REUTERS EVENTS™

100 INNOVATORS LEADING THE GLOBAL ENERGY TRANSITION

2024 EDITION

INTRODUCTION & METHODOLOGY

Innovation is the bedrock on which the global energy transition is built. Over the last decade, innovations in renewable technology, carbon management, supply chain efficiency, energy software, and policymaking have forged a rapidly-growing energy transition market, set to unlock trillions in revenue.

In this third edition of the Energy Transition Innovators Report, Reuters Events gives recognition to some of those organizations around the globe who form the tip of the transition spear as they innovate across the value chain.

To assemble our list of innovators for the energy transition, we asked our community for recommendations throughout October 2023. We received more than 1,000 nominations from industry stakeholders from an online survey that was written and conducted adhering to strict market research guidelines. The resulting list of nominations was vetted internally and our final list was assembled taking into consideration their stated achievements, with special considerations given to organizations nominated by third parties on more than one occasion.

The list is divided into 10 categories of 10 organizations each, three of which have been given a detailed profile. The Report is not ranked and should be considered as a celebration of those making notable contributions to the energy transition.

DECARBONIZATION

The rapid and meaningful decarbonization of energy production and manufacturing processes is one of the steepest challenges facing transition stakeholders today. Where is tangible progress being made?

SPECIAL MENTIONS

Bp

Bp's decarbonization strategy is well underway in Teeside, where it is working to slash emissions from one of the UK's largest industrial clusters in a region home to 5 of the country's top emitters. Built on a foundation of carbon capture, utilization, and storage (CCUS) technology, respondents identified bp's development of the world's first commercial-scale gas fired power station, set to generate 860MW, alongside localized green hydrogen production and transportation, as a strong market signal to deliver meaningful decarbonization.

Ørsted

Ørsted's extensive offshore wind deployment has positioned it as a market leader in renewables – but in 2009, 85% of Ørsted's power was generated by fossil fuels. Respondents noted that Ørsted's complete transformation from fossil to renewables – achieved in 2019, decades ahead of its stated 2040 goal – demonstrates that net zero is not only possible, but achievable and profitable. Ørsted remains on track to divest out of oil and gas by 2024, and to achieve carbon neutrality by 2025.

Equinor

Norwegian energy stalwart Equinor struck respondents with their balanced, technology-driven approach to practical decarbonization. Equinor's Hammerfest LNG plant is undergo-ing significant upgrades, including electrification of gas turbine generators, electric steam boilers, and functional CO2 capture capabilities. Equinor's Hywind Tampen project, now fully operational, is also the first floating wind farm built specifically to power offshore oil and gas installations, further slashing emissions from this carbon-intensive production process.

OTHER DECARBONIZATION INNOVATORS

- **Tata Steel,** for carbon-neutral steelmaking technology
- **Gas Technology Institute,** for methane emissions monitoring and mitigation technology
- **Climate Trace,** for tracking GHG emissions activity
- **Kiewit,** for developing industrial-scale carbon capture projects
- **Tourmaline,** for the lowest GHG emissions intensity in Canada
- **Carbon Upcycling,** for its carbon upcycling technology
- **Cenovus Energy,** for an estimated 59% reduction in methane emissions from 2019 levels

DIGITAL TRANSFORMATION

Process automation has been an important tool for energy and industrial businesses for several decades, but the increasing interconnectivity of producers, distributers, and users means software and data are more important than ever.

SPECIAL MENTIONS

Octopus and Kraken

As technology like smart meters increases in popularity, retail energy customers are engaging with their own use patterns in more detail than ever before. Respondents lauded Octopus for consistently putting customers first – through innovations in flexible-rate tariffs, including Agile Octopus, all backed by its Kraken utility operating system featuring customer information, billing, meter data, and AI-powered communication and automation.

Siemens

Respondents highlighted Siemens' energy monitoring technology – just one portion of its extensive energy software offering – as a reflection of the critical importance that digital transformation holds in the transition. The SIMATIC Energy Management Software platform, providing detailed data on production-related energy monitoring, load management, and company-wide energy analysis, demonstrates a potential future for digitalized energy solutions – end-to-end, company-wide, and holistically integrated.

