

FII INSTITUTE OUTLINES WAYS
TO BEAR DOWN ON AND TACKLE
THE ENERGY TRILEMMA

ENERGY INSIGHTS FROM **ARAMCO**,
SABIC, **ACWA POWER** AND
STANDARD CHARTERED

MCKINSEY AND **KSIA** EXPLAIN
WHY THE ENERGY QUADRILEMMA
IS A QUANDARY

BALANCING THE MEGAWATTS

IMPACT

AN FII INSTITUTE PUBLICATION

CAN WE SOLVE THE ENERGY TRILEMMA?

From three priorities to
a four-point plan

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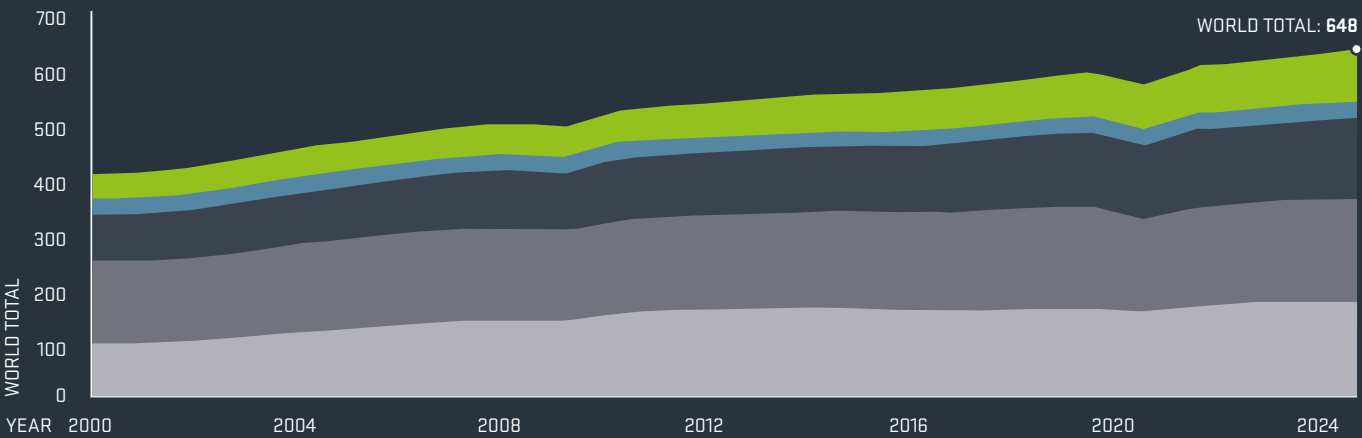
Impact
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FACTS AND FIGURES

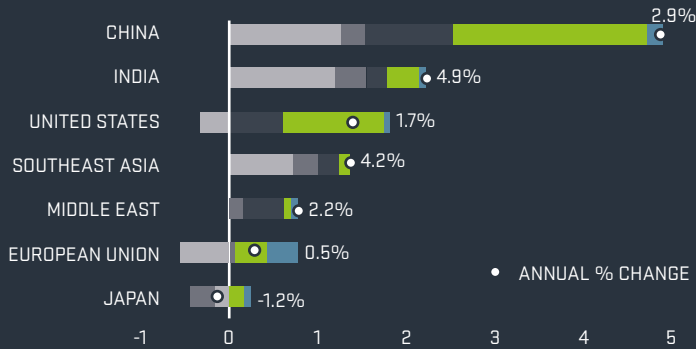
GLOBAL ENERGY TRENDS

RENEWABLES NUCLEAR NATURAL GAS OIL COAL

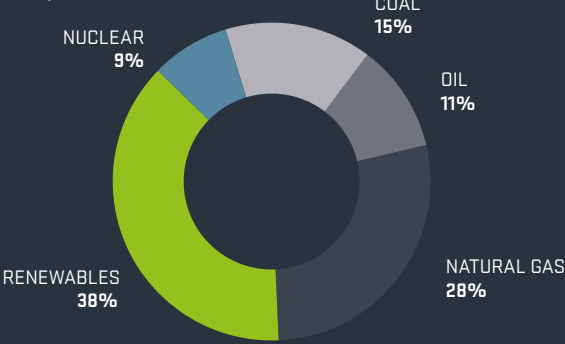
ENERGY SUPPLY BY SOURCE, exajoules



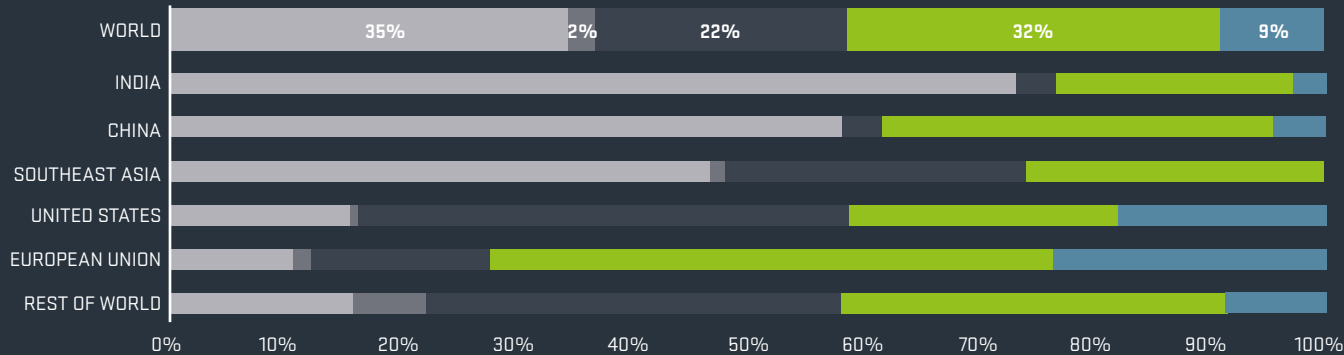
CHANGE IN ENERGY DEMAND
selected regions, 2023-24, exajoules



ENERGY DEMAND GROWTH
by source, 2024



ELECTRICITY GENERATION MIX
selected regions, 2024



BALANCING THE ENERGY QUADRILEMMA



AT EVERY FII INSTITUTE SUMMIT – FROM RIYADH TO HONG KONG, Miami to Rio – I hear the same concern from leaders, innovators and communities: energy is the defining challenge of our time.

For years, the debate has centered on the trilemma of security, sustainability and equity. How do we guarantee reliable access to power, ensure it is clean and make it affordable for all?

Today, a fourth pillar has emerged: speed. The urgency of transition has transformed the trilemma into a quadrilemma – one that demands bold, shared global action.

Nowhere is this more critical than in the Global South – the region that contributes least to climate change, yet suffers most from its effects. Its voice must be central to every solution.

At FII Institute, we are more than conveners of dialogue. We are catalysts for action. We connect policymakers, entrepreneurs, financiers and scientists to turn ideas into investments, partnerships and tangible solutions. We ensure knowledge flows across geographies so that no region is left behind.

This report continues that mission. It is a call to ambition and a blueprint for impact. Together, we can shape a future where energy is not only secure, sustainable and equitable – but also delivered at the speed our planet demands.



Richard Attias
Chairman of the
Executive Committee, FII Institute

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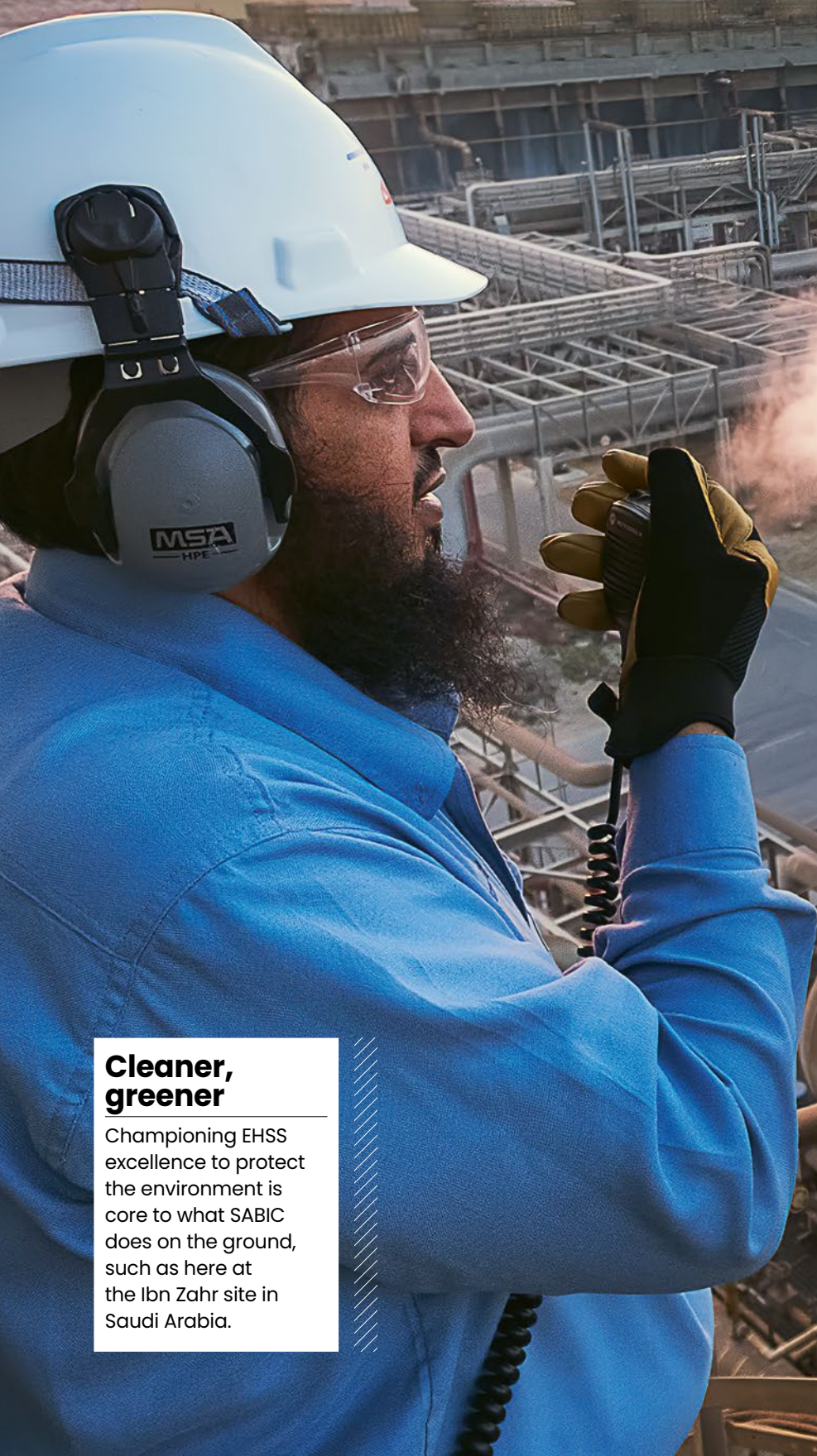


