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PATENT ATTORNEYS • TRADE MARK ATTORNEYS

J A Kemp COP 29 Series

Top Climate Tech Growth Areas

Innovation is central to our ability to respond to climate-related changes affecting our planet. New technologies may offer solutions for tackling the drivers of climate change.

We scrutinised some of the outcomes of the 28th Conference of the Parties (COP28) in our COP28 article series. Now COP29 is approaching, we turn our attention to some predictions for the November 2024 forum in Baku.

Many observers anticipate that COP29 will feature a heavy emphasis on the private sector, and some are already referring to it as the 'finance COP'. With this in mind, we expect there to be a focus on investment in climate technologies with the potential to improve the efficiency and resilience of existing systems, as well as to drive implementation of new solutions. In this white paper we review some of the key growth areas in Cleantech – from plastics recycling to agriculture – that we think deserve attention.

Cleantech: Where will growth come from?

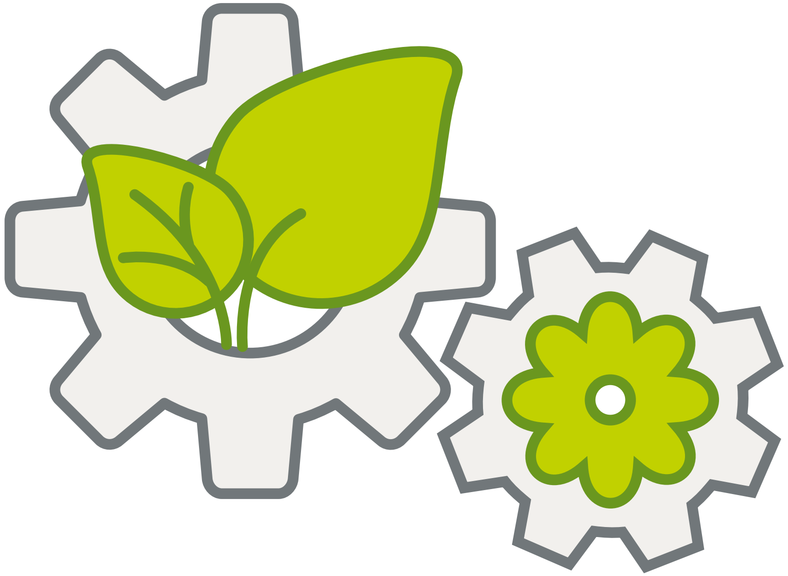
As the demand increases for solutions which address climate change and aim towards net zero, a thriving cleantech sector is emerging. Cleantech focuses on developing technologies for a greener future.

Globally, growth in green technologies is consistently outperforming ‘brown technologies’ (fossil-fuels); in fact, cleantech is the fastest-growing technology sector, seeing nearly 400% growth in patenting activity between 2000 and 2020 according to the UK Intellectual Property Office.

Innovations currently in their infancy will have an important role to play in carbon reduction, with the potential to revolutionise some of our most carbon-dependent industries such as power generation, agriculture and transportation.

As patent attorneys we are in the privileged position of seeing inventions at the earliest stages of development, and game-changing technologies are emerging from across the innovation landscape, from university spin-outs and start-ups to more established corporates.

It is impossible to review all that is emerging, but we are particularly excited by the possibilities of cleantech developments in the following areas.



Carbon capture

The development of world-leading technology to capture and store harmful emissions has an important role to play in tackling climate change, with the UK aiming to remove 10 million tonnes of carbon dioxide by 2030.

Typically, carbon capture involves catching carbon dioxide, transporting it and then using it or storing it deep underground. One form of the technology captures emissions as they are released from industrial processes or from the burning of fossil fuels in power generation. Another form removes carbon dioxide directly from the atmosphere.

Carbon removal start-up Climeworks' direct air capture and storage technology, for example, utilises pumps to suck in air and water flow to remove CO2, which is then stored underground. The technology contributes to the removal of historic and unavoidable CO2, but it isn't hugely efficient: CO2 makes up only around 0.04% of the atmosphere so the impact of direct removal is relatively small.

In comparison, CO2 is emitted from industrial processes and power generation at concentrations of up to 40%, so technologies that remove CO2 at source may have more immediate impact. And it is here where we are seeing considerable innovation, with the development of compact systems designed to remove most (if not all) CO2 from emissions and which are easy to install and retrofittable. One such technology uses centrifugal forces to distribute the solvent employed for capturing CO2, enabling much more effective mass transfer than gravity-based systems.

