WORLD ENERGY COUNCIL

100 YEARS OF IMPACT

WORLD ENERGY ISSUES MONITOR 2024

REDESIGNING ENERGY IN 5D

REGIONAL PERSPECTIVES PREPARED BY THE FUTURE ENERGY LEADERS

Image from the World Energy Council's Humanising Energy Series featuring Invenergy (El Salvador) produced by BBC StoryWorks.

ABOUT

WORLD ENERGY COUNCIL

The World Energy Council is the world's oldest independent and impartial community of energy leaders and practitioners. Through our Humanising Energy vision, we involve more people and communities in accelerating clean and just energy transitions in all world regions. Formed in 1923, the Council has convened diverse interests from across the full energy ecosystem for a century, and today has over 3,000 member organisations and a presence in nearly 100 countries. Our global network draws from governments, private and state corporations, academia and civil society, as well as current and future energy leaders. We effectively collaborate on impact programmes and inform local, regional and global energy agendas in support of our enduring mission: to promote the sustainable use and supply of energy for the benefit of all people.

Further details at www.worldenergy.org and on LinkedIn and Twitter

Published by the World Energy Council 2024

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Registered in England and Wales No. 4184478
VAT Reg. No. GB 123 3802 48

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WORLD ENERGY ISSUES MONITOR 2024

The World Energy Issues Monitor provides a snapshot of what keeps CEOs, Ministers and experts awake at night in over 100 countries.

The Monitor helps to define the world energy agenda and its evolution over time. It provides a high-level perception of what constitute issues of critical uncertainty, in contrast to those that require immediate action or act as developing signals for the future. It is an essential tool for understanding the complex and uncertain environment in which energy leaders must operate, and a tool through which one can challenge one's own assumptions on the key drivers within the energy landscape.

This 14th iteration of the World Energy Issues Monitor is based on insights of nearly 1,800 energy leaders in over 100 countries to provide 40 national assessments across six world regions.

World Energy Issues Monitor 2024, published by the World Energy Council.

PAGES

TABLE OF CONTENTS

ABOUT THE WORLD ENERGY ISSUES MONITOR

For the past 14 years, the World Energy Council has diligently monitored energy leaders' perspectives on issues impacting energy transitions through the annual World Energy Issues Monitor, serving as a vital global source of critical information guiding action priorities for faster, fairer and more far-reaching energy transitions. The World Energy Issues Monitor assesses the impact and uncertainty of pre-identified energy transition issues by soliciting feedback from policymakers, CEOs and leading industry experts. It offers insights into a) **Action Priorities**, representing areas where countries are actively advancing their energy transition efforts; and b) **Critical Uncertainties**, highlighting issues that are of concern to energy leaders and require leadership attention.

For this edition of the World Energy Issues Monitor, the Council surveyed nearly 1,800 energy leaders and global experts drawn from its global network spanning over 100 countries. The survey also included two distinct groups: the World Energy Council Future Energy Leaders, comprising energy professionals under 35 years of age, and Start-ups and Innovators, consisting of companies founded less than 10 years ago that can present a functioning prototype with a proved scaled model. The survey was conducted in early 2024, following the conclusion of the 28th Conference of the Parties (COP28), which was held in Dubai in the United Arab Emirates in November 2023. The 2024 World Energy Issues Monitor should be considered within this context.

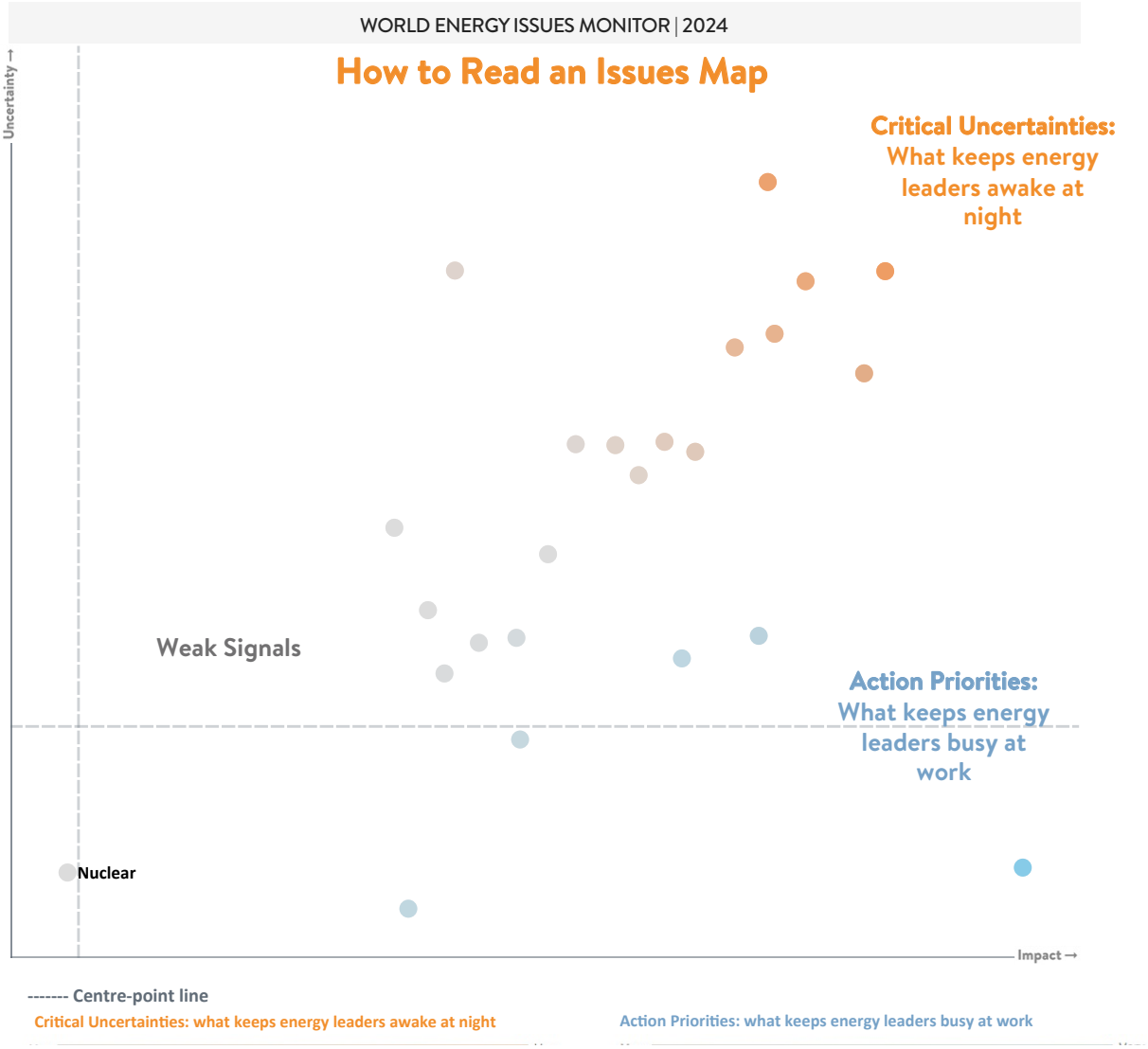
The World Energy Issues Monitor survey questionnaire underwent a thorough review and update to ensure its alignment with the evolving context and the imperative to redesign energy systems to improve billions of lives on a healthy planet. The 2024 survey included 33 core energy transition issues, organised into six categories. The full descriptions of the issues give more context and will help guide the reader in reaching new insights and connections.

Table 1: Issues' Categories and Definitions

	Short name	Full description
Geopolitical issues	Risk to Peace*	War/extended conflicts/risk to peace
	Supply Chains	Supply chain disruptions (solar, wind, etc)
	Critical Minerals	Critical minerals and metals bottlenecks
	Investment	De-risking investment
	Commodity Prices*	Commodity price volatility
	International Collaboration*	Effective International collaboration
Economic issues	Capital Cost*	Cost of/access to capital
	Global Growth	Global economic growth
	Domestic Growth*	Domestic growth outlook
	Workforce*	Workforce transitions
Societal Issues	Accessibility*	Accessibility – access to reliable and clean energy services
	Affordability*	Affordability – cost of energy services
	Acceptability	Acceptability – permit/licence delays
	Societal Needs	Active engagement from a critical mass representing broader societal needs
	Stakeholder Coordination	Complex coordination and collaboration of multiple stakeholders
	Populism	Rise of populism
Regulatory regimes	Fossil Subsidies*	Removal/reduction of fossil subsidies/tax breaks
	Infrastructure	Infrastructure action planning - strategically building and upgrading physical systems
	Demand management	Policy environment to transform energy demand across sectors
	Trilemma Management	Energy transitions trilemma management - working across policy silos
Technology gamechangers	Artificial Intelligence*	Artificial Intelligence (AI)
	Energy Storage*	Energy storage
	Circularity	Circularity - Closed loop systems that reduce, reuse, recycle, restore
	Transmission Grids	Transmission grids
	CCUS	Carbon Capture, Utilisation and Storage (CCUS)
	DAC	Direct air capture (DAC)
	H2 and P2X*	Hydrogen and Power-to-X
Environment and climate change	Food-Energy-Water*	Food-energy-water nexus
	Climate Adaptation*	Adaptation to the impacts and risks of climate change
	Ecosystems Reparation*	Carbon removals and repair/restoration of ecosystems
	Climate Mitigation*	Mitigation/net zero implementation to prevent and offset emissions
	Compensation	Compensation to offsets losses/damages due to climate impacts
	Life Cycle Impact	Full life cycle impact of renewable energy solutions

Issues with an (*) can be tracked from previous surveys since 2009, to show trends over a longer period.

Figure 1: How to Read an Issues Map



Each Issues Map provides a visual snapshot of the Critical Uncertainties and Action Priorities that policymakers, CEOs and leading experts strive to address, shape and manage. The bubbles in the Issues Map represent the averaged level of a) uncertainty; and b) impact that respondents attribute to each energy transition issue. Those issues in the top right-hand corner of the map highlighted in orange have the highest levels of impact and uncertainty and are defined as Critical Uncertainties. The bottom right-hand corner of the map highlights issues in blue that have high impact, but low uncertainty and are defined as Action Priorities. The centre-point of the issues map represents the medium level for impact and uncertainty to help comparison between different issues maps. Colour shades, graded according to proximity to the right-hand corners of the maps, allow the reader to differentiate between the varying degrees of uncertainty and impact attributed to issues and to highlight (lighter shades) issues that are close to becoming Critical Uncertainties and Action Priorities.

The Issues Monitor serves as a valuable reality check tool utilised by the World Energy Council's Member Committees and the global energy community, offering a snapshot of perspectives on energy transitions from various stakeholders within each country. Through the Issues Maps and accompanying commentaries, the report presents an insider's view of the evolving energy landscape, reflecting diverse global, regional and national viewpoints. These insights highlight the array of unique needs and approaches shaping the multifaceted journey of energy transitions.

REGIONAL PERSPECTIVES

The Council's regional energy communities engaged actively in discussions about the regional results of the World Energy Issues Monitor in March 2024. The insights and evaluations gathered were further refined during the 26th World Energy Congress, held April 22-25, 2024, in Rotterdam, the Netherlands. This analysis includes a comparison of common and unique uncertainties and priorities across different regions. Highlights from the survey results offer a deeper understanding of the perspectives of regional energy leaders from this latest survey cycle.