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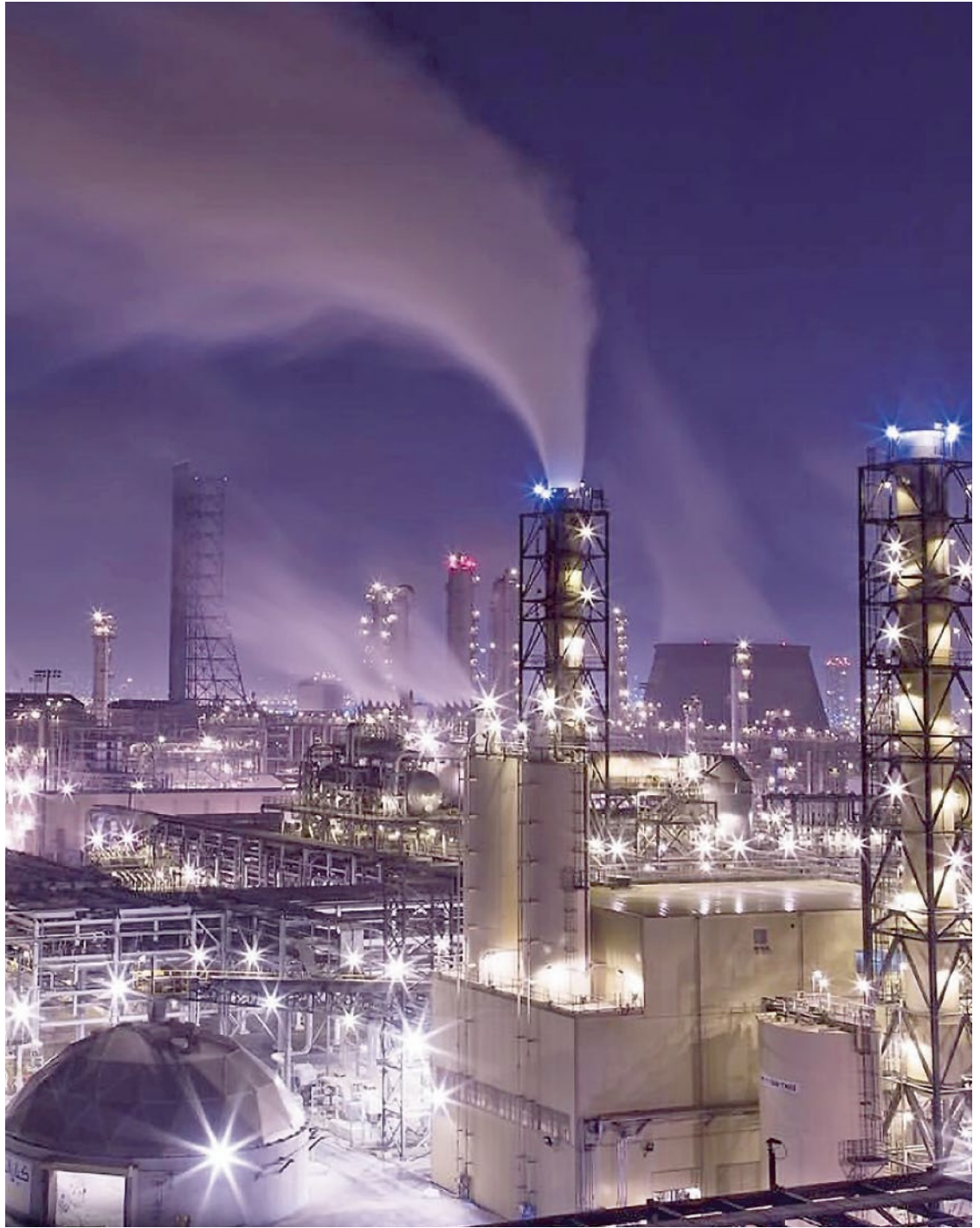
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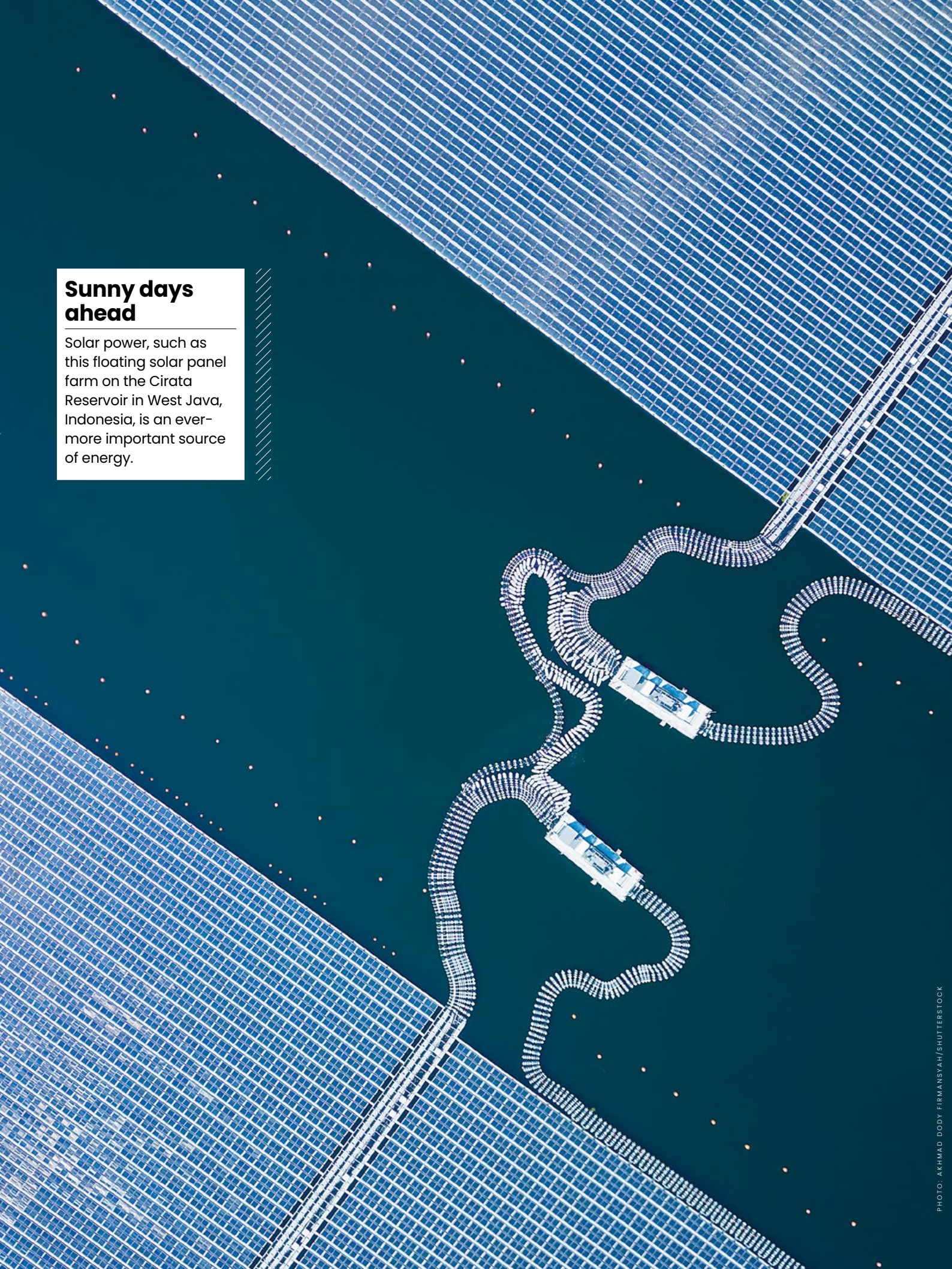
Cleaner, greener

Championing EHSS excellence to protect the environment is core to what SABIC does on the ground, such as here at the Ibn Zahr site in Saudi Arabia.



Addressing challenges

“The key challenge is to strike the right balance, whereby each element is addressed appropriately and timely,” says Abdulrahman Al-Fageeh, CEO of SABIC. Read more on p22.

An aerial photograph of a large-scale floating solar panel farm. The solar panels are arranged in a dense grid pattern, covering a significant portion of a dark blue reservoir. The panels are connected by a network of white cables and floats, which are visible as a series of small white dots and lines. The overall scene is a vast expanse of blue water with a large area of blue solar panels floating on it.

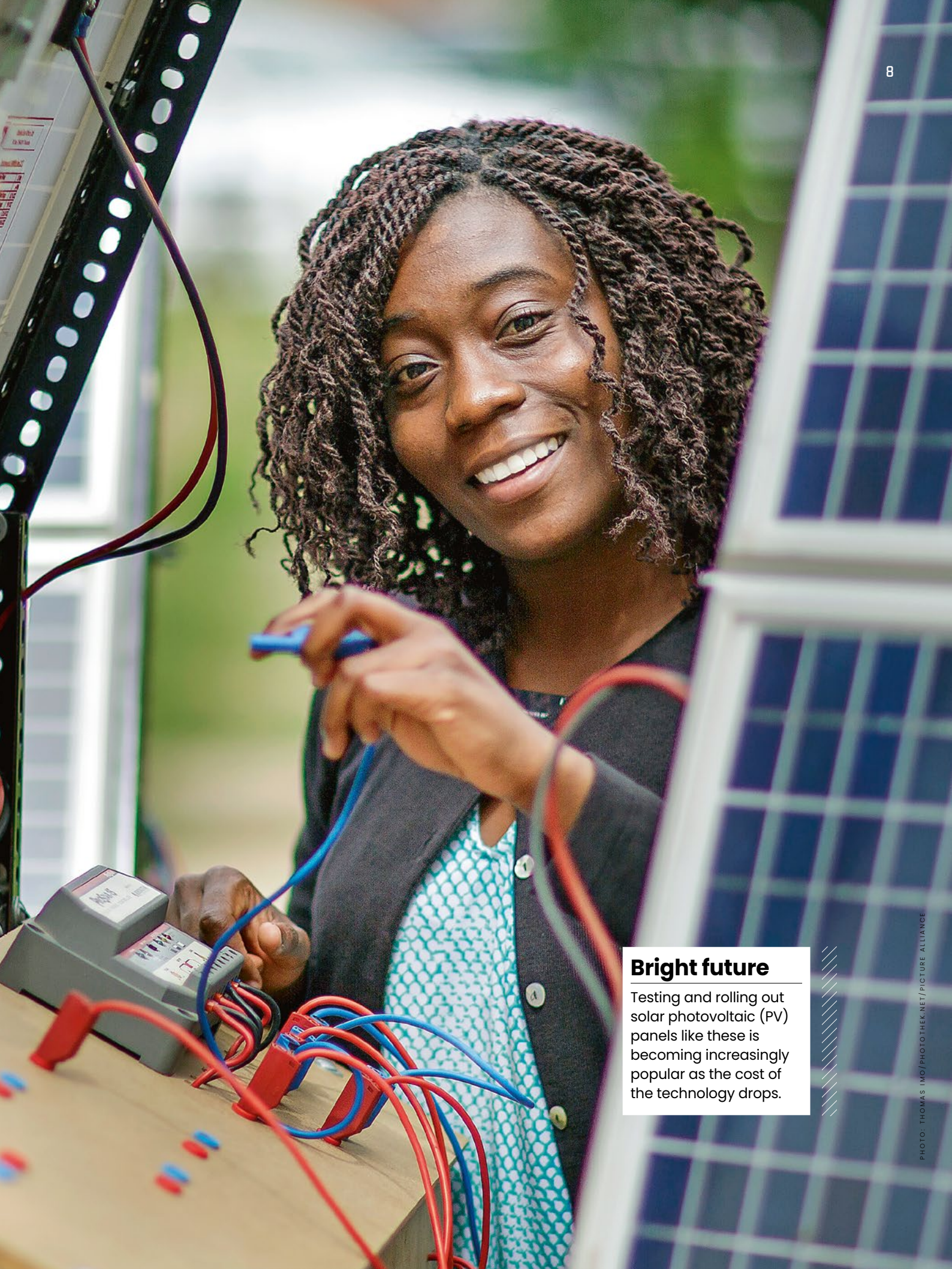
Sunny days ahead

Solar power, such as this floating solar panel farm on the Cirata Reservoir in West Java, Indonesia, is an ever-more important source of energy.

Green goals

Green designs, such as this one for King Salman International Airport, will greet millions of travellers in years to come. Read more with Marco Mejia, Acting CEO, KSIA, on p46.





Bright future

Testing and rolling out solar photovoltaic (PV) panels like these is becoming increasingly popular as the cost of the technology drops.

BALANCING THE MEGAWATTS

The world faces a gargantuan task: to solve the energy trilemma. Can it be done?



THE WORLD'S ENERGY DEMAND KEEPS ON RISING,

but comes at a cost. Our heating planet, and the impacts of climate change, mean we feel it keenly. Keeping the lights on without further heating the planet, and doing it fairly, is the core challenge of the energy trilemma. The World Energy Council's framework sets the stakes plainly: we need security through reliable, resilient supply; sustainability through rapid decarbonization; while ensuring equity via affordable, universal access.

And we have to do all three at once. No pressure, then.

BUILDING A SECURE BACKBONE

The energy transition is slamming into an engineering wall: our grids. While wind and solar surge, ageing transmission networks and slow permitting threaten reliability of supply. In Europe, analysts estimate more than \$2 trillion of grid upgrades will be needed by 2050 to integrate variable renewables and avoid the cascading outages that hit Spain and Portugal in 2025. The IEA says global grid investment must double to \$600 billion per year by 2030. Security, in 2025, is spelled “wires,” plus flexibility from batteries and demand response.

SCALING SUSTAINABLY

When the world signed up at COP28 to triple renewable power capacity to 11 TW and double the annual rate of energy-efficiency gains to more than 4% by 2030, it was a lofty target. But there's real momentum here. 2023 saw a record 473 GW of new renewables, and 2024 set another record of 585 GW, up 15%, led by solar.

But even that falls short of the COP28 target. It would put the world on track for just over 2.5x growth by 2030, falling short of the tripling pledge. So more work is needed.

MAKING THINGS MORE EQUITABLE

Affordable and universal energy access remains a fantasy for too many. More than 650 million peo-

ple still lacked electricity in 2023, overwhelmingly in sub-Saharan Africa – and many more face price volatility. We need concessional finance, de-risking tools, and local supply chains so clean electrons are not a luxury good. Today, emerging markets receive less than 10% of ESG capital flows despite representing 58% of global GDP – an imbalance we must fix to deliver a just transition.

BALANCING THE MEGAWATTS

The task is therefore tricky, but there are ways forward. We need to accelerate grid and storage development, treating transmission like national infrastructure, with one-stop permitting, anticipatory build-out and cross-border interconnectors.

We also need to work smarter, not harder. Doubling efficiency improvements is the cheapest way to cut emissions, reduce bills and relieve grid stress this decade. Speed is of the essence. Where supply chains are concentrated, they can be diversified with local content and skills programs in the Global South to advance equity alongside capacity.

