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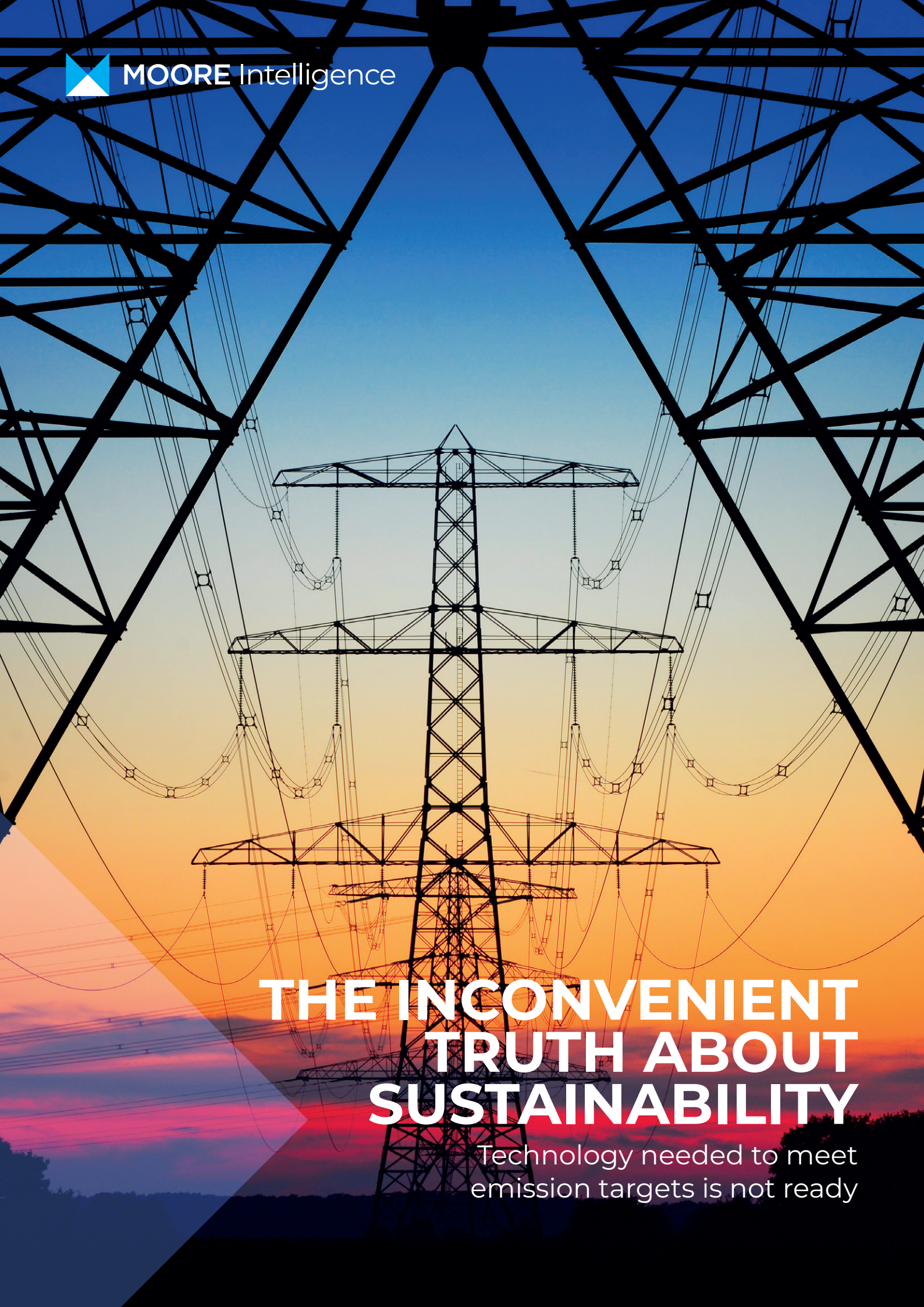

THE INCONVENIENT TRUTH ABOUT SUSTAINABILITY

Technology needed to meet emission targets is not ready

Presidents and prime ministers have spoken, emissions targets have been announced and the world is set on a course to replace the carbon fuels that have powered economic growth for almost three centuries with climate-friendly alternatives. Except, many of the new technologies required to make this shift are yet to prove their viability.