Amazon Web Services (AWS)

For oil and gas stakeholders, navigating market and regulatory volatility is a significant challenge – and in the age of data-driven solutions, cloud-scale titan AWS is leveraging its computing power to optimize upstream data and augment exploration operations. Respondents noted AWS' ODSU Data Platform is best-in-class for providing advanced analytics to oil and gas players.

OTHER DIGITAL INNOVATORS

- **GE Vernova,** for its extensive software portfolio
- **SAP,** for digital twin integration and implementation
- **Schneider Electric,** for microgrid management technology
- **Origin Energy,** for its focus on digitalization
- **Piclo,** for the PicloFlex platform
- **Electric Power Research Institute,** for the Digital Transformation Research Initiative (DXRI)
- **Aspen Technology,** for asset optimization software

WIND POWER

A core renewable generation technology, a familiar sight around the world, and deployed at scale on and offshore – innovations in wind power are accelerating at pace as generating capacity continues to ramp up.

SPECIAL MENTIONS

Iberdrola

Whilst many organizations set their sights on 2030, 2040, or even 2050 plans, renewable generator Iberdrola has committed €47 billion to its 2023-2025 Strategic Plan, with extensive wind deployment over the next two years. Most recently, this includes commissioning of the Baltic Eagle wind farm by the end of 2024, installation of the first turbine at the Vineyard Wind I project, also due to come online in 2024. Respondents praised Iberdrola's efficiency and standardization across their project deployments.

ENGIE & EDP Renewables

Respondents highlighted the Moray West wind farm, a 50-50 venture between ENGIE and EDP Renewables off the coast of Scotland, as a successful commercial wind model – Moray West is the first UK offshore wind farm to commercialize output mostly through corporate power purchase agreements (PPAs). Moray West is expected to reach full 882MW capacity by 2025, where it will join Moray East's 950MW generation capacity.

Emirates Water and Electricity Company & Masdar

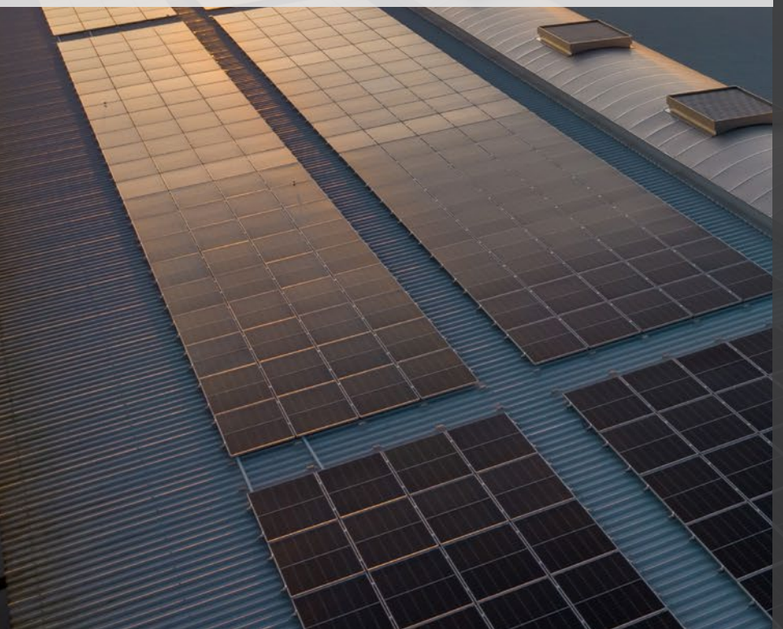
Following the official UAE Wind Programme inauguration this year, EWEC signed an PPA agreement with Masdar to procure wind power from three utility-scale wind farms, with a stated generation capacity of up to 99MW from 22 turbines. A landmark agreement and the first of its kind in the UAE, respondents applauded EWEC's aggressive mobilization of renewable generation as its wind capacity increases.

OTHER WIND INNOVATORS

- **SINTEF,** for AdaPfab, a sustainable and cost-effective wind prefabrication process
- **Bentley Nevada / Baker Hughes,** for turbine condition-monitoring systems
- **Emerson,** for wind turbine control software
- **Aker Solutions,** for offshore project management
- **SSE Renewables,** for developing open of the world's largest floating offshore wind farms
- **Vestas,** for 1700 offshore turbines installed across 48 projects
- **Vattenfall,** for the world's first subsidy-free offshore wind farm

SOLAR POWER

Estimates suggest global solar power spending is due to hit more than $1 billion a day in 2023, and new projects are being installed at a staggering pace.