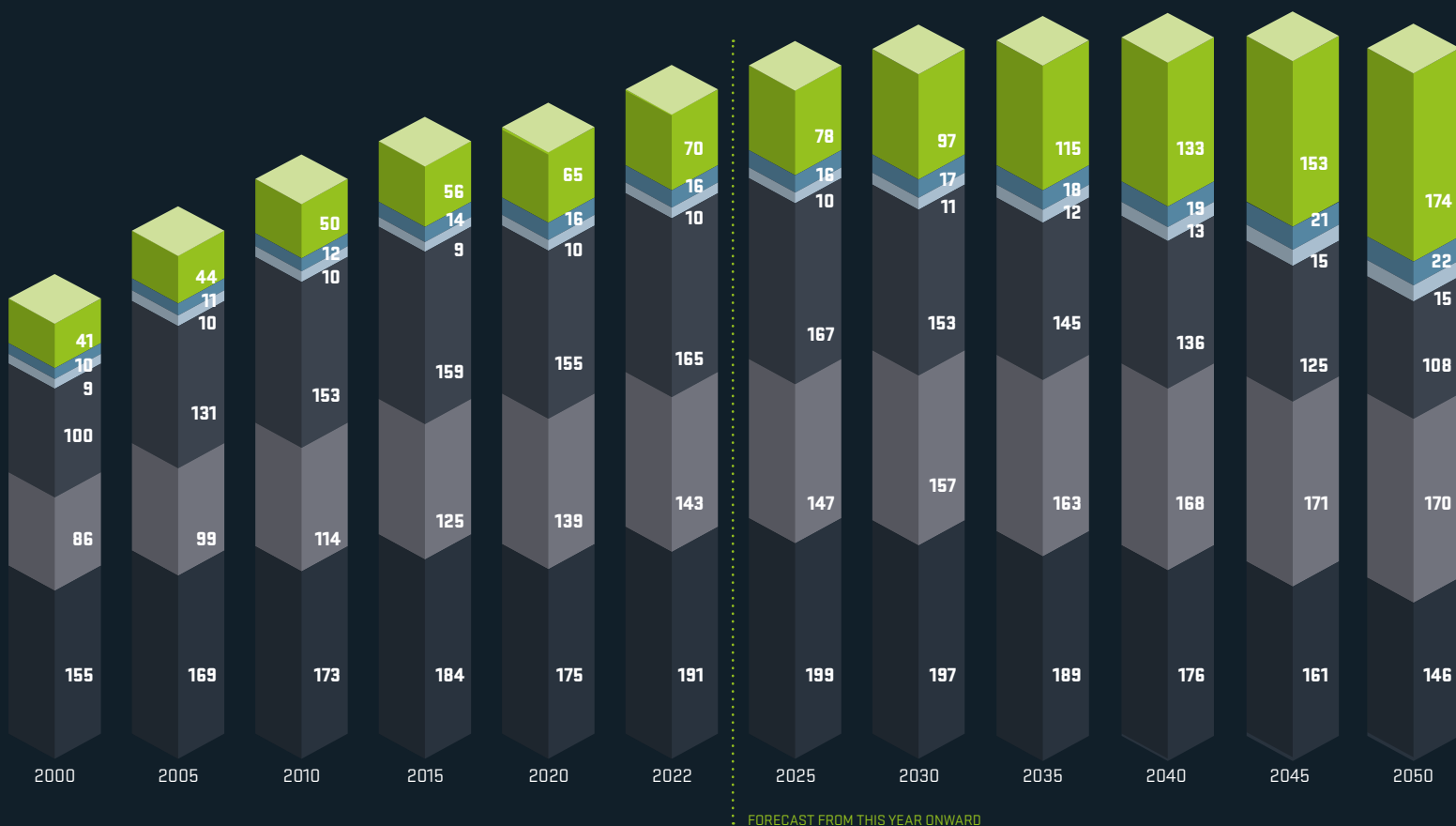
Smart capital will be key. Scaling blended finance and guaranteeing pools and FX hedges will help private investors enter frontier grids and distributed solar. Where politically feasible, carbon pricing (or equivalent standards) plus long-term signals for firm low-carbon power can align markets with the trilemma. That requires thinking through a trilemma lens for decision-making: every policy and project should show how it moves all three needles.

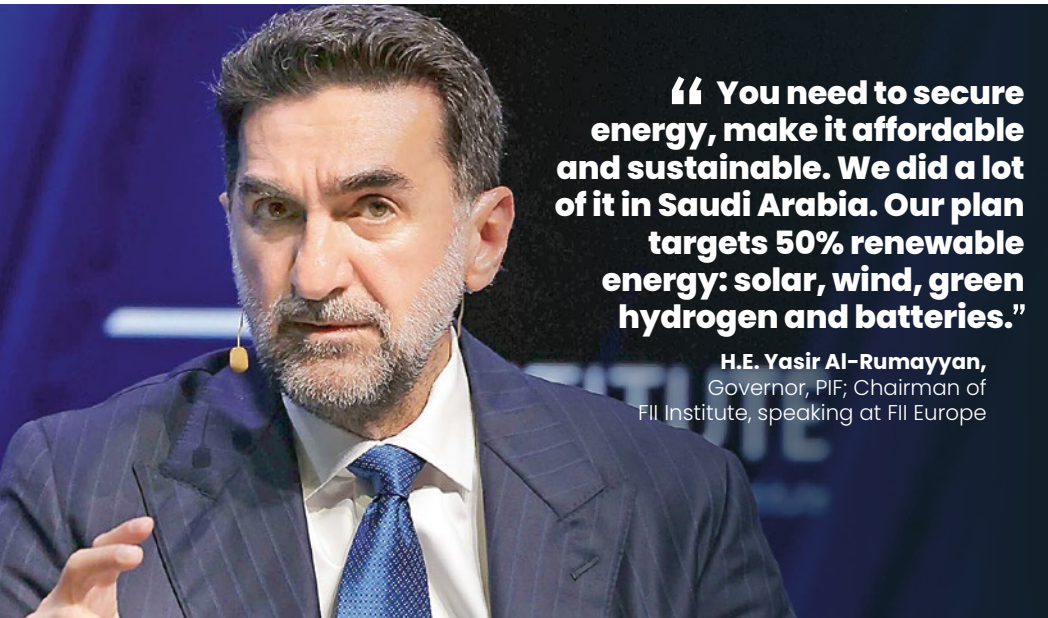
It's possible, but difficult to do, and requires a concerted effort from all elements of society. Which is where FII Institute comes in. Through our regular events, and these Impact reports, we convene the biggest thinkers and the brightest minds in the world to discuss the issues – and to offer potential solutions. So read on for potential options to solve the energy trilemma, and the quadrilemma that also looms over us.

GLOBAL PRIMARY ENERGY CONSUMPTION BY ENERGY SOURCE

Primary energy consumption worldwide from 2000 to 2022, with a forecast until 2050, by energy source (in exajoules)

- RENEWABLES
- HYDROELECTRICITY
- NUCLEAR ENERGY
- COAL
- NATURAL GAS
- OIL





“ You need to secure energy, make it affordable and sustainable. We did a lot of it in Saudi Arabia. Our plan targets 50% renewable energy: solar, wind, green hydrogen and batteries.”

H.E. Yasir Al-Rumayyan,
Governor, PIF; Chairman of
FII Institute, speaking at FII Europe



“ You don’t build renewables because of ideology. You build them because they’re the cheapest, fastest, simplest technology that you can install. So, technically, an electrical system will naturally go to 100% renewables over time.”

Marco Arcelli,
CEO, ACWA Power,
speaking at FII Europe

AN ONGOING CONVERSATION

Energy has been front of mind for the FII Institute community for a long time, as these insights from prior events highlight.



“ Energy affordability is about optionality. It’s finance 101: having more options reduces costs and allows for scalable solutions. Focusing on only one solution while ignoring others will be very expensive.”

Musaab M. Almula,
Vice President – Energy & Economic
Insights, Aramco,
speaking at FII Europe



A woman with short blonde hair, Carme Artigas, is speaking at a podium. She is wearing a white blazer and has a small microphone clipped to her collar. The background is a blurred blue and white pattern.

“ Even though tech companies are more powerful than ever, they are more dependent on national governments than ever. They depend on them for national grids, energy and peace.”

Carme Artigas,
Cochair, UN AI Advisory Body,
speaking at FII Miami

A man with glasses, Rob Kapito, is speaking at a podium. He is wearing a grey suit, a blue shirt, and a striped tie. He is holding a blue folder. The background is a blurred red and white pattern with the text "FII INSTITUTE" visible.

“ The Kingdom of Saudi Arabia has comprehended that they’re not in the oil business – they’re in the energy and the technology business.”

Rob Kapito,
President &
Cofounder,
BlackRock,
speaking at
FII Miami

A woman with blonde hair, Dr. Angela Wilkinson, is speaking at a podium. She is wearing a dark blue jacket with a gold zipper. The background is a blurred blue and white pattern.

“ AI models can help us with aggregating huge amounts of different types of data and identifying places where we can improve process efficiencies, or other types of efficiencies in monitoring.”

Dr. Angela Wilkinson,
Secretary General & CEO, World
Energy Council, speaking at FII8

Without security of supply, progress in all areas will stall – which makes it a vital pillar of the trilemma.



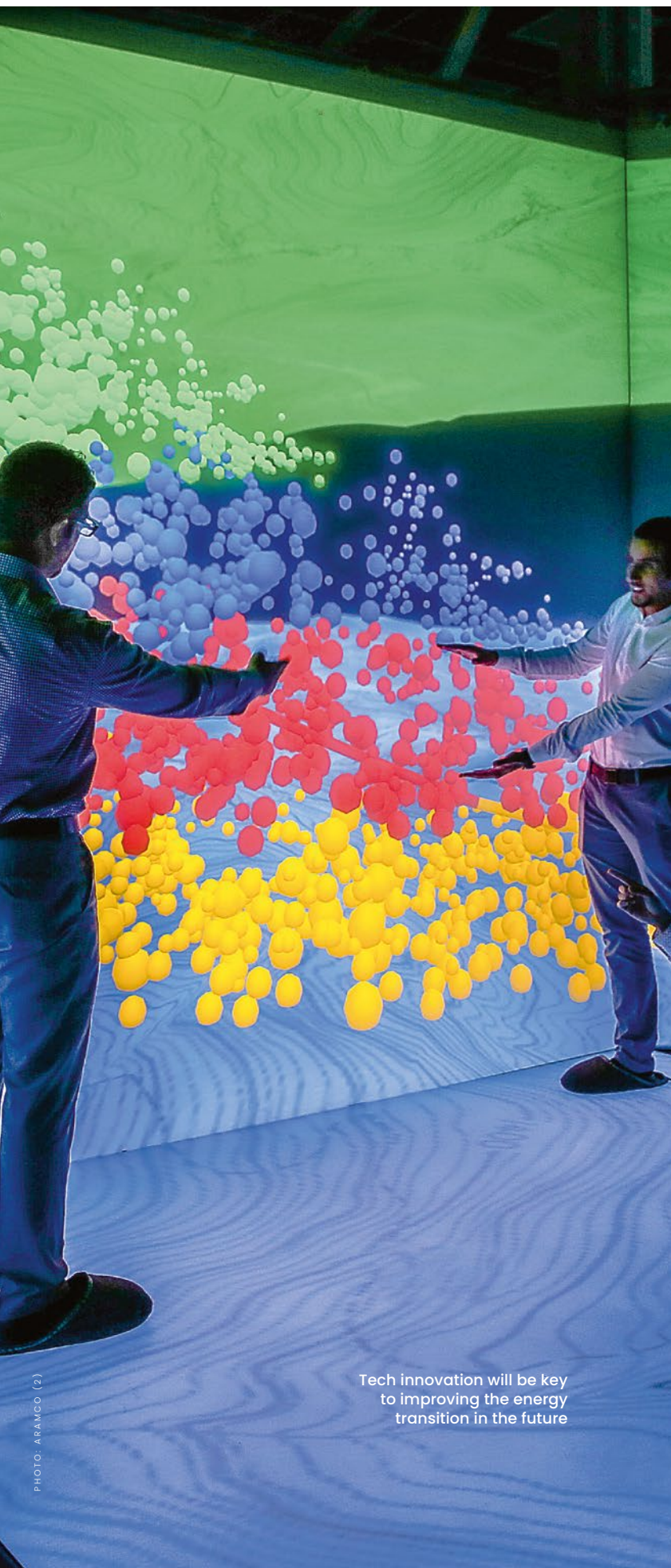
MOVING FROM BIAS TO BALANCE

Thanks to the inherent flaws in the current energy transition plan, and a resulting wave of public dissatisfaction, the world can benefit from a balanced transition built on a realistic view of the energy future, as Amin H. Nasser, President & CEO, Aramco explains.

→ **FOR AMIN H. NASSER, THE** current global energy transition plan has become progressively divorced from reality, with promises that are far too complicated and costly, and often contradictory. He prefers simplicity. In his view, the primary mission is to keep the molecules flowing, as they will be required for decades to come, while accelerating lower-carbon solutions. This balanced approach can then serve the whole world, not just those with the deepest pockets and loudest voices. “This may be Asia’s century,” he told Singapore International Energy Week in October 2024, “but Asia’s voice and priorities, like those of the broader Global South, are hard to see in current transition planning.” He noted that, as a result, “transition progress is far slower, far less equitable and far more complicated than many expected” when it comes to the developing world.

His prescription is pragmatic, not ideological. “We need a multi-source, multi-speed and multi-dimensional approach that addresses the actual security, affordability and sustainability priorities of all countries, not just a few,” Nasser said in Singapore.

