



EXECUTIVE SUMMARY

The World Power-to-X Summit 2023 was held in Marrakech from September 19th to 21st, 2023, under the High Patronage of King Mohammed VI, May God Assist Him. The summit was organized by the Moroccan Research Institute for Solar Energy and New Energies (IRESSEN), the Green H2 Cluster, the Mohammed VI Polytechnic University (UM6P), under the aegis of the Moroccan Ministry of Energy Transition and Sustainable Development, in partnership with the Council of Guelmim Oued Noun Region, and with the support of Industries du Maroc Magazine. Despite the difficult post-earthquake circumstances, this third edition showcased the resilience of the Moroccan people and their commitment to sustainability. Positioned as a premier event on green hydrogen at the national, regional, and international levels, this third World PtX Summit was a milestone for the global hydrogen community, addressing the world's pressing challenges.

International Hydrogen Economy Roadmaps

During the opening high-level ministerial session, Morocco unveiled plans to triple annual investments in renewable energies, leveraging its renewable energy potential, political stability, and strategic partnerships. Challenges in transitioning to a hydrogen-centric economy were highlighted, emphasizing competitiveness, technology mitigation, financial risk management, and local manufacturing integration. The call for global cooperation resonated, with Morocco inviting nations, including those from the Middle East and Africa Region and the European Union, to join its sustainable energy journey. Endorsing the Power-to-X (PtX) value chain for decarbonizing key industries, international collaboration was emphasized, including partnerships with UN and regional organizations, marking significant strides toward global sustainable energy goals.

Discussions underlined green hydrogen's eco-friendliness amid current cost challenges, focusing on enhancing economic viability through R&D and Innovation. Notably led by Public-Private Partnerships (PPP), Morocco and other nations showcased multiple large-scale projects, highlighting the industry's need for

policy support and market incentives. In addition, insights into the hydrogen market revealed the European Union's gradual emission reduction efforts through the REPowerEU plan, competing with the United States' Inflation Reduction Act (IRA) plan. In the MENA region, there was a strong advocacy for improved regulations and implementing carbon pricing/premiums to advance toward a low-carbon economy. Collectively, the discussions underscored the evolving dynamics of the hydrogen market and emphasized the necessity for adaptive policies and collaborative efforts.

The Role of Geopolitics and Diplomacy in Advancing Green Hydrogen

Navigating recent global hydrogen developments proves challenging due to complex geopolitical factors, with rivalries emerging between various regulatory frameworks and strategic plans addressing industrial decarbonization and hydrogen adoption. Two critical success factors in the global hydrogen race include expediting permitting processes and strategically locating electrolyzer gigafactories near PtX projects. Emphasis is placed on large-scale projects exceeding 100 MW and investment in local training for a competitive workforce. Shifting to the Middle East and Africa's commercial landscape, the region witnesses significant developments in hydrogen strategies and projects, signaling its growing prominence in shaping the future of hydrogen economies.

Underscoring the pivotal role of diplomacy in shaping the green hydrogen economy, represented diplomats highlighted the importance of international cooperation and shared some examples. Korea's national hydrogen roadmaps and infrastructure development showed leadership in driving the shift to clean molecules. Denmark, aiming for a fossil-free energy system by 2050, collaborated with Morocco on projects like the Green Atlas Project and Maersk's green hydrogen and shipping initiatives. Spain's sustainable endeavors, such as the green ammonia plant and joint research with Morocco, demonstrated the results of mutual efforts.



The Green Hydrogen Journey: From Renewable Sources to Clean Applications

Green Hydrogen Value Chain - Upstream: Deep-dive sessions emphasized optimizing clean hydrogen production, addressing renewable source challenges, and showcasing a stable electricity supply. Discussions extended to integrating water desalination, proposing industrial-scale strategies for electrolysis, and emphasizing gigawatt-scale operations for global transport efficiency. Insights showcased cost reductions with electrolysis plant scaling. Furthermore, various hydrogen storage options, including solid-state and salt caverns, were explored, with Morocco showcasing alternative solutions, with a special focus on underground storage. Additionally, different carriers for international hydrogen trade were discussed.