SPECIAL MENTIONS

Enel Green Power

Respondents referenced Enel's Quorn Park Hybrid Project, set to break ground in 2023 and become operational in 2025. With an investment value of over $200 million, and combining solar power production with battery energy storage systems (BESS), the Quorn Park site will ultimately power around 45,000 Australian homes and produce 96WM of solar and 20MW of battery capacity.

Shell and Microsoft

Shell and Microsoft formed a strategic alliance to reduce carbon emissions in 2020, and this year Shell signed a 15-year PPA to secure 600MW of capacity from Germany's largest solar project, managed by MOVE ON Energy. A significant purchase in and of itself, Microsoft has already secured 323 MW of this capacity from Shell as it steams towards its 100% renewable power commitment by 2025.

Repsol

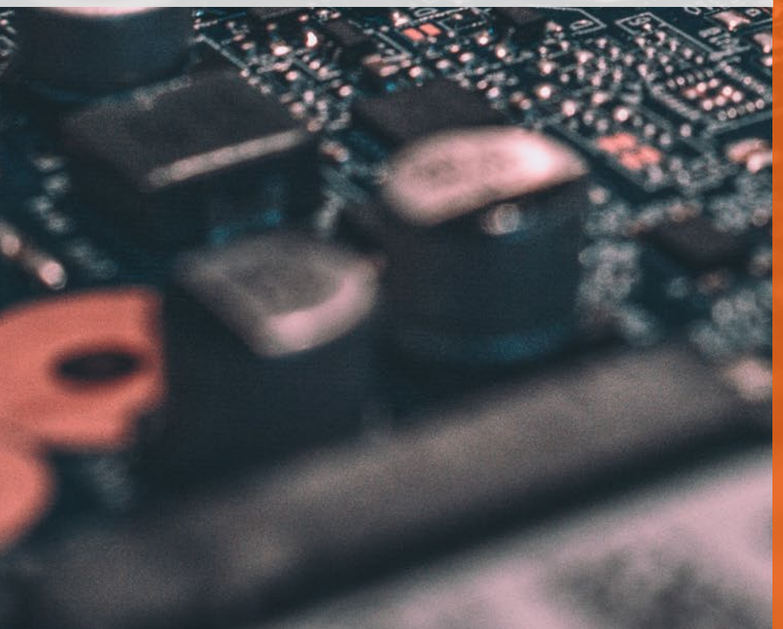
Repsol's renewable project capacity in Spain now totals 3,200MW after it adds 250MW through the purchase of three wind farms and two solar plants in 2023. Respondents noted Repsol's robust target of 6,000MW renewable capacity by 2025 – with the Delta II project consisting of 26 wind farms nearing completion, Repsol is making progress on deployment of extensive renewable assets.

OTHER SOLAR INNOVATORS

- **Canadian Solar,** for an $800 million investment in a solar cell production facility
- **Heliogen,** for innovating in its solar thermal technology
- **Beam Global,** for solar EV charging infrastructure
- **TATA Power,** for India's largest solar EPC order
- **Sonelgaz,** for launching a 2GW solar tender
- **Qotto,** for its autonomous solar kit
- **Hydeal,** for the Hydeal Ambition platform

R&D AND TECHNOLOGY

The existential challenge of the energy transition to the energy and industrial ecosystem has forged a hotbed of research projects and innovative technology in organizations around the world.



SPECIAL MENTIONS

Eni

As the carbon capture value chain continues to grow, the market readiness of CCUS solutions remains uncertain. However, this doesn't stop the pace of innovation – respondents expressed admiration for Eni's extensive research and development into decarbonization technology, including its patented carbon mineralization process, in which CO2 reacts with naturally-occurring silicate minerals to form stable, inert, and non-toxic carbonate. If scaled effectively, carbon mineralization could be a highly effective piece of the carbon management toolkit.

SLB

SLB's extensive R&D efforts into new technologies were applauded by respondents. One such project has produced SLB's Autonomous Robotic Inspections solution, where mobile robots patrol process facilities, offshore platforms, and other project sites to provide instantaneous asset performance data that is contextualized and synchronized across the business. These robots reinforce the growing appetite for autonomous monitoring solutions to augment safety and efficiency and lower costs.

