

The green innovation cycle: growth through planetary problem-solving

RADAR

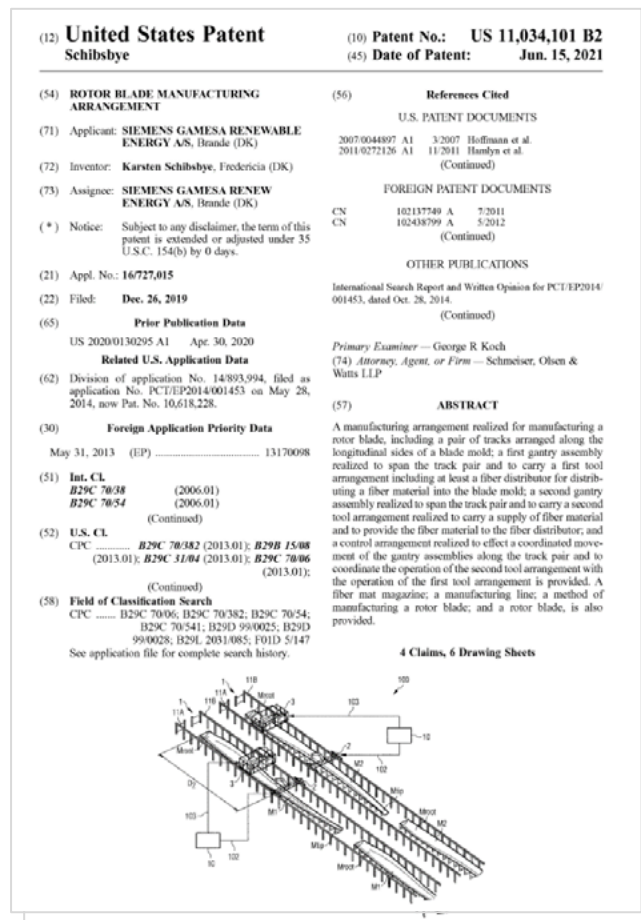
November 2021



Key takeaways

A new innovation cycle is developing, driven by the need to find technological solutions to environmental challenges. Green innovation – which focuses on optimizing resource efficiency or reducing pollution, has the potential to be a major source of economic growth and opportunities for discerning investors

- Environmental challenges will increasingly be a key focus for innovation
- A broadening out of innovation is needed across sectors
- Green innovation has a compounding benefit and can have a significant positive affect across industries
- Green innovation can provide attractive opportunities for investors



Source: <https://patentimages.storage.googleapis.com/5f/08/a4/f873ddc24fa688/US11034101.pdf>

Co-authored by:



Maxime Le Floch, CFA
Investment Analyst, Regnan
Equity Impact Solutions team



Freeman Le Page, CAIA
Portfolio Specialist, Regnan

The green innovation cycle

“The opening up of new markets, foreign or domestic, and the organizational development from the craft shop to such concerns as U.S. Steel illustrate the same process of industrial mutation—if I may use that biological term—that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism.”

Joseph Schumpeter

Multiple forces, from consumers to public authorities and investors are driving businesses to account for their environmental costs and develop new environmental solutions. As mechanisms for pricing environmental costs develop, for instance the rise of carbon prices, non-environmentally-friendly businesses are increasingly penalized, while green innovators are rewarded. As a result, a green innovation cycle is forming, which we believe will be instrumental in addressing the environmental challenges we face, while driving attractive investment returns.