CRITICAL UNCERTAINTIES ACROSS REGIONS

(WHAT IS KEEPING ENERGY LEADERS AWAKE AT NIGHT)

AFRICA

Commodity Prices
Stakeholder Coordination
Capital Cost
Affordability
Investment

ASIA

Commodity Prices
Stakeholder Coordination
Climate AdaptationSupply
Chains
Risk to Peace

EUROPE

Commodity Prices
Climate Adaptation
Supply Chains
Risk to Peace
Demand Management

LAC

Commodity Prices
Stakeholder Coordination
Climate Adaptation
Populism
Compensation

MEGS

Commodity Prices
H2 and P2X
Investment
Ecosystems Reparation
Climate Mitigation

NORTH AMERICA

Societal Needs
Infrastructure
Populism
Acceptability
Transmission Grids

UNIQUE REGIONAL ISSUES

- **Africa:** Affordability, Capital Cost
- **Europe:** Demand Management
- **Latin America and the Caribbean:** Compensation
- **Middle East and Gulf States:** H2 and P2X, Ecosystems Reparation, Climate Mitigation
- **North America:** Societal Needs, Infrastructure, Acceptability, Transmission Grids

FREQUENT OCCURRING ACROSS SEVERAL REGIONS

- Commodity Prices
- Stakeholder Coordination
- Climate Adaptation

ACTION PRIORITIES ACROSS REGIONS

(WHAT IS KEEPING ENERGY LEADERS BUSY AT WORKS)

AFRICA

Transmission Grids
Energy Storage
Food-Energy-Water
Domestic Growth
Demand Management

ASIA

Transmission Grids
Energy Storage
Climate Mitigation
International Collaboration
Artificial Intelligence

EUROPE

Transmission Grids
Energy Storage
Affordability
Infrastructure
Capital Cost

LAC

Transmission Grids
Energy Storage
Capital Cost
Affordability
Trilemma Management

MEGS

Transmission Grids
Energy Storage
CCUS
Domestic Growth
Demand Management

NORTH AMERICA

Transmission Grids
Demand Management
Stakeholder Coordination
Capital Cost
Investment

UNIQUE REGIONAL ISSUES

- **Africa:** Food-Energy-Water
- **Asia:** Climate Mitigation, International Collaboration, Artificial Intelligence
- **Europe:** Infrastructure
- **Latin America and the Caribbean:** Trilemma Management
- **Middle East and Gulf States:** CCUS
- **North America:** Stakeholder Coordination, Investment

FREQUENT OCCURRING ACROSS SEVERAL REGIONS

- Transmission Grids
- Energy Storage
- Capital Cost
- Demand Management

REGIONAL DEEP DIVE

AFRICA

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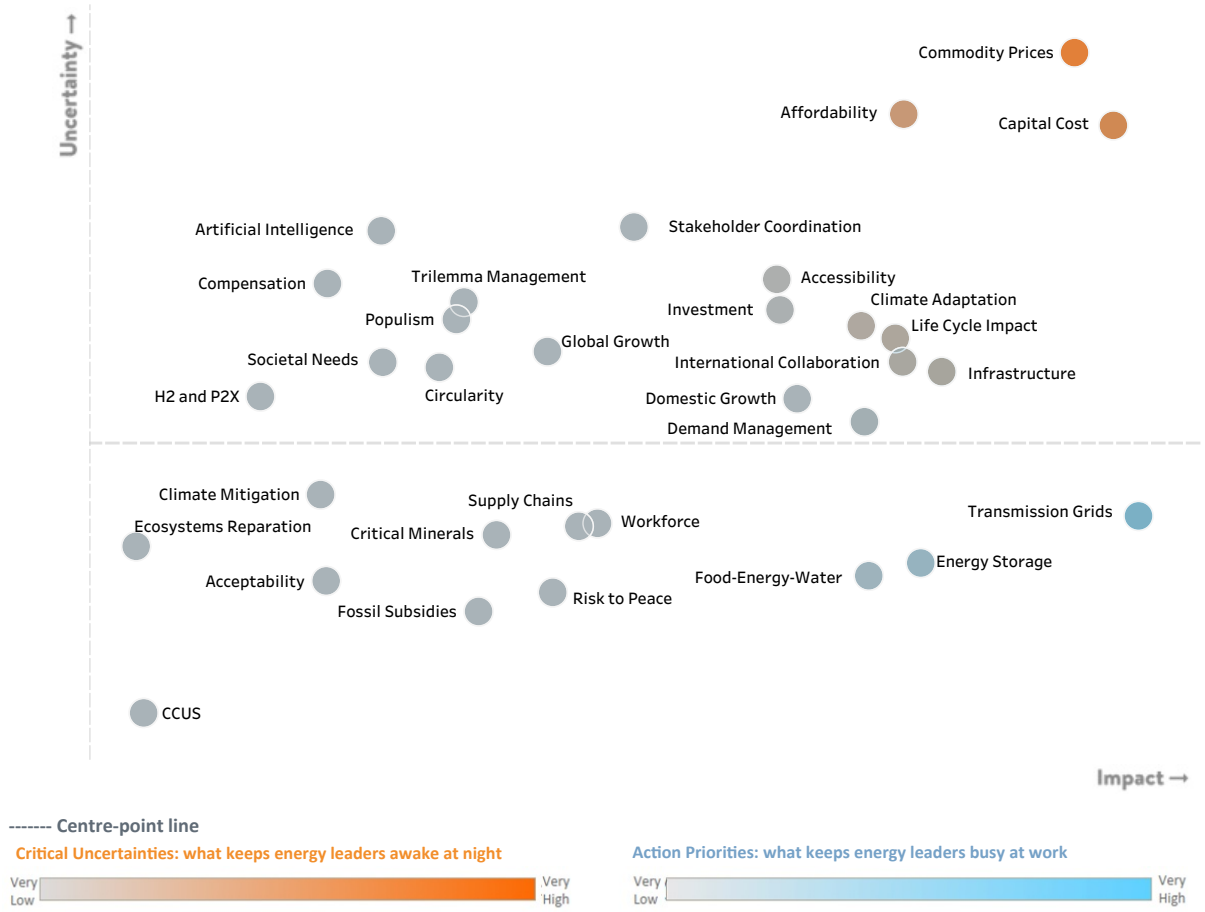
Africa



MAJOR REGIONAL CHANGES

The African continent stands at a crossroads on its journey to energy sustainability, grappling with numerous challenges while seizing a wide range of opportunities. A comparative analysis of Africa's energy priorities in 2022 and 2024 reveals a dynamic and evolving landscape characterised by shifting uncertainties and action priorities. The changes in Africa's energy sector from 2022 to 2024, especially the actions leaders are prioritising, are influenced by a mix of factors that shape energy management and priorities across the continent, forming a bigger puzzle. While certain challenges persist, such as **commodity price** fluctuations, access to **investment capital, access and affordability,** new challenges, such as **stakeholder coordination** have emerged. **Transmission grids** and **energy storage** were identified as action priorities with high impacts on energy and development in Africa. The active management of the **food-energy-water nexus** is highlighted as an action priority with high impact on people, communities, and ecosystems. **Climate change mitigation** imperatives are driving the need for sustainable energy solutions and challenges in water supply in different African regions continue to be exacerbated by climate change, driving adaptation imperatives and water in particular.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

Over the past five years, Africa's energy sector has experienced significant developments, including the exploration of **hydrogen** production, increased financing and investment, and diversification. Efforts to improve **energy access** and electrification in remote areas have intensified, driven by **investments** in off-grid and mini-grid solutions. However, ensuring energy access to affordable, reliable, sustainable, and modern energy to propel economic activities that increase income, improve living standards, and foster local development remains a key challenge across large parts of the continent. There is an increasing focus on **energy efficiency**, with policies promoting energy-efficient appliances and industrial processes. Additionally, the adoption of **digital technologies** and **smart grid solutions** has enhanced energy system efficiency and reliability. Furthermore, there is a growing trend towards **decentralisation and distributed generation**, empowering communities, including those in the agriculture sector, to generate their own clean energy. Waste-to-energy technologies are also gaining traction, contributing to a circular economy approach in energy production.

These trends collectively reflect a shift towards more sustainable, resilient, and inclusive energy systems in Africa, driven by **technological advancements, policy initiatives,** and a commitment to addressing energy access challenges and electricity transportation while mitigating environmental impacts. However, these policy initiatives still need to become more attractive for investors in many African countries.

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

Emerging leadership in integrating people and communities in the energy transition in Africa is driven by a mix of initiatives from a variety of stakeholders including grassroots organisations, governments, academia, private-sector and youth, many supported by international organisations. These initiatives empower communities through capacity building, advocacy, and collaborative projects, ensuring their active participation in renewable energy adoption and sustainable development. By leveraging local knowledge, cultural practices, and innovative solutions, they foster inclusive and participatory approaches to energy transitions. This promotes social empowerment, economic development, and environmental sustainability within communities across Africa.

Key components such as **grid transmission,** renewable energy deployment, and enhanced **energy efficiency** contribute to the promotion of equitable access to clean energy technologies. **Collaborative** initiatives between public and private sectors, alongside targeted **investments** in **infrastructure** and innovation, are key to accelerating progress towards these goals.

A SNAPSHOT OF 2024 RESULTS

ENERGY FINANCING CHALLENGES

The 2024 results highlight a pressing need for increased capital **investment**, resource allocation and integrated **infrastructure** planning to ensure reliable and **affordable** energy, which is crucial for economic prosperity across the region. As economic development takes precedence, climate risk and resilience are pushed down the list of priorities. As a result, **climate mitigation** and **ecosystem restoration** remain low on the agenda for energy leaders, despite the region's significant climate vulnerability and the growing importance of adaptation strategies. The African Development Bank estimates a gap in Africa's requirements for infrastructure financing of approximately 50%.

Achieving universal access to affordable electricity in sub-Saharan Africa (SSA) by 2030 requires a significant acceleration in efforts, with a target of connecting 90 million people annually - triple the current rate. Currently, 760 million people lack electricity in the world, 80% of this population lives in sub-Saharan African nations. In this context, countries such as Ghana, Kenya, South Africa and Rwanda serve as success models for others to emulate. Extending national grids emerges as the least costly and most practical option

for nearly 45% of those expected to gain access by 2030. In rural areas, where over 80% of the electricity-deprived population resides, mini-grids and standalone systems, primarily solar-based, emerge as the most viable solutions. This strategic approach, combining grid extension with decentralised solutions, can pave the way for sustainable and inclusive energy access across the region.

Financing energy development in Africa remains a critical challenge. Despite accounting for one-fifth of the global population, the region currently receives only 3% of global energy **investment**. To achieve their energy-related development goals, including universal access to modern energy, African countries need to double their energy investment to over USD 200 billion per year by 2030. This investment is essential for meeting their nationally determined contributions and ensuring sustainable energy access for all.

Key points related to energy financing in Africa:

- **Sustainable Africa Scenario (SAS):** The IEA's Africa Energy Outlook 2022 introduced the SAS, emphasising the need for innovative investment solutions to scale up energy investment across the continent. The report highlights the positive spillover effects of increasing the availability of affordable capital for clean energy projects.

- **Cost of Capital:** Currently, the cost of capital for energy projects in African countries is significantly higher (at least 2-3 times) than in advanced economies and China. This high cost hinders investment by raising project expenses. Notably, countries' ability to develop and implement energy policy effectively and to achieve energy goals, as measured by the World Energy Trilemma Index, remains low and affects their attractiveness to investors.

- **Private Investment:** Scaling up private investment is crucial. Development finance institutions (DFIs) and donors play a vital role in de-risking clean energy projects. By 2030, USD 28 billion of concessional capital will be necessary to mobilise the required USD 90 billion in private investment in clean energy.

There are several finance opportunities that have been put in place to help the African energy sector, including the Sustainable Energy Fund for Africa (SEFA) managed by the African Development Bank, aimed at unlocking private sector investments in renewable energy and energy efficiency. However, addressing the energy financing gap requires **collaborative** efforts from governments, international organisations, and the private sector to ensure a sustainable and equitable energy future for Africa.

