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UK-India Energy Opportunities

APRIL 2021





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About Bridge India

Bridge India is a progressive non-profit think tank dedicated to discourse on public policy. But the 'India Story' abroad is often presented through a narrow lens, be it focusing only on business and the economy, society or policy landscape. Given its diversity, everything about India, and its polar opposite, is true in unison. Bridge India seeks to highlight and celebrate this nuance, to help India-watchers understand India better. It is registered with the Charity Commission of England & Wales, number 1183696. Find out more at www.bridgeindia.org.uk.



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About Howard Kennedy LLP

Howard Kennedy is a London based, full-service law firm specialising in providing straightforward advice to entrepreneurial businesses and individuals on domestic and international matters. The firm has an extensive clean energy practice which touches on every part of the sector, advising on high profile clean technology projects including wind, solar PV, combined heat & power, energy storage, district heating and cooling, electric vehicles, geothermal and wave and tidal. When advising Indian clients with interests in the UK energy market or vice versa, the collaborative working relationship with firm's India team provide multi-lingual assistance and a wealth of experience in supporting bilateral trade between the UK and India. Find out more at www.howardkennedy.com/Expertise/Sectors/Energy.



About Mercia Asset Management

Mercia is a proactive specialist asset manager with a focus on regional businesses seeking venture, private equity or debt finance to scale their businesses. Mercia aims to be the first-choice provider of capital across our specialist private capital classes for businesses that typically seek less than £10million. They are exclusively a UK domestic investor, with focus on the UK regions. Find out more at www.mercia.co.uk.

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Bridge India conducted a series of interviews in 2020. We spoke to engineers, scientists, businessmen and lawyers – not just in energy but also in key related sectors, including automotive. We're grateful for inputs from Ashok Leyland, AssetCool, Essential Minerals, Exide Industries, Faradion, Hero Electric, Howard Kennedy LLP, IIT Madras, Mercia Asset Management,

Micropore, McDermott, Will & Emery LLP, Ministry of Science and Technology, NITI Aayog, Nova Pangea Technologies, Suvarna Capital and others.

Thanks also to the British High Commissioner to India, Alex Ellis CMG, and the Indian High Commissioner to the UK, Gayatri Kumar, IFS, for their Forewords. Given their unique experiences of both the UK and India, their contributions have added weight to the findings.

We look forward to advancing this agenda onward with government representatives as well as other stakeholders in India and the UK to see what we can achieve together, in an important year for the climate agenda globally.

About the authors



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corporations on their public policy and government engagement programmes.

She attained a distinction in her Masters in Politics and Communications and holds a post-graduate degree in media law.

Foreword



Alex Ellis, CMG

British High Commissioner to India

This report comes at a critical moment, as countries decide how they power their economies. Decisions today will have impacts for many years to come. Developing cleaner energy and reducing emissions is an essential part of any smart economic growth and business strategy.

India and the UK are at the forefront of this clean energy revolution. We are committed to climate action under the 2015 Paris Agreement, and both have to ensure we can develop sustainably. That India and the UK start from different places in terms of development, and have a shared ambition, makes us natural partners.

Under Prime Minister Modi's leadership, India has made remarkable progress in improving energy efficiency and developing new renewables. India now produces some of the cheapest solar energy in the world. The scale and speed of this transformation is astonishing.

The UK is also showing leadership; we have nearly halved our emissions in less than 20 years whilst growing the economy by 75%. We sent a clear policy and market signal by enshrining a Net Zero emissions target in law. And we have turned laws and aims into outcomes, reducing coal's share of electricity generation from 40% to 2% in less than a decade; developing the largest offshore wind capacity in the world; and creating one of the world's leading green finance markets.

But we both need to do more, at home and globally. The UN COP26 Climate Conference, which the UK will host in November this year, must be a moment when the UK, India and the world demonstrate ambitious action to keep the Paris process on track and work towards a Net Zero emission world.

This report highlights useful areas of UK-India collaboration on this journey. Our partnership on energy already includes joint investments, research and innovation, and collaboration on policy and technical issues. Through initiatives like the International Solar Alliance we are also mobilising the global transition to clean energy.

Our businesses and innovators are an actual and potential force to, for example, develop smart tech and energy systems, increase manufacturing for the renewable and storage industries, and prepare for new electric mobility.

There's a lot to do. By working together, we can get the UK, India and the world on the track to clean, affordable energy.



Gaitri Issar Kumar, IFS

High Commissioner of India to the UK

I congratulate Bridge India for their initiative in bringing out this Report on the potential of India-UK collaboration in the energy sector. It is a timely and welcome addition to the relevant information base.

UK-India collaboration in this core area of our respective economies spans more than three decades and includes investment, research, policy, technical and commercial partnerships in the power, renewables, energy efficiency, civil nuclear and oil and gas sectors.

India has embarked on the world's largest expansion plan in renewable energy – and is set to be the foremost global contributor to renewable electricity generation in 2021 - when her annual addition will have nearly doubled from the 2020 level.

Our nation's guiding principle of 'Aatmanirbhar Bharat' will, among other things, boost India's Photo Voltaic cells manufacturing capacity and ensure their quality and competitiveness.

In 2019, India was ranked the fourth most attractive renewable energy market in the world. Up to 100% FDI is presently allowed under the automatic route for renewable energy generation and distribution projects - subject to provisions of The Electricity Act, 2003.

The shared commitment of both governments, the United Nations Framework Convention on Climate Change and its Paris Agreement are the beacons showing the way to business houses wishing to partner in further strengthening the energy sector in both countries. The successful India-UK Green Growth Equity Fund is an example of such collaboration.

With the UK hosting COP26 this year and India assuming the Presidency of G20 in 2023, both countries are well placed to provide leadership and direction to the effort of the international community towards the objectives of UNFCCC.

I offer Bridge India my best wishes for the success of this publication.