GE Hitachi

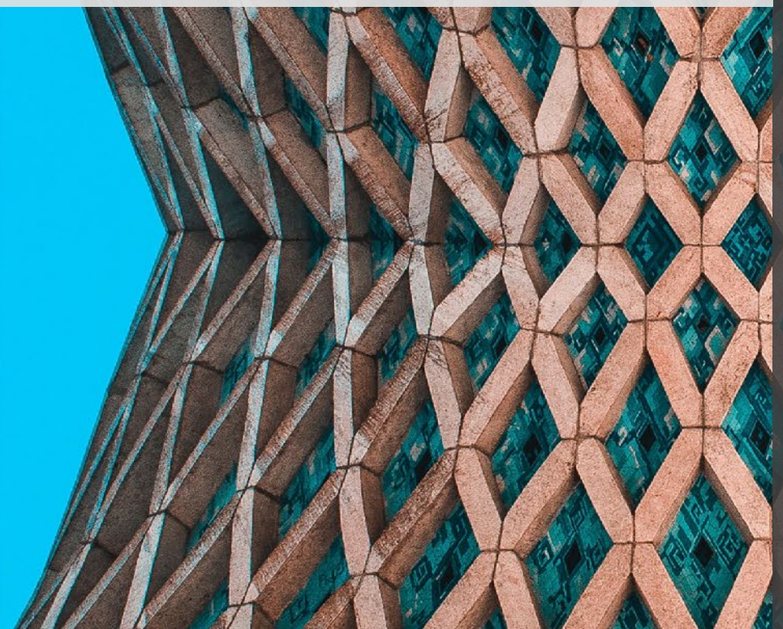
As small modular reactors (SMRs) vie for market viability, GE Hitachi is leading the charge following a recent agreement to deploy its BWRX-300 SMR model at the Darlington site in Ontario following a $400 million shared investment from Ontario Power Generation, Tennessee Valley Authority, Synthos Green Energy, and GE Hitachi. With 300MW of proposed generation capacity and construction set to complete in 2028, respondents highlighted successful deployment of the BWRX reactor as a critical step towards accelerating low carbon energy sources.

OTHER TECHNOLOGY INNOVATORS

- **8 Rivers,** for bringing the oxyfuel technology to market
- **Breakthrough Energy,** for the Breakthrough Energy Fellows program
- **Chevron New Ventures,** for its investments in new technology
- **Columbia Technology Ventures,** for accelerating technology commercialization
- **Rocky Mountain Institute,** for in-depth analysis, broad outreach, and policy advocacy
- **Topsoe,** for research on next generation electrolyzers
- **Greentown Labs,** for startup incubation

COLLABORATION

The way energy and industrial stakeholders work together is changing – cross-sectoral collaboration is now a core tenant of delivering the energy transition.



SPECIAL MENTIONS

Porthos

A collaborative CCUS project, led by three Dutch state organizations – EBN, Gasunie, and the Port of Rotterdam – Porthos will aim to store approximately 37Mton of CO2, captured and transported from nearby refineries and held for 15 years. Respondents noted the collaborative nature of Porthos as Air Liquide, Air Products, ExxonMobil, and Shell have all signed deals to begin work, connecting a wide industrial base into one network. Porthos estimates CO2 storage can begin in 2024 following a two-year construction period.

OGCI

Well-known in the oil and gas sector and comprised of CEOs of 12 leading energy companies, respondents noted the Oil and Gas Climate Initiative's (OGCI) wide range of collaborative initiatives and projects underway on CCUS, transportation, policy, and more. The latest such initiative, Aiming for Zero, launched in 2022 and focuses on slashing methane emissions by 2030. It features 21 signatories including bp, ExxonMobil, Shell, and TotalEnergies,

Plug Power & Johnson Matthey

Hydrogen solution developer Plug Power has several cross-sectoral collaborations in place with corporate organizations like Amazon and Walmart, where hydrogen-powered forklifts have already been deployed. This year, it has added another string to its collaborative bow following the announcement of a long-term strategic partnership with chemicals company Johnson Matthey (JM). JM will provide components, precious metals, and recycling capabilities to Plug in pursuit of the shared goal of accelerating the hydrogen economy.