The economic reality behind that argument is blunt. Even if oil demand growth slows, Nasser notes that “more than 100 million barrels per day would realistically still be required by 2050.” In other words, reports of the almost overnight death of conventional energy have been greatly exaggerated. Yet, the current approach to the transition has delivered underinvestments in these essential, proven energy supplies, which threatens the world’s affordability, security and sustainability goals. As Nasser has said, that’s because “new sources cannot even meet the growth in demand, while the proven sources needed to fill ↘



Tech innovation will be key
to improving the energy
transition in the future

PHOTO: ARAMCO (2)

**“ If prosperity
only favors the
few, then it
clearly fails the
many. ”**



AMIN H. NASSER

is President & CEO, Aramco, the world's leading integrated energy and chemicals enterprise, and the largest provider of crude oil to global markets. He is also a member of the company's Board of Directors.

During a company career spanning four decades, Nasser has served in a number of leadership positions, including as senior vice president of Upstream. In that role, he led Saudi Aramco's largest capital investment program in its integrated oil and gas portfolio. Under Nasser's leadership, the company is now building on its upstream leadership position by expanding its presence in the downstream and chemicals segments of the petroleum value chain, with significant investments and joint-venture partnerships in the Kingdom, as well as a number of overseas markets.

the gap are demonized and discarded.” Indeed, 60% of new energy demand in 2024 was still met by conventional sources, according to a report from The Energy Institute.

In Nasser’s view, a balanced energy transition acknowledges that new sources add to the energy mix and complement existing sources, rather than replace them. This puts a premium on investing in all sources and in game-changing technologies, as Aramco is doing. The company’s investments include everything from hydrogen to petrochemicals and advanced materials, stationary carbon capture and storage, direct air capture, and a heavy focus on artificial intelligence, which Nasser calls a “game-changing enabler.”

Nasser is adamant that everyone must benefit from the prevailing transition narrative, not just a few. “By 2050, 80% of hydrocarbon demand is going to be in the Global South,” he told an audience at CERAWEEK in Houston earlier this year. This emphasis on the Global South is crucial, highlighting the need for a balanced energy transition that considers the needs of all

countries. It’s a timely reminder that models built on the Organisation for Economic Co-operation and Development (OECD) assumptions can miss where demand and population growth are happening. For most nations, a one-size-fits-all pathway is neither affordable nor politically durable. “We need continued investment in all sources of energy to ensure progress for everyone,” he says. “If prosperity only favors the few, then it clearly fails the many.”

Above all, Nasser believes, it is time to stop reinforcing failure, noting the historic opportunity to change course, as the fictions of the promised transition wash away. Ever the pragmatist and realist, he would far rather shape an energy future the

world wants, can actually afford and can actually reach, including climate goals. That’s why he is confident that bringing balance to the transition could herald a truly golden new era of energy – for all. ■

90%+

of projected global mobility growth to 2050 will come from non-OECD economies

\$1.5 bn

Aramco Sustainability Fund consists of 36 portfolio companies

\$500 m

total committed amount from the fund

Plants like this one, the Khurais oil plant, 150 km southeast of Riyadh, will remain important during the energy transition.





THE CHANGING FACE OF ENERGY

The world is moving from oil to hydrogen, electricity and batteries in an attempt to tackle the challenges of the energy trilemma.



A ONCE-IN-A-CENTURY REWIRE OF THE ENERGY

system is underway. The molecules that powered the 20th century are giving ground to electrons, green molecules and small modular reactors. The shift, is messy, uneven – and accelerating.

Oil still dominates how the world uses energy: petroleum products make up roughly 40% of final consumption, while electricity accounts for about 21%. That imbalance explains why oil shocks still bite – and why electrification is such a powerful lever for change. Yet even here things

are changing: the International Energy Agency (IEA) now expects demand for each fossil fuel to peak by 2030 if current clean-energy momentum holds.

Hydrogen is coming around the corner. Global hydrogen demand reached about 97 Mt in 2023, but less than 1% was low emissions hydrogen. Electrolyser deployment is ticking up: installed capacity was around 1.4 GW at the end of 2023 and could have quintupled to 5 GW by the end of 2024, through China's use. And as this report makes clear, clean hydrogen is being developed in the Middle East.



Wind power has been earmarked as a major transition source – at a scale scarcely imaginable in previous decades

97 Mt
hydrogen demand
in 2023

21%
proportion of electricity
as final energy

40%
proportion of oil products
as final energy

(SOURCE: IEA)

CHANGING SUPPLIES

Electrification is the workhorse of decarbonization to date. Electric car sales topped 17 million in 2024, with China again the anchor market. But counter to that, power demand is also surging from heat pumps, industry and data centres. On the supply side, renewables are scaling faster than any technology in energy history: the IEA sees renewables' share of global electricity rising from 30% in 2023 to 46% by 2030, mostly from solar and wind.

The glue is storage. After a record 97 GWh added in 2023, the market crossed the 100 GWh annual-additions threshold in 2024 and is set to post another jump in 2025 as projects spread from the US and China to Saudi Arabia, South Africa, Australia and Europe. Costs are cooperating: global lithium-ion battery prices fell 20% in 2024 to a record \$115/kWh, thanks to manufacturing scale, cheaper materials and LFP chemistry.

None of this is automatic. Grids need reinforcing and interconnecting to transmit cheap clean power. Storage markets need clear demonstrations of how to return revenue. Hydrogen needs bankable offtake. The IEA's World Energy Outlook suggests the peak of fossil demand by 2030 is plausible, but meeting climate goals requires faster electrification, more flexible power systems and sharply higher clean-energy investment this decade.

THE BOTTOM LINE

Small modular reactors (SMRs) are the latest new trend, with countries pursuing lifetime extensions of existing fleets and private enterprises recognizing how SMR units are positioned to provide round-the-clock, low-carbon power where grids are weak or land is scarce. Their appeal is obvious thanks to shorter build timelines and the potential to supply process heat and even hydrogen, though they remain more theoretical than reality-based ideas – as of yet. Still, pair them with advanced geothermal and modern district heat, and it's possible to build firm, local sources that take pressure off peak electricity demand and complement wind, solar and batteries rather than compete with them.

The energy system is diversifying. Oil will matter for years, but electrons and green molecules are steadily taking share as EVs scale, renewables flood the grid, batteries provide flexibility, and hydrogen shifts from niche to necessary in heavy industry and shipping. The prize is cleaner, more secure energy – but only if policymakers, investors and operators tackle the boring (but vital) plumbing of grids, markets and demand creation now. ■

UNLOCKING CIRCULAR CARBON

The trilemma can only be addressed through collective action built on pragmatism and real-world realities, says Abdulrahman Al-Fageeh, CEO of SABIC.



THE ENERGY TRILEMMA –

security, accessibility and sustainability – is easy to sketch on a slide but much harder to deliver in the real world. Saudi chemical giant SABIC, whose materials and molecules sit deep in global value chains, knows that well. But they're turning thoughts and intentions into actions.

CEO Abdulrahman Al-Fageeh says, “The key challenge in this regard is to strike the right balance, whereby each element is addressed appropriately and timely.” But the company is up to the task.

“SABIC essentially embraces these elements in its day-to-day operations, as it holds security of its supply, reliability of its supply chains and its environmental practices at the highest consideration,” he explains. “SABIC has in fact gone miles, and sometimes even extra miles, to meet its objectives and achieve the global status it enjoys nowadays.”

GUIDING PHILOSOPHY

Growing while decarbonizing at the same time is not a simple task; yet, Al-Fageeh points to a guiding principle embedded from SABIC's plant floor to its boardroom: EHSS – or the protection of the environment, human health and safety and ➤



Megaplants of this type can help unlock opportunities in circular carbon.



PHOTO: SABIC (2)

“ EHSS Excellence has become embedded in the way we, at SABIC, think and act at all levels. ”



ABDULRAHMAN AL-FAGEEH

is SABIC's CEO and Executive Member of its Board of Directors and the Chairmen of SABIC Agri-Nutrients Company and the NUSANED™ Investment company. His career spans more than 35 years, during which Al-Fageeh held many senior and executive positions, including Executive Vice President of Petrochemicals, Performance Chemicals and Polymers strategic business units at SABIC. He is also the Chairmen of the Gulf Petrochemicals and Chemicals Association (GPCA) and the Saudi Petrochemical Manufacturers Committee, as well as a board member of the Royal Commission for Jubail and Yanbu, the General Authority of Foreign Trade and the Boao Forum for Asia.

“ Innovation, technology advancement and smart solutions have been a cornerstone for SABIC's successful journey for almost five decades. ”

“ The key challenge in this regard is to strike the right balance, whereby each element is addressed appropriately and timely. ”

Abdulrahman Al-Fageeh,
CEO of SABIC

645 m

people will continue to lack electricity access by 2030 without needed investment.

The SABIC academy trains the next generation of great energy thinkers.

security. “EHSS Excellence has become embedded in the way we, at SABIC, think and act at all levels,” he says. The discipline is an operating system that aims to help protect the plant and people; it is far away from a box-ticking exercise.

This operating system also encompasses the Circular Carbon Economy (CCE) lens that Riyadh has pushed on the global stage. “Improving SABIC’s environmental credentials is a key priority and guiding philosophy,” Al-Fageeh says, adding that “SABIC proactively and responsibly looks into all possibilities for managing our environmental footprint, whether on a small or large scale.”

VALUE CREATION

Decarbonization is a continuous effort. SABIC’s Agri-Nutrients Company is progressing in its plan to build a new ammonia plant in Jubail designed to produce 1.2 million metric tons of low-carbon ammonia per year, along with 1.1 million metric tons of urea. This is expected to be one of its kind, supplying low-carbon ammonia as a hydrogen carrier to the energy market and as a low-carbon feedstock to farmers for food security.

The initiative chimes with Al-Fageeh’s view that reducing footprint is a collective responsibility that should be addressed by all stakeholders.

Sustainability often focuses on protecting the environment, a crucial objective that overshadows another equally crucial pillar of the trilemma: accessibility – getting important chemicals to markets reliably. “Accessibility is indeed a key component of the trilemma,” Al-Fageeh highlights. SABIC’s contribution on this front is vital: constant review of supply chains to ensure “reliability and smoothness,” while “enhancing efficiency and strengthening capacities.” Those in turn boost value, he points out.

ADVANCED SOLUTIONS

As plastics play a key role in our lives, it is important that we look for ways to continuously manage their impact.

SABIC’s answer is TRUCIRCLE™, a platform launched in 2019 to advance circularity in plastics via alternative advanced chemical recycling and bio-based feedstocks and value-chain collaboration. “The initiative is designed to implement pioneer solutions wherever needed and it aims to find solutions to waste,” says Al-Fageeh.

Yet for all the chemistry, the other ingredient involved in decarbonizing is code. “The rapid evolution of technology has reshaped the entire petrochemical industry,” says Al-Fageeh. SABIC is utilizing everything from big data to AI to raise competitiveness and productivity to unlock growth. “Innovation, technology advancement and smart solutions have been a cornerstone for SABIC’s successful journey for almost five decades,” he explains.

GLOBAL BUT LOCAL

Those five decades of success have come from attracting national and international talents. He argues, though, that “developing necessary knowledge, skilled human capital and required processes locally is essential for robust economies and empowered societies.” Al-Fageeh adds that localization, which is one of the objectives of Vision 2030 of the Kingdom of Saudi Arabia, supports all three trilemma pillars: boosting security by reducing dependency on external variables; supporting sustainability by finding and implementing solutions; and improving affordability via lower risk and logistics costs.

That logic extends to the most valuable asset – human capital. “The petrochemical industry is a dynamic and multidisciplinary sector that

requires diverse skill sets,” explains Al-Fageeh. SABIC recruits globally but also invests locally, notably through the SABIC Scholarship Programme to “shape young Saudis to become industry professionals and future leaders.” A Saudi talent pipeline aligned to the Kingdom’s National Industrial Strategy, he suggests.

It all helps address the complexity of the trilemma. “The trilemma is complex by nature; hence, one should look at the full picture and progress made rather than a single indicator,” Al-Fageeh says. Still, the destination is clear: SABIC’s strategy is “firmly committed” to the Kingdom’s Vision 2030 and its various initiatives, such as the Saudi Green Initiative and localization.

SCORING SUCCESS

Al-Fageeh’s definition of success goes beyond benefitting SABIC. “To successfully address the trilemma, an inclusive, practical and all-embracing approach is required,” he says. Context matters: “conditions of economies, needs of societies and circumstances of peoples vary from one place to another.” He cites a sobering datapoint from the UN’s Sustainable Development Goals report: without urgent investment, 645 million people could still lack electricity access by 2030. “It is imperative to remain objective and balanced when addressing such a complex global issue,” he explains.

SABIC’s CEO doesn’t pretend the trilemma can be solved by a single person or action, but a collective approach is rather needed.

“We believe protecting the environment is in the interest of all, including us, as we all live in one planet – our planet,” Al-Fageeh says. Hence, a collective approach, where all voices can be heard, that relies on pragmatism and realities of the world is what is needed to move forward. ■

Centuries of burning fossil fuels and other polluting energy sources have caused a reckoning – making sustainability a core tenet of the trilemma for the future.



ENTERING THE FOURTH DIMENSION

The energy trilemma is a well-meaning issue to tackle, but there's a fourth dimension, reckons Marco Arcelli, CEO, ACWA Power – speed.

→ **THE ENERGY TRILEMMA IS AN** energizing concept around which the world can congregate and come up with solutions to tackle the energy issues facing our planet and its people. But there's more to it than three problems, says Marco Arcelli, CEO, ACWA Power.