Introduction

Energy in many ways is, and will remain, the key to the future. It not only stands at the core of our economies but is a sector that requires constant innovation and strategy in order to respond to the monumental challenge of global warming. Leading economies like the US, China and Europe are all working on innovative ideas from mini nuclear plants to tapping the heat from the earth's core. Both UK and India have an immense opportunity to collaborate in this area.

Bridge India is proud to introduce this review of UK-India energy opportunities. Its launch is timely, as the UK will be hosting the COP-26 meeting in Glasgow in November 2021. Across the world, governments face a litany of issues to resolve, including the twin challenge of tackling climate change and re-starting the economy following the disruption of COVID-19.

The UK's ambitions on energy transition are world-leading. In 2019, it became the first G7 country to legislate for net-zero emissions, with a more than 40% cut to emissions since 1990, the fastest rate in the G7. This has been followed up with a ten-point plan for a green industrial revolution and a policy white paper. Key commitments include a hydrogen strategy, £1 billion investment in carbon capture & storage, a target of producing enough offshore wind to power every home, and the creation of a revenue mechanism for private sector green investment.

Likewise, India, which has a vast population, a fast-growing economy and is the world's third-largest energy consumer,¹ is in the middle of the world's largest expansion of renewable energy,² with strong impetus from the Modi administration. The International Energy Agency (IEA) expects India to be the largest contributor to the global upswing in renewable energy in 2021, with solar photovoltaic panels (PV) and wind energy playing a key role in this transition.³

Climate change is especially important for India's clean energy ambitions, where rapid urbanisation and industrialisation are being accompanied by increasing carbon emissions. Six of the world's ten most polluted cities are in India. Four of these – Delhi, Noida, Gurugram, Greater Noida and Ghaziabad – are in the Delhi NCR cluster. According to the World Health Organisation, one out of every four people killed by air pollution globally each year is in India.⁴

"The biggest challenge of our time is climate change and we need to work together to deliver a cleaner, greener world and build back better for present and future generations."

Alok Sharma MP, President, COP26



Bridge India engaged with key stakeholders in energy related sectors in both countries. One conclusion from our conversations is that the energy transition challenges facing India are even more daunting – and the opportunities no less exciting. Whether supporting the UK's ambitions or driving India's own green agenda, the potential mutual benefit is immense. Key areas of interest identified so far include the hydrogen economy, battery technology, electric vehicles, power grid development and project financing, where collaboration between the two economies can set a global standard.

We found that while India's desire to transition to renewable energy is relatively new when compared to the UK, it has enormous ambition to rapidly scale up capacity and infrastructure over the next decade and has quickly emerged as an attractive energy investment destination. In areas like offshore wind technology or development of robust electric vehicle (EV) ecosystems, the UK has

a first-mover advantage. As such, there is immense scope for knowledge and capital transfer to India as it looks to deliver affordable and sustainable energy to all.

There is great potential for the UK to leverage India's strong manufacturing base and engineering skills into a competitive advantage, especially in areas like battery technology, where India is looking to achieve greater self-reliance. UK-based companies like Faradion and AMTE Power, which have significant expansion plans in India, have already recognised this potential.

This report is all about sharing these highlights of our engagement with key stakeholders in the industry. We hope it will provide a stimulus to further UK-India collaboration, at a time when collaboration will be the key to shared prosperity. We hope you share our excitement at these possibilities.

Literally trillions of dollars globally are being invested in hydrogen, in electric vehicles, in carbon capture, in battery storage, in zero emission plants, in new forms of energy — some we don't even know about today.”

John Kerry, President Joe Biden's Special Presidential Envoy for Climate



CASE STUDY



Tata Chemicals Europe: Capturing carbon dioxide from power generation, low carbon hydrogen production and industrial processes

Tata Chemicals Europe (TCE) is a subsidiary of the giant Indian Tata conglomerate and one of the UK's few manufacturers of soda ash and high purity sodium bicarbonate. In 2019, it received a £4.2 million grant from the UK's Department of Business Energy and Industrial Strategy (BEIS) to construct the country's first industrial-scale CCU demonstration plant.

The plant will be commissioned in 2021 at TCE's Norwich industrial site and is capable of capturing up to 40,000 tons of carbon dioxide per year. Carbon emissions at the plant are expected to reduce by 11%. The project is also expected to help TCE tap into new export markets for sodium bicarbonate.

State of Play in Both Countries

Both the UK and Indian governments have ambitious plans to create sustainable and cleaner energy systems. The UK has invested US\$122 billion in the renewable energy sector between 2010 and 2019,⁶ while the sector in India has seen more than \$42 billion of investment between 2010 and 2018.

Both markets represent strong growth potential for the future. India will need to double its electricity output by 2030 to meet its growing energy demand, with 50 percent of that output likely to be generated by renewable sources.

This expansion offers investment opportunities worth \$30 billion per year over the next decade.⁶ The Centre for Energy Finance (CEEF) has estimated that India's EV market alone could be worth \$206 billion by 2030, with investment opportunities worth \$12.3 billion in battery manufacturing, and \$2.9 billion in the deployment of charging infrastructure.⁷

Similarly, the UK, as part of its Ten-Point Plan, is set to invest £5 billion to support a green recovery (including £256m to develop its energy storage market⁸), with several times more

anticipated from the private sector. Key areas identified by the UK of particular interest to India include low-carbon hydrogen, low-emission vehicles, CCUS (carbon capture, usage and storage) and green finance.⁹

FICCI's Economic Survey in January 2021 said that the government's Atmanirbhar Bharat Abhiyaan (the Self-Reliant India Campaign) will bear fruit in the coming years – particularly the announcement of production-linked incentive schemes and the government's keenness on improving national infrastructure.

We think future collaboration could have a recurring theme of 'Innovate in Britain', as also for the 'Make in India' initiative.