Technologies that can use captured carbon and convert it for other uses are another growing area of development.

Aviation, one of the highest emitting sectors, is set for huge change in the coming years. As well as exploring the use of hydrogen – a green fuel – the industry is also developing processes whereby usable aviation fuel can be made from carbon dioxide captured from industrial processes as the carbon source for the fuel. While using the fuel still releases CO2, it is essentially 'net zero' as it is using pre-existing CO2 rather than fossil fuels. This has huge potential and there are already facilities being developed to undertake this process.

While there is currently a lack of infrastructure for transporting waste CO2 to processing plants, as we see the generation of fuel from carbon waste ramp up, investment in this infrastructure will bring down the cost. Many governments offer incentives for companies aiming for net zero and those involved in carbon capture and biofuels will undoubtedly access the multi-million-pound grant funds available.

Battery technology

Battery technology underpins much of the cleantech system, from electric cars to renewable energy. Anything that previously required an engine to power it – vehicles being the most obvious – needs batteries that last as long as possible and charge in the shortest possible time. In addition, the main renewable energy sources (such as solar and wind power) are not constant and rarely match demand; batteries can store energy at times of high production and low demand until required.

The current lithium-ion technology has been around a long time but needs to be updated to optimise battery performance. To meet this challenge, new materials are being developed to improve the electrodes, electrolytes and separation of the electrodes. Moving to a solid-state electrolyte, for example, could increase energy density and reduce the risk of fire.

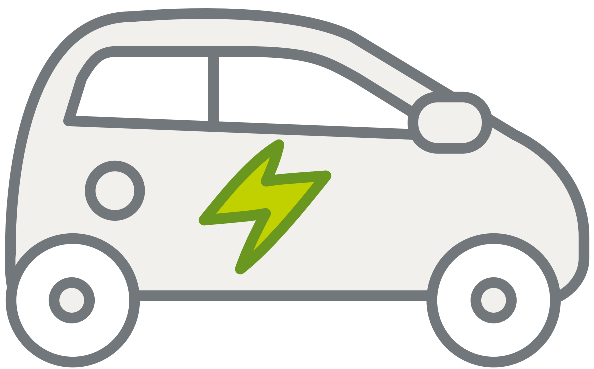
There is also research going into improving the underlying chemistry.

Lithium-sulfur batteries have a similar chemistry at the anode to lithium-ion batteries but operate in a different way at the cathode. They are particularly attractive because they have a high theoretical energy density, and because sulfur is abundant, lightweight and environmentally friendly.

Lithium-air batteries can store an impressive amount of energy per kilogramme of lithium but are still at a relatively early stage; considerable advances are needed before their efficiency and life-cycle characteristics can satisfy the requirements for use in electric vehicles and grid-scale storage.

These battery types all rely on the oxidation of lithium at the anode, but non-lithium alternatives are also being developed, replacing lithium with sodium or potassium, for example. The key advantages of sodium and potassium are the greater abundance of these raw components and their lower cost. Sodium-ion batteries may also allow us to avoid the use of expensive metals such as cobalt, copper and nickel, while potassium-ion batteries have the potential to be faster charging than their lithium-based counterparts.

Aluminium-ion batteries are also being developed that potentially allow for greater energy storage capacity but will need further improvements if they are to become a viable alternative to current lithium-ion technologies.



Plastics

The issue of plastic waste is a well-documented environmental challenge. Globally we produce 460 million tonnes of plastic per year and production has more than doubled in the last 20 years.

Manufacturers are working hard to use less plastic in packaging, changing their designs and using paper and card where practical.

We are also seeing the development of newer biopolymer materials as alternatives to plastic. One example is alginate, a substance derived from seaweed that can be used to package food and drink. It is proving effective in single use sauce sachets for example.

While ideally we want to get to a place where we no longer use single use plastics, there are ways we can lessen the impact of the plastics we do use by either making plastic that is easier to recycle or through more effective recycling processes.

One example of the latter is depolymerisation. Usually recycling plastics involves melting them down, cleaning them and making them into something new. The polymer chains remain intact throughout.