"We always talk about the trilemma," he explains. "But if it happens in 2200, then we're all dead by then." Arcelli means that the traditional balancing act of security, sustainability and affordability is no longer sufficient to manage. A fourth pillar – speed – has, in his view, joined them if the world is to install more than 1,000 GW of clean energy capacity a year, which would be required to keep alive the goal of maintaining global warming under 1.5°C.

That sense of urgency has defined ACWA Power's rise. Since Arcelli relocated from Europe to Riyadh, the company's assets under management has doubled to \$117 billion – and, he predicts, will double again by 2030. The numbers matter, but the tempo behind them could rewrite the rules of our global energy world.



MARCO ARCELLI

is CEO of ACWA Power, responsible for overseeing the strategy and operations of its growing global footprint and ensuring continued growth and success worldwide. He is a seasoned C-level executive with over 20 years of international experience in energy and infrastructure, retail and digital innovation and has played a crucial role in the strategic positioning and growth of multinational companies.



INNOVATING IN ALL WAYS

The importance of adding speed to the energy trilemma is clearly seen in NEOM's green hydrogen project in Saudi Arabia. There, ACWA Power has shepherded the world's largest renewables-to-hydrogen scheme from concept to financial close in just three years, persuading international banks to back a venture that had never been tried at scale before. After the template was drawn up, it was easy to adapt: a \$7 billion sister project in Uzbekistan has sped from idea to signing in under 12 months.

Arcelli explains that the most important lever to bring these

megaprojects quickly to fruition is "leadership" in three different areas: a developer willing to take risk, offtakers that "get ahead of the queue" by demanding low-carbon molecules, and governments determined to smooth permits and paperwork. Saudi Arabia's streamlined bureaucracy was key to NEOM's success, says Arcelli. "Once there is a vision from the top, there is fast execution on the ground," he says.

But the level of finance needs to match the speed. ACWA Power invests between \$15 and \$20 billion every year (tripling its assets to \$250 billion by 2030) – something Arcelli points

out is at "the level of a major oil and gas company, but in renewables, in water desalination, solar power and green molecules." ACWA Power is able to commit that cash through trust built up with development-finance institutions and commercial lenders. "If you can achieve 30, 40 or 50% of blended financing, you bring down the cost of the final commodity by a level that you cannot reach with any other optimization," he argues. "And if you do that, what you achieve is really power and water at very low cost that support the local economies to then thrive and bring stabilities to emerging continents like Africa." ▾



The speed at which the Khizi-Absheron wind facility was rolled out should be echoed elsewhere.

▣ BIG PROJECTS, BIG FINANCE

The model enables ACWA Power to offer renewable electricity in Saudi Arabia at a quarter of European prices while still earning competitive returns – evidence that decarbonization is possible without pushing up prices. Lenders, seeing rapid construction milestones met on time, have also learned to recycle their capital faster.

ACWA Power benefits from operating in both water and energy. Desalinating water took 15 kWh per cubic meter 15 years ago. Today, it has cut that to 2.7 kWh per cubic meter, and aims to push below 2 kWh. That makes desalination cheaper, which in turn produces the vast volumes of ultra-pure water needed for hydrogen electrolysis.

1,000 GW

clean energy capacity needed a year to keep 1.5°C targets alive

\$117 bn

ACWA Power assets under management

\$15–20 bn

average annual investment by ACWA Power

ACWA Power operates primarily in developing economies in the Middle East and the Global South, where countries are growing between 5% and 8% a year, and new coal was still a temptation. “Unless you invest in renewables, we risk seeing an increase in emissions,” says Arcelli. That investment pays off. “I wouldn’t say that today it’s an ideological choice in the Global South to do renewables,” he says. “Simply in every era, societies develop the simplest, fastest, most efficient technologies that they can find. At the beginning it was coal-fired. Then it became hydro and nuclear, and now it is renewables, solar and wind. It’s simply the cheapest, the fastest, the simplest technology that you can install.”

Grand projects like Noor Energy 1 in the UAE will be vital for the future.



“ In every era, societies develop the simplest, fastest, most efficient technologies that they can find. ”

COMMUNITY EFFORT

But to drive down costs requires a concerted effort from the global community – which is where forums such as FII Institute’s flagship events and initiatives stitch the ecosystem together. “It’s extremely important,” Arcelli says, describing ACWA Power as “a catalyst of the good and willing.” The company is a developer, an operator and an investor that scours laboratories and supply chains around the world for the next incremental efficiency in modern technology, then mobilizes equity partners, banks and even philanthropy to make things happen. “Our idea is: channel it through us,” he says. “Make infrastructure more affordable through blended financing, concessional financing, so that more projects can go ahead faster.”

However, that acceleration doesn’t come at the expense of local communities. ACWA Power works with two large technical academies in Saudi

Arabia and Uzbekistan, graduating students who join the industry and further collective expertise. “By localizing talent, you shrink the supply chain and so reduce the execution risk over the short term,” Arcelli says. “You also create local demand,” he adds.

Those decisions breed success – and shape a new vision of how the energy of the future can look. “In Saudi Arabia, it’s impressive,” says Arcelli. “We went from having hardly any renewable energy or gas-fired plants, five, six or seven years ago, and under the vision of decarbonizing the system and making it 50–50, renewables and gas-fired, at the end of the year we will already have more than 30 GW under construction of renewables and combined cycles.” That’s equivalent to the capacity of Spain.

GRAND VISIONS

The ultimate aim, in Arcelli’s words, is audacious. “We want to turn Saudi

Arabia from the greatest exporter of oil to the greatest exporter of low carbon and water desalination technology in the world,” he says. “That’s success.”

And speed is of the essence. It’s why ACWA Power has turned the energy trilemma into a quadrilemma. It’s difficult to achieve, but is – as the company and its projects are showing – possible. What makes it doable are the actions and processes put in place by leaders in the countries where ACWA Power operates. “There is a very efficient bureaucratic system,” Arcelli says. “Once there is a vision from the top, there is fast execution on the ground.”

It comes down to determination to see a different future for the planet. “I see more determination in the authorities who need to take the decision to first do the project, and second to execute the project and get all the permits and get everything done,” he says. ■

THE AI OPPORTUNITY FOR ENERGY

On the one hand, artificial intelligence looks poised to push up energy demand – but could it help bring down demand and improve efficiency in the long run?



GENERATIVE AI HAS FLUNG A WRECKING BALL

through many parts of our society. From upending the world of work to changing the information space, its impact has already been felt. The technology is such an epoch-shifting one that it's possible to divide the world into BAI (before AI) and AAI (after AI) eras.

And nowhere is the BAI-AAI rupture felt more obviously than in the world of energy.

Before the widespread deployment of generative AI (the pre-2022 BAI era), global energy demand from data centers was already rising due to digitalization, but forecasts projected moderate, gradual increases, often tied to more efficient hardware and infrastructure.

THE AFTER AI ERA

Following the big bang moment of ChatGPT and what has happened since, that all changed. The International Energy Agency (IEA) and industry forecasts now expect electricity demand from data centers worldwide to more than double by 2030 to around 945 TWh, slightly more than the entire electricity consumption of Japan today. Things won't stop there. By 2035, the IEA suggests demand could reach 1,700 TWh.

They aren't alone. Goldman Sachs projects data center power demand could rise by up to 165% by 2030, compared to 2023, with generative AI accounting for a major portion of this growth. The energy demand charts have been torn up and replaced – with steeper, more shocking lines rising up and to the right.

If the energy trilemma was already pressing, then generative AI's massive explosion onto the scene turns it into a full-blown crisis that demands the world's attention. "AI is one of the biggest stories in the energy world today," says Fatih Birol, Executive Director, IEA, announcing the release of the organization's latest forecast in April.

A CHANGING WORLD

To counter this changing world, the energy industry – and decisionmakers in business and politics – are scrambling to adapt to the new norm. There is no AI without energy, specifically electricity, which is crucial for training and deploying AI models in power-hungry data centers. Massive spikes in energy demand have to be met somehow if the AI revolution is to continue apace. But the world's climate change targets can't be thrown out in pursuit of a tech revolution.

\$4.2 trillion

cumulative investment in data centers between 2025–2030 (base case)

1.2 trillion

liters per year of water demand due to data centers by 2030 – double today's

60%

increase in the number of servers in data centers by 2030

(SOURCE: IEA ENERGY AND AI, APRIL 2025)

Change is no good without ensuring it benefits all, wherever they are in the world, making equity the bedrock of the energy trilemma.



ENSURING EQUITY IN ENERGY

De-risking emerging market power while also championing new entrants into the market is vital – as Bill Winters, Group Chief Executive, Standard Chartered explains.



THE SCALE AND IMPORTANCE

of the investment challenge in the Global South is enormous and can't be overstated, says Bill Winters, Group Chief Executive, Standard Chartered. "Delivering the energy transition is critical across our markets in Asia, Africa and the Middle East," he says – yet the money is not flowing at the speed or scale required. Emerging markets excluding China drew \$116 billion of renewable energy investment in 2023, a healthy 35% jump from 2022, but "trillions of dollars are needed each year" to align with Paris and build resilient economies. "Investment levels remain inadequate to support energy transition," Winters says.

For Winters, the fix starts with crowding in private capital and building a robust pipeline of bankable projects. That means translating national ambitions into investable, risk-allocated deals that send a "longer-term investment horizon" signal to markets. He points to Standard Chartered's role connecting global finance with local opportunity, and cites major blended finance mobilizations, such as the Just Energy

Transition Partnerships (JETPs), where Standard Chartered, along with its JETP partners, committed \$15.5 billion to support Vietnam's energy transition and \$20 billion to Indonesia to phase out coal and invest in renewable energy. "A well-structured pipeline tangibly translates broader investment themes into commercial opportunities and sends strong market signals to investors of a longer-term investment horizon," Winters says.

If "green finance" rewards the already clean, Winters argues, "transition finance" is where the heavy lifting happens. "All sectors of the global economy, including hard-to-abate industries, need to

decarbonize," he says. Without it, we will not meet the Paris climate goals. Standard Chartered's Transition Finance Framework sets out what the bank will finance, and under what conditions, in high-emitting sectors such as transport, energy and agriculture.

The lesson from three years of implementation is that nuance is important. "Clients are starting from different places and transition for one client does not look the same as transition for another, even in the same sector or market," says Winters.

BREAKING BOTTLENECKS

The bottlenecks are not only technological or political. Currency

“All sectors of the global economy, including hard-to-abate industries, need to decarbonize.”



Decarbonizing our energy mix requires significant investment into alternative fuel sources around the world.

risk remains a deal killer for many clean power projects in the Global South. Winters sees promise in blended finance and guarantee mechanisms designed to soak up FX shocks. He cites the World Economic Forum's proposed Exchange Rate Coverage Facility as one model and notes Standard Chartered's own moves – from backing JETPs in Vietnam and Indonesia, where the bank has committed \$15.5 billion and \$20 billion respectively, to a \$50 million standby liquidity facility for GuarantCo that expands local-currency guarantees across Africa and Asia. "This helped de-risk investments, allowing improved access to local capital markets and reduced reliance on hard currency financing," he says.

Another underused lever is Islamic finance. With \$4.5 trillion in assets and deep cultural fit across many energy transition hotspots, Islamic finance "can support energy projects addressing the energy trilemma," says Winters. Standard Chartered's Saadiq platform covers more than 25 of them, and recent deals include €103 million of Islamic financing for solar streetlights in Senegal, as well as a €150 million program with ICIEC and Agrobank to support SMEs in Uzbekistan.

What about tapping tomorrow's carbon revenues to unlock finance today? Winters reckons not until markets mature. "The carbon market needs greater standardization, transparency and credibility" before banks can treat future carbon credits like securitizable collateral, he says, pointing to convergence around robust methodologies, legal clarity on ownership and insolvency treatment, and forward price discovery. In the near term, "insurance products or first-loss capital provided by multilaterals" can help catalyze early transactions.

THE NEED FOR SPEED

The energy trilemma has in recent years gained another pillar: speed, ➤



BILL WINTERS

is CEO of Standard Chartered. Bill has had a distinguished career in banking, having spent 26 years with JP Morgan in diverse leadership roles, becoming co-Chief Executive Officer of the Investment Bank in 2004 until he stepped down in 2009. Bill was the only career banker to be invited onto the committee of the Independent Commission on Banking, established by the UK government in 2010 to recommend ways to improve competition and financial stability in banking.



■ alongside security, affordability, and sustainability. Time is of the essence, and time is being lost at early-stage development and risk allocation, says Winters. He points to permitting, land and grid access that can create delays of 12 to 36 months. Complex ESG due diligence in blended structures doesn't help. To solve that, pre-approved risk-allocation templates, digital one-stop shops for land and environmental approvals, could be developed – also AI-assisted ESG screening, catalytic grants and first-loss capital to de-risk feasibility, as well as better coordination among MDBs, DFIs and commercial banks.

Equity is non-negotiable. Winters says deals should be structured to

benefit “low-income consumers with lower tariffs or distributed energy access, rather than bearing the cost of de-risking and FX buffers.” It's not charity: it's risk management. “Structuring deals this way improves repayment rates, reduces political risk and aligns with ESG mandates.”