COLLABORATION AND COORDINATION NEEDS

Each African region faces unique challenges and opportunities, and tailored approaches are essential. The table below highlights the priority actions needed from regions within the continent.

REGION	ACTIONS
Sub-Saharan Africa	**Universal Access:** Prioritise expanding access to electricity in rural and underserved areas. Invest in off-grid and mini-grid solutions. **Renewable Energy:** Accelerate investments in solar, wind, and hydropower projects. Leverage abundant renewable resources. **Capacity Building:** Strengthen local institutions, enhance technical skills, and promote knowledge sharing. **Policy Alignment:** Align national policies with regional energy goals for harmonised development.

REGION	ACTIONS
North Africa	**Cross-Border Cooperation:** Collaborate on energy infrastructure projects (such as interconnectors) to enhance energy security. **Energy Efficiency:** Implement energy-saving measures in buildings, industries, and transportation. **Investment Promotion:** Attract private investment by creating an enabling environment and offering incentives.
West Africa	**Transboundary Projects:** Develop regional power pools for efficient energy exchange. **Clean Cooking Solutions:** Promote clean cooking technologies to reduce indoor air pollution. **Grid Expansion:** Invest in transmission and distribution networks to improve reliability.
East Africa	**Geothermal Potential:** Tap into geothermal resources for sustainable power generation. **Community Engagement:** Involve local communities in energy planning and decision-making. **Innovation:** Explore innovative financing models and technology adoption.
Central Africa	**Hydropower Development:** Leverage abundant water resources for hydropower projects. **Forest Preservation:** Promote sustainable biomass use to preserve forests. **Investment Partnerships:** Collaborate with development partners for funding.
Southern Africa	**Energy Trade:** Enhance cross-border electricity trade to optimise resource utilisation. **Mining Sector:** Address energy needs of the mining industry, a significant energy consumer. **Climate Resilience:** Factor climate change adaptation into energy planning.

These priorities can be adapted to each country's specific context, considering social, economic, and environmental factors. Effective implementation of these actions will improve the wellbeing of people and planet and advance their performance across the World Energy Trilemma dimensions - energy equity, energy security and environmental sustainability.

CLIMATE RISK AND RESILIENCE

Climate adaptation remains a key action priority for Africa. According to the Intergovernmental Panel on Climate Change (IPCC), Africa is a low emitter of greenhouse gases, but is very vulnerable to climate change risks, with some regions being "hotspots" and warming above average than the rest of the world. The continent is already experiencing severe impacts, including droughts, decreased crop yields, reduced economic growth, and loss of life. Climate adaptation is therefore critical for the continent and impacts many of the opportunities highlighted above. **Investment** into energy and related **infrastructure** projects must prioritise climate resilience and sustainability. Given that many countries in Africa rely on hydropower, energy security is also at risk in periods of severe drought.

FINAL CONSIDERATIONS

Africa's energy landscape presents a dynamic and evolving picture, marked by a balance between challenges and opportunities. The period from 2022 to 2024 has seen significant shifts in priorities, with emerging concerns such as **stakeholder coordination** and **energy storage** gaining prominence alongside persistent challenges including **commodity price** fluctuations and **access to capital**. Despite these challenges, there is a growing momentum towards sustainable and inclusive energy systems.

However, financing remains a critical hurdle. Addressing this challenge requires innovative solutions and collaborative efforts from governments, international organisations, and the private sector. As the region transitions to sustainable and resilient energy systems, tailored approaches will be essential. Each country must prioritise actions according to its unique context, ensuring that efforts are both effective and sustainable.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as geopolitical disruptions, energy security, gas crises, workforce shifts, social unrest and equity concerns?
- Is the evolving policy and regulatory landscape in the region aligned with the principles of a just energy transitions? How is a just energy transition defined and prioritised within the continent? What new conversations should be held?
- How can we address the complex interplay between critical uncertainties surrounding capital costs and affordability in the energy sector? What implications does this have for energy access?
- What efforts are being made to promote industrialization around critical minerals to foster economic development and social upliftment? Additionally, what steps are necessary for achieving a just transition, and what are the trade and energy trilemma implications?
- In what ways can prioritising action on transmission grids help to better interconnect the continent and enhance resilience to climate change? How can climate finance play a role in accelerating these efforts?
- What innovative mechanisms of stakeholder coordination can be employed to enhance accessibility and effectively manage the energy trilemma?

ACKNOWLEDGEMENTS

FUTURE ENERGY LEADERS

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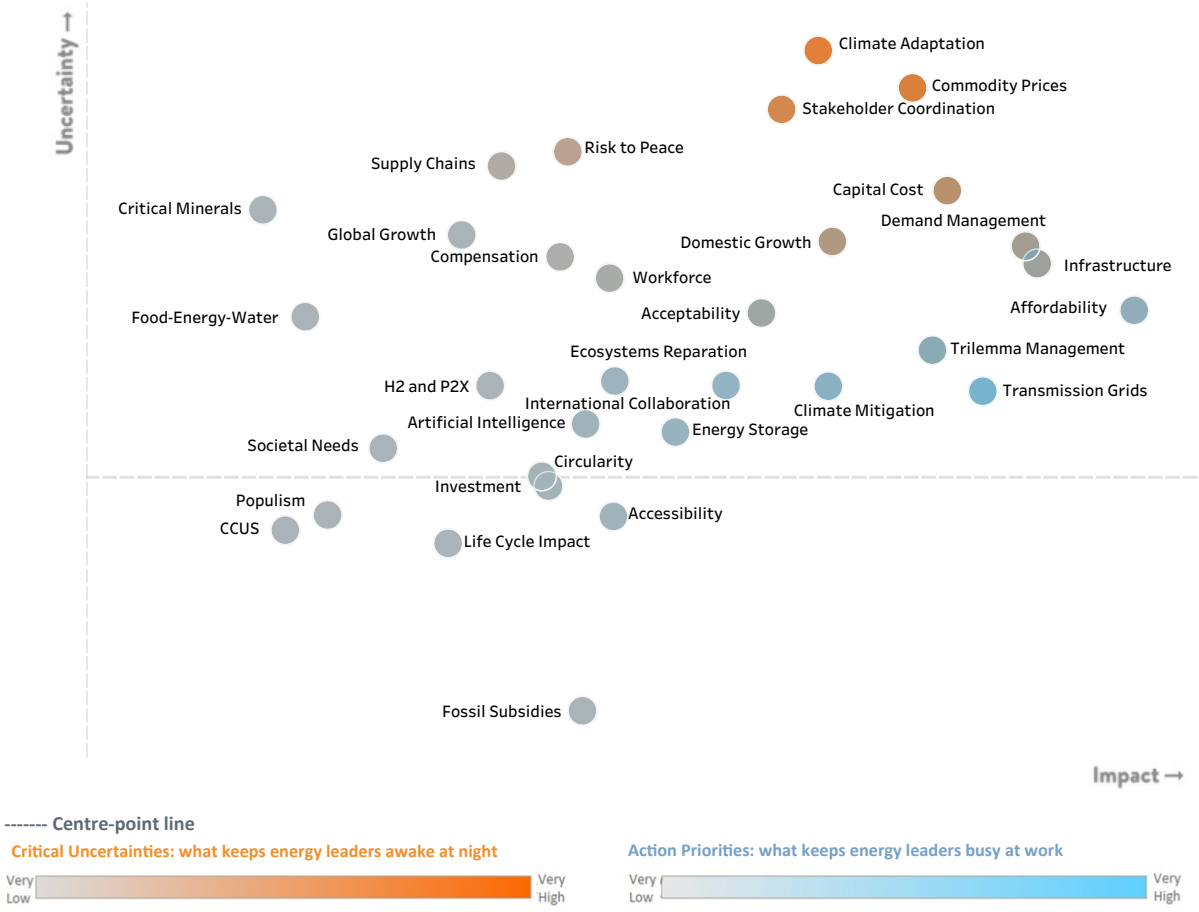
Asia



MAJOR REGIONAL CHANGES

Asia is a very diverse region in terms of energy demand, **economic development**, demographics and geographical opportunities. The trajectories of two powerhouses in the region, China and India, are starting to diverge. 2023 was expected to be a year of recovery for China after strict COVID-19 policies severely impacted its economic development. However, the recovery of the Chinese economy has been upended by a property crisis, youth unemployment and low foreign investment. On the other hand, India's economy has been one of the fastest growing in the world, with Gross Domestic Product (GDP) expected to grow by 7% in Fiscal Year 2024. Similarly, while China's population, currently the largest in the world, peaked in 2021 and is starting to decline, India's population is expected to grow to 1.7 billion in 2050, claiming top spot.

Economic growth in the ASEAN block looks promising, driven by stronger domestic consumption, investment in infrastructure and growing foreign investments. As a result, India and Southeast Asian countries are expected to account for 44% of the growth in final global energy demand by 2050.

Despite various energy transition plans announced by governments in the region, it is unlikely that this additional demand will be met solely by clean energy sources. Coal is still expected to account for more than 40% of Asia's primary energy consumption in 2030, contributing 50% and 64% of the power generation mix in China and India, respectively.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

Coal demand is accelerating but at a slower rate. Despite the transition plans announced by many Southeast Asian and South Asian countries, Asian coal consumption accounted for close to 75% of global coal demand in 2022. In 2023, coal demand rose by 8% in India and 5% in China due to rising electricity demand and low hydropower generation. The phase-out of coal is expected to take longer than anticipated, partly due to the relatively young age of coal-fired power plants in Asia. As renewable energy remains unreliable, coal is seen as the most promising option to meet increasing power demand in India.

Hydrogen development is accelerating but at a slower rate. Green hydrogen and ammonia production is experiencing a new boom in Asia. India is strategizing to excel in low-cost production for export and domestic consumption in the fertiliser and steel industry. Japan is testing ammonia and hydrogen for co-firing in thermal plants. In Australia, six green hydrogen projects have been shortlisted to receive US$1.35 billion under the Hydrogen Headstart scheme. However, uncompetitive prices of green hydrogen and the significant investment required to develop hydrogen infrastructure remain as important roadblocks.

With potential delays in energy transition plans, countries are actively searching for alternative, lower-cost options such as geothermal energy.

Nuclear power production is accelerating slowly. Japan has restarted 11 GW of nuclear power plants since the Fukushima incident. China is currently constructing 21 nuclear reactors, which can generate more than 21 GW of power. India has plans to add 14 GW of nuclear capacity by 2031. While countries in Southeast Asia recognise that nuclear power could potentially be part of future energy mix, public perception on safety remains a key concern. Indonesia signed a Memorandum of Agreement with the United States to study the viability of constructing a new nuclear plant and will also receive US$1 million for capacity building. Thailand and the Philippines are also partnering with the United States as they seek to add small modular reactors (SMRs) into the energy mix. Singapore will be investing in a new research facility to further develop knowledge in nuclear safety before committing to the development of nuclear power.

Partnerships, collaboration and new market players are accelerating. To mitigate the intermittencies of renewable energy and strengthen grid stability, developing an interconnected ASEAN grid would be a fundamental step. However, the lack of cross-border energy frameworks and technical constraints hamper the development of cross-border power interconnection. In Southeast Asia, bilateral agreements between governments and regulators are most common. There are some encouraging signs, such as the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project, which supports the import of 100 MW of hydroelectric power from Lao PDR through Thailand and Malaysia into Singapore. However, establishing a regional grid would require greater stakeholder **collaboration**. Issues such as transmission frequencies, market structure and regulation would necessitate a concerted and coordinated solution.