Green Hydrogen Value Chain - Balance of Plant: During a comprehensive debate, expert scientists discussed modeling hydrogen systems, including sector coupling, co-optimization, Life Cycle Assessment (LCA), and sustainability, for deploying gigawatt-scale green molecule plants. Discussions then shifted to catalysts and materials, focusing on the critical role of electrode separators, particularly in alkaline systems. As per alternative, addressing efficient hydrogen system integration, topics included renewable energy conditions, electrolyzer operation, heat management, and the valorization of oxygen by-products, all interconnected through the concept of digital twins. The potential of Carbon Capture and Utilization (CCU) was also explored, with technologies like biogenic CO₂, Direct Air Capture, and amine scrubbing aiming to build a robust CCUS economy. This comprehensive exploration highlighted the interdisciplinary nature of advancements in modeling, materials, and integration strategies shaping the future of sustainable hydrogen systems.

Green Hydrogen Value Chain - Industrial End Uses: Specialists convened, offering insights into transformative shifts across sectors. In agriculture, the spotlight was on electrolysis-driven green ammonia, exemplified by OCP Group's forward-looking investment plan. In addition, steel industry stakeholders witnessed innovations like GraviHy's green hydrogen-powered Direct Reduced Iron production, signaling a strategic move towards emissions reduction. UNIDO's active involvement underscored the importance of international

collaboration in advancing global hydrogen projects. The discourse extended to the transformative potential of Power-to-X technologies, addressing carbon emissions in cement and lime industries. Collectively, these discussions painted a vivid picture of a world in transition towards sustainable practices, leveraging renewable energy and innovative technologies for a more efficient and eco-friendly future.

Green Hydrogen Value Chain - Sustainable Mobility: In-depth sessions traversed the evolving landscape of hydrogen mobility, spotlighting NamX's "capsule hydrogen" technology for cars and ventures into heavy-duty road mobility, including the "H2Trucks" project and hydrogen-fueled trains in the "FCH2RAIL" initiative. Shifting to maritime, eFuels for shipping were discussed, emphasizing compatibility and high energy density, with projects by HIF Global, Fistera, and MGH Energy. Regional initiatives, like the "Corridor H2" project, aimed to establish hydrogen refueling stations. In aviation, the focus was on eFuels, Sustainable Aviation Fuels (SAFs), and initiatives like RefuelEU, with Airbus leading sustainability efforts.

Green Hydrogen Enablers: Infrastructure, Investments, and Societal Governance

Trade & Corridors Challenges: As a decarbonized economy enabler, ports are pivotal for advancing PtX projects. However, substantial investments in essential infrastructure, including electrolyzers and transportation networks, are crucial. Pipelines offer a cost-effective, nearly carbon-free solution for green hydrogen transport, especially over long distances. Additionally, experts' discussions emphasized the importance of international cooperation for certification and standards to facilitate global hydrogen trade.

Funding Strategies: In funding and investment, substantial support is driving global hydrogen projects, with a focus on Europe. A recent study envisions significant green hydrogen production in Africa by 2035, notably in Morocco. Discussions underscored precise financial modeling and considerations like carbon credits for project viability. The global conversation on green hydrogen policies highlighted the need for comprehensive laws. Addressing contracts for Power-to-X involved tackling challenges such as regulatory gaps and



meticulous legal documentation.

Positive Societal Impact & Effective Governance: Green hydrogen development gains from domestic manufacturing and shifting car spending. Safety and environmental concerns prioritize socio-economic impacts, citizen needs, and efficient waste management. Training emphasizes a knowledgeable workforce through global courses and tailored Moroccan initiatives. Governance discussions highlighted the need for hydrogen roadmaps, improved regulations, policy development, international collaboration, and the creation of a Moroccan cluster for effective PtX development.

Post-Earthquake Resilience and Power-to-People Initiatives

Amidst the earthquake's aftermath on September 8th, 2023, Marrakech, the chosen venue for the 3rd World Power-to-X Summit, stood resilient near the epicenter. Undeterred by the challenges, the organizers proceeded with the Summit on September 19th and 20th, 2023, showcasing Morocco's economic resilience and commitment to sustainability. This edition not only underscored the significance of Power-To-X solutions for a sustainable future but also served as a powerful platform to express global solidarity. The Summit, commencing with a solemn minute of silence to pay tribute to the earthquake victims, unveiled