In contrast, depolymerisation uses different combinations of chemistry, solvents and heat to break down polymers into their monomer building blocks. Potential contaminants are isolated from the monomers to remove them and the monomers go back into the normal plastic production processes. This raw material is far more versatile that recycled plastic and can be used to make plastics of a similar quality to those made from traditional fossil resources.

Green Agritech

Agriculture runs on very tight margins. To be viable, current farming methods have tended towards highly carbon-intensive industrialised techniques. Huge fields, all planted with the same crops, sprayed with pesticides and fertilisers and harvested by diesel tractors are the norm.

The process of fixing nitrogen from the atmosphere to produce fertiliser products such as ammonia and ammonium nitrate has barely changed since the early 20th century. It is estimated that it accounts for around 1% of global emissions – a significant amount for a single process.

The process is very energy intensive, and the resulting artificial fertilisers bring additional cost to the environment by running into local water courses during rainfall, causing algae blooms in rivers and lakes and damaging wildlife.

One way to lessen farming's environmental impact is automation. Robots are being developed to harvest crops such as asparagus or apples, for example. Use of robots means less damage to produce and therefore less wastage. They can be more targeted and precise than current, heavy duty machinery. Unlike people, robots don't need breaks and can work 24/7 so even if the process takes longer, it can still be more efficient.

Robotics' inherent efficiency could lead to a reduction in monoculture practice (whereby huge fields of the same crop are planted, depleting soil nutrients and hindering crops' carbon sequestration). With more scope for crop rotation, diversification and smaller fields that allow for an increase in hedgerows, trees and shrubs, biodiversity can be enhanced alongside the potential for greater carbon sequestration.

Machine learning can be used to train robots to automatically monitor crop fields and detect areas where weeds are prevalent. These areas can then be selectively sprayed with herbicides appropriate to the weed species, avoiding the need for indiscriminate spraying of large areas with multiple or wide-spectrum herbicides, thereby reducing the impact on surrounding areas.

Much of the robotic technology required has already been developed, including automated control and machine vision technology, robotic parts needed for harvesting, planting, weeding or spraying crops, and machine learning algorithms that can be used to teach a robot to recognise ripe fruit or vegetables. Although there are some cutting-edge technologies being developed, growth in this sector focusses more on adapting existing technologies for use in the agricultural context and getting them to the point where they are economically viable.

We are also seeing growth in on-the-ground alternatives to fertilisers and pesticides. One low-tech alternative is the use of mixed crops. Generally, farmers plant a single crop in a field, but there can be benefits in planting a mixture of crops alongside each other. For example, if one type of plant has resistance to a certain pest it can help prevent spread to the other crops. Plants will necessarily remove nutrients from the soil as they grow, and planting the right complementary crop alongside can replace or fix the depleted nutrients in the soil.

These effects can also be achieved by seeding specific (or even bespoke) fungi and micro-organisms into the soil. These microbes can themselves fix nutrients in the soil or produce chemicals to prevent pests.

Already in widespread use (and undergoing continuous development) is gene editing and genetic modification. This is particularly true in the US where there is more lenient regulation than in Europe. These genetic techniques can be used for a vast array of environmentally beneficial applications, including creating crops that are more resistant to pests or require less fertiliser to grow.

Gene editing – the modification of a crop's own DNA - has become much more practical in the last 10 years and is considered less controversial than introducing entire new genes from other species through traditional genetic modification. Since Brexit, UK regulation in this area has become less stringent than European Union rules, and the European Union is in discussions to bring their regulation in line with modern genetic capabilities. This will hopefully open the door to further innovation.

Green buildings

According to a UK Intellectual Property Office (IPO) report published earlier this year, of all the different green technologies prioritised by the UK government, greener buildings have seen the highest average percentage growth in patents over the last 20 years.

The UK demonstrates a degree of specialism in patenting technologies for greener buildings, topping the list of the top 10 patenting countries worldwide.

Solutions such as green roofs that can retain rainwater and then filter it for recycling or release into the ground and films that can be applied to windows to reduce overheating aim at tackling the consequences of climate change, such as flooding and overheating. Examples include Microshade's solar shading technology, a micro-structured film that adapts to sunlight and provides up to 100% beam shading in summer and 35% solar transmittance in winter, and Filia, a blackout blind that integrates solar film to existing or new blackout blinds and doors, transforming them into solar panels.