The EU carbon price has soared and could top

€100 by 2030

EU-ETS carbon price



Source: Gavekal Dragonomics/Macrobond, November 2021

Innovation can help solve environmental challenges and boost economic growth

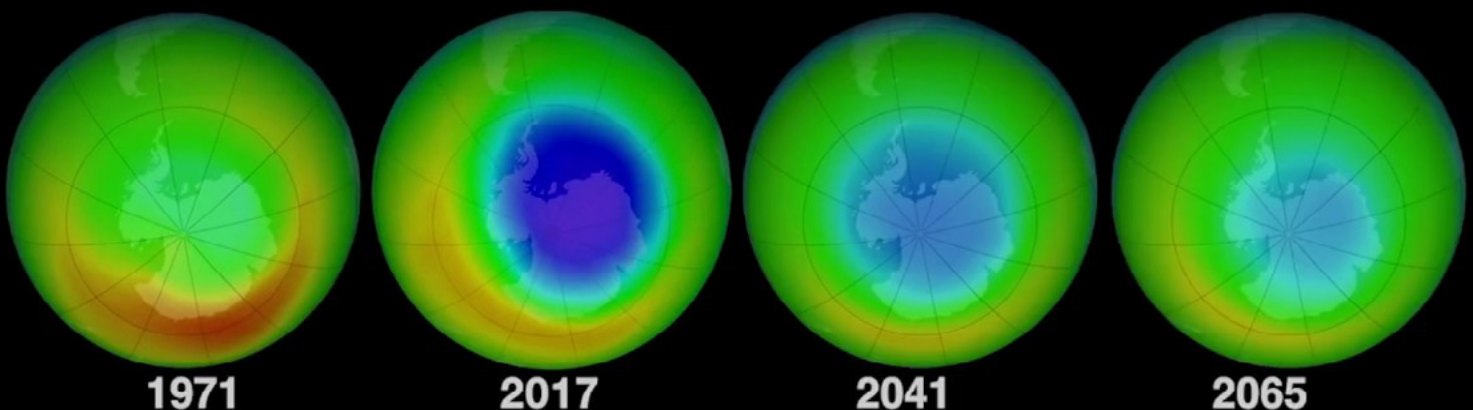
Environmental challenges such as climate change, biodiversity loss, plastic pollution, and water scarcity need innovative solutions. A look back through history shows that environmental innovation, driven by technology, can help contribute to economic prosperity while also tackling critical environmental challenges.

Technical innovation and the need to find alternatives to chlorofluorocarbons (CFCs) has been a key driver of ozone layer regeneration. The broad adoption of CFCs, chemicals used as refrigerants, aerosol sprays and coolants, was later proven to contribute to ozone depletion, leading to negative human health impacts through increased risk of skin cancer. The breadth and scale of CFC adoption required a concerted and coordinated response from nations. The Montreal Protocol has been heralded as one of the most definitive successes in tackling a global environmental problem. One key success factor was an innovation drive by companies in the lead up to the protocol, which resulted in more ozone-friendly alternatives becoming available.¹ These alternatives reduced the cost of transitioning away from CFCs and encouraged broad adoption. The ozone layer is now expected to fully recover in our lifetime.

Innovation needs to be increasingly shaped by sustainability, with practical tools such as life cycle analysis now available to innovators. Investors should consider both positive and negative impacts of solutions and companies' operations in determining if an innovative solution is truly sustainable and on balance, delivers a positive outcome. Biodiesel is one example of a development which offered great promise. However, there has been much debate around sourcing raw materials and the use of land that could otherwise be used for food production or retained as rainforest. Integration of life cycle analysis to the innovation process through methodologies such as eco-design, will allow investors to better understand environmental impacts and optimize design to augment positive impacts while minimizing negative impacts. For instance, Ansys, a simulation software provider based in the US, offers solutions to embed materials' environmental footprints into product designs. Thanks to this, R&D engineers can integrate energy footprints, recyclability, biodegradability, and other characteristics into their designs.

¹Source: governance-global-environmental-commons.pdf (wri.org)

The healing of the ozone layer



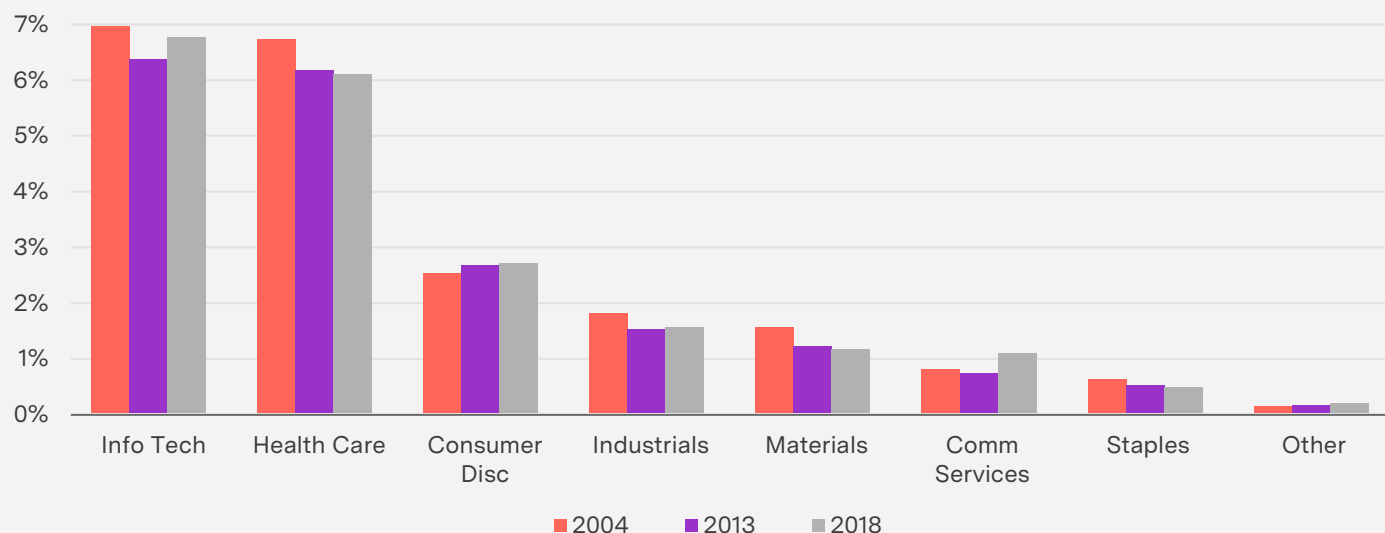
Innovation can help solve environmental challenges and boost economic growth

Greater resources than ever are allocated to finding innovations, yet a broadening out of innovation is needed across sectors. R&D spending in the OECD has steadily increased, with a four-fold increase in global R&D spending between 1997-2017 to over \$2.2 trillion and representing an increasing percentage of global GDP. Interestingly the R&D trend looks beyond short-term market dynamics such as the global financial crisis and short-term corporate profitability, showing a strong upward trajectory over time. Information technology and healthcare have been two highly innovative sectors, but other areas of the economy have not innovated at the same pace. However, industries such as transportation, industrials, and materials – which are central to global decarbonization efforts, require higher R&D intensity to commercialize and bring about wide adoption of solutions such as electric vehicles, smart grids, and low carbon buildings.

More focus on disruptive innovation is needed, after decades of incremental improvement. Incremental innovation to improve energy efficiency of existing industrial processes may not be sufficient to reach goals such as net zero emissions by 2050. Disruptive innovation has the potential to be more transformative, rethinking and reengineering processes to address key factors or limitations. One example is cement manufacturing, the source of 8% of GHG emissions globally. The industry is currently focusing on marginal improvements such as clinker substitution and adjustments to the fuel mix. French cement business Hoffmann Green Cement, however, has developed a radical low-carbon solution, with a clinker-free process that reduces emissions by 5x while providing superior technical performance in an industrial process that is highly scalable, lower cost, and could offer much higher returns on investment, especially as other players struggle with higher carbon prices.

R&D intensity in industrial sectors has lagged IT and healthcare sectors²

MSCI ACWI aggregate R&D intensity
(Cumulative R&D as % of cumulative sales)



Source: FactSet, Goldman Sachs Global Investment Research, as of year end 2004, 2013, 2018.

²'Other' includes Energy, Financials, Real Estate and Utilities; ex. GICS 4 Internet & Direct Marketing Retail and Interactive Media & Services

²Source: Goldman Sachs.

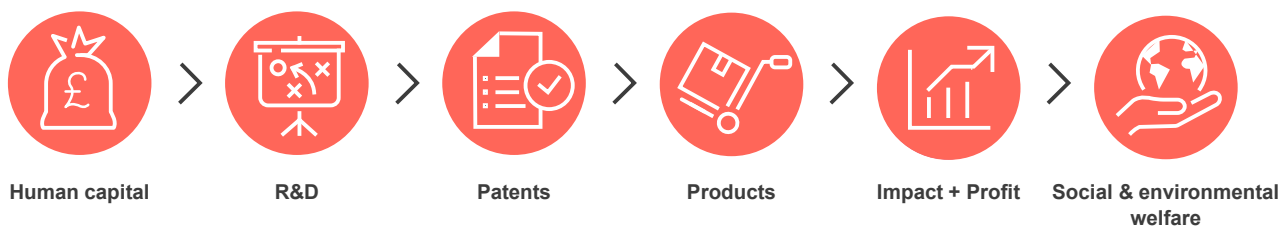
Environmental challenges will increasingly drive innovation

Innovation in environmental solutions has accelerated in recent decades and green patents now constitute a larger proportion of total patents worldwide. As those patents get translated into new green solutions, economic growth will become increasingly driven by green innovation. Innovation is an evolutionary process which starts with research, and when successful, can generate tremendous value for society, the environment, and investors.

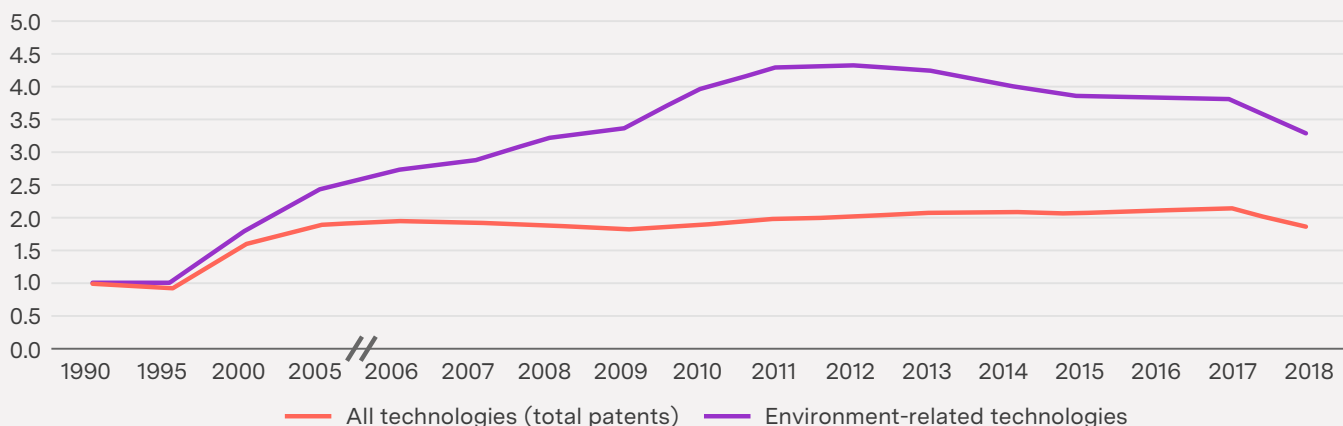
Innovation is a key determinant of competitive advantage. Patents enable companies to leverage intellectual property (IP) to develop novel solutions and products. Innovation is a key source of competitive advantage, providing the potential for attractive margins and opportunities for higher return on investment and corporate profitability, along with the potential for positive real-world impact. Patent trends can provide an indication of corporate innovation. Patents are costly to file so when companies choose to protect their IP through patent, they signal their conviction in the potential of a patent to lead to a commercial product or solution from which they can generate profits.

Green patents have become a larger part of total innovation. OECD data shows that the growth of patenting for environment-related technologies has outpaced patenting for all technologies. Green patents made up just above 6% of total patents in 1990; they now represent more than 10%. The peak in the early part of the last decade reflects some environmental technologies maturing. Onshore wind and solar PV patents led to product innovations that improved the cost competitiveness of renewable energy versus fossil fuels. Improved economics in-turn led to widespread deployment of renewables. So, while green patents as a group represent a larger share of innovation, maturity levels of each technology also matter. Wind energy saw rapid growth in patenting until the early 2010s, and since then, patents have remained elevated, albeit below the earlier peak, this is indicative of a maturing technology.

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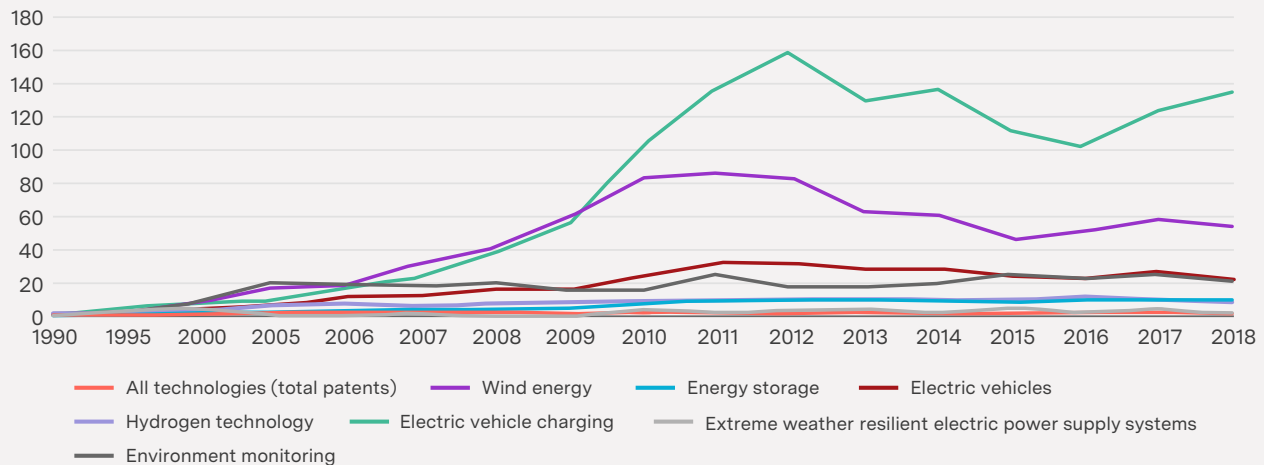
Trend in patents for environmental vs. general technologies, normalised.



Source: OECD, as of July 17, 2019

Environmental challenges will increasingly drive innovation

Trend in patents for environmental vs. general technologies, normalised.



Source: OECD, as of July 17, 2019

A new boom in green innovation is likely, as companies and countries commit to increasingly stringent climate change targets. According to the Energy & Climate Intelligence Unit, at least one-fifth of the world's 2,000 largest companies have committed to net zero targets, while two-thirds of countries have now committed to net zero.³ This is a major, growing source of demand for innovative environmental solutions that will catalyze patenting efforts in the decade to come and is likely to result in a new boom in green patents.

³Source: Energy & Climate Intelligence Unit, <https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets>, as of March 2021

Green innovation can far outpace the rate of change in general technologies. Some applications have seen particularly robust growth over the last decade, including smart grid equipment, energy storage, electric vehicles, and software technology linked to energy and environmental management.

Autonomous vehicle technology has seen rapid innovation, growing at a 27% CAGR over the last decade, according to Thundersaid Energy. While we are yet to see the benefits flowing through to earnings in the companies involved, it signals a second wave of change set to take place in the automotive sector, after the current wave of electrification of mobility.



Environmental challenges will increasingly drive innovation

Current energy inflation may well lead to further green innovation. UCL researchers Michael Grubb et al concluded in a recent study that the rate of green patenting has been increasingly driven by demand-pull forces: market forces are a stronger driver of innovation than “technology-push”. They find that higher energy prices have historically acted as an incentive to innovate, with a 10% increase in energy prices leading to a 5% increase in green patent filings in 1 year and an 8.5% increase over 3 years. This amplifies the fact that green innovation has been a major driver of cost reductions across environmental technologies, making them increasingly attractive, and boosting demand. For instance, the cost of wind energy has reduced by 70% since 2009 and the cost of solar energy by 90% over the same period, according to Lazard.⁴

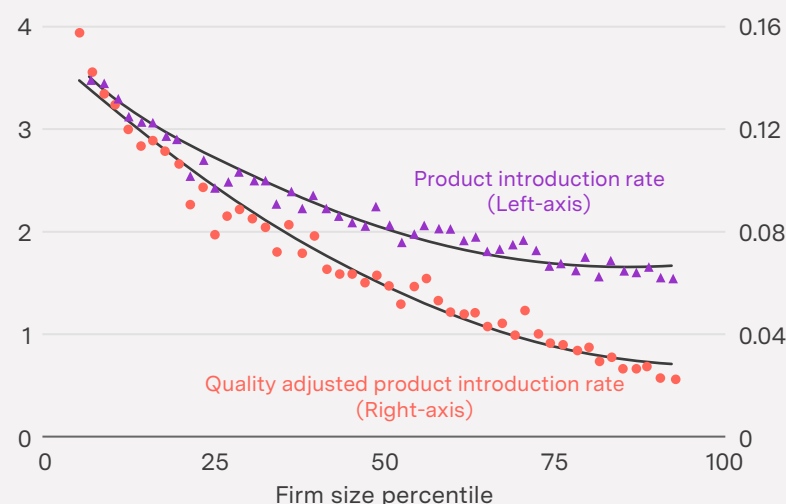
Academic literature supports the view that small and medium sized companies have more productive patents, so investors might focus on those to capitalize on the benefits from the green innovation cycle. R&D does not always result in functional, profitable, or impactful product launches. But when it does, it can be a significant driver of growth, as innovation-led sales growth often delivers higher product differentiation, and thus potential for higher returns.

Indeed, Federal Reserve Bank of Atlanta researchers Argente et al find that firms introduce more and better-quality products around the time of a patent application. But this is more relevant for small and mid-sized companies: *“Though larger firms’ innovation rates are lower; they are patenting more intensively. But the patent filings of larger firms have significantly weaker association with their product introduction. Moreover, the average quality improvements of new products decline more steeply with firm size than the rate of product introduction does.”**

Stronger balance sheets and a lower cost of capital can enable larger firms to use patenting as a defensive strategy to constrain product innovation of competitors. In the context of decarbonization, that can prevent higher carbon investments from becoming stranded assets. Given their innovative product development, mid- and small-cap businesses can offer investors attractive opportunities where innovative solutions are a key source of corporate growth.

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Product innovation rate by firm size



“Note: This figure plots the relationship between product innovation and the size of the firm, defined by the firm’s sales. We use the firm x product category level data for the period 2007-2015, restricting the analysis to observations with sales above \$1,000. For each x product category, we compute average sales, the average product innovation rate (new products divided by the total number of products sold). Within each product category, we assign firms to 50 bins for average sales and plot the average product innovation rate and the quality-adjusted product innovation rate for each bin. Each dot/triangle plots the averages after weighting each product category by its importance in the whole sector, as measure by the share of sales accounted for by the category.”

*Source: Federal Reserve Bank of Atlanta, <https://www.econstor.eu/bitstream/10419/228256/1/1695645685.pdf>, as of April 2020

⁴Source: <https://iopscience.iop.org/article/10.1088/1748-9326/abde07#erlabde07f5>, <https://www.lazard.com/media/451881/lazards-levelized-cost-of-energy-version-150-vf.pdf>, as of October 2021

The compounding of green innovation

As environmentally unappealing as a 'spillover' sounds, the additional knowledge and benefits received from innovation 'spillovers' can be significant and have positive impacts across industries. The solutions and products of companies like PTC have application across many industries. Their leading software solutions include computer-aided design, product life cycle management, the industrial Internet of Things and augmented reality. PTC's solutions increase productivity and efficiency of R&D by reducing design time by up to 30%, make manufacturing more efficient and less wasteful, with up to 30% reduction in prototypes, thereby reducing costs and raw material use, and reducing the time to market by up to 57%.⁵

Promising ideas are contagious and knowledge spillover often spurs further innovation; green innovation is a particularly good compounder. Researchers from the LSE estimate that green technologies' knowledge spillover effect (the positive externality from those innovations contributing to wider innovation) is much higher than for 'dirty' technologies. They find that green patents get on average 43% more citations than dirty patents, meaning green patents have a much larger ripple effect, helping inspire further innovation.⁶ Using a similar approach to citations in academic literature, patents are required to cite other patents that have inspired a new, separate innovation. We like to think of it as '*patenting it forward.*'

Why innovation matters to investors

An innovation cycle is forming, driven by the need to find technological solutions to environmental challenges. We believe green innovation to be instrumental in addressing those challenges, multiplied by spillover effects inspiring more R&D and positive outcomes. Green innovation can be a major driver of economic growth and prosperity; and for those businesses able to harness this innovation to develop environmental solutions, it could be a key driver of corporate profitability, providing a rich source of opportunity for discerning investors.

As impact investors focused on identifying and investing in solutions to some of the world's most pressing social and environmental challenges, we are orientated towards innovative, mission-driven companies that disrupt the status quo and bring about positive change. This investment lens reveals the increasing relevance of green innovation as a key driver of companies' ability to create solutions that directly address the environmental and social challenges we collectively face and create a prosperous future along with the potential for attractive investment returns.

⁵Design World, <https://www.designworldonline.com/leadership-companies/ptc/>, February 10, 2021

⁶London School of Economics, https://cep.lse.ac.uk/_NEW/PUBLICATIONS/abstract.asp?index=4503, September 22, 2014



About Regnan

At Regnan we've been thinking forward and shaping the responsible investment movement since 1996 – long before it became mainstream.

2020 marked our expansion into funds management supported by the investment platform of J O Hambro and the Pandal Group. We've brought together proven sustainability and impact teams with track records tested through cycle, with the depth of insights provided by our engagement, advisory and research team.

Our collective purpose is to contribute to a more sustainable future by developing and promoting principled, rigorous and outcome-oriented approaches in responsible investment.

Client solutions sit at the heart of all that we do and are based on four key pillars:

- Delivering our clients attractive investment returns; we aim to grow their real wealth over the long term.
- Understand the materiality of sustainability issues to deliver improve decision-making and real world outcomes.
- Creating differentiated, innovative strategies that serve a purpose in client portfolios.
- Our strategies are authentic and provide significant exposure to underlying sustainability opportunities.

Regnan Global Equity Impact Solutions

The Regnan Global Equity Impact Solutions strategy is a solutions-first approach, focused on investing in mission-driven businesses that address underserved environmental and social challenges and deliver real, systematic change for the better. It is a high-conviction, global, multi-capitalization portfolio with low turnover and a strong emphasis on driving impact by engaging companies to improve measurable outcomes.

Regnan Sustainable Water and Waste

Our Thematic Investing team joined Regnan in April 2021 and launched the Regnan Sustainable Water and Waste Strategy in September 2021. Combining exposure to both water and waste-related companies makes this strategy a distinctive thematic investment proposition with diversification benefits.



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