The world must reduce greenhouse gas emissions to net-zero by mid-century to limit global warming as close as possible to 1.5°C. Most analysts accept that greater electrification will be key to decarbonising many sectors of the economy, from family cars to domestic heating systems and airliners to container ships.

That means electricity's share of final energy demand will grow from only 20% today to more than 60% within 30 years. The Energy Transitions Commission, an international think tank, estimates that will require a huge ramping up of global electricity supply from today's 27,000 terra-watt hours to around 130,000 terra-watt hours by 2050.

So, there is an inconvenient truth about sustainability targets announced by world leaders in a series of headline-grabbing speeches on Earth Day in April 2021. It is this: these pronouncements focus on the desirable end point of a world powered by renewable energy while glossing over the uncomfortable fact that the investment, technology upgrades and infrastructure required are not yet in place to make them a reality.

"The world must transition from traditional energy sources and mining techniques if we hope to meet targets of net zero emissions by 2050 and every day we delay makes the task a little bit harder." says David Tomasi, Global Leader of Energy, Mining and Renewables at Moore Global. "We need to stop talking about targets and green dividends and start considering the practical steps we need to take to get to the point where we have a truly sustainable global economy."

130,000

terrawatt hours of electricity will be needed by 2050

Moore energy, mining and renewables experts around the world, have considered some short- to medium-term solutions to the most pressing issues that can be implemented now while better technology is being developed:

ELECTRIFY VITAL PARTS OF THE MINING PROCESS:
Many of the precious minerals vital to producing carbon-neutral products come from vast open cast mines but the mining process is not inherently "clean". In Australia iron ore majors have launched a global competition to develop new concepts for electrifying the mining industry's fleet of diesel-hungry haul trucks.

USE LNG AS A MARINE FUEL:
Shipping is responsible for nearly 3% of all global carbon dioxide emissions and powering the next generation of ships that are due to be commissioned over the next five years would create a new fleet that produces 30% lower emissions. They could still be converted to "super fuels" like hydrogen and ammonia in the future.

IMPROVE INFRASTRUCTURE TO SUPPORT ELECTRIC VEHICLES:
Charging networks are expanding quickly in developed countries and Tesla pioneer Elon Musk has said there could be 30 million EVs on the roads by 2027. This will reduce automotive carbon emissions but the challenge is to match that spread of charging stations across Latin America, Africa and swathes of south Asia where population densities are lower and the higher cost of EVs is a disincentive to consumers.

REDUCE THE ENERGY REQUIRED BY CRYPTOCURRENCY MINING:
Bitcoin is the most popular of these new virtual currencies but the mechanism used to validate transactions demands huge amounts of computational power, much of which comes from coal. Trend tracker site Digiconomist claimed the surge in Bitcoin price at the start of 2021 may result in the network consuming as much energy as all the world's data centres globally. Ethereum, the biggest rival currency, plans to move to "proof of stake" validation which is deemed less energy-intensive.

TAKE A FRESH LOOK AT NUCLEAR:
At US$7 billion each, nuclear power plants are expensive to build but they will last for at least 60 years and latest technical advances have addressed many of the safety and security issues that have made politicians nervous of commissioning them in the past.

30%
lower emissions through LNG use at sea

A TYPICAL ELECTRIC CAR REQUIRES SIX TIMES THE MINERAL INPUTS OF A CONVENTIONAL CAR

The need for concerted global action was spelled out in a recent report by the Paris-based International Energy Agency (IEA) that focused on the critical minerals required for clean energy technologies such as copper, lithium, nickel and cobalt.

"The data shows a looming mismatch between the world's strengthened climate ambitions and the availability of critical minerals that are essential to realising those ambitions," says Fatih Birol, Executive Director of the IEA. "Left unaddressed, these potential vulnerabilities could make global progress towards a clean energy future slower and more costly – and therefore hamper international efforts to tackle climate change."

