and consequential study of the resultant effect on system performance
- Study and improvement of an energy distribution network to lessen inefficiencies such as distribution losses or inherent intermittency of renewable energy sources
- Scaling up from a prototype energy system to one which is commercially viable
- Reducing noise and vibrations in a system
- Development work related to the scaling up of the blending process for specific fuel compositions, such as enthalpy and stirring considerations
- Development and analysis of a renewable energy system to operate in extreme environments, such as marine or high temperature
- Development of a processing facility to provide different or less expensive alternative fuels
- Creating a sustainable energy system which achieves the same output as other systems, but can be constructed or operated at a lower cost
- Laboratory work undertaken to fully understand the specific emissions created through the combustion of specific fuel blends (CO_2, NO_X gases etc.)
- Cooperative research with an external institution, such as a university or research body
- Improving an older system to make it more efficient or increase its capabilities, through the integration of new technologies
- Using an existing technology for a different application and to achieve a different outcome
- Developing a new energy production system or prototype with improved functionality or capability
- Development of processes to reduce or valorize waste streams
- Conversion of industrial processes to utilize alternative fuels such as solid recovered fuels solid recovered fuels (SRFs)
- Predictive utilization of stored energy, i.e. analysis of whether energy should be stored for internal use or sold back to the grid based on integration with the Internet of Things (IOT)
- Development of platforms to analyze energy production, with the possibility of extending into predictive control of fuel combustion, or predictive maintenance.

Bradley Mitchell

Manager, Innovation Incentives

Bradley is a Manager at Ayming with four years' experience working with Innovation Incentives. He has a master's degree in Civil and Coastal Engineering and a BTEC National Diploma in Manufacturing Engineering. Previously he worked within the Oil and Gas, Civil and Structural Engineering industries. Using his academic and professional engineering background he has worked with companies within a wide range of technical sectors, including Mechanical, Renewable, Manufacturing, Chemical and Civil Engineering to identify and claim R&D incentives enabling companies to grow and continue to develop and progress their market offerings.

Email: bmitchell@ayming.com
Telephone: 020 30 58 58 00

Jamie Earl

Consultant, Innovation Incentives

Jamie is a consultant at Ayming with a Masters degree in Chemistry from the University of Oxford. He has worked with a wide range of clients on a variety of projects. These have included state-of-the-art biodiesel refineries and the integration of alternative fuels into large-scale industrial processes.

Email: jearl@ayming.com
Telephone: 020 30 58 58 00

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