The UK is leading the way in the transition to a net zero economy. As well as implementing legally binding climate change mitigation targets, the UK Government recently announced its Ten Point Plan for a Green Industrial Revolution that will seek to make the UK a global leader in green technologies, such as offshore wind, low carbon hydrogen and green transport as well as innovative green finance mechanisms. With India's vast population, fast-growing economy and rapid urbanisation and industrialisation, there are clearly many areas of mutual interest, knowledge sharing and collaboration between the two nations. This is a very exciting time for the UK-India relationship."

Jonathan Cohen, Head of Energy, Howard Kennedy LLP

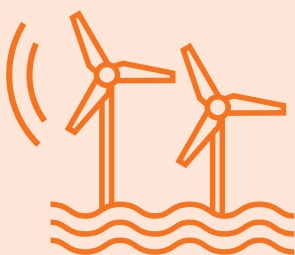


UK: 2020 was the greenest year ever

The energy sector in the UK has transformed over the last decade. 2020 was a record-breaking year, with wind generation, solar, and coal-free records helping to make it the greenest year ever for its electricity network, as Britain ran for nearly 68 days without fossil fuel between 10 April and 16 June 2020.

This trend is set to continue as the UK pushes on towards 40 GW of offshore wind capacity by 2030. Low-carbon hydrogen in combination with CCUS is the next big opportunity, de-carbonising both the power sector and heavy industry.

On 18 December, wind generated a record **17.2GW**

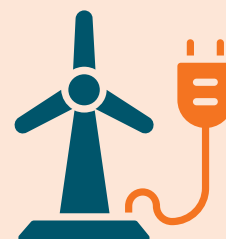


Coal now contributes just **1.6%** of the electricity mix, compared with almost **25%** in 2015

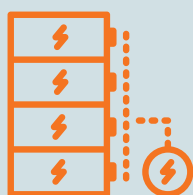
The UK's low-carbon industries already support over **460,000** jobs¹¹



Over **20%** of electricity is now obtained from wind¹²

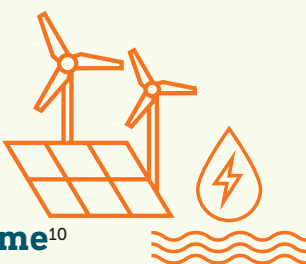


£256m of government funding to develop the energy storage market

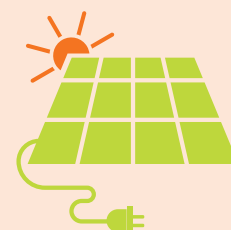


\$122bn invested in UK renewable energy generation projects between 2010 and 2019¹³

In **2020 Q1**, renewable's share of generation exceeded **40%** for the first time¹⁰



Solar generation set a new record of **9.7GW**



India: Leading the pack in solar and e-mobility

In 2014, the government of India introduced its ambitious Solar Park Scheme, which has exponentially increased India's solar energy capacity over the last decade. Furthermore, it has led to the creation of ultra-mega power plants across the country.¹⁴ These utility-scale solar installations, based on a plug-and-play model, have attracted significant global capital into India's renewable energy sector, reducing solar power tariffs by more than 75%.¹⁵

The Indian government has also initiated the creation of the International Solar Alliance to encourage greater cooperation among 122 solar-rich countries by facilitating the exchange of ideas, mobilising new investments and identifying synergistic opportunities.¹⁶

Electric mobility is another area that has received considerable policy attention in recent years. The Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) incentives were a work-in-progress, but FAME2 has been more successful in promoting the sector, albeit with a bias towards lithium-ion batteries from the government and NITI Aayog.

In order to facilitate this transition at a larger scale, there is an equal push to develop the required infrastructure, with plans to extend capital grants to organisations that promote the use of electric vehicles and/or install EV charging points across petrol stations in the nation.¹⁷

These efforts, alongside investments in thermal power capacity, have helped India resolve its longstanding power deficit and become a net exporter of electricity. While transmission and distribution losses still occur,¹⁸ there are various different methods under consideration to ensure the supply of reliable and quality power, with the power supply deficit down to 0.5% in 2020.¹⁹ India has also strengthened its position as a net exporter of electricity since 2017 and continued to trade power with its regional neighbours.²⁰ India's rapid improvement in the World Bank's Ease of Doing Business (EODB) rankings in Getting Electricity to 22nd best in the world, is evidence of the success of its energy policy – although it continues to face the challenge of ensuring the financial health of its power sector, especially its state government-owned power distribution companies, called DISCOMS.

CASE STUDY

Nova Pangaea Technologies: Technology for a low carbon world



NOVAPANGAEA
TECHNOLOGIES

Nova Pangaea Technologies' world-first, patented process, REFNOVA, sustainably converts forestry and agricultural residues into sustainable biochemicals and biopolymers and drop-in products for advanced biofuels.

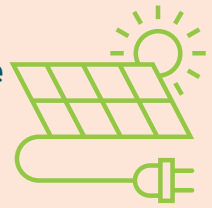
Nova Pangaea, based at Wilton International in Redcar, is part of a consortium that won a three-year grant commencing in 2018 from the Newton Fund via InnovateUK. The support is for valorising waste from sugar cane industries utilising their innovations in pre-treatment, bioproduction and process intensification. The Vasantdada Sugar Institute is the India lead for the consortium.

According to Simon Crabtree, Investment Manager at Mercia, "Nova Pangaea Technologies will make a significant impact on both a national and international scale. A truly circular business, it is working towards breaking our reliance on oil, while meeting the world's energy needs".