Winters sees organizations like the FII Institute as a way to knit together a messy world of rules and labels. Rather than chase a single global taxonomy, Winters favors practical mutual recognition agreements that let capital flow across regimes. Initiatives such as FII Institute's ESG toolkits and convenings “could evolve into significant platforms for aligning taxonomies,” he says.

\$1 bn

of Sustainable Finance Income over the past 12 months

\$121 bn

of Sustainable Finance mobilization in 2024

\$300 bn

goal of Sustainable Finance mobilization in 2030



The abundance of solar energy could be more intelligently harnessed to help alleviate fossil fuel reliance.

THE CASE FOR CHANGE

Energy transition “makes commercial sense,” Winters explains – and to prove it, he has the numbers. Standard Chartered generated more than \$1 billion in sustainable finance income over the last 12 months and has completed baseline and target setting for its 12 highest-emitting sectors – “the first Globally Systemically Important Bank (GSIB) to do so,” he notes. The bank is targeting net-zero financed emissions by 2050 and aims to mobilise \$300 billion in sustainable finance by 2030, having already mobilised \$121 billion by 2024.

For Winters, “success means achieving a resilient energy system that delivers reliable, clean and

accessible energy without sacrificing one pillar for another.” He adds: “The World Energy Council’s Trilemma Framework states success is not about perfection in each dimension, but about managing trade-offs transparently and effectively.”

None of this, Winters cautions, happens in a vacuum. Regulatory upgrades can turbo-charge outcomes, particularly in the Global South. He highlights grid unbundling and market liberalization to diversify supply and competition, streamlined permitting and land access to cut costs, local-currency financing frameworks to protect affordability, social tariffs to shield the poorest, and credible carbon-

market rules to unlock revenues. It’s through those routes that we can affect an equitable energy transition.

“We’re clear that the transition to a low-carbon economy presents a significant opportunity to accelerate sustainable and enduring growth across our markets,” he says. “Whether we’re supporting clients with their transition strategies and business models of the future, developing solutions to finance new innovative technologies, or financing low-carbon infrastructure projects in India, Indonesia, South Africa and beyond – it is important business for Standard Chartered.” ■

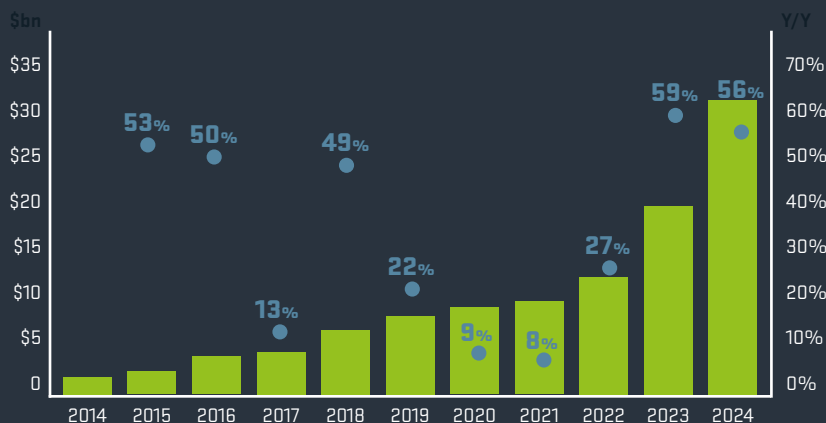
INFOGRAPHIC

COUNTING THE COST OF TRANSITION

The energy trilemma is biting in many different ways as our world evolves – here are some of the numbers to get to grips with.

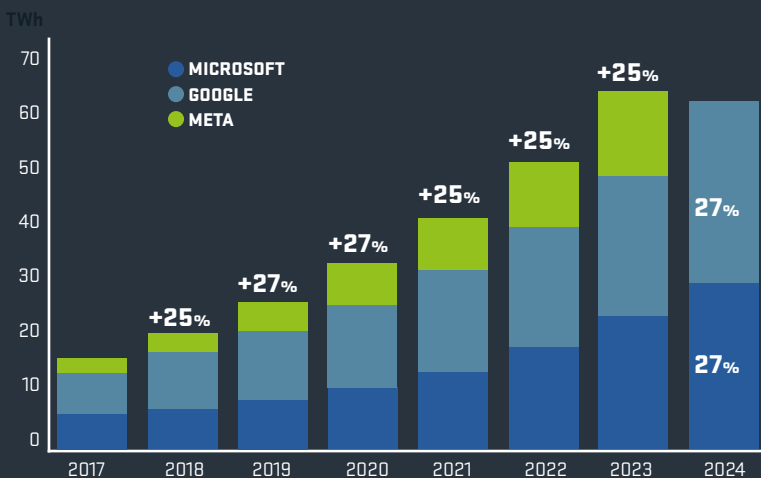
AI'S IMPACT ON ENERGY DEMAND ...

Data centers are becoming ever more powerful to meet the demands of AI inference – and with that, are pushing up worldwide electricity demand.



SOURCE: COMPANY REPORTS, BARCLAYS RESEARCH

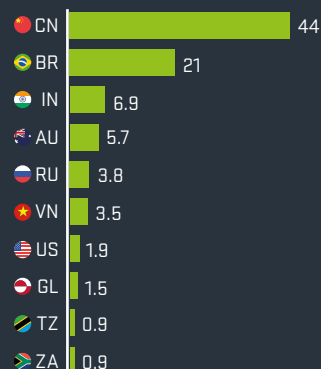
HYPERSCALER GLOBAL ELECTRICITY USE



SOURCE: COMPANY REPORTS, BARCLAYS RESEARCH

WHERE ARE THE WORLD'S RARE EARTHS?

Top 10 countries with the greatest known reserves of rare earths in 2024 (in million tonnes of rare earth oxide)



SOURCES: USGS

ENERGY OPPORTUNITIES REMAIN SCARCE

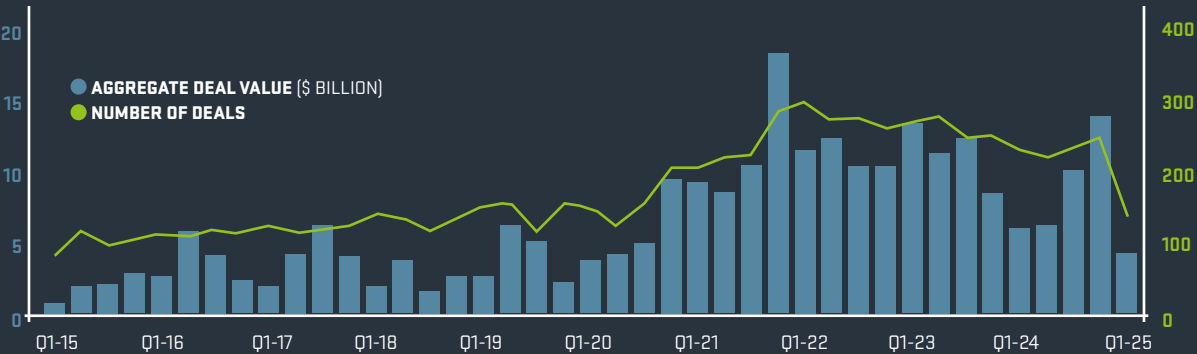
While much of the world is washed in energy, large swathes of the population struggle.

- Over **1.18 billion** people worldwide live in energy poverty
- 675 million** people are without electricity globally
- 78-141 million** additional people are pushed into extreme poverty due to the energy price crisis

SOURCES: NATURE/UNIVERSITY OF MICHIGAN, 2024; WORLD BANK ENERGY OVERVIEW 2025; NATURE, 2023

FUNDING CLEANER ALTERNATIVES

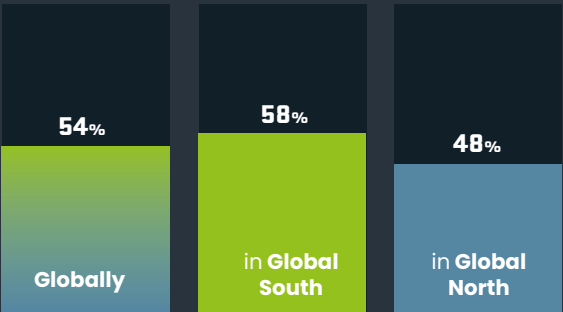
Facing supply crunches, the market is trying to tackle the issue with funding for cleantech.



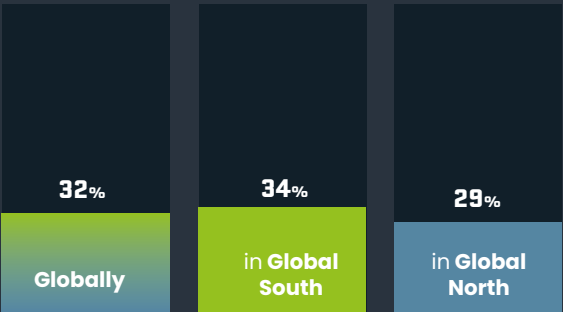
ANALYSIS INCLUDES FUNDING ROUNDS ANNOUNCED BETWEEN JAN. 1, 2025, AND MAR. 31, 2025. TARGET COMPANIES WERE IDENTIFIED BASED ON S&P GLOBAL MARKET INTELLIGENCE TOPIC TAGS FOR CLEAN ENERGY, CLEANTECH AND CLIMATECH. TOPIC TAGS ARE GENERATED ON S&P BUSINESS DESCRIPTIONS. EXCLUDES TERMINATED DEALS AND ADD-ON ACQUISITIONS. SOURCE: S&P GLOBAL COMMODITYINSIGHTS

THE WORLD WANTS CHANGE

FII Institute’s own PRIORITY Compass data demonstrates the desire for change:



regard **pollution** as the most important environmental issue



regard **excessive use of resources** as the most important environmental issue

SOURCE: FII PRIORITY COMPASS 2024

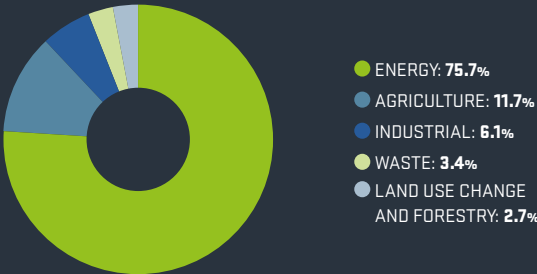
BEYOND AI, PROBLEMS PERSIST

AI has focused attention, but the issues that the energy trilemma highlight have existed long before this.

- Power sector CO₂ emissions hit an all-time high of **14.6 billion tonnes** in 2024
- Global CO₂ emissions are projected to reach **37.41 GtCO₂** in 2024 (1.08% increase)
- The energy sector accounts for **75.7%** of global greenhouse gas emissions

SOURCES: EMBER; STATISTA; WORLD RESOURCES INSTITUTE

GLOBAL GREENHOUSE EMISSIONS BY SECTOR AND END USE, 2021



SOURCE: WORLD RESOURCES INSTITUTE

TURNING TRAVEL INTO SOMETHING SUSTAINABLE

King Salman International Airport (KSIA) is Saudi Arabia's gateway to the world – and Marco Mejia, Acting CEO, KSIA, sees a way to ensure travel contributes sustainably.

KSIA is planned to transform what an airport looks like – while putting sustainability at its core.



WHEN MARCO MEJIA, CEO, King Salman International Airport (KSIA), talks about the airport, he's talking about more than runways and terminals. He's talking about building a national landmark – one that embodies Saudi Arabia's Vision 2030 ambitions, redefines the travel experience, and balances the “quadrilemma” of speed, security, sustainability and equity.

“Our strategy is rooted in a conviction that KSIA is more than a major infrastructure project,” Mejia says. It's “a symbol of a bold national identity, capturing the essence of a modern and ambitious Saudi Arabia.” That conviction, he explains, has guided every decision – from its Salmani-inspired architecture to its promise of accessibility for all.

By 2030, KSIA aims to handle 100 million passengers and 2 million tonnes of cargo annually. The scale alone would place it among the world's largest airports, but Mejia insists that growth will not come at the expense of environmental and social responsibility. “We firmly believe that environmental sustainability is not a future aspiration but a present-day operational pillar,” he says. And the aim is a grand one. “We are transforming aviation,” he says.

The airport is a major development, designed to be an international travel hub and a showcase for the Kingdom's grand future. It blends luxury with inclusivity and a human-centered experience for all travelers, while benefiting the local community and the wider region.

GOING GREEN

KSIA's development is being phased to allow rapid but controlled growth. This ensures operational efficiency and high-quality service from day one, while embedding sustainability standards such as LEED certification from the outset.

Sustainability, Mejia notes, is embedded in the project's DNA. The airport is targeting full carbon neutrality, powered by “maximum reliance” on renewable energy. Solar power has been integrated from the early design stages, while advanced energy management systems will monitor and optimize consumption in real time. And for a sector responsible for 2.4% to 2.8% of global annual CO₂ emissions, sustainable Aviation Fuel (SAF) will play a major role in cutting the environmental impact, with infrastructure for storage and distribution already in development.

Even during construction, KSIA has sought to reduce its footprint, using B100 pure biodiesel for heavy equipment to curb fossil fuel use. Waste management is similarly ambitious: the goal is “Zero Waste to Landfill” through 100% recycling of recyclable operational waste.

“At its core lies the goal of becoming one of the world's first fully carbon-neutral airports,” Mejia says, “embedding green solutions into the heart of KSIA operations.”