OTHER COLLABORATIVE INNOVATORS

- **Kiewit,** for its partnership with Svante
- **X-Energy,** for partnering with end users
- **IRENA,** for its Collaborative Frameworks
- **Acciona,** for its Open Innovation program
- **Neste,** for partnering with Rio Tinto at the Borax mining site
- **Southern California Gas,** for the Angeles Link project
- **Maersk,** for its green methanol partnership with SunGas

TRANSITION INVESTMENT

Unlocking public funding and private investment is critical to developing the necessary technology to deliver net zero. How and where is green capital been mobilized?

SPECIAL MENTIONS

ExxonMobil

ExxonMobil's latest Advancing Climate Solutions Progress Report indicated it intends to raise investment on lower-emission alternatives to approximately $17 billion through 2027, an increase of 15%. Respondents noted ExxonMobil's appetite for investment in decarbonization, with 60% of total investment focused on emissions reduction, and 40% aimed at expanding its lower-emissions businesses.

TotalEnergies

Known as a legacy fossil fuel business, TotalEnergies' diversification into renewable energy is on the rise, with $4 billion invested in low-carbon energies in 2022. TotalEnergies has indicated this figure is expected to rise to $5 billion in 2023, which would be higher than its projected expenditure on oil and gas projects. Respondents praised TotalEnergies' growing appetite for renewable investment and praised their balanced approach to delivering supply today whilst preparing for tomorrow.

Joint Energy Transition Partnership

The Indonesian government launches a $20 billion renewable energy investment plan this year, seeking to cut CO2 emissions by 100 million metric tons and increase the portion of renewable energy in its power mix up to 44% from 12% in 2022. The JETP is the biggest of its kind and demonstrates the critical role that government engagement will play in accelerating and delivering the transition.

OTHER INVESTMENT INNOVATORS

- **Oxy,** for investments in direct air carbon capture (DAC)
- **Air Products,** for global investments in hydrogen
- **Hydro-Quebec,** for its 12-year, $185 billion emissions reduction investment plan
- **Vale,** for investments in the sustainable startup ecosystem
- **Walmart,** for its collaboration with ENGIE North America
- **European Commission,** for the Just Transition Mechanism tool
- **Google,** for its novel PPA collaboration with LevelTen Energy

CLEAN HYDROGEN

The hydrogen production and offtaker markets continue to grow as new innovations in electrolyzer technology and transportation solutions accelerate.

SPECIAL MENTIONS

Mitsubishi Power Americas

With a series of breakthroughs and first-to-market wins, Mitsubishi Power Americas continues to lead the hydrogen charge. Their flagship project, ACES Delta has already secured c.$500 million USD in loans from the U.S. Department of Energy and is one of the largest green hydrogen projects in the world currently under construction.

BayoTech

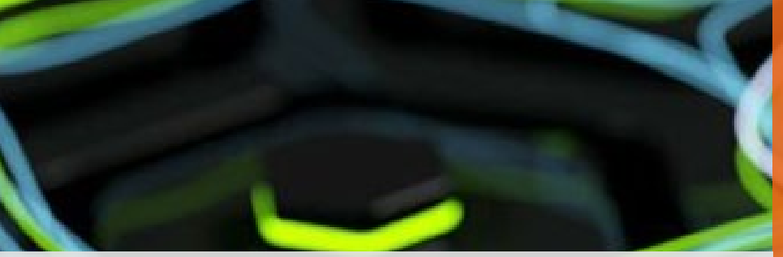
New Mexico-headquartered hydrogen production firm BayoTech was noted by respondents for bringing compact, modular hydrogen production to the market. BayoTech's inaugural Midwest Hydrogen hub is now producing 350 tons of hydrogen per year, serving gas suppliers, fleet operators, fuel cell equipment manufacturers, and other industrial customers. A second site, due to come online in mid-2024, will situate at the Port of Stockton in northern California.

ThyssenKrupp

Respondents referenced ThyssenKrupp's strength in producing large-scale water-based electrolyzers for hydrogen production. With over 600 electrochemical projects worldwide and more than 10GW installed, ThyssenKrupp's standard 20MW electrolyzer unit brings modularity to green hydrogen production, as it sets its sights on potential future applications across industry, mobility, and long-term storage.