5th global position
for overall installed
renewable energy
capacity

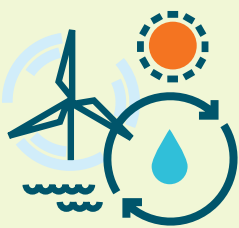
Solar power capacity
has increased by more
than **14 times** from
26 to 34 GW between
2014 and 2019²¹



In **2018**, India's
investment in **solar PV**
was greater than all
fossil fuel sources of
energy combined²²



\$7 billion of FDI
equity inflow into India's
renewable energy sector
between **2000-2018**²⁵



\$9.6 billion:
cumulative FDI equity
inflow in the non-
conventional energy
industry between
April 2000 to
September 2020²³

\$80 billion
worth of investments
in renewable plants
until **2022**



\$250 billion worth of
planned investments in renewable
plants between **2023-2030**

\$1.2 billion:
highest annual FDI inflow
into India's renewable
energy sector between
2017-2018²⁴



As of November
2019, a total of
280,994
electric vehicles
have been sold



\$7 billion
estimated cost savings
as a result of energy
efficiency programs in
2017-18²⁶



\$42 billion
of renewable energy
investment in India
since **2014**

Key areas of existing collaboration

At a macro level, the UK is now the second largest investor in India; India is the second largest job creator in the UK over the last 15 years. Despite economic disruptions caused by the pandemic, annual bilateral trade was up by nearly 12% in 2020.²⁷

In the energy sector, the existing story is one that relates close collaboration and a strong foundation for further opportunity. At the first bilateral 'Energy for Growth' Dialogue in 2017 - which, in part, was facilitated by members of the Bridge India Board - India's Power and Renewable Energy Minister, Piyush Goyal and the UK's Secretary of State for Business, Energy and Industrial Strategy, Greg Clark, provided momentum for collaboration on priority areas in the energy sector.

Energy Efficiency Services Ltd (EESL), the fastest-growing Indian company in Grant Thornton's India Tracker 2020, was formally launched during this meeting. EESL was set up by the Indian Government's Ministry of Power to create and sustain markets for energy efficiency in India. They have committed to investing £100 million in the UK over three years to promote and implement low-carbon, energy-efficient, renewable energy solutions via its Joint Venture EESL EnergyPro Assets Ltd, which made several acquisitions in 2019.

On the private sector front, the two countries have launched a \$700m Green Growth Equity Fund, which was structured as a joint venture between the UK-based Lightsource and Indian private equity firm, Everstone Capital, in 2018. Backed by BP, India's National Investment and Infrastructure Fund (NIIF), and the UK's Department for International Development (DFID), the fund has supported the growth of India's renewable energy sector, through investments in Ayana Renewable Power, Radiance Renewables, GreenCell Mobility, and EverEnviro.

The UK's aim is to be a global leader in the technologies needed to decarbonise its economy and transition to net zero. The UK government will launch a £1 billion Net Zero Innovation Portfolio and has committed to raising total R&D investment to 2.4% of GDP by 2027. Furthermore, it aims to launch its first Sovereign Green Bond in and use its world-leading London financial sector to encourage private investment in innovation.

Green finance remains another area of active bilateral collaboration, especially following a series of Green Bond issuances by India's Axis Bank and the National Thermal Power Corporation (NTPC) on the London Stock Exchange in 2016. These landmark listings open up a new channel of finance for India's renewable energy projects, and signal growing investor confidence in India's aspirations. Unfortunately, it is uncertain whether investor appetite will remain if London's financial muscle diminishes after Brexit, and pandemic response efforts reallocate the remaining capital elsewhere.

Beyond these flagship projects, there are a variety of bilateral collaborations occurring which involve path-breaking SMEs. Sodium-ion battery producer Faradion is in advanced discussions for several orders for its batteries from India and is due to start manufacturing its batteries there shortly, a leading innovator in the transmission sector, AssetCool, has ambitious India plans, and Nova Pangea Technologies has been working with sugar cane factories in India to help produce bioethanol.

The UK's Ten Point Plan

The Ten Point Plan was published in November 2020 and sets out the government aims for creating green growth, jobs, and accelerating the country's path to net zero by 2050.

Overlaying the UK's Plan with the perspectives from our interviews demonstrates a high level of mutual interest. Some opportunities are ready now with others set to generate significant value in future.



Key features of the Ten Point Plan

Offshore wind: by 2030, the UK aims to produce 40 GW of offshore wind. By 2030, this could support up to 60,000 jobs and help deliver around £20 billion of private investment.

Low-carbon hydrogen and CCUS: the UK is aiming for 5 GW of low-carbon hydrogen capacity by 2030. This is to be co-located with renewable energy and CCUS in industrial 'SuperPlaces' (North East, the Humber, North West, Scotland, Wales), creating up to 100,000 jobs by 2050. Two CCUS industrial clusters should be in place by the mid-2020s, rising to four by 2030, capturing up to 10 Mt of carbon dioxide per year. The UK will publish its Hydrogen Strategy in 2021 and finalise its preferred business models by 2022.

Zero-emission vehicles: the UK has brought forward its ban on sales of new petrol and diesel cars and vans to 2030, five years earlier than previously planned and in a similar timeframe to India. Home to several key motor manufacturers, and supporting key technology providers and a supply chain, the UK anticipates that the switch to zero-emission vehicles could support around 40,000 new jobs in 2030.

Green finance and innovation: The UK government will launch a £1 billion Net Zero Innovation Portfolio. It aims to launch its first Sovereign Green Bond in 2021. There is commitment to raising total R&D investment to 2.4% of GDP by 2027 (it currently stands at 1.7%²⁸).

A Sector Approach

This section focuses on the key areas of potential collaboration that arose from our interviews.