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

As countries embark on the energy transition, it is crucial for societies and communities to be on-board for this journey. Closely intertwined with climate mitigation and adaptation, strategies for adaptation and transition will be fundamentally dependent on the commitment and willingness of the communities involved. Balancing the World Energy Trilemma – energy security, energy equity and environmental sustainability – requires engagement and collaboration among all stakeholders. As part of the New Zealand's Energy Strategy, the government actively engages with indigenous communities (known as

Iwi) to ensure a just and inclusive energy transition. Key engagement points include affordability, energy efficiency, emissions reduction, and readiness for renewable electricity. By fostering collaboration and understanding, New Zealand aims to accelerate its path toward a sustainable and equitable energy future.

While Japan has recently started some nuclear power reactors, the government is cautious about the progress on nuclear power development given the mixed public support. Large numbers of educational events are being organised by the Japan Atomic Energy Agency to engage local communities on long-term benefits of having nuclear power in the energy mix. A key challenge to these objectives is the lack of a skilled workforce to operate the nuclear plants, consequence of the shutdown of most nuclear reactors after the Fukushima incident. To re-skill and rebuild a suitable workforce, Japan Atomic Power has set up a training centre with a simulator, where over 13,000 workers have attended trainings.

A SNAPSHOT OF 2024 RESULTS

GEOPOLITICAL UNCERTAINTIES PERSIST

Similar to 2022, commodity prices remain one of the top uncertainties in Asia. Although prices of oil and natural gas have dropped from highs in 2022, trigger events such as maritime trade disruption and conflicts in the Middle East could easily cause prices to increase. As a result, risks to peace and supply chain are key concerns among survey respondents.

INFRASTRUCTURE ACTION PLANNING AS A PRIORITY

As countries in Asia continued their push towards greener electricity supply, there has been a surge in the addition of renewable energy. Solar and wind capacity in ASEAN rose by 20% in 2023, while China added 216 GW of new solar capacity. However, grid infrastructure in most countries have not been designed to cope with the intermittency of renewable energy. In addition, grid infrastructure has also been damaged by adverse weather events. The need to upgrade infrastructure and systems has never been more pressing, however it requires massive investment and detailed planning. Besides upgrading the transmission grid, countries in Asia are also actively exploring the possibility of energy storage systems to mitigate the intermittencies of renewable energy. Data analytics is used to assess power consumption patterns and renewable energy generation to better balance energy supply and demand.

DEMAND FOR GREATER RESILIENCE

In 2023, many countries in Asia experienced extreme temperatures and suffered devastating and costly natural disasters such as typhoons, floods and bushfires. The rise in temperatures and the disruptions to daily lives have heightened awareness of climate change within societies. As governments and corporations strive to enhance climate resilience, it is crucial to engage local communities as partners and leverage their unique perspectives and knowledge in designing future-proof infrastructure. Despite growing emphasis on climate adaptation and mitigation efforts among governments and corporations, uncertainty regarding action towards greater resilience remains significant.

FINAL CONSIDERATIONS

As economies in Southeast Asia and South Asia continue to develop in the coming years, energy demand in Asia is expected to rise. High capital investment and collaboration among key stakeholders are critical to upgrade and update ageing grid infrastructure in most countries. Greater collaboration among governments and regulators in Asia is fundamental to facilitate cross-border power integration, which may address energy security and energy affordability issues. Importantly, the diverse economic progress and energy mix in this region will result in multiple pathways and varying speeds as countries strive towards net zero.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as mega city development, security and gas crises, technology uncertainty and decoupling energy and economic growth?
- What measures need to be taken to enhance the resilience of the energy sector in Asia to the impacts of climate change? What are the associated risks to capital costs and supply chains?
- Are the changes in policy and regulation in the region effectively supporting the transition to a just energy system? What innovative approaches could be considered?
- While affordability remains a significant issue, uncertainty is on the rise. What novel strategies are being explored in the region to address this uncertainty?
- The uncertainty surrounding hydrogen and P2X has notably decreased. How does this trend align with related systemic issues such as infrastructure and workforce readiness? How can new forms of collaboration help scale up?
- In what ways can artificial intelligence (AI) contribute to the energy transition, particularly when considered alongside other factors such as transmission grid upgrades, smart home technologies and the adoption of electric vehicles?

ACKNOWLEDGEMENTS

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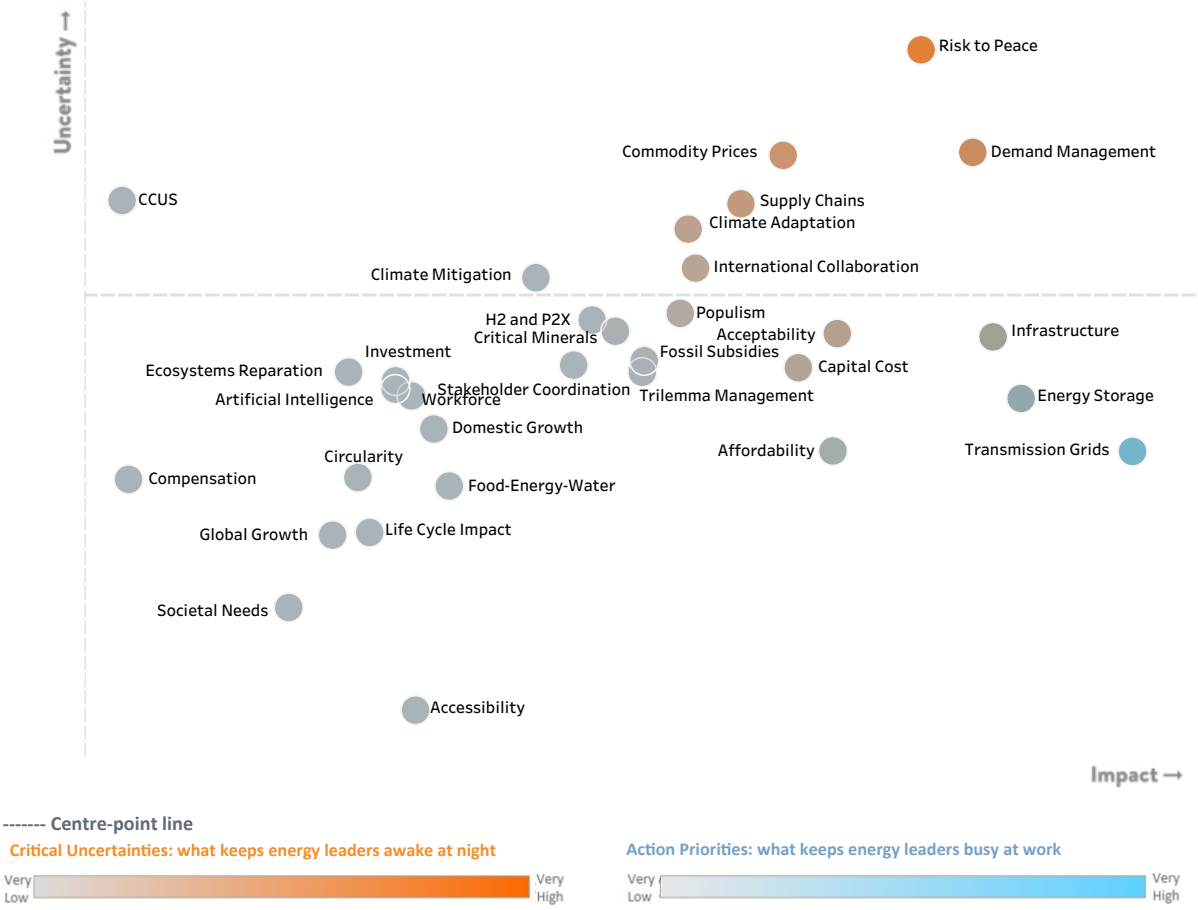
Europe



MAJOR REGIONAL CHANGES

Since the last publication of the World Energy Issues Monitor in 2022, the energy landscape in Europe has undergone a profound transformation, driven by a combination of geopolitical events, technological advancements, and shifting societal priorities. The energy-related priorities in the region have evolved from a singular focus on energy security to a more holistic approach that encompasses security, equity, and affordability. For example, many governments in the European Union (EU), while aiming to diversify their gas imports, took measures to combat **affordability** issues for consumers. This shift reflects a growing recognition of the interconnectedness of energy issues and the need for comprehensive solutions that address the diverse needs and concerns of stakeholders across the energy value chain.

One of the key drivers of change since 2022 has been the **geopolitical tensions** due to the war in Ukraine, which has had far-reaching implications for energy markets in Europe and beyond. The conflict has highlighted the risks of relying on a limited number of energy suppliers and has underscored the importance of diversifying energy sources and supply routes. As a result, policymakers and industry

stakeholders have prioritised initiatives aimed at enhancing energy security through increased diversification, **investment** in domestic energy production, and the development of alternative energy sources. **Risk to peace, commodity prices,** and **supply chains** are therefore critical uncertainties for respondents.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

The energy transition has gained momentum, driven by growing awareness of the need to address climate change and reduce greenhouse gas emissions. The European Green Deal, introduced in 2019, has provided a framework for accelerating the transition to a low-carbon economy and has galvanised action across the continent. Ursula von der Leyen, President of the European Commission, noted, *"The European Green Deal is our roadmap for transforming Europe into a sustainable and climate-neutral economy by 2050".* There has been a significant increase in investment in renewable energy **infrastructure**, with a particular focus on wind, solar, hydropower and renewable gases such as green **hydrogen** and biomethane.

This momentum is reflected in the results through the action priorities of **transmission grids** and **energy storage.** For instance, following the North Sea Summits in 2022 and 2023, Belgium, Denmark, Germany, the Netherlands, Norway, the United Kingdom, Ireland, Luxembourg and France have committed to developing around 300 GW of offshore renewable energy capacity in the North Seas by 2050 to support the EU, UK, and Norway in achieving net zero and enhancing energy security. Central to this plan is the development of a North Seas grid through offshore hybrid projects, such as hybrid interconnectors and energy hubs, and hydrogen infrastructure. The expanded Offshore Transmission System Operator Collaboration (OTC) Group is working to identify suitable projects and solutions, focusing on supply chains, market design, and cost sharing. Key projects and policy recommendations are outlined to underpin the long-term grid development, including enhancing procurement processes, public funding, transparency, skill development, and technology partnerships. Emphasis is placed on the necessity for strong **collaboration** among transmission system operators (TSOs) and stakeholders to overcome challenges, secure investments, and share costs and benefits equitably, ensuring the successful deployment of the offshore **transmission grid.**

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

The transition to a low-carbon economy is not without its challenges. One of the biggest challenges is ensuring a fair and equitable transition, with benefits distributed equitably across society. This is particularly important considering the socio-economic impacts of the transition, which are likely to be felt most acutely by vulnerable and marginalised communities. Examples for such transition processes include Germany's Ruhr region coal mining phase out of the early 2000s, and the most recent energy transition in the city of Aberdeen, in Scotland. To address this challenge, policymakers and industry stakeholders must place greater emphasis on inclusive decision-making processes that involve a wide range of stakeholders, including local communities, civil society organisations, and labour unions. Reflecting this context, **acceptability, populism, and affordability** have emerged as both critical uncertainties and action priorities for the region.

Leadership in **integrating people and communities** into the energy transition has emerged as a critical factor in driving progress towards a more sustainable and equitable energy system. For example, E.ON in Germany has launched community energy projects such as the SolarCloud initiative, enabling individuals to invest in solar panels on public buildings and earn credits for generated electricity. Similar examples include a Vattenfall initiative, working closely with local communities to minimise the environmental impact of its offshore wind projects and maximise the socio-economic benefits for nearby residents; and EDP Renováveis, establishing the Renováveis Educa program to engage communities through educational programs on renewable energy benefits.