OTHER HYDROGEN INNOVATORS

- **ACWA Power,** for the NEOM Green Hydrogen Project
- **ATCO,** for its hydrogen blending project in Alberta
- **Caterpillar,** for introducing hydrogen-fuelled engines
- **H2Pro,** for the E-TAC production technology
- **LS Power,** for its partnership with Monarch Energy
- **TritenIAG,** for its biomass and landfill gas to hydrogen conversion technology
- **Xcel Energy,** for proposed investment of up to $2 billion over a decade in clean hydrogen production



ENERGY STORAGE

Counteracting the intermittency challenge posed by renewable energy isn't simple – but energy storage solutions could be the key to overcoming this barrier.

SPECIAL MENTIONS

NextEra Energy

One of the largest utility companies in North America, NextEra also has higher storage capacity than any other company in the US, with an extensive portfolio of storage systems in operation. NextEra continues to set its sights on expanded storage capacity in 2023, with the US Bureau of Land Management recently approving the Sunlight Storage II BESS project, built on the existing Desert Sunlight BESS and due to add a further 300MW of BESS capacity to its existing 230MW.

Wärtsilä

Respondents noted Wärtsilä has muscled its way to the top of the pack in the storage market, with over 100 deployments in 200 locations and a fully-integrated GridSolv Quantum storage solution on the market. Next year, another 200MW storage system is set to become operational in Scotland, and will be a first-of-a-kind solution using a transmission-connected battery.

Tesla

Tesla's energy storage business is a small, but rapidly expanding portion of the EV giant's portfolio. 2023 saw a 62% increase in the company's storage capacity, up to 2.1GWh, and its large-scale Megapack BESS solutions continue to come online around the world, the latest being a 150MW capacity project now operational in Australia. Respondents were impressed with Tesla's commitment to growth in the storage space and its innovations in lithium-ion technology.

OTHER STORAGE INNOVATORS

- **Edison International,** for the Hybrid Enhanced Gas Turbine System
- **OMV,** for its Gas Storage arm and facilities
- **RWE,** for its planned utility-scale battery storage project in the Netherlands
- **ABB,** for powering up one of the world's largest BESS systems in the Philippines
- **AES,** for its acquisition of the Bellefield project
- **Convergent Energy And Power,** for its joint venture with Alectra Energy Solutions
- **Aramco Ventures,** for its investments in Rondo Energy

HARD TO ABATE

Roughly 30% of the world's emissions come from the hard-to-abate sectors like steel, cement, and petrochemicals. Removing heavy-emitting processes and products from supply chains is high priority.

SPECIAL MENTIONS

Ivanhoe Mines

A successful transition to net zero must be just and equitable, and respondents were impressed by the community engagement efforts of Canada's Ivanhoe Mines. Ivanhoe has recently opened the doors on the Kamoa Centre of Excellence, a higher education facility dedicated to preparing 150 students for a career in the Democratic Republic of the Congo's mining industry. This follows a stated $20 million in spending on social-economic initiatives in Ivanhoe's host communities in 2022.