Filia is just one of a range of products aimed at enabling buildings to generate their own renewable energy, including solar roofs, energy-producing facades to replace traditional cladding and mechanical facades that track the sun, adapting to provide different levels of shading.

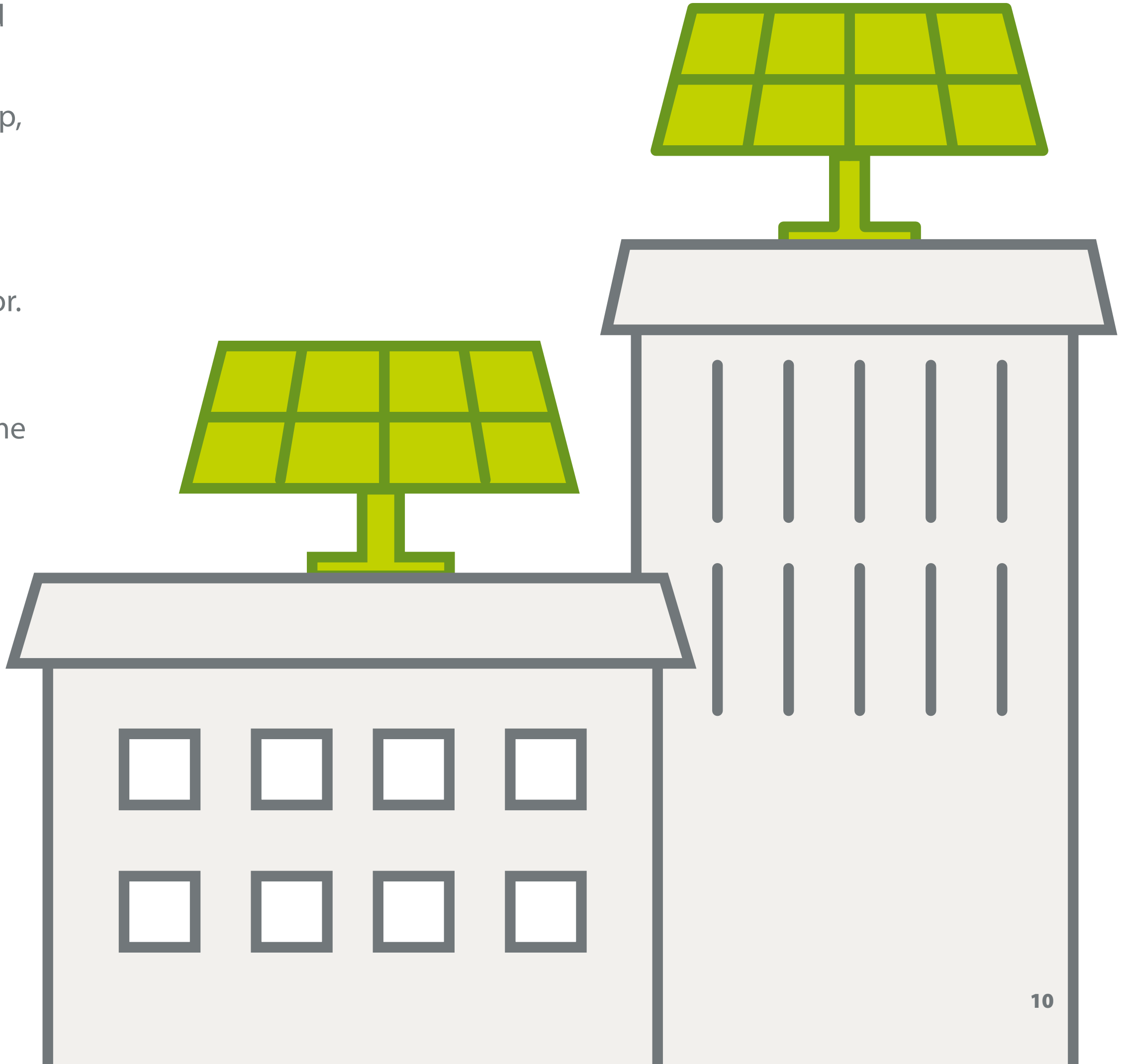
Another strong area of development is in sustainable building materials. According to a 2018 Chatham House report, concrete accounts for 8% of emissions globally. More sustainable options, such as those using alternative aggregates like demolition waste or unrecyclable plastic waste are being developed.