Government initiatives, such as the establishment of one-stop shops and the Energy Community Repository project are helping to raise awareness and empower consumers to make informed decisions about their energy use. Youth-led initiatives, such as the National Future Energy Leaders programmes in many European countries, including in the Netherlands, Portugal, Germany, Austria, Romania, and Norway, are playing an increasingly important role in engaging citizens and mobilising support for the transition. At the same time, grassroot energy communities, such as RESCOOP, are demonstrating the potential for local leadership in driving sustainable energy initiatives.

Inclusive decision-making processes, facilitated by initiatives such as the Energy Efficiency Citizens' Panel, are helping to ensure that the energy transition is guided by the diverse needs and aspirations of communities across Europe. Labour unions are also evolving to advocate for workers affected by the transition and to champion just transition policies that safeguard workers' rights and livelihoods. These diverse forms of leadership are essential for **building public trust** and support for the transition and for ensuring that it is inclusive, equitable, and sustainable. In the long run, if successful, this can lead to changes in the importance of the issues of acceptability and populism.

A SNAPSHOT OF 2024 RESULTS

FOCUS ON EFFICIENCY

To progress faster, fairer, and more far-reaching energy transitions, there is an increasing emphasis on scaling up renewable energy sources and improving **energy efficiency.** There is a general upward trend in the deployment of renewable energy projects. For example, the share of renewable energy consumed in the EU increased from 21.9% in 2021 to 23% in 2022, mainly driven by the expansion of solar PV (European Environment Agency). At the EU level, initiatives such as the Revision of the Energy Efficiency Directive (EED) mandate binding measures to promote energy efficiency by upgrading buildings, endorsing energy-efficient products, and investing in efficient technologies. Türkiye, Armenia, Moldova, Georgia, and Ukraine have adopted energy efficiency plans across various sectors to bolster their energy security, economic development, and climate objectives. In Portugal, the Plano de Promoção da Eficiência no Consumo de Energia (PPEC) promotes energy efficiency among consumers through measures such as energy audits and financial incentives, encouraging energy-saving behaviours and reducing overall energy consumption. Examples of funded projects include EcoVale, focusing on raising awareness about energy vulnerability and efficiency among students and citizens of Vila Nova de Famalicão and Barcelos, and Industry of the Future, which supports the hard-to-abate industrial sector through sharing scientific knowledge on renewable gases including green hydrogen and biomethane, aiming for energy efficiency and decarbonisation. Local efforts, such as Oslo's Climate and Energy Strategy, further contribute to advancing energy efficiency and sustainability goals.

CLEAN TRANSITION ADVANCEMENTS

In 2023, Europe made significant strides in transitioning from fossil fuels to clean electricity, with fossil fuels share dropping by a record 19% to their lowest ever level, constituting less than one-third of the EU's electricity generation. Concurrently, renewables rose to a record 44% share, driven by wind and solar, producing 27% of EU electricity, with wind generation surpassing gas for the first time. Additionally, many European countries have initiated agreements with North African nations to explore pilot projects for green hydrogen production and exportation. Despite these advances, challenges remain in **grid capacity and financing,** exemplified by the Netherlands' grid congestion issues and the offshore wind sector's struggles with **higher costs and supply chain problems.** Addressing these challenges will require policy interventions, technological innovations, and financial incentives, including better financing for renewable projects and a focus on rapid implementation of local electricity and gas distribution grids, alongside transparent and participatory decision-making to build public trust and support.

CLIMATE RISK AND RESILIENCE

Efforts to build climate resilience in Europe are intensifying with initiatives such as energy-efficient renovations and loss and damage funds. The European Commission's Renovation Wave aims to expedite energy-efficient building renovations to improve energy performance, reduce emissions, and enhance climate resilience. Several European countries have also introduced climate insurance programs, such as Germany's Natural Hazards Insurance Scheme, to help manage climate risks through public-private partnerships. The European Climate Risk Assessment report identifies 36 significant climate risks, grouped into five impact clusters: ecosystem destruction, food security threats, health hazards, infrastructure risks, and economic/financial risks. The Climate-ADAPT 2022-2024 Strategy outlines priority actions to address these risks. European countries are investing in **sustainable infrastructure, innovative financing** mechanisms, and **adaptive capacity** to build resilience. This requires **collaboration** between public and private sectors, mobilising resources for transformative projects, and leveraging public funds to attract private investment. The European Commission is also fostering public-private partnerships and developing regulatory frameworks to boost investment and innovation in fusion energy technologies.

FINAL CONSIDERATIONS

The 2024 World Energy Issues Monitor highlights a transformative period in Europe's energy sector, with a significant shift from traditional dependencies to a more resilient and diversified system. This evolution, influenced by broader societal and geopolitical factors, aligns with ambitious climate goals aimed at increasing sustainability, resilience, and inclusivity. However, navigating this path will require concerted efforts, strategic planning, and regional cooperation. As Europe advances its energy landscape, the coordination between technology, policy, and market dynamics will shape the effectiveness and sustainability of the region's transition strategies.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as geopolitical disruptions, energy security, risk of deindustrialisation, workforce transition and cost of living crisis?
- What lessons have been learned in stakeholder coordination, and what new approaches are proving effective? How do these efforts contribute to futureproofing the regulatory environment and avoiding compartmentalization and misaligned policy?
- As technology gamechangers are being embraced, what are the implications for the workforce, trade, and research and development? What lies ahead for Carbon Capture, Utilisation and Storage (CCUS)?
- What new policies are necessary to ensure a comprehensive and lower-risk approach to demand management?
- Considering that international collaboration is a critical element for change, how is this affected by interplay with risks to peace, commodity prices, critical minerals and supply chain disruptions? What approaches are no longer effective, and what needs to be done differently?

ACKNOWLEDGEMENTS

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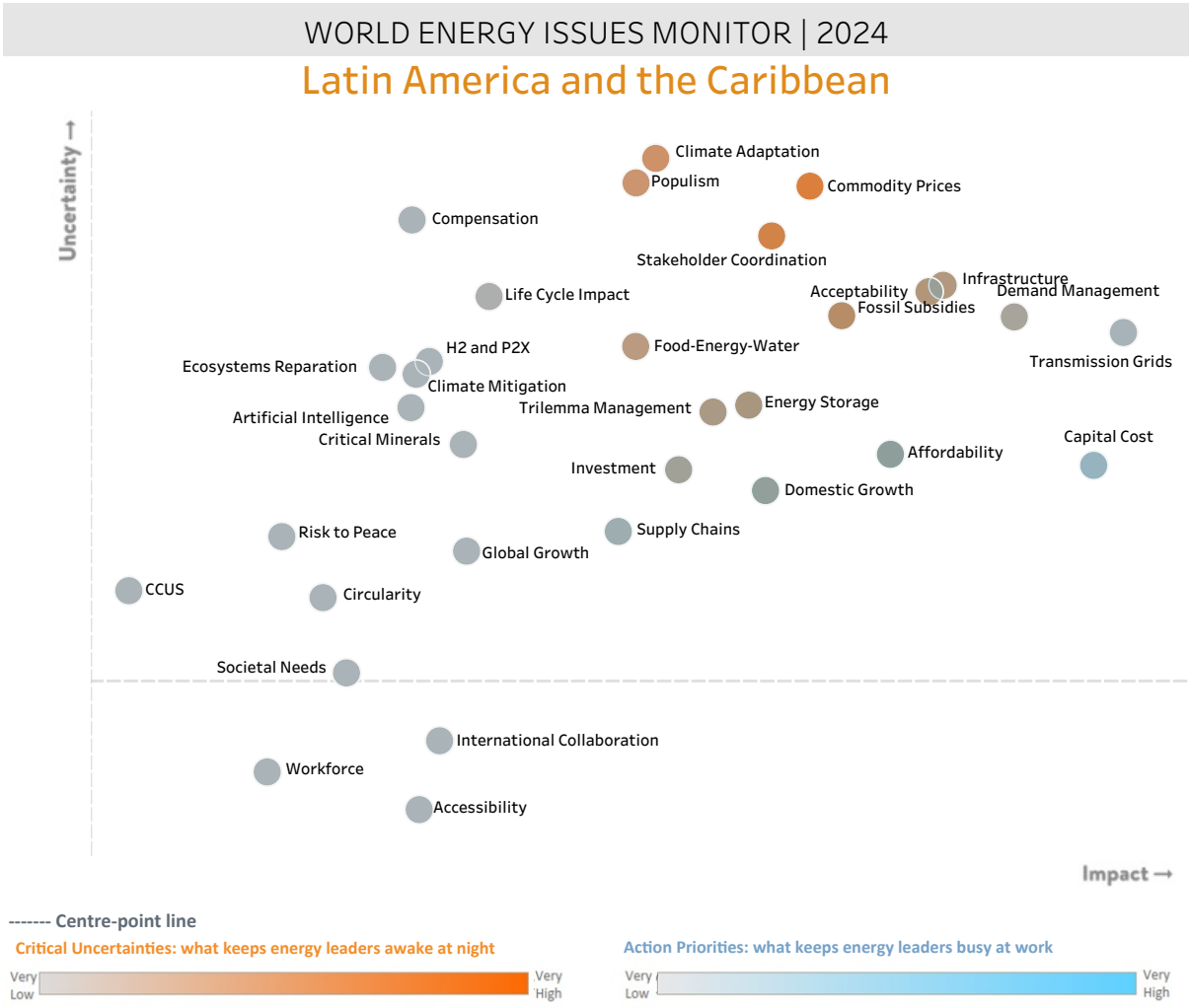
LATIN AMERICA AND THE CARIBBEAN



MAJOR REGIONAL CHANGES

The 2024 World Energy Issues Monitor reveals significant shifts in priorities and uncertainties for the Latin America and Caribbean (LAC) region. While **Economic Growth** was a primary concern in 2022, by 2024, the focus has shifted towards **Climate Adaptation,** demanding increased leadership attention. Across the region, the pressing need for climate resilience and adaptation is increasingly apparent, particularly as disadvantaged communities disproportionately suffer from the harsh impacts of climate change.

A key aspect of this challenge is the **food-energy-water nexus,** which underscores the need to balance the **Energy Trilemma** of energy security, equity, and environmental sustainability. This balancing act is especially critical in areas like local agricultural production and water resource management. The relevance of this challenge is seen through the region's status as the world's largest net exporter of agricultural products, with Brazil alone being the world's third largest exporter of agricultural products behind the European Union (EU) and the United States. In response, Brazil is leveraging advanced technology to address land use and carbon footprint issues related to biofuels. The country is innovating through second-generation ethanol (E2G), produced from plant residues like sugarcane straw and bagasse. This biofuel has a carbon footprint up to 80% lower than fossil fuels, making it a cleaner and more sustainable fuel option.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

Over the past 5 years, there has been a notable acceleration in the integration of **green hydrogen** within LAC economies. Many countries in the region have already defined or are in the process of developing a Hydrogen Strategy, making substantial investments and forming strong alliances to bridge private and public sectors, as well as national and international funding sources, to support its development.

One key characteristic of the LAC region is its heterogeneity in terms of economic development, energy mixes, natural resources, and exposure to the effects of climate change. A significant portion of the region relies on hydrocarbon imports, which impacts **energy security,** particularly geopolitical disruptions. Developing and increasing the contribution of diverse and domestic renewable energies can enhance the region's energy security. As is the case in other parts of the world, the adequacy, expansion, and reliability of **transmission grids** is considered an action priority by regional energy leaders.

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

Energy equity remains a challenge for the Latin America and the Caribbean, with approximately 3% the population lacking access to electricity and 15% lacking access to clean cooking fuels or facilities. Efforts to expand access to energy, such as the massification of the natural gas distribution system in countries like Peru, and the enhancement of electrical transmission and distribution networks across the region, are underway. However, it is crucial that these investments are integrated with climate action planning to ensure the reliability of supply.