Rio Tinto

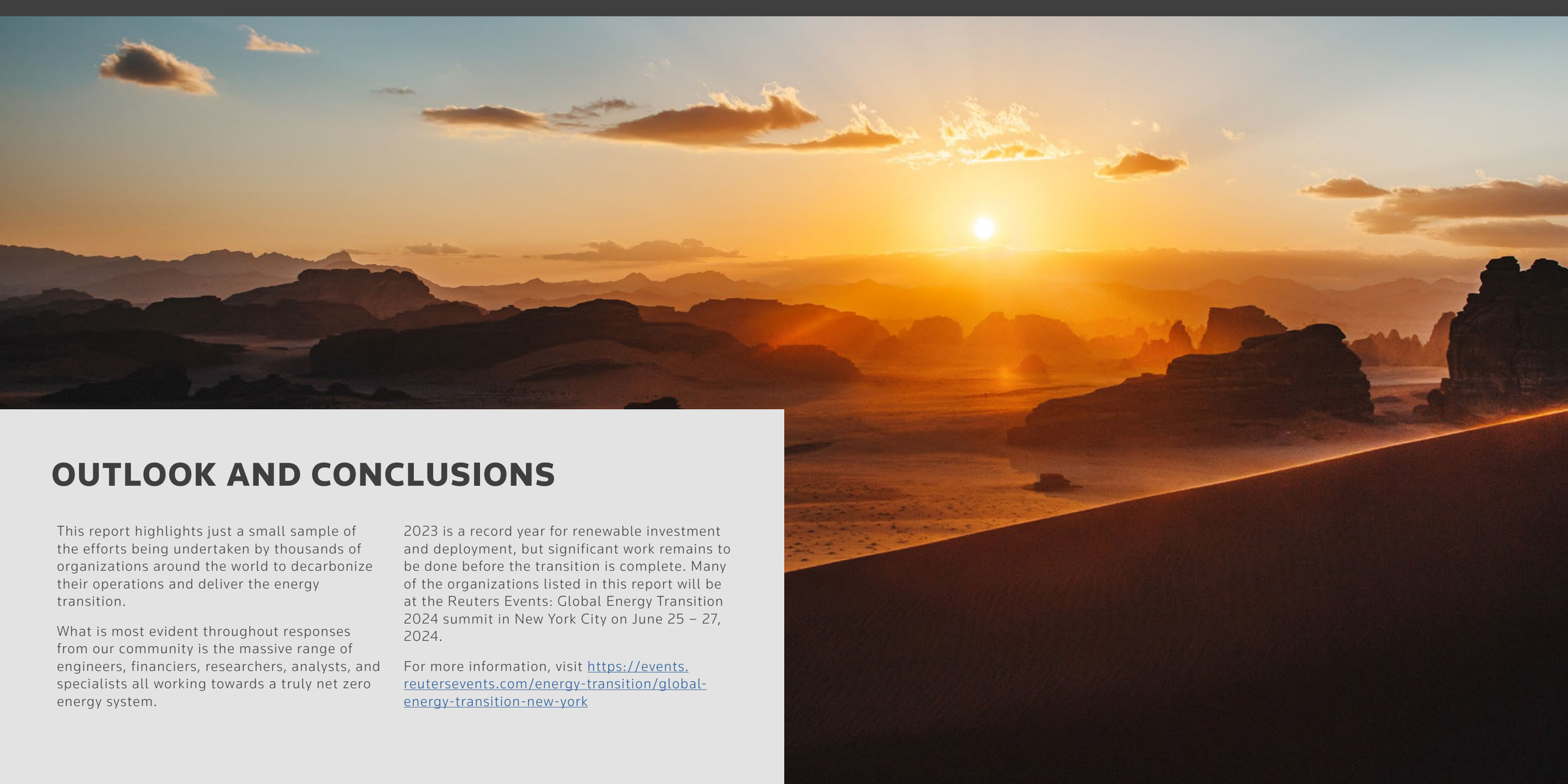
Respondents highlighted Rio Tinto's renewable energy supply and commitment to sustainability – Rio Tinto acknowledges its major carbon footprint and has leveraged hydropower to bring the level of electricity in its managed operations from renewables up to 75%. Respondents also noted Rio Tinto's investment strategy, including research into zero-carbon aluminium smelting, and integrating renewable hydrogen into the refining process.

BHP

BHP has announced a trial of a new fleet of electric mining equipment at its Olympic Dam site, already home to its fully electric Jumbo drill, taking a critical step towards reducing mining emissions. Respondents commended BHP for its adoption of this electric equipment, alongside concrete transportation trucks, as practical demonstrations of electrified operations.

OTHER HARD-TO-ABATE INNOVATORS

- **Alliance for Responsible Mining,** for its work with small-scale and artisanal miners
- **Alcoa,** for its investments in innovation
- **ArcelorMittal,** for its Innovative DRI and Smart Carbon technologies
- **Fortescue,** for its Real Zero plan
- **Mitsubishi Heavy Industries,** for wide-ranging investment in decarbonization technology
- **Vale,** for its agreement with Wabtec Corporation to decarbonize the Carajas railway
- **Primetals Technologies,** for its circular slag valorization process



OUTLOOK AND CONCLUSIONS

This report highlights just a small sample of the efforts being undertaken by thousands of organizations around the world to decarbonize their operations and deliver the energy transition.

What is most evident throughout responses from our community is the massive range of engineers, financiers, researchers, analysts, and specialists all working towards a truly net zero energy system.

2023 is a record year for renewable investment and deployment, but significant work remains to be done before the transition is complete. Many of the organizations listed in this report will be at the Reuters Events: Global Energy Transition 2024 summit in New York City on June 25 – 27, 2024.

For more information, visit https://events.reutersevents.com/energy-transition/global-energy-transition-new-york