Mimicrete, a Cambridge-based startup has developed a self-healing concrete system based on a vascular network containing a healing agent. The technology requires no manual intervention post-installation. It increases the strength of the concrete on day one and more than doubles its lifespan. The need to monitor and maintain infrastructure is reduced. The extension in lifespan reduces the volume of concrete utilised in the overall built environment, in turn reducing the negative environmental impact of construction itself.

US company, Sublime Systems has created a low carbon cement using electrochemistry to extract reactive calcium and silicates from raw materials as an alternative to the traditional, fossil fuel intensive methods of cooking limestone, sand and clay in kilns. Biozeroc's BioConcrete solution removes the need for cement in the concrete manufacturing process by using cutting-edge biotechnology to optimise and scale up bacterial processes that bind together the aggregate, replacing the need for conventional cement altogether.

Bio-based materials are on the rise, with natural substances such as hemp, mycelium – a network of fungal threads - grass and straw all being used for insulation materials. Algae can even be incorporated into paint to absorb CO2.

Innovation is happening on multiple fronts across the construction sector. With the new UK government committed to swathes of housebuilding across the country alongside a green agenda, it is expected that more of these sustainable and eco-friendly options for greener buildings will come into play.

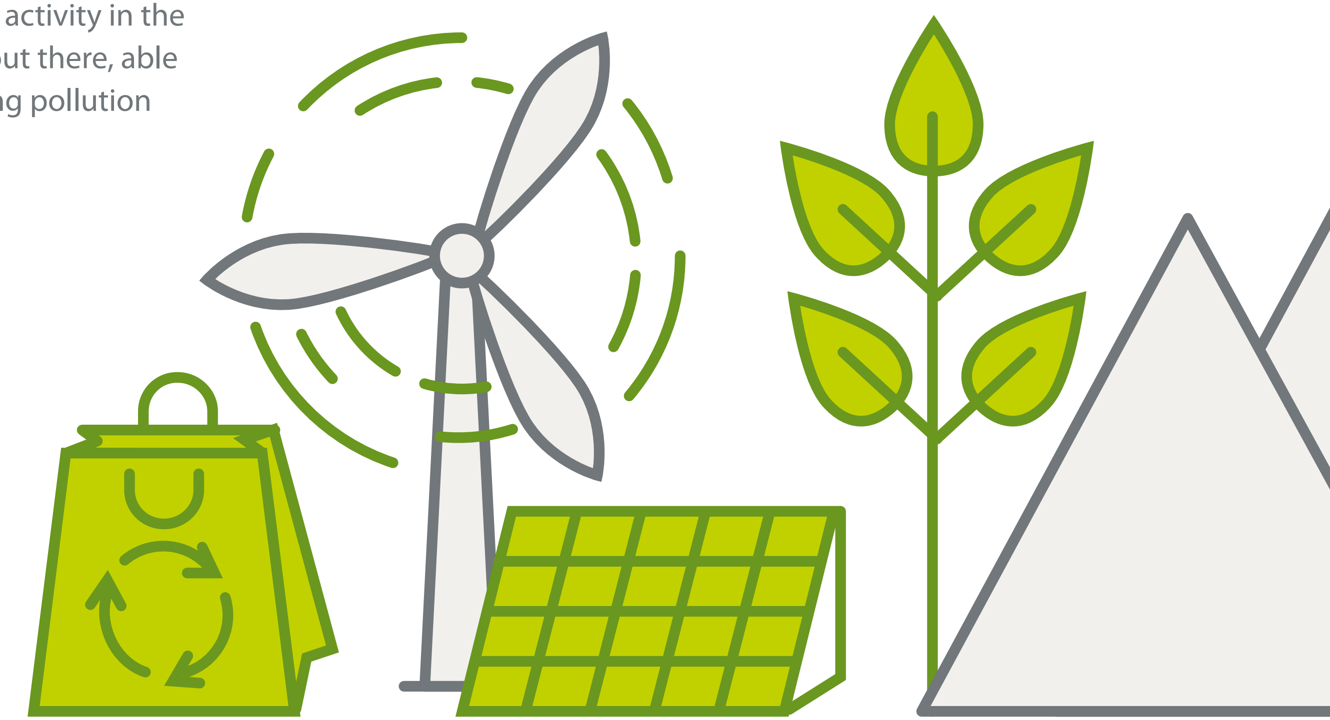


A thriving sector

These examples only scratch the surface of the exciting innovations that are happening across the cleantech sector and showcase its considerable potential.