While progress has been made, there is a clear need for increased leadership attention in policy and regulation towards **climate change** resilience. For instance, the implementation of distributed dams can serve multiple purposes, including buffering increased water cycles, generating electricity, and mitigating floods. Furthermore, it is essential to integrate the **societal needs** of local communities into decision-making processes. This can be achieved through the development of tools for gathering and sharing information related to climate adaptation, similar to Trinidad and Tobago's Climate Adaptation and Resilience Portal (CARP). Similarly, IDB Invest, part of the Inter-American Development Bank Group, uses an Impact Management Framework and a Corporate Results Framework to align financial strategies with impact assessments throughout project lifecycles. This approach highlights the private sector's contribution to addressing climate change, along with promoting gender equality and diversity.

Stakeholder coordination and participatory climate action are vital not only to ensure that citizens' perspectives are incorporated into policies, but also to make policies and programmes more sustainable, actionable, and effective over the long-term. Addressing citizen's diverse resources and resilience needs can help achieving a just transition thereby co-creating a sustainable future that is fair and inclusive of the region's diversity.

A SNAPSHOT OF 2024 RESULTS

TRANSMISSION FOR TRANSITION

Many challenges faced by the region can be addressed through a comprehensive strategy that includes diverse, resilient, reliable, and distributed energy generation. Key to this strategy is leveraging local renewable resources and developing **energy storage** solutions. This approach is important given the region's vulnerability to extreme weather events like high temperatures and droughts, which stress the energy systems. This is particularly significant as 45% the region's electricity consumption relies on hydropower.

In addition, regulatory efforts are intensifying to establish frameworks expanding and modernising **electrical grids,** incentivising energy storage adoption, and fostering collaboration among key stakeholders. Currently, interconnections exist between several countries, including Brazil and Uruguay, Brazil and Argentina, Argentina and Uruguay, Argentina and Chile, Argentina and Paraguay, Paraguay and Brazil, Peru and Ecuador, Ecuador and Colombia, Colombia and Venezuela and Venezuela and Brazil. In June 2023, a new transmission line interconnecting Argentina and Bolivia was inaugurated, with studies for interconnections involving Bolivia, Chile, Peru, Colombia and Panama underway.

A COMPLEX POLICY ENVIRONMENT

Populism and **Commodity Prices** are positioned on the LAC Energy Issues map within the realm of high uncertainty. The regional energy conversation may shift with the upcoming 2024 general elections in many countries in the region. Given that many nations in the region are classified as developing, the energy transition presents both challenges and opportunities.

The region boasts vast reservoirs of resources of critical minerals like Lithium and Copper, as well as renewable energies such as solar and wind power. These will be key for **climate mitigation** worldwide. However, government strategies must set out incentives, regulations and/or programmes that can enable the development of clean energies and local industry, whilst maintaining national competitiveness and responding to the needs of local communities.

In this context, raising awareness about **demand management** solutions, including energy efficiency and responsible energy consumption, is critical. Initiatives such as Barbados' Public Sector Smart Energy Programme exemplify effective strategies for promoting sustainable energy practices and driving positive change across the region.

Furthermore, strategies are required to address short-, medium- and long-term energy transition objectives. These strategies should encompass various resources such as natural gas, renewables, energy storage, hydrogen, and critical minerals. However, challenges may arise from differing political standpoints and governments across countries, potentially impacting cooperation initiatives.

CLIMATE RISK AND RESILIENCE

Latin America and the Caribbean is vulnerable to adverse climate conditions, with consequences for both the energy sector and the economy. Some examples of the impact of climate change underscore the need for **climate adaptation** and resilience measures. For instance, Brazil faced severe drought in 2021, resulting in reduced hydropower generation and increased energy prices. Hurricanes in the Caribbean disrupted power supply, demonstrating the need for resilient infrastructure investments.

A drier climate can have detrimental effects on hydro and fossil power plants, as well as critical mineral extraction, due to the requirement for water in their processes. Droughts also threaten bioenergy production by impacting crop yields. Increasing temperatures, particularly in Brazil, northern Chile and southern Peru may lower the efficiency of renewable and thermal power plants. Rising temperatures will also boost demand for **cooling**, straining electricity grids.

In response to climate challenges, the Panama Canal Authority is making strides toward carbon neutrality by the end of the decade, capitalizing on its role in reducing global CO2 emissions by providing a shorter shipping route. The canal's initiatives include the adoption of electric and alternative fuel vehicles, a transition to renewable energy sources such as photovoltaic and hydraulic power, and the enhancement of operational efficiencies through water conservation and transit optimisation. Supporting these endeavors, the Canal utilizes tools like the Emissions Calculator and engages in both national and international environmental initiatives, including Panama's "50 First Carbon-Neutral Organisations" and the International Maritime Organisation (IMO) 2020 regulation. These efforts are aimed at significantly reducing the Canal's carbon footprint and advancing sustainable practices within the global shipping industry.

FINAL CONSIDERATIONS

Latin America and the Caribbean's energy landscape is evolving, with climate adaptation now a top priority alongside economic growth. This shift highlights the need for resilient infrastructure and sustainable energy systems, supported by equitable financing and robust policies. Over the past five years, there has been significant progress in integrating green hydrogen, reflecting a broader commitment to renewable energy and climate action. However, challenges remain, including the region's diverse economic development and vulnerability to climate change. To address these challenges, proactive measures such as stakeholder engagement, transformative policies, and resilient infrastructure investments are crucial for achieving a sustainable energy future.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as political changes, energy equity, climate adaptation, fuel prices, infrastructure planning and critical minerals?
- What impacts on energy security are being observed due to climate change? How has the policy environment either supported or hindered energy security, and what emerging opportunities exist? What climate adaptation measures should be implemented, and how do these measures relate to the energy-water-food nexus?
- How can efforts to promote energy equity be expanded, and how does energy equity intersect with infrastructure action planning, affordability and climate mitigation?
- Why is agility essential in advancing permitting and financing for projects aimed at advancing energy transitions? How do countries manage the complex coordination and collaboration of multiple stakeholders with diverse interests?
- How is the capital cost affecting affordability and domestic growth in the energy sector? What are the implications of this for the energy industry?

ACKNOWLEDGEMENTS

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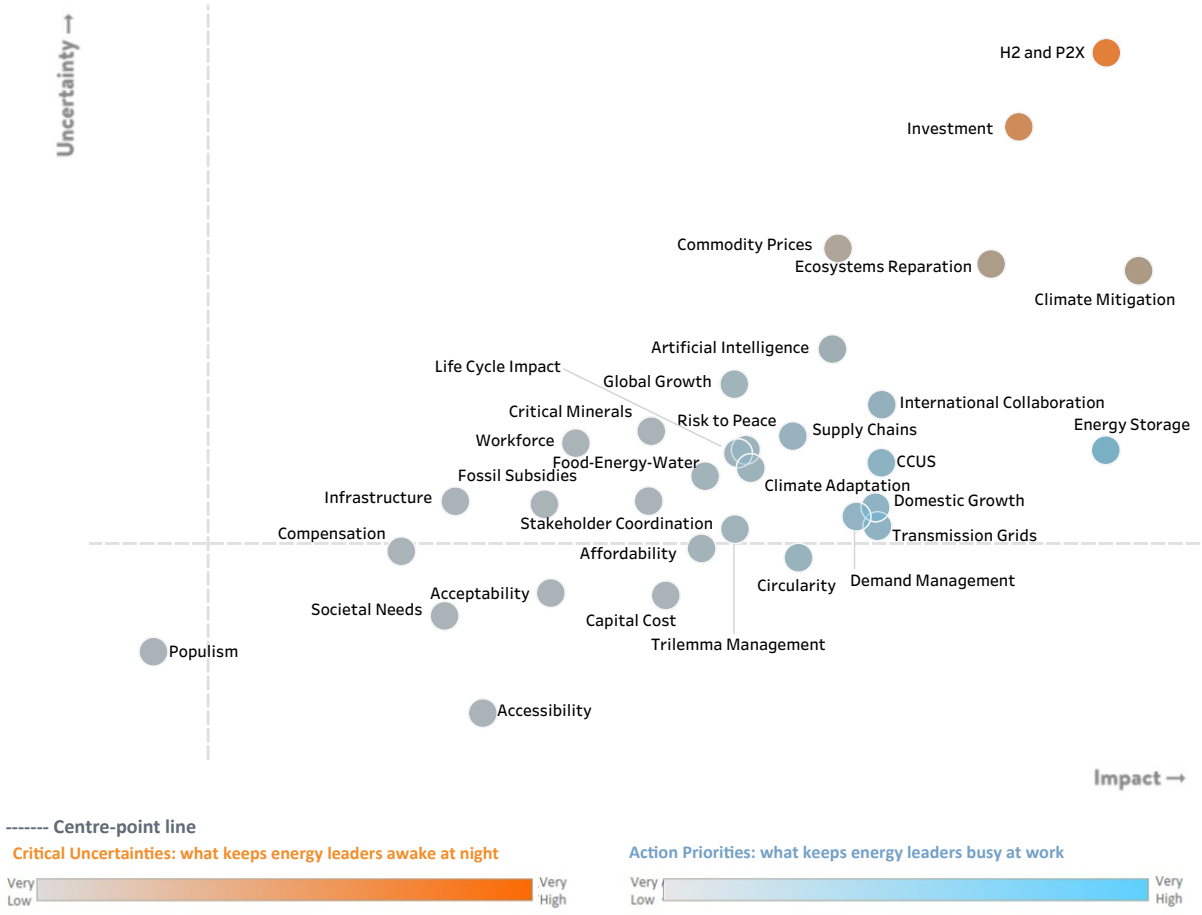
REGIONAL DEEP DIVE

MIDDLE EAST AND GULF STATES

WORLD ENERGY ISSUES MONITOR | 2024

Middle East and Gulf States



MAJOR REGIONAL CHANGES

The dominance of oil in the Middle East and Gulf States (MEGS) faces an unprecedented challenge. A growing focus on clean energy and the potential for declining oil demand necessitate a bold transition to a new energy paradigm. On one hand, these countries are heavily reliant on oil and gas revenue, and diversifying their economies and **infrastructure** will require significant **investment** and a shift in mindset. Yet, there is a growing sense of urgency as the region has been warming more rapidly than the global average.

The Middle East energy landscape faces multifaceted challenges ahead with energy transition, poised between tradition and innovation. Beyond the conventional concerns of oil and gas stability, the region grapples with the complexities of energy **supply chains, data security, and geopolitical instability,** particularly heightened by events around the Gulf States. Furthermore, Carbon Capture and Storage (CCS) initiatives, vital for mitigating greenhouse gas emissions, demand well-defined frameworks and clear liability assignments. The capability to manage these issues varies across the region: affluent nations like Saudi Arabia and the UAE are actively diversifying their energy portfolios to enhance future competitiveness. Lebanon is on a virtuous cycle of clean energy development driven by economic and

energy security interests. On the other hand, countries like Libya and Iraq, with less effective resource management, struggle with both energy transitions and maintaining stability.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

The region's geology and existing energy **infrastructure** make it well-suited for long-term carbon storage, especially near industrial zones like Jubail, Ruwais, and Ras Laffan, which can facilitate the organic development of a Hub and Cluster CCS model. The Gulf States have ambitious emissions reduction targets, and despite underdeveloped emissions regulations, they have precedence and can rapidly implement laws and frameworks. Government action is necessary to support CCS projects and incentivize emitters to capture emissions while National Oil Companies (NOCs) lead in providing CO2 storage solutions. Regional governments are working on drafting laws for long-term storage, providing clarity for investment from the private sector, which has historically been vital for large hydrocarbon projects. Foreign partnerships can also provide technology and expertise beyond investment to ongoing projects.