The two countries have very different energy needs and sources. According to think tank Ember, the UK's renewable electricity generation outpaced its fossil fuel generation for the first time in 2020. It said that renewable energy generated 42% of the UK's electricity in 2020 compared with 41% generated from fossil fuels. India's energy consumption is 45% coal and about a quarter from petroleum and other liquids.²⁹

British company Cairn Energy transformed India's oil and gas sector after assuming control of the Ravva oil and gas field in the 1990s and discovering the Mangala field in Rajasthan. Cairn's discoveries have generated revenues of more than US\$20 billion for the state and national government.³⁰

A company like NPT, which focuses on the development of biomass and waste, is a good example of British innovation finding a ready application in India. As part of our wider interview process, we spoke to several young

British companies that are keen to licence their products in the biomass, renewables and other sectors of the energy market in India. One of the key issues they raised concerned their inability to find the right counterparties to collaborate with in India. One solution to this problem would be to host UK/India trade delegations specifically focused on SMEs in this sector. Similar initiatives already exist, such as ACT4Green (Accelerating Clean-tech for Green), an initiative by the Foreign Commonwealth and Development Office (FCDO), aimed at supporting the clean-tech start-ups in the two countries. Whilst such initiatives can be very effective, some of our interviewees highlighted the fact that such schemes tend to favour "well-networked" rather than meritorious startups.

Taking into account the different energy consumption patterns in the two countries, we focus the rest of section on the highest-value collaboration opportunities that were evident in our research.

Our experience with Indian partners has been direct, hands-on and productive. A strong prevalence of Indian engineering excellence and favourable attitude towards innovative products leads offers great potential for closer UK-India collaborations."

Niall Coogan, CEO, AssetCool



Zero-Emission Transport

The shift from fossil fuels to zero-emission transportation has two key objectives in India: reduction in emissions (greenhouse gases and pollutants) and reduction in dependence on imported crude oil. Although transport accounts for a low share of India's total energy demand, it has effectively doubled in the last ten years.³¹

The UK is a leading manufacturer of electric vehicles, as demonstrated by the success of the Nissan Leaf factory in Sunderland. Other UK zero-emission manufacturers include LEVC (London taxi), Wrightbus and JCB (construction equipment). Jaguar-Land Rover (owned by Tata) are set to launch a range of EVs and are also researching hydrogen fuel-cells.

According to the Grant Thornton India Tracker 2020, Indian automotive companies Tata Motors, TVS and Rico Auto Industries are amongst the fastest growing Indian companies in the UK. TVS is actively looking at alternatives to lithium-ion battery technology in its vehicles, as is Ashok Leyland (part

of the London based Hinduja Group).

The government is also pushing the EV agenda and has recently ramped up its FAME2 incentives to boost the market, just as China phases down its subsidies. While this is expanding the breadth of India's EV landscape, the need for a radical overhaul in transport is more urgent in certain parts of the country. For instance, Delhi NCR's pollution problems are caused by particulate pollution from its sclerotic traffic. This is further exacerbated by diesel generators, crop-burning in nearby farmlands and the use of fossil fuels in stove cooking. Hence, it is unsurprising that the Delhi government is the most advanced in developing plans for expanding the use of electric vehicles.

"We want to ensure that Delhi has at least 25% electric vehicles by 2024 ... I also want to appeal to the youth to buy an electric vehicle as their first vehicle."

Arvind Kejriwal, Chief Minister of Delhi, India



EV adoption in India is expected to grow significantly in the next decade, especially with the government's National Electric Mobility Mission Plan (NEMMP), which is targeting 30% EV penetration in India by 2030. To facilitate this transition, massive infrastructure upgrades will be required, especially the deployment of EV charging points as well as robust grid capacity. The UK, which has been rapidly rolling out EV charging points of its 2030 phase-out of diesel and petrol cars and now has over 20,000 chargers available for public use across the country, is well-positioned to offer technical expertise and experience here. This could range from date-driven, optimised location of charging stations through to developing smart, robust grid capacity, which also intersects with the generation of renewable power generation, especially solar.

Another potential area for bilateral collaboration is the opportunity for India to transfer its perspective in last-mile connectivity solutions to the UK. As the single-biggest global market for two-wheelers, India has enjoyed success in this field with the development of e-rickshaws and light-weight battery-powered three-wheelers which transport commuters from residential areas to the nearest metro stations.

While India's EV growth has been driven largely by two-wheelers and three-wheelers up until now, this market is expected to grow. Similar solutions could be deployed in the UK in conjunction with autonomous technology as lightweight, last mile urban solutions.

Energy Storage

For renewables to become a major part of India's energy mix over the next decade, energy storage will be critical. This is especially significant for India, where much of its installed energy capacity is expected to come from solar power, an energy source with a clear split in day-night output. According to government estimates, the country will require 27 GW of grid connected battery storage by 2030.³²

Increasing storage capacity would allow India to store any excess power generated by its fuel sources, which can then be returned to the grid to meet peak demand – thus minimising power waste. Whilst electric vehicles can act as a giant, single battery via G2V (grid-to-vehicle) technology, dedicated batteries for storage will also be a key new sector. Battery research is also taking place in both countries, which can present opportunities to collaborate on R&D.

At present, India is heavily dependent on lithium battery imports from China. As sodium is relatively easier to source than lithium, leading companies in the UK and India consider it a viable alternative for energy storage. Globally, there is only one sodium-ion battery energy storage power station (100 kWh, in China). British companies Faradion and AMTE Power are seeking to change that. The next sodium-ion battery plant may well be in India.

CASE STUDY



Innovating in Sheffield, investing in India: Faradion

Sheffield-based Faradion is the world leader in non-aqueous sodium-ion cell technology. Dr Chris Wright, who was one of the pioneers of commercialising lithium-ion technology, saw potential in sodium-ion in 2011, and co-founded Faradion to develop sodium-ion technology and bring it to market. He teamed up with world-renowned battery scientist Dr Jerry Barker and investor Ashwin Kumarawamy. Today, its IP portfolio comprises 21 current patent families, focussing on cell materials, cell infrastructure, and safety and transportation.

The company started commercialising the product in 2019, with Bridge India supporting them with their first India market visit. Since then, it has announced its first major orders from industrial conglomerate ICM Australia, a licensing deal with listed energy company AMTE Power, a technical collaboration on the development of new anode materials with Texan company Phillips 66 and several orders from India in the pipeline.

It will soon be manufacturing its batteries in India with a joint venture partner, in a big win for Atmanirbhar Bharat.