The report points out that mineral requirements of an energy infrastructure powered by clean technologies are entirely different to one that runs on fossil fuels. For example, a typical electric car requires six times the mineral inputs of a conventional car, while an onshore wind plant needs nine times more mineral resources than a similarly sized gas-fired power plant.

As these minerals become ever more integral to new product development their value – and price – will rise. Revenue from coal production is currently ten times higher than that from so-called energy transition minerals: by 2040 the IEA expects that position to have reversed.

After modelling a number of scenarios for the report, the authors concluded:

- mineral demand for use in batteries for electric vehicles and grid storage would grow at least thirty times to 2040;
- the rise of low-carbon power generation to meet climate goals also means a tripling of mineral demand from this sector by 2040;
- the expansion of electricity networks also requires a huge amount of copper and aluminium.

The IEA says that while there is no shortage of resources, the quality of available deposits is declining because the most immediately accessible deposits have been exploited.

"It is clear that restricting global warming by 2050 will require a combination of mindset change, policy enhancement and technology innovation to advance energy transition," says Lilia Liu, of Moore Panama.

"This will require a mindset change, policy enhancement and technology innovation to advance energy transition."

Lilia Liu,
Moore Panama

Electric vehicles (EVs) and the smart electronic devices that have become essentials of everyday life highlight many of the unforeseen consequences of moving to a greener future.

They rely on lithium for their batteries. Lithium starts life as a salt and is refined into a metal in a highly specialised process.

The result is that it takes 5.3 tons of lithium carbonate, the salt, to make a ton of lithium metal for use in EV batteries. It is doubtful if there are enough developed mines in the world to meet the expected demands for new cars.

Very little of the lithium used in modern batteries is recycled: estimates vary from 2% to 5% depending on country. The technology that does exist requires vast amounts of energy and does not recover all the battery materials.

While efficient battery recycling is taxing the international research community, those whose livelihoods have depended on fossil fuels continue to adapt and innovate.

In Texas, Moore's Justin Varnon says: "I have a client involved in automobile engine remanufacturing who has a very interesting take on the immediate future. He does't see a significant change in new gas-powered vehicle numbers until 2026 or later, and then it will still be a mixture of gas and EVs."

Varnon, a partner in the Dallas office of Armanino LLP, part of Moore North America, says there are general worries about jobs in the future but believes there will be opportunities for oil companies to exploit decades of experience in rapid technology development and move into renewables. For example, his engine remanufacturing client who sees no immediate switch from fossil fuel to battery power is still planning to invest in research into reconditioning EV motors.

Meanwhile in Colombia, where oil and mining account for around 70% of income from foreign exports, the government is pressing ahead with tough greenhouse gas emission reductions and encouraging the use of biofuel, recycling, solar and wind energy.

"It's not possible to stop using oil and gas here because they have been the engine of the economy of

"It's not possible to stop using oil and gas here because they have been the engine of our economy."

Samuel Tenorio, Moore Colombia

5%

Maximum amount of lithium recycled from batteries in cars and gadgets

our country," says Samuel Tenorio, Audit Manager of Moore Colombia in Bogota. "However, there is sustainable technology in Colombia and we apply it. Some natural resources are being used in a way that avoids their depletion or destruction."

The Gulf states, another traditional hub of oil and gas, are also actively pursuing new energy technologies.

"Oman has the fourth largest gas reserves in the world – it is mainly used to make electricity but that is not a particularly high value-added activity," says Paul Callaghan, Partner at Moore Oman and UAE. "Exporting crude oil is not a sustainable or best use of the resources, not when you could make fertilisers or petrochemicals, which are much bigger value-add, or turn it into LNG to power huge cargo ships. If you turn it into fertiliser, India will buy as much as you can make.

"I am optimistic about human ingenuity. Oman is very advanced in solar power to generate steam to inject into oilfields but they found that produces a lot of horrible water. They thought long and hard about a technical solution and the result is that Oman is now a world leader in developing an environmentally-friendly way of treating dirty water using reed beds."

With oil and gas potentially finding more attractive markets, nuclear energy is expected to fill much of the energy gap. The first foray is the Barakah Nuclear Energy Plant 300km from Abu Dhabi City which, will have the capacity to produce 5.6 gigawatts and supply 25% of the UAE's electricity needs when all units are operational .