The Middle East and Gulf countries have several major operational **CCS projects,** such as Qatar's LNG operations in Ras Laffan, Abu Dhabi's Al Reyadah steel project, and Saudi Arabia's Hawiyah NGL CCS project, storing around 3.7 million metric tonnes per annum (MMTPA) of CO2. These projects, along with plans for significant new capacity, demonstrate the role of CCS in helping national oil companies (NOCs) enhance the value of reserves by remaining competitive in nearly all transition scenarios. CCS projects, including those announced in Qatar, Saudi Arabia, and the UAE, could see further expansion with a contribution to the production of low-carbon blue hydrogen using natural gas reserves

Additionally, low-cost mature technologies such as methane monitoring, zero flaring solutions, and low-emission refinery technologies can support a circular carbon economy. Infrastructure improvements to enhance trade corridors can also boost regional cooperation for carbon management, leading to a significant expansion of the CCS project pipeline in the region.

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

The identification of **societal needs** as an action priority with low uncertainty demonstrates the many opportunities presented by the energy transition. **Stakeholder coordination** and affordability have also emerged as key action priorities, offering significant societal benefits.

The energy transition presents an opportunity for upskilling and reskilling the region's workforce, fostering new job creation and driving economic development. However, the Gulf Cooperation Council (GCC) countries exhibit differences in their approaches to expatriates. While some, including Saudi Arabia, aim to attract millions of highly skilled expatriates by offering premium residency, others are more reserved in their visions for expatriate populations by 2040. Nevertheless, expatriates remain integral to GCC economies, stimulating demand for infrastructure and subsequently energy. As these countries navigate through these shifts, they must account for the evolving role of expatriates and their impact on economic growth and energy consumption.

The vulnerability of the region to climate change and the need for **adaptation** and resilience is evident and the risk of further water scarcity and reduced agricultural yields. The involvement of people building resilient societies is critical. Examples of such initiatives include the UAE's Emirates Youth Climate Strategy 2018–2021 and the Youth Climate Delegates Programme.

A SNAPSHOT OF 2024 RESULTS

A GREEN MOLECULE HUB

The region is strategically positioning itself as a hub for **hydrogen** production, leveraging its abundant solar and natural gas resources along with the availability of capital for **investment**. For instance, Saudi Arabia's NEOM project aims to build a large green hydrogen facility using renewable energy sources, producing up to 650 tonnes of carbon-free hydrogen daily. The UAE's green hydrogen plant in Dubai is a pilot project in partnership with Siemens Energy and DEWA, using solar power. In Oman, the Hyport Duqum project involves collaboration between Omani and international companies to develop green hydrogen facilities. **Sustainable Aviation Fuels (SAF)**, particularly **power-to-liquid fuels (P2X),** offer promise but necessitate overcoming financial barriers and policy misalignments. In this regard, hydrogen production can help the region achieve their carbon emission reduction targets while also leveraging their abundant natural resources for economic diversification.

Several reasons can explain the high uncertainty levels regarding **hydrogen and P2X** in the Middle East and the Gulf States, including immature technology, insufficient infrastructure investment, lack of regulation and standards, competition from renewables, and the legacy of fossil fuels. The most promising option appears be green hydrogen production, due to abundant sunshine and wind. Furthermore, green hydrogen has the potential to help economic diversification, reduce fossil fuel dependency, and enhance and diversify the region's energy export capacity. As per the report published by Strategy&, green hydrogen, once seen as a futuristic idea, is now becoming a realistic possibility with the GCC potentially at the forefront. While the GCC has a clear advantage in producing green hydrogen due to its plentiful and affordable renewable resources, delivering it cost-effectively is the key hurdle. Transporting green hydrogen can be very expensive, even doubling the initial production cost. To compete in major import markets like Europe and East Asia, GCC producers must focus on minimizing the total delivered cost by optimizing every step of the supply chain.

STRIVING FOR BALANCE

Transitioning away from oil in the Middle East and Gulf States requires collaboration, partnerships, and **stakeholder coordination.** This is particularly crucial for securing critical minerals essential for batteries and equipment, requiring cooperation with other countries. From this perspective, the Saudi Green Initiative (SGI), launched as part of Vision 2030 in 2021, is actively investing in collaboration for clean transitions by uniting government and private sector efforts under a single umbrella, overseeing over 80 initiatives to accelerate Saudi Arabia's green economy, enhance sustainability, and implement the Circular Carbon Economy approach.

The Middle East and the Gulf States face challenges in balancing the interconnected needs of food, energy, and water security, often referred to as the **food-energy-water nexus.** While the Gulf States ensure food security through trade agreements and acquiring stakes in large agricultural industries, other Middle Eastern countries depend more on domestic agriculture. The region as a whole depends on desalination to fulfil its water needs. To address these challenges, holistic policy approaches are being adopted, including pilot programs that focus on water-saving irrigation techniques and the use of treated wastewater for agriculture. Saudi Arabia has introduced subsidies for drip irrigation systems and the development of drought-resistant crops. In parallel, the UAE is investing in technologies to treat wastewater for irrigation and desalinate seawater. Despite these efforts, many challenges persist, primarily due to the fragmented governance, hindering a unified food-energy-water strategy. Water scarcity remains a major concern in the region, exacerbated by a growing population and climate change, placing further pressure on already limited resources.

The region as a whole depends on desalination to fulfil its water needs. To address these challenges, holistic policy approaches are being adopted, including pilot programs that focus on water-saving

irrigation techniques and the use of treated wastewater for agriculture. Saudi Arabia has introduced subsidies for drip irrigation systems and the development of drought-resistant crops. In parallel, the UAE is investing in technologies to treat wastewater for irrigation and desalinate seawater. Despite these efforts, many challenges persist, primarily due to the fragmented governance, hindering a unified food-energy-water strategy. Water scarcity remains a major concern in the region, exacerbated by a growing population and climate change, placing further pressure on already limited resources.

CLIMATE RISK AND RESILIENCE

The "UAE Consensus" at COP28 is significantly influencing action priorities in the region, prompting a shift towards sustainability and the greening of economies. COP28's ambitious goals, which include tripling **renewable energy** capacity and doubling **energy efficiency** by 2030, require adjustments in regional priorities. This entails accelerating **investment** in renewable energy, green hydrogen production, and sustainable projects such as CCS.

Notably, 2023 witnessed an increase in green financing, particularly in the UAE and Saudi Arabia, where it is estimated at nearly USD$14.6 billion of green debt. This surge in financing is fostering economic diversification and job creation. The region's sovereign wealth funds play a crucial catalytic role in climate finance by providing capital to back long-term, capital-intensive renewable energy projects in both developed and developing nations. While UAE's Mubadala has already deployed more than USD$20 billion in clean energy projects, Saudi Arabia's sovereign wealth fund has committed to developing 70 per cent of the country's renewable energy by 2030. Additionally, the Saudi Energy Efficiency Center enhanced energy efficiency across various sectors, reducing energy consumption intensity by 12% from 2012 to 2022, and implemented the Saudi Corporate Average Fuel Economy (CAFE) standard to improve fuel efficiency. Meanwhile, Lebanon is enhancing its renewable energy landscape through the Distributed Renewable Energy Law (Law No. 318/2023), which facilitates distributed renewable energy production and has initiated projects totalling 165 MW of PV capacity to expand energy access and promote sustainability.

The region already produces the lowest-cost solar energy in the world. This cost advantage is opening significant opportunities for the Middle East in green fuels such as green **hydrogen**, green manufacturing such as green steel, and for the emerging area of converting energy.

FINAL CONSIDERATIONS

The transition towards clean energy in the Middle East and Gulf States is not only about economic diversification but also about enhancing energy security and proactively addressing the severe impacts of climate change. The integration of Carbon Capture and Storage (CCS) technologies exemplifies the region's commitment to reducing greenhouse gas emissions, though this introduces complexities related to regulatory and liability frameworks. The shift to a sustainable energy paradigm in the Middle East and Gulf States will necessitate both regional and global cooperation. Cross-border partnerships will be crucial in securing the necessary technologies, investments, and markets needed to support the development of new energy products.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as hydrogen and P2X, investment, commodity prices?
- Why is uncertainty regarding hydrogen and P2X so high and what are the available energy sources for producing hydrogen? Which of these sources is best suited for the region and what actions can be taken to prioritise it?
- How is the UAE Consensus perceived to impact action priorities in the region, and how do the region's economies plan to adjust their priorities to meet the ambitious goals set at COP28?
- What strategies could be employed to effectively integrate circular carbon economy principles and scale up CCS technologies in the Middle East, thereby fostering sustainable economic growth, reducing carbon emissions and enhancing energy security?
- What are the interlinkages and synergies between climate mitigation, international collaboration, critical minerals and metals and supply chain disruption in the region?
- What progress has been made on the water-energy-food nexus in the region, and what are the next steps to address remaining challenges?

ACKNOWLEDGEMENTS

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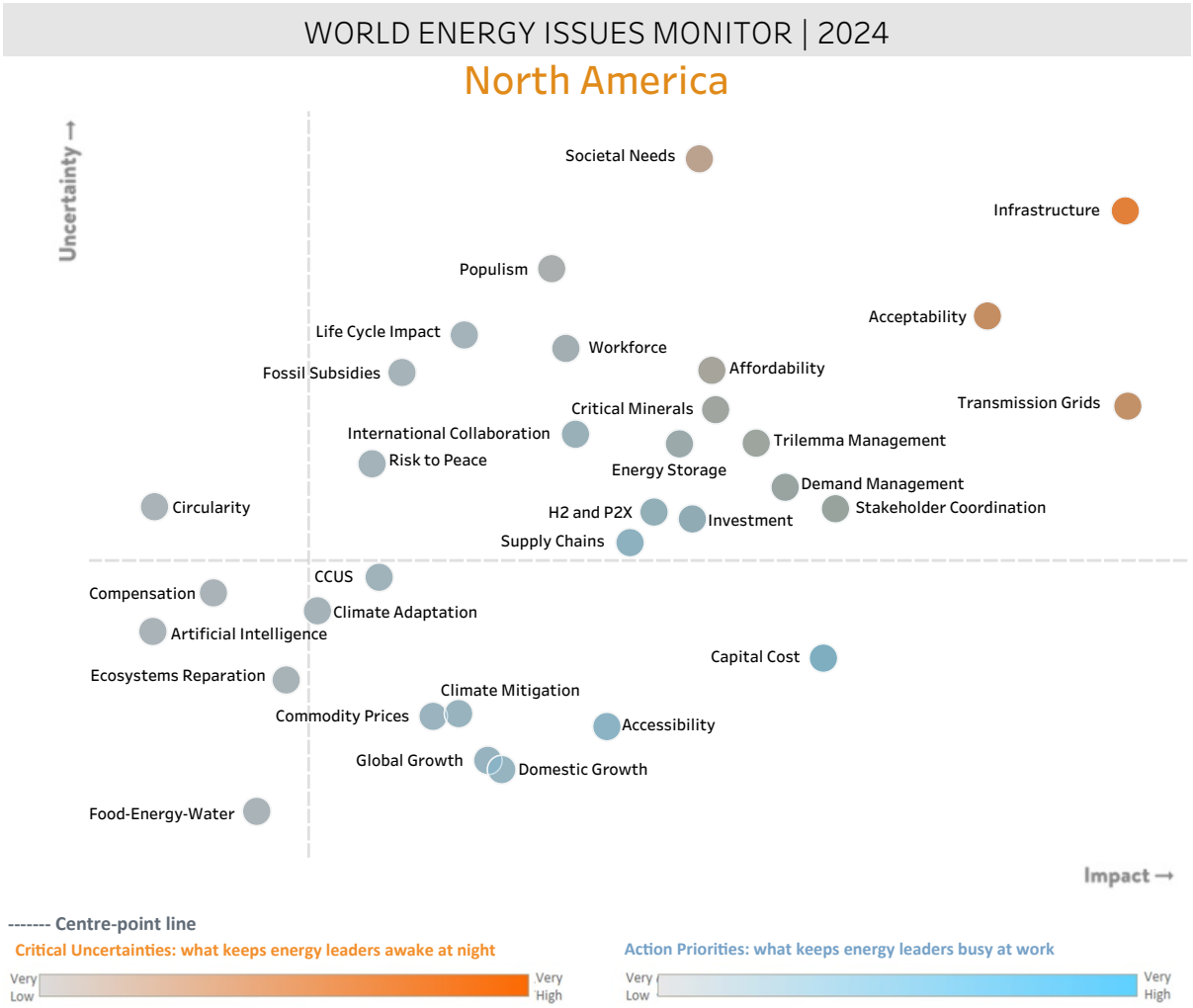
REGIONAL DEEP DIVE

NORTH AMERICA



MAJOR REGIONAL CHANGES

The 2024 North America World Energy Issues Map attributes the highest degree of impact and uncertainty to **infrastructure**, compared to **climate change management**, recognised as the highest critical uncertainty in the 2022 Issues Map. This change was expected following the enactment of major energy and climate investment packages over the last couple of years, making aging infrastructure a limiting factor for large-scale deployment. In the United States (U.S.), the Inflation Reduction Act's incentives to growth in renewable power generation, increased the demand for a stronger transmission infrastructure, capable of responding to the technical requirement of intermittent power inputs. Considering the largest share of U.S. respondents in the North America Issues Survey, the 2024 Issues Map highlights the high impact of **transmission grids** to achieve the region's energy and climate targets. With major government investments in energy technologies and climate solutions, the **investment** indicator moved from high to medium uncertainty, compared to 2022.