As investment flows into these technologies, new start-ups and bigger players will move in and competition for market share will increase. Those developing them will need to ensure they have the necessary intellectual property protection in place and think strategically to ensure they have the necessary space and control to develop and monetise their innovations.

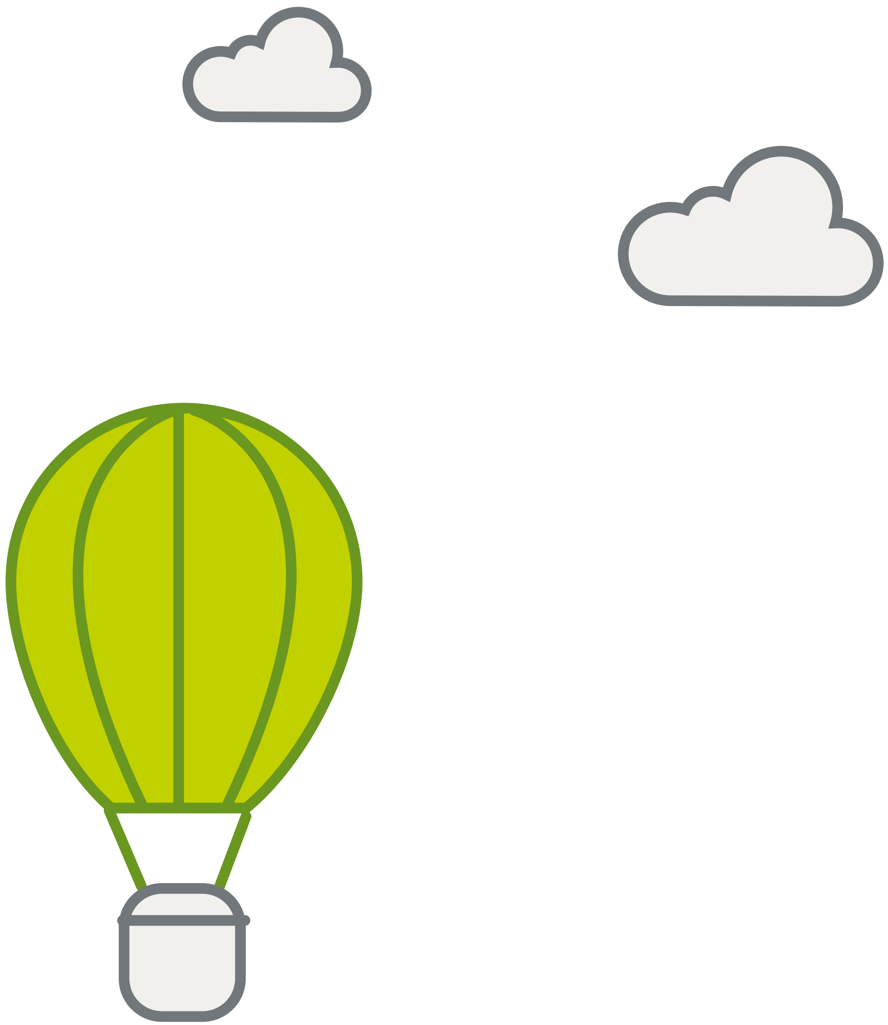
This is a fast-moving sector that is only going to grow in prominence. While the challenges presented by climate change are huge, activity in the cleantech space is showing us there are potential solutions out there, able to contribute to achieving carbon net zero, as well as reducing pollution and protecting our ecosystems.



About J A Kemp

J A Kemp attorneys are working with clients to secure protection of their innovative intellectual property across the sector.

Our clients in this field include start-ups, universities, research institutions and multi-national companies. We have experience working with clients in a wide range of cleantech-related technologies. As just a few highlights, we lead work on carbon capture utilisation and storage, hydrogen production, methane reforming, battery technologies, fuel cells, bioreactors, biofuels, plastics recycling, combined heat and power systems, air purification technologies, water treatment and gene editing technologies to improve food security.



Meet our Green Energy and Cleantech team

We have a **team of attorneys** with the relevant technical backgrounds and experience for assisting our clients with all aspects of green energy and climate technologies.

If you would like to receive cleantech or other updates from J A Kemp **please complete this form.**