KEEPING COOL

Building a vast aviation complex in the desert brings unique challenges – especially cooling without excessive energy use. KSIA's answer mixes cultural heritage and modern engineering, drawing on Salmani architecture principles – authenticity, sustainability and innovation – with building orientations that maximize natural shade and the use of thermally insulating, earth-based materials.

Terminal 6 will feature expansive indoor gardens to cool the air naturally, while shaded walkways in the “Wadi Loop” connect different areas of the airport. Underground facilities exploit cooler ground temperatures, reducing reliance on traditional HVAC systems. High-efficiency, solar-powered central cooling plants will fine-tune climate

control while keeping energy demand in check. “This integrated approach reflects KSIA's belief that sustainability must be a practical solution and not just a slogan – ensuring a comfortable and climate-optimized experience for travelers while proving that extreme weather challenges can be overcome through architectural and environmental innovation,” Mejia says. ➤



MARCO MEJIA

is Acting CEO of King Salman International Airport. He has been in the role since October 2021. Prior to this, Mejia was Vice President, Aviation for WSP in Canada, creating and implementing the strategic vision for the aviation group in Canada, Caribbean and Latin America, and Vice President, Infrastructure at Calgary Airport Authority.

103,000direct and indirect
jobs to be created**100 m**passengers
annually by 2030**2 m**tonnes of cargo handled
annually by 2030**▀ A CITY WITHIN A CITY**

Spanning more than 57 square kilometres, KSIA operates as an “aerotropolis” – a fully integrated hub combining travel, commerce, entertainment, residential communities and logistics. The scale is designed to ease pressure on Riyadh’s existing transport systems while boosting economic diversification.

More than 103,000 direct and indirect jobs will be created, supported by training programs to build Saudi talent across aviation, logistics, engineering and technology. Local suppliers are being prioritized in procurement, aligning with Vision 2030’s goal of 60% domestic spend.

On mobility, KSIA will be linked to metro, rail and bus networks, alongside autonomous vehicles, cycling routes and shaded pedestrian corridors. Smart transport management, robotic parking and underground connections aim to make movement within and beyond the airport seamless. It’s all in aim of meeting and addressing the energy quadrilemma we all face.

“At its core lies the goal of becoming one of the world’s first fully carbon-neutral airports.”

ANSWERING THE QUADRILEMMA

“The key indicator of KSIA’s success in passing the ‘quadrilemma’ test will be its ability to safely and efficiently accommodate over 100 million passengers annually by 2030,” explains Mejia. “More than just an ambitious target, this figure reflects the airport’s success in balancing the four interconnected pillars of the quadrilemma: speed, security, sustainability and equity.”

This passenger volume, he says, will only be possible through robust security systems – including AI-powered surveillance, advanced cybersecurity, and smart operational controls – coupled with renewable-powered infrastructure and inclusive services for all traveler demographics.

KSIA’s facilities will serve not only business travelers and tourists, but also budget-conscious passengers, people with disabilities and expatriate workers.

MAKING A LOCAL IMPACT

For Mejia, KSIA’s impact will extend deep into the Saudi economy. Local content rules create vast opportunities for Saudi suppliers across sectors from logistics and technology to hospitality and real estate. The airport company is helping domestic firms meet global standards through supplier development and qualification programs.

Partnerships with firms such as Foster + Partners, Jacobs, and Bechtel



The grand airport will become a major global hub for travelers, and one of the most environmentally advanced, too.

are also transferring world-class expertise to Saudi engineers, architects and project managers. “We’re not just building a new airport,” Mejia says. “KSIA demonstrates a commitment to maximizing national capabilities, localizing value chains and presenting a development model that connects economic opportunity with human capital growth and sustainability.”

There are plenty of challenges in building any kind of megaproject such as this. “What sets KSIA apart,” he says, “is how these challenges are being transformed into drivers of innovation and integration.”

LOOKING TO THE FUTURE

KSIA aims to become one of the world’s most environmentally advanced airports – powered entirely by renewable energy, recycling all recyclable waste and leading the region in Sustainable Aviation Fuel (SAF) integration. It will create thousands of high-skill opportunities for Saudis and serve as a model for how infrastructure can be both globally competitive and locally grounded.

For Mejia, success will be measured not only by passenger numbers, but also by the depth of local supplier participation in the airport’s supply chain and the value it delivers to the Saudi economy. ■



KEEPING IN BALANCE

When the energy trilemma becomes a quadrilemma, understanding how to keep things in balance, and all elements equitable, becomes a challenge – as Rachid Majiti, Senior Partner, McKinsey & Company explains.



BALANCING THE ENERGY

trilemma is at the heart of the global transition. What has shifted is not the definition of the challenge – security, sustainability, affordability – but the debate around feasibility and speed: how quickly countries and companies can deliver progress without losing balance across the three dimensions. This tension between ambition and execution is shaping choices at every level.

THE EVOLVING ENERGY MIX

Power is the fastest-growing part of the energy system, and central to any credible net-zero pathway. According to McKinsey's latest Global Energy Perspective (GEP), renewables are expected to account for about 45%–50% of global power by 2030 and 60% by 2050, led by the rapid cost declines and scale advantages of solar.

Hydrogen will be essential where direct electrification is not feasible

in steel, refining, chemicals, heavy transport and more – but likely only a meaningful contributor closer to the 2040/2050 time frame. However, oil and gas are expected to account for 35%–48% of final energy use, depending on how quickly the transition unfolds. Oil demand is likely to stabilize and then gradually decline, with ongoing relevance in sectors that are harder to decarbonize, such as aviation, shipping and chemicals. ↘



Keeping supplies running is important for resiliency in an increasingly uncertain future.

“ Closing the gap requires translating ambition into approvals, accelerating execution capacity and putting power onto the grid. ”



RACHID MAJITI

is a senior partner at McKinsey & Company based in the Middle East office. He joined the firm in Amsterdam in 2001 and moved to the Middle East in 2012. A member of McKinsey's Global Energy & Materials Leadership team, he works with energy and industrial companies and governments on a broad range of strategic transformation topics. He holds several global leadership roles in McKinsey, is a core shaper of its research and knowledge development (including the editorial boards of its Global Energy and its Global Materials Perspectives) and a frequent contributor at industry conferences.

➤ Natural gas, meanwhile, is expected to remain part of the mix as a transition fuel, supporting the stability of power systems and certain industrial uses.

Yet while momentum for (renewable) power is strong, the sector needs to accelerate – and a number of frictions stand in the way. As Rachid Majiti, Senior Partner at McKinsey & Company, explains: “Closing the gap requires translating ambition into approvals, accelerating execution capacity and putting power onto the grid.”

FINDING FIXES

So why are deployments lagging? Majiti identifies four main sources of friction: overall grid stability and flexibility, permitting and interconnection constraints, supply chain bottlenecks and materials intensity, and macroeconomic or geopolitical factors that raise financing costs and execution risk.

What can resolve these frictions? “Streamlining approvals, standardizing permitting, prioritizing grid investments, scaling long-term PPAs, coinvesting in enabling infrastructure, and applying advanced planning and risk management,” Majiti says. Markets that move fastest combine policy clarity, bankable project structures and infrastructure readiness. “They attract capital by demonstrating transparent interconnection queues, stable renewable targets and creditworthy offtake contracts,” while reducing

execution risk by building domestic EPC and operational capabilities.

Mobilizing more private capital will depend on a mix of de-risking instruments (such as guarantees, capacity payments for dispatchable sources and blended finance), market signals (such as carbon pricing and renewable quotas), and building capability in project development, procurement, and grid operations.

SPEED AS A DESIGN PRINCIPLE

Time can be embedded as a design principle. Regulatory efficiency, front-loading environmental reviews, adopting “default-yes” interconnection milestones and using standardized contracts can be paired with industrialized delivery methods such as modular design, prefabrication and digital twins to slash project timelines significantly. Equally, organizational shifts matter: “Integrating permitting, engineering and procurement into concurrent workflows will allow utilities and developers to pull quarters, not just weeks, from schedules,” Majiti says.

The transition also depends on securing affordable and sustainable supplies of key metals. “Electrification relies heavily on lithium, nickel, cobalt, copper and rare earths,” Majiti says, and current supply might meet only 10%–35% of projected 2050 demand without investment. A portfolio approach – across materials and geographies – is needed: diversifying upstream supply and processing, scaling recycling and circularity, and

increasing materials efficiency and substitution. “Regulatory throughput, including permits, social licensing, and supporting infrastructure – is just as critical as geology in converting resources into actual supply,” he emphasizes.

THE ROLE OF GOVERNMENT

“Governments have an opportunity to act as reliable market shapers,” Majiti says. Success comes from a disciplined mix of durable targets, clear economic signals, public investment in enabling infrastructure and efforts to improve affordability and competitiveness. When these conditions line up, “capital costs fall, learning curves steepen and projects move faster from MoUs to final investment decisions,” he says.

Speed, however, must go hand in hand with fairness. “A just transition is a deliberate design choice,” Majiti notes. “Equity improves further when clean energy build-out creates local jobs and financing spreads upfront costs over time.”

The Gulf is particularly well-positioned to lead, given its resources and economic growth, provided infrastructure and regulatory frameworks keep pace. “A meshed regional grid lowers reserve requirements, smooths variability and enables cross-border trade,” he says. “Shared hydrogen pipelines reduce unit costs and support certification.” But the right rules will be vital: “Agreeing on common technical and market codes, staging priority

corridors aligned with generation siting and structuring PPP financing with anchor offtake agreements are all key.”

MEASURE WHAT MATTERS

As we’ve been asking all contributors to this report, we asked Majiti what single proof point will show this has all worked. “There is no single KPI,” he says. For the power sector a balanced scorecard could include system reliability and outage minutes, carbon intensity of supply, affordability as share of household income or industrial factor costs and deployment lead times (keeping speed up). “Progress, in other words, is plural.”

Ultimately, “Success means a resilient, affordable, low-emissions

45%–50%
renewables’ share of
global power by 2030

60%–70%
renewables’ share of
global power by 2050

10%–30%
proportion of 2050
demand for critical
minerals met without
major investment

60–240 Mt/yr
hydrogen demand
by 2050

system that maintains industrial competitiveness and empowers households,” Majiti says. In practice, that looks like rising renewable shares, firm capacity and storage, grids ahead of build plans and energy bills hopefully reflecting system efficiencies. And it’s a system where, for the foreseeable future, different energy sources coexist.

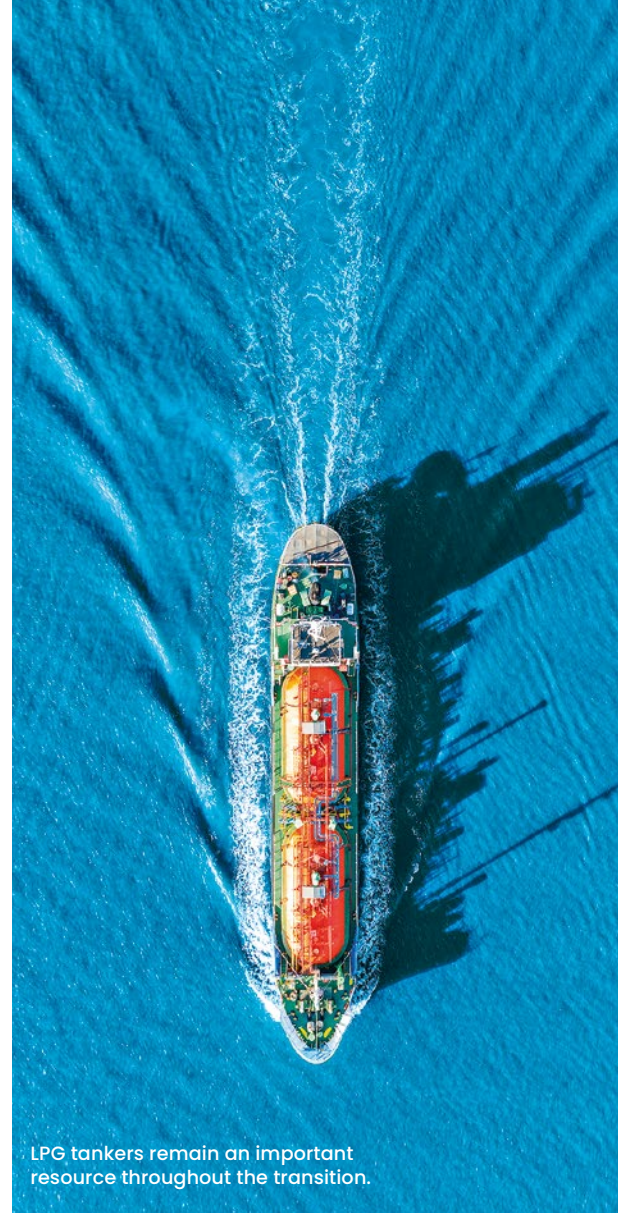
“The lesson is composure: the coexistence of rising renewables with a continued role for oil and gas underlines that crises should validate rather than derail the architecture of a balanced transition,” he says. “Ultimately, it is about keeping all elements in balance while advancing a path that benefits both economies and the planet.” ■

Vast solar plans, like this one in Fujian, China, have the ability to transform power supplies.