The main batteries used in the electric vehicle and energy storage market, lithium-ion, are still expensive and have major sustainability issues.

There are simply not enough raw materials for today's lithium-ion batteries to be a safe, viable solution in the medium-term. They are exclusively reliant on finite metals that are difficult to extract from the Earth's crust. This is dangerous for a country's energy independence, as China owns 75% of the global supply chain.

Faradion's technology works better because it is able to match lead-acid lifetime cost of ownership, with performance at least as good as lithium-ion; second, it enables India to invest in its own supply chain, moving away from Chinese dependency; third, sodium is the sixth most abundant element in the earth's crust so there is no scarcity; and fourth, sodium-ion batteries can be discharged to 0 V (zero energy), so are safer than lithium-ion.

Hydrogen Economy

Hydrogen is the lightest, simplest and most abundant chemical element in the universe. It could provide a clean source of fuel and heat for our homes, transport and industry.

Hydrogen is a flexible means of storing and transporting energy. It can be deployed as an alternative or a complement to battery-based solutions. This fact, alongside the fact that hydrogen can operate across the three major energy vectors of electricity, heat and transportation is why hydrogen is considered an attractive option for a fuel source.

As governments around the world develop new hydrogen policy, the UK and India, for differing reasons, are well placed to benefit. In the UK, 'blue' hydrogen is set to be produced from natural gas by means of carbon capture and storage technologies, which will minimise emissions. The UK is also making strong progress in 'green' hydrogen – a good example being the European Marine Energy Centre on the Orkney islands, where renewable electricity is used to feed the electrolysis process. The UK government is currently exploring a switch to hydrogen (or a natural gas – hydrogen blend, as piloted at Keele University) for domestic heating, which is currently through natural gas. ITM Power is an early leader in hydrogen fuel-cells and will open the world's largest electrolyser manufacturing plant (1GW) in Sheffield. The UK is already exploring hydrogen opportunities and is set to launch an overall hydrogen strategy as per Japan, Germany and the EU.

India imports 80% of its crude oil requirements, and a move towards a carbon-free fuel must include hydrogen as part of the mix. Hydrogen can be generated from a range of zero-carbon power sources, from solar to nuclear. Reliance Industries sees hydrogen as key to its effort to making itself a net carbon-zero firm by 2035, whilst Mahindra & Mahindra has been involved in major R&D work with the MNRE.³³

Although the exploration of hydrogen is in its infancy in India, it is expected to constitute a growing part of the national energy mix. According to some estimates, nearly 80% of India's hydrogen is projected to be green, driven by cost declines and new production technologies.³⁵ India is expected to roll out its first national hydrogen project later this year, which will lay out a blueprint for capitalising on this energy source.³⁶ British technical expertise, alongside joint funding opportunities through Innovate UK and the Newton-Bhabha Fund could accelerate bilateral cooperation in this area.

One of the investors we interviewed for this report pointed out that governments often like the idea of exploring new technologies such as hydrogen, but are unwilling to put the substantial risk capital behind it that is required.

I am sure more companies will start to look at hydrogen in India as big companies like Reliance are making their intentions clear ... policy makers should do a systematic analysis on whether EVs or hydrogen-based fuel cells will be better,"

Ravinder Kumar Malhotra, President, Hydrogen Association of India³⁴



Wind

The UK has one of the best natural locations for wind power and has embraced this opportunity, ensuring that 20% of electricity is now obtained from wind. Having developed capacity to provide 10.4 GW³⁷, it is the largest global player in offshore wind power. India, the world's fourth-largest wind power market, has just started to explore its wind power capability, with a particular interest in offshore wind, which presents significant opportunities for bilateral engagement.³⁸

India has already recognised the UK as a preferred partner to collaborate and develop its offshore wind potential.³⁹ Entities like the UK Science & Innovation Network have been in active dialogue with the state governments of Tamil Nadu and Gujarat,⁴⁰ which are located along India's coastline and have the best offshore wind resources.

A key area for collaboration is the design and development of offshore turbines, especially those that are optimised for operation in India's low-wind conditions. International companies like Siemens Gamesa and Vestas, which have manufacturing facilities in India, have already captured this market and received large contracts from independent power producers like Adani Green Energy and MSPL. Another area where joint R&D opportunities lie is in assessing India's largely unexploited offshore wind capacity, including meteorological and data science expertise to consistently evaluate wind patterns and energy production potential.

Joint manufacturing and R&D opportunities like these are critical to helping India. There could be similar opportunities for UK companies to adapt their technologies for the Indian market.

The integration of wind energy is also a key consideration for India, as this requires transmission and balancing capacity to keep up with the seasonal variation of the wind power generation.⁴¹ This is a promising avenue for collaboration, as the UK is innovating rapidly in this space to reduce the effect of wind variability is having on the power grid.⁴² The UK's Offshore Transmission Network Review, which is currently underway,⁴³ could be a valuable source of information to India as it looks to sustainably integrate offshore wind with other clean technologies.

CASE STUDY



Micropore Technologies: Leader in membrane emulsification technology

The Redcar-based company specialises in creating stable emulsions that can be used in a range of sectors, such as pharmaceuticals, agrochemicals, personal care, food and drink, and even rocket fuel.

Developments in our fundamental understanding of membrane emulsification technology from Loughborough University and Micropore have resulted in equipment that enables a seamless transition from lab, through development and into manufacturing.

It opened an India office following a trade delegation

to Telangana in September 2019, as Hyderabad accounts for 35% of national pharma production.

In January 2020, the company was awarded first prize in both the Pharma and Innovative Product categories of the The IChemE Global Awards, widely recognised as the world's most prestigious chemical engineering awards.

Green Financing

Project financing is a critical consideration for the viability of renewable energy projects, which often require large volumes of capital investment. This is especially important for India, where solar projects are predominantly financed by debt, and credit market options for long-term infrastructure financing are limited.⁴⁴ Hence, International finance will be a key component to scaling up the country's climate action plans, whether it is in the form of developmental finance or traditional capital markets.