Hydrogen and **power-to-X** underwent a remarkable transformation from very high uncertainty in 2022 to relatively low uncertainty in the 2024 map, benefiting from strong policy signals and a generous tax credit system from the U.S. government for hydrogen (a 10-year incentive of up to US$3/kg H2) and low-carbon

fuels production (a tax credit of up to US$1/gallon for non-aviation fuels and US$1.75/gallon for sustainable aviation fuels).

North America stands out as the sole region among affluent industrialized areas that exports more fossil fuels than it imports. Scoring an "A" in the Security Dimension of the World Energy Trilemma Index, the United States and Canada have significantly enhanced their economies and secured their energy supply through the exploitation of shale gas and oil sands. Since 2018, Mexico has also prioritised its domestic fossil fuel industry for security reasons. In the Federal Budgets for 2021 and 2022, more than 70% of the funds earmarked for 'climate change mitigation and adaptation effects' were allocated to the transportation infrastructure of fossil gas. Consequently, **energy security** in North America primarily revolves around strengthening infrastructure to prevent disruptions. This focus on domestic **infrastructure** results in energy security uncertainties rooted more in local concerns than in international politics. From this emphasis on robust infrastructure, issues of **societal needs and acceptability** have become pivotal in the energy security discussions, driving the priorities of policy makers and energy leaders in the region.

ACCELERATING REGIONAL TRENDS OVER THE LAST 5 YEARS

In the past five years, North America has experienced dramatic changes, which show no signs of slowing. Regional trends include increasingly extreme weather conditions and growing **infrastructure** needs. Both issues are being addressed through diverse policy levers to ensure the reliability and security of the power system. The North American Electric Reliability Corporation (NERC) released its annual state of reliability report based on trends from the previous five years. The 2023 report notes that the extreme weather events have increased dramatically in frequency, footprint, and duration, and pose a significant risk to reliability and stability. The report pointed out risks of supply shortfalls, which materialised during peak conditions in summer and winter. For instance, in September 2022, a Heat Dome event triggered seven Energy Emergency Alerts (EEAs) across parts of the Western Interconnection in Canada, the U.S., and Mexico. Factors contributing to reserve shortages included record demand, transfer curtailments, reduced energy output from generators, and limited generator availability.

The energy industry has been **collaborating** to update and identify reliability standards and to discuss these challenges and map out the evolution of the bulk power system. The booming amount of diverse generation provides additional flexibility, but also presents technical challenges such as performing through disturbances observed on the system.

In March 2023, the U.S. and Canada have committed to strengthening North American nuclear fuel supply chains and supporting the development of small modular reactors (SMR) through initiatives like the FIRST program and a one-year Energy Transformation Task Force. This collaboration aims to accelerate clean energy transitions, integrate economic and security policies, and enhance grid resilience and access to critical minerals, fostering regional energy cooperation and economic growth. The Energy Transformation Task Force was renewed for another year in May 2024.

INTEGRATING PEOPLE AND COMMUNITIES IN THE ENERGY TRANSITION

Equity measures are at the centre of efforts to integrate people and communities in energy transitions. That is why **stakeholder coordination and acceptability** are identified as high impact issues with low to medium uncertainty. There has been an increasing number of projects focusing on community engagement and promoting more equitable energy transition. The Inflation Reduction Act (IRA), the largest investment in reducing carbon pollution in U.S. history, has dedicated an Energy Community Tax Credit Bonus of up to 10 percent (production tax credits or investment tax credits) for projects, facilities, and technologies located in energy communities. Moreover, the Justice40 Initiative has been signed, to ensure that 40 percent of overall benefits of Federal climate and energy investments are dedicated to disadvantaged communities.

A SNAPSHOT OF 2024 RESULTS

SCALABLE TECHNOLOGY AND COMMUNITY STRENGTH

The trajectory from 2022 to 2024 in North America's energy landscape reveals a complex evolution, that marries ambition with the realities of economic and geopolitical volatility. The emphasised commitment to **energy storage** and **renewable energies** illustrates a push to upscale sustainable solutions (for example, with a projected 89% growth in storage), yet this ambition is now measured against the backdrop of fluctuating investment returns and a challenging market that still lacks large demand signals and regulatory clarity around permitting and siting timelines.

Despite the substantial energy consumption of data centres, telecommunications networks, and smart devices - accounting for 3-4% of the world's electricity in 2023 with expectations to double by 2030 - and the ever-growing opportunity space for Artificial Intelligence (AI) in energy, AI as a gamechanger technology was not high on the radar of North American survey respondents. This is unexpected considering the significant investments by major technology firms like Microsoft, Amazon, Google, and Meta in energy-efficient technologies and renewable energy sources, including next-generation nuclear power, to manage the escalating digital energy demand.

It is important to acknowledge that the push for groundbreaking energy technologies is not just about innovation, but it is also about making sure these advances are cost-effective and align with ever-changing policies. Additionally, the growing concerns around **infrastructure** and **societal needs** highlight the importance of ensuring that technological advances go hand in hand with community well-being and the strength of our public systems.

Canada provides a valuable example of community-centred approaches, where First Nation communities are the largest owners of renewable energy projects. These include wind, solar, hydro, and biomass. First Nation communities either own these projects outright or through partnerships involving revenue-sharing, employment, and capacity-building. Significant projects like the Henvey Inlet Wind Project, Grand Renewable Energy Park, and Mesgi'g Ugju's'n Wind Farm demonstrate the economic and infrastructural benefits these ventures offer, enhancing energy sovereignty and environmental stewardship. Supported by government and Indigenous-led organizations, this growing involvement positions First Nations as central players in Canada's shift towards sustainable energy, aiming to equitably distribute benefits and address past inequities.

BALANCING ECONOMIC GROWTH WITH ENVIRONMENTAL RESPONSIBILITY

In the 2024 North America World Energy Issues Map, the dynamics of **affordability, investor environment,** and **public acceptability** emerge as increasingly uncertain and critical pieces of the energy transition puzzle. For example, the recent delays in offshore wind projects along the United States coastlines show how the combination of these three factors can impact the energy transition. In Canada, provincial fragmentation represents a significant challenge to economic growth and affordability, with research showing disparate levels of commitment to clean energy across provinces—from Quebec's proactive approach to Alberta's lower support for renewable energy development. Addressing the **affordability** concern is crucial to maintaining public support, as the energy transition's success relies on the widespread adoption of new technologies.

Equally, a stable and receptive **investor environment** is essential to fuel the financial investment necessary for overhauling energy infrastructure. From this perspective, Mexico's incoming administration has pledged to support private investment in the energy sector as long as it complements the country's energy sovereignty, designating 54% of the electricity market to the state-owned CFE and 46% to private companies, thus creating a regulated yet accommodating market environment.

Lastly, the increased uncertainty in **acceptability** highlights the importance of public approval and the efficacy of regulatory processes, which, if not carefully managed, can hinder the implementation of renewable technologies. These factors underscore the need for continued work to ensure the policy framework is not just environmentally ambitious but also socio-economically considerate, leading to a truly inclusive energy transition.

CLIMATE RISK AND RESILIENCE

Trends in energy outcomes across North America provide invaluable insights into the region's climate vulnerabilities and its capacity for resilience. In 2023, the United States experienced 28 climate disaster events with costs exceeding US$1 billion in damage for each. In 2023, Canada recorded its hottest summer in 76 years, with temperature anomalies as high as +3.1°C in some regions and ocean temperatures around its coasts reaching historic highs. Canada's 2023 wildfire season was the most destructive ever recorded. Over 6,500 wildfires burned more than 18 million hectares of land, surpassing the previous record of 7.6 million hectares by a large margin. Thousands of people were displaced, critical energy infrastructure was destroyed, and oil and gas production were temporarily halted. In the same year, Mexico experienced heatwaves leading to a surge in electricity demand and operating reserve margin dropping below 6%. This record for climate disasters puts resilience at the centre of energy policy.

The growing embrace of renewable energy in the region highlights a significant stride towards a greener, less carbon-intensive future, reducing dependence on fossil fuels and improving resilience by broadening the energy mix and reducing risks of supply disruptions. Additionally, scrutinising energy consumption patterns exposes the ramifications of extreme weather events on energy **infrastructure**, spotlighting vulnerabilities and areas for enhancement to better confront climate-related adversities. Through monitoring of **transmission grid** performance, the implementation of **energy efficiency** measures, and the promotion of inclusive **community involvement**, North America can construct a sturdier energy framework adept at confronting the uncertainties posed by climate change.

FINAL CONSIDERATIONS

From 2022 to 2024, North America has demonstrated a dynamic approach to managing its energy portfolio amid economic and geopolitical shifts. This period has been marked by a strengthened commitment to sustainability, propelled by regional collaboration, technological advancements, evolving policies, and a re-evaluation of both infrastructure and energy security. The region has actively pursued the adoption of renewable energy, the enhancement of infrastructure, and the integration of societal considerations into energy policies. The U.S. Inflation Reduction Act is a pivotal development in balancing economic growth with environmental stewardship. However, the rate and focus of this transition remain subjects of ongoing debate, emphasizing the need for policies that reconcile energy security and economic imperatives with environmental objectives.

CONVERSATION STARTERS FROM THE ISSUES MONITOR 2024

- What are the specific challenges anticipated in the regional energy context in the year ahead, considering factors such as infrastructure action planning, acceptability and active stakeholder engagement?
- How do energy storage, critical minerals, supply chains and international collaboration interact with each other, and what implications does this interplay have?
- How is the active engagement of people and communities representing broader societal needs evolving, and what new approaches can be taken to reduce uncertainty?
- Why has uncertainty around hydrogen and P2X significantly declined, and what measures are needed to unlock their potential further?
- What factors have led to climate mitigation and adaptation transitioning from being the highest uncertainty to being in the action space? Is there an established acceptable level of climate resilience, and what additional conversations with stakeholders and supply chains may be necessary?
- The life cycle impacts of renewable energy solutions are a moderate uncertainty. Is this aspect gaining more attention and moving onto the radar, and if so, why?

ACKNOWLEDGEMENTS

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