WHAT NEEDS TO CHANGE – AND HOW THE FII INSTITUTE HELPS IT HAPPEN

Key thinkers in the space have offered their options throughout this report – and provided an outline of what needs to change.



LPG tankers remain an important resource throughout the transition.



IF ONE THING IS CLEAR FROM THE PRECEDING

pages, it's that the energy transition isn't a neat trilemma anymore. Security, affordability and sustainability still matter, but speed now also dictates the outcome. Closing the gap between ambition and execution is important to address the energy crisis we're facing and to keep climate change in check.

Capital has to flow to transition fuels, not just the already-green projects. That requires strong pipelines, blended finance to cushion FX shocks, and – as our interviewees have suggested – wider use of Islamic finance where it fits the market.

Not every project is adapting what's already there. The spike in demand from AI and data centers shows that new

projects will be needed. Where we can start afresh, the experts recommend embedding reliability, storage and digital control into projects from day one. One blueprint to follow is NEOM's approach outlined earlier, which demonstrates how to pair abundant wind and solar with firm capacity and competitive costs.

MAKING RARE EARTHS LESS RARE

Electrification's future will rely on plenty of lithium, nickel, cobalt, copper and rare earths, and what we have today will cover only a small slice of 2050 demand. We know the fix: diversify upstream supply and processing, scale recycling and speed up permits and social licensing alongside geology.



Lithium mines like this one in Chile are becoming increasingly vital.

But electrons won't do everything. Hydrogen, ammonia and carbon capture and storage (CCS) can cut emissions where processes are hard to electrify. Here too we have examples: Aramco's multi-source strategy, from e-heated SMR pilots to a 9 Mtpa CCS hub, is the kind of pragmatic scaling the Global South can use, while SABIC's low-carbon ammonia and circular carbon lens push down industrial footprints.

As well as bringing on new supply, one of the fastest, fairest routes to decarbonization is to waste less. Those we've spoken to point out that can cut energy use by 20% in year one, allowing cleaner supply to then displace more fossil generation.

ADOPTING AI

The topic of conversation at previous FII Institute events has shown how AI can turn unstructured data into investing insight, pricing climate risk better and unlocking energy transition finance. But we need to beware the risks of AI pushing up energy demand to unsustainable levels – even if in the long run it seems it could help find better solutions.

More than anything, we need to ensure everyone benefits from the energy transition. A just transition is a design choice: local jobs, social tariffs and regional grids and pipelines can cut costs while raising reliability for countries.

Which is where FII Institute comes in. We are a do tank: surfacing what works, convening the people who can build it, then pushing practical solutions. Our global network brings together developers, financiers, policymakers and innovators to recycle capital faster and spread proven models across regions. And we believe change needs to come to balance the megawatts and solve the energy trilemma. More than that, speed is of the essence, if the quadrilemma has told us anything.

So let's address the quadrilemma by designing for speed, financing the transition's hardest bits, then sharing the playbooks that work. FII Institute's job is to keep the conversation honest, global and focused on doing more than talking – in order that progress moves quicker than the problem can. ■

The digitization of energy cannot be overlooked as the transition takes place.

CHARTING A COURSE FOR THE FUTURE

We've understood the issues, and how to tackle the trilemma – plus the need for speed. Hawazen Nassief, Board member of Tanmiah and MEPCO & former Head of Sustainability & Stewardship at the PIF, charts a course for the future.

→ **THERE IS NO SHORTAGE OF** challenges the world's decision-makers must tackle to address the energy trilemma – and as the addition of speed to make the quadrilemma indicates, time is of the essence. But Hawazen Nassief, sustainability expert and former Head of Sustainability & Stewardship at the PIF warns that for all the need for speed, it's a marathon as well as a sprint.

Change needs to be pragmatic, inclusive and focused on efficiency first. "An orderly energy transition is one that considers social equity, economic stability and energy security



HAWAZEN NASSIEF

is a well-known sustainability expert and the former Head of Sustainability & Stewardship at PIF. She is a recognized authority in sustainability, governance and corporate leadership, with an impressive portfolio of roles across some of Saudi Arabia's leading organizations. Her efforts are shaping a responsible investment future, rooted in transparency and long-term value creation.

As a board member for entities such as Makkah Province Development Authority, MEPCO and Tanmiah Food Company, Hawazen plays a key role in risk, ESG, and remuneration committees, advocating for sustainable governance and ethical leadership. A graduate of The Fletcher School at Tufts University and Boston University, she brings a global perspective to sustainability and regional climate action.

“As global temperatures continue to rise, we can expect more strain on the grid and more frequent power outages, especially during peak heat months.”

security in implementing transition plans,” she says. That’s how to ensure a blueprint designed to avoid “unnecessary volatility in energy markets, including supply shortages and price spikes.”

Orderliness, in Nassief’s framing, is the opposite of one-size-fits-all. While action must be taken globally, the real changes must be local. “Transition timelines and plans need to be customized to the specific conditions, realities and needs of individual countries,” she says. That means deliberate support for communities and workers most exposed to disruption, and guardrails against widening energy poverty as prices or access wobble during the shift. “Consideration of the impact of transitioning on societies and designing transition strategies that minimize disruption is key to an orderly transition,” she says.

RACE TO LOWER EMISSIONS

But where to begin? “The most sensible place to start is to focus on optimizing energy consumption,” she says, pointing to “reducing energy use and energy waste, while maintaining optimal performance and productivity” as potential wins. Do that well and organizations could potentially reduce energy consumption by at least 20% in the first year, according to conservative estimates.

Some of that comes through hardware, some through habit, combining sensors, control systems and process change. “Entities can recuperate their investments over a few years from cost savings and taking advantage of carbon tax incentives where applicable,” Nassief points out.

Efficiency, however, only carries you so far if the grid stands still. Utilities will also play a role, and many major utilities “are



2025 Energy Transition Index Scores

65.8

Advanced economies

59.4

Emerging Europe

52.1

Middle East, North Africa and Pakistan

48.8

Sub-Saharan Africa

➤ demonstrating their commitment to sustainability and energy transition through net zero commitments, sustainability-linked financing and linking KPIs to sustainability targets,” she says. Yet their shifts are capital-intensive and come with uncertainty, so risk must be shared. “The introduction of creative regulations and flexible financing, and the development of power purchase agreements to reduce volatility and uncertainty for the utility companies will accelerate the pace of transition,” Nassief says.

CHANGING THE CLIMATE

All this is done with the backdrop of a warming planet. “As global temperatures continue to rise, we can expect more strain on the grid and more frequent power outages, especially during peak heat months,” Nassief warns. On the supply side, power providers need to invest in smarter and more resilient grids, with sensors and digital meters that allow operators to reroute power to where it is most needed. Storage is also needed to

smooth spikes by soaking up excess and releasing when demand is high. Hardening transmission against climate challenges by “placing [transmission lines] underground or using heat-resistant material” is also important. She points to energy firms like the Saudi Electricity Company (SEC), which is committed to achieving net-zero emissions by 2050 in line with Saudi Arabia’s commitment to net-zero by 2060 and its aim to generate 50% of power from renewable sources by 2030.

On the demand side, flexible consumption matters: rooftop solar and home batteries at the residential end can help, as can dynamic controls, thermal storage and efficient cooling in commercial sectors. Small behavioral nudges compound, too. “Setting air conditioners to higher temperatures and unplugging

electronics when not in use” slash the peaks that topple systems, she says.

TACKLING THE TRANSITION

Transitions can widen divides if gains do not stick locally. Nassief wants growth to remain in the communities that do most to lower emissions. “Reskilling workers in industries that are negatively affected is key to maintaining economic stability and social order,” she says. Investment in education is important, as is capacity building locally. Companies that “trickle down best environmental and social practices to their local suppliers” shrink their own footprints and “support the transformation of economies,” she says.

Transition also comes in stages. “Enhancing efficiency is key to emissions reduction and supply reliability,” she says, but a pragmatic portfolio is necessary. “Investment in reducing the emissions of the oil and gas sector is key,” she says, because “the stability and sustainability of the oil and gas sector is crucial for energy

security, availability and affordability in the near and medium term.” Nassief is clear: “I cannot foresee a scenario that successfully addresses the energy trilemma without oil and gas in the future energy mix.” But it’s important to optimize that mix. “The importance of producing energy from all sources, better and cleaner – through investments in technology, infrastructure, R&D – cannot be overemphasized,” she says.

It’s a tricky challenge, but worth pursuing. “Through analyzing energy consumption patterns and identifying opportunities and mechanisms, organizations could potentially reduce energy consumption by 20% in the first year according to conservative estimates,” she says. So it’s important to accelerate alignment among policy, finance and operators, and focus attention on what works. “FII can support creating awareness around the need for investments to be channeled towards pragmatic energy transition,” she explains. ■



As well as top-down initiatives, bottom-up ones, like these DIY-installed solar panels, can shift demand.

TACKLING THE ENERGY TRANSITION

Here are nine practical shifts to move from talk to traction when it comes to the trilemma – and the FII Institute levers that make change real.

Add speed to the trilemma.

Security, affordability and sustainability aren't enough – execution speed is as important. Always think about time as a core design variable to try and build projects faster without cutting corners. Standardizing permitting and licensing can help with this.

Find finance for the transition, not just the already-green.

Private capital with bankable pipelines and blended finance will be crucial so emerging markets can build at scale. FII Institute's global fora bring together policymakers, MDBs, DFIs and commercial banks to unblock deals.

Put equity at the core of everything.

Emerging economies host most of the world's population, and the majority of future energy demand, yet receive a sliver of ESG funding. FII's Inclusive ESG Framework has already championed the need for attention and capital to flow where it's most needed.

Design systems from the ground up.

Where possible, plan reliability, storage and digital control into renewables-led grids. Where that's not possible, retrofit aggressively. Blueprints like NEOM's renewables-hydrogen-digital platform model is useful for others to adapt.

Remember resources of all types.

The energy transition won't happen without metals and molecules. But we can't repeat the extractive history of energy development. Champion responsible mining, water stewardship and certification so supply, sustainability and affordability rise together – then localize processing and skills so value sticks.

Embrace AI – but govern it.

AI can supercharge sustainable finance and operations (from data extraction to risk modeling and telling you where to drill), but needs to ensure organizations deploying it addressing bias, non-transparency and resource use.

Ensure efficiency.

The fastest, fairest decarbonization involves wasting less: sensors, controls and smarter processes can cut consumption materially and provide a base upon which cleaner supply can build.

Build for people, not projects.

Linking mega-investments to jobs, training and local content is vital to benefit a community and country. When thinking about megaprojects, design access and affordability in from the start (from social tariffs to distributed energy).

Keep the conversation global – and honest.

Progress needs regular check-ins and a range of voices. Through FII Institute's PRIORITY Compasses, our global summits spanning the world and Impact reports like this one, we keep every part of the planet and civil society in the room.

TAKE ACTION TODAY

FII Institute has laid down the gauntlet as a “do tank,” not just a think tank, spearheading a number of initiatives designed to create a better world. Many large organizations have already committed to change. Will you join them?

To join our community, visit <https://fii-institute.org>.



BALANCING THE MEGAWATTS DEMANDS SHARED ACTION



SOLVING THE ENERGY TRILEMMA

while adding a fourth imperative of speed is the defining systems challenge of our time. And like all systems challenges, it will only be cracked through coordination across borders, sectors and income levels. As FII Institute has made clear in our past Impact reports on health and AI inclusivity, the path forward must be innovative and inclusive.

From grid-scale storage and smart demand response to small modular reactors, green hydrogen and digitally optimized transmission, new technologies are powerful tools to balance megawatts and megawatt-hours. But technology alone won't enact the transition how we need it

to. We must pair frontier solutions with pragmatic deployment models that work for every grid and every community, especially where energy poverty and volatile prices bite hardest. Focusing equally on the cutting-edge and the accessible should be at the core of our energy agenda.

FII Institute's role is to convene capital, capability and commitment to solve problems. Our community brings together utilities and developers, policymakers and financiers, innovators and operators. By aligning all incentives, we can reduce price shocks and keep the lights on while accelerating emissions cuts without leaving the Global South behind. It's a virtuous circle. When investment

THE FII INSTITUTE IS

GUIDED IN ALL IT DOES BY A STRONG PURPOSE, VISION AND MISSION.



PURPOSE

Enabling a brighter future for humanity



VISION

Empowering the world's brightest minds to shape a brighter future for ALL, and with ALL



MISSION

Curating and enabling ideas to impact humanity sustainably

FII-I has three pillars to deliver its mission:
THINK, XCHANGE and ACT

1 FII-I THINK

Identify societal challenges and current inhibitors

Curate the brightest ideas to address societal issues

3 FII-I XCHANGE

Create platforms for live discussions on the future of humanity

Share knowledge, stories and publications with different stakeholders

2 FII-I ACT

Catalyze innovation and initiatives by mobilizing partners and resources

frameworks reward reliable clean power and local value creation, the transition speeds up and spreads out.

But good governance matters as much as good kit. We need workers to be reskilled and households to be protected.

Ultimately, energy is a public good and a growth engine. Balanced systems deliver resilient economies and cleaner air. They also unlock opportunity. The shadow of the energy quadrilemma is a reminder that trade-offs don't disappear, but can be managed and, over time, reduced. FII Institute exists to help leaders do exactly that: to think boldly, collaborate practically and scale solutions that power prosperity – for everyone. ■

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