"You can see there is going to be a much bigger blend of power generation technologies in this region," says David Haboubi, Head of Nuclear and Power for the SNC-Lavalin Group in the Middle East and Africa, one of the companies supporting the Barakah programme. "Nuclear can provide base load power. These plants are designed for 60 years minimum, extendable to 80 years, and provide a lot of job creation and skills – and that is a factor.

"Exporting crude oil is not a sustainable or best use of the resources"

Paul Callaghan, Moore Oman and UAE

Elsewhere in the world nuclear is in the equation. In the UK, plans for two new plants at Sizewell and Hinkley are actively being developed. France relies on nuclear for around 75% of its power and is planning new units to potentially replace its current fleet. The Russians and Chinese are actively building new gigawatt-scale plants domestically and abroad."

The United States is looking to decommission its ageing plants but the Biden administration launched its FIRST programme in April. This is designed to support the development of small modular reactor (SMR) technology which supporters say offers developing nations a way of embracing nuclear technology at a scale small enough to alleviate concerns over cost, safety and terrorism.

Haboubi sees the potential benefits on cost, schedule and integration to the grid networks, but recognises there are challenges: "There are around 30 SMRs in different stages of development. They are more of a mid-term solution as it is likely to be a decade until any are commercially available, and there are regulatory differences between countries which means one size might not necessarily fit all. For a country to have one or two SMRs does not make sense, you need a fleet of them to be commercially viable."

His own long term solution? "I would like to say in 2050 we will have commercial fusion reactors ... for me that is the ultimate."

Nuclear fusion happens when hydrogen nuclei collide, fuse into heavier helium atoms and release tremendous amounts of energy in the process, but far less hazardous than fission technology.

The International Thermonuclear Experimental Reactor (ITER) project in southern France is the biggest and most ambitious attempt yet to prove fusion a commercially viable new energy source. "The engineering behind it is not easy," says Haboubi. "You are trying to create temperatures that are 10 times hotter than the centre of the sun and materials that can deflect that heat away.

While some may see fusion as a "unicorn", there are other more down-to-earth ways of harnessing the sun's power. Solar farms have expanded widely across the planet to collect the power from its rays to heat homes and small scale commercial developments.

"I would like to say in 2050 we will have commercial fusion reactors: for me that is the ultimate."

David Haboubi, SNC-Lavalin

They work well during the day when the rays are beating down on thousands of reflective panels but battery technology has not evolved enough to store much of that energy for use at night when families are at home and bars and restaurant are operating at capacity.

"We are getting enough solar to power a grid during the day but you still need other sources of energy to power the grid at night when people who are at home need their energy," says Peter Gray, Corporate Finance Director at Moore Australia in Perth. "This ends up with a situation where, at peak solar energy in the middle of the day, people are being paid to burn energy to keep it off the grid."

Perhaps solar technology development has been held back by its own cheapness. With power sold at around four cents per kilowatt hour in Perth, Gray says there is little appetite among investors to invest the considerable research sums required for new battery technology.

"Solar is commercially viable as it stands," says Gray. "but what holds it back is the battery technology. As far as I can see, it is not even halfway there even after 10-15 years.

"The other catch with solar is acreage. You need an immense amount of land to build enough panels to power a whole city. It is much harder to make work in the rest of the world and, so, it will never replace the entire energy generation of the grid because there are too few places it will work effectively."

As the world's climate changes in the years ahead, the efforts of political leaders to offset and reduce carbon emissions will loom ever larger as the 2020s draw nearer to a close.

They will point to the rapid development of successful Covid vaccines in the space of 12 months as examples how industry, regulators and government can come together and work harmoniously to tackle a global emergency. If it can conquer a pandemic, then why not climate change?

That conveniently ignores the reality that defeating Covid may have required a technological leap but it exploited existing pharmaceutical research.

The inconvenient truth is that when it comes to carbon-free technology we may not find answers in some industries in the necessary timeframe.

That is why it is vital to act now and push through changes we can make that will have a material impact on reducing emissions without hampering economic growth.

"Solar is commercially viable but what holds it back is the battery technology."

Peter Gray, Moore Australia

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