The UK understands the need to grow global markets for clean technologies, and has therefore pledged to mobilise \$100 billion per year in climate finance to developing countries.⁴⁵ Development institutions like the CDC Group have been instrumental in driving this commitment in India, with priority given to renewable energy, demonstrated through their investments in platforms like Ayana.⁴⁶

The UK and Indian governments have collaborated to create a bilateral Sustainable Finance Forum in order to mobilise private capital and technical expertise to help both countries achieve their sustainability goals.

Green bonds are another area where greater collaboration can open-up new financing options for renewable energy projects in both countries. While India is the second-largest emerging green bond market, its issuances only constitute a fraction of the country's green finance requirement. Greater emphasis on corporate

governance and ESG disclosures, especially the guidelines set out by the Task Force on Climate-Related Financial Disclosures (TCFD), will play an important role in driving forward the sustainable finance agenda. Although the Securities and Exchange Board of India (SEBI) issued its guidelines on green bond listings,⁴⁷ and has mandated business responsibility reports from the top 100 listed entities, it has not made concrete progress toward implementing the TCFD recommendations.⁴⁸ On issues like this, there is scope for borrowing the best practices from the UK, which is set to become the first country to make the TCFD aligned disclosures fully mandatory across its economy by 2025.⁴⁹

In 2021, the UK is set to bring forward details for a revenue mechanism to bring private sector investment into key projects including hydrogen and CCUS. These innovative business models provide opportunities for globally minded companies in India to invest in the UK and to finance its own ambitions plans for clean growth.

CASE STUDY

AssetCool: A unique solution for overhead transmission line conductors



ASSETCOOL
THERMAL METAPHOTONICS

Sheffield-based AssetCool is a company dedicated to the development of novel materials for electricity transmission. They have developed a photonic coating for overhead transmission line conductors which increases current carrying capacity or reduces transmission losses. The coating provides these benefits via a passive cooling mechanism which reduces a conductor's temperature at a given current and particular conductor size. This passive cooling mechanism involves simultaneously reflecting solar radiation and increasing the rate at which heat energy is emitted from the conductor. This results in more efficient conductors, which means lower capital requirements when designing lines and an opex saving over time due to reduced power losses.

According to the CEO Niall Coogan, India is a target market for them because energy requirements scale with economic growth. Improved transmission capacity and efficiency (i.e. reduced power losses) will be critical to fuelling India's economic potential over the coming years, particularly when budgets are squeezed in the wake of the pandemic. Given this macroeconomic picture, transmission line development is a very attractive market in the region.

Risks

Despite India's rise in the World Bank Ease of Doing Business rankings, foreign investors remain concerned on contract enforcement in a flawed legal system, IP protection and certainty over taxation. India ranks 163rd in the world in Enforcing Contracts.

The UK India Business Council (UKIBC) has been vocal in its demand to remove the retrospective taxation provision. Long-running disputes with Cairn Energy, Vodafone and Devas have hurt investor sentiment towards India.

Two important geopolitical factors are likely to benefit bilateral collaboration in the energy sector. First is Brexit. The EU counted for around half of the UK's total trade, and India counted for less

than five percent. That David Cameron's largest-ever trade delegation was to India, Theresa May's first non-EU trip as Prime Minister was to India, and Boris Johnson's likewise had planned one for January 2021, indicates the importance of a move towards India to increase this bilateral trade that augurs well for the relationship.

The second is China. Sentiment in the UK, as elsewhere, has soured on China, particularly in the

From 2012 onwards, the policy of retrospective taxation has surely proven to be a dampener in the inflow of foreign capital from the UK and elsewhere into India.”

Jayant Krishna, Group CEO, UK India Business Council



last year. India benefits from being an important democratic counterweight to China. Furthermore, the Indian government is keen to proactively assist in creating manufacturing opportunities for foreign companies. A prosperous India is important to the UK's economic, geopolitical and maritime interests in the Asia Pacific especially the Indo-Pacific.

A significant concern to both countries ambitious plans for energy reform is affordability. The UK's Ten Point Plan aims to "mobilise" £12 billion of

government investment, and "potentially" three times as much from the private sector. India's emerging green economy requires additional investments of around \$80 billion until 2022, and up to \$250 billion between 2023-30.⁵¹ The pandemic has pushed the UK's debt-to-GDP ratio to its highest since World War II, while India's finances to support its economic recovery are likewise stretched when off-book non-performing assets from the banking sector are taken into account.



Our economy will grow at 10% in 2021-22 in real terms. By the end of next year, we will reach pre-COVID level.”

Rajiv Kumar, Vice Chairman, NITI Aayog⁵⁰

Next Steps and Recommendations

UK-India collaboration already strengthens ties and delivers mutual benefits. Bridge India hopes that this report will act as a stimulus to further action.

Our recommendations are framed as ones which could, if implemented within a five-year timeframe, propel bilateral collaboration in the energy sector. They are ambitious but achievable. Brexit, the post-pandemic global recovery and COP26 all combine to make 2021 the ideal year to strengthen such ties.



Innovate in the UK, grow in India

The market opportunity in India for British SMEs is immense and largely untapped. UK policymakers should work more closely with British venture capital and other investors, to directly assist their investee cleantech and energy companies secure pilot projects and joint venture opportunities in India. State governments in India should explore more trade delegations to the UK.

UK-based SMEs can bring their innovation to the energy transition by innovating in small-scale solar power generation (and associated battery storage) and in 'last mile' urban transport connectivity solutions.



Make in India, finance in London

London's position as the go-to venue of choice for raising green bonds was further underscored by the Chancellor announcement in November 2020 that the UK Government will issue its first Sovereign green bond in 2021. There are now more than 240 active bonds from over 60 issuers admitted to the LSE's Sustainable Bond Market. India should take advantage of market appetite further finance its ambitious climate agenda.

At the same time, India should encourage the growth in Environmental, Society and Governance (ESG) practises in corporate India.



The EV revolution hitting the road

There are numerous examples of innovation and risk capital in both countries flowing into the EV sector. Sales of two-wheelers and three-wheelers continue to grow strongly in India. With some notable exceptions (Tata / Jaguar Land Rover and Ashok Leyland / Optare), the potential for shared development and roll-out of zero-emission vehicles, from private cars to trucks and buses, is not close to be realised. Both countries have the opportunity to work together to build international champions. In part, this is important to act as a bulwark against China's dominance of the market.



Stepping together towards a hydrogen economy

Hydrogen (in partnership with CCUS) will be a key to unlocking low-carbon growth across the power, heating and transportation sectors. While both markets are taking their first steps towards a hydrogen economy, there is considerable scope for technology sharing as the UK's CCUS market grows, which could support India's production of hydrogen from natural gas. Advancements in the performance of electrolysers, another area where the UK is rapidly innovating, could also enable the small and medium-scale production of green hydrogen in India from solar and wind.

Bridge India remains committed to supporting stakeholders in both countries achieve greater collaborations, through research, private briefing sessions, contributions from our Members and trade delegations.

References

- ¹ US Energy Information Administration, India.
- ² Invest India website, accessed 06 February 2021.
- ³ Renewables 2020: Analysis and forecast to 2025, International Energy Agency, November 2020.
- ⁴ 6 of the world's 10 most polluted cities are in India, World Economic Forum, Douglas Broom, 5 March 2020.
- ⁵ Department for International Trade (DIT) website, accessed 06 February 2021.
- ⁶ Why India is the new hotspot for renewable energy investors, 14 January 2020, Sumant Sinha, World Economic Forum.
- ⁷ Financing India's Transition to Electric Vehicles, Centre for Energy Finance, December 2020.
- ⁸ DIT website, accessed 06 February 2021.
- ⁹ The Ten Point Plan for a Green Industrial Revolution, November 2020, HM Government.
- ¹⁰ Energy Trends, December 2020, Department for Business Energy & Industrial Strategy.
- ¹¹ Ibid.
- ¹² Digest of UK Energy Statistics, July 2020, Department for Business Energy & Industrial Strategy.
- ¹³ Department for International Trade website, accessed 06 February 2021.
- ¹⁴ India's Utility-Scale Solar Parks a Global Success Story, Institute for Energy Economics and Financial Analysis, May 2020.
- ¹⁵ Ministry of New and Renewable Energy (MNRE) website, accessed 06 February 2021.
- ¹⁶ International Solar Alliance website, accessed 06 February 2021.
- ¹⁷ Mobilising Finance for EVs in India, Niti Ayog and Rocky Mountain Institute, January 2021.
- ¹⁸ India 2020 Energy Policy Review, International Energy Agency, January 2020.
- ¹⁹ Growth of Electricity Sector in India from 1947-2020, October 2020, Central Electricity Authority.
- ²⁰ India 2020 Energy Policy Review, International Energy Agency, January 2020.
- ²¹ MNRE website, accessed 06 February 2021.
- ²² Ibid.
- ²³ Make in India website, accessed 06 February 2021.
- ²⁴ Why India is the new hotspot for renewable energy investors, 14 January 2020, Sumant Sinha, World Economic Forum.
- ²⁵ Ibid.
- ²⁶ Economic Survey 2019-2020, January 2020, Government of India.
- ²⁷ Sterling Access 2020 Review Report, CBI and EY, November 2020.
- ²⁸ Research Briefing: Research and Development Spending, 17 June, 2020, House of Commons Library.
- ²⁹ International Energy Agency, World Energy Outlook 2019.
- ³⁰ Cairn Energy website, accessed 06 February 2021.
- ³¹ India 2020: Energy Policy Review, January 2020, International Energy Agency.
- ³² India Energy Outlook 2021, International Energy Agency, February 2021
- ³³ MNRE website, accessed 06 February 2021.

- ³⁴ From IOC to Reliance: India's hydrogen ambitions get stronger by the day, S&P Global Platts, July 2020
- ³⁵ The Potential Role of Hydrogen in India, The Energy Resources Institute (TERI), December 2020
- ³⁶ India Budget website, accessed 06 February 2021.
- ³⁷ Energy Trends, December 2020, Department for Business Energy & Industrial Strategy.
- ³⁸ Global Wind Energy Council website, accessed 06 February 2021.
- ³⁹ Making Renewable Energy Markets Work, Climate and Development Knowledge Network, July 2017.
- ⁴⁰ Proceedings of the UK-India Workshops on Offshore Wind Energy, February 2014, UK Science and Innovation Network
- ⁴¹ India 2020 Energy Policy Review, International Energy Agency, January 2020.
- ⁴² Energy Innovation Needs Assessment, October 2019, Department for Business Energy & Industrial Strategy
- ⁴³ The Ten Point Plan for a Green Industrial Revolution, November 2020, HM Government.
- ⁴⁴ India 2020 Energy Policy Review, International Energy Agency, January 2020.
- ⁴⁵ UK Government website, accessed 06 February 2021.
- ⁴⁶ CDC Group website, accessed 06 February 2021.
- ⁴⁷ India Budget website, accessed 06 February 2021.
- ⁴⁸ Sailing from Different Harbours: G20 approaches to implementing the recommendations of the Task Force on Climate-related Financial Disclosures, Centre for Sustainable Finance, May 2018.
- ⁴⁹ Chancellor sets out ambition for future of UK financial services, 9 November 2020, HM Treasury.
- ⁵⁰ Quoted by Asian News International (@ANI), Twitter, 31 December 2020.
- ⁵¹ Volume 2: Economic Survey 2020-2021, January 2021, Government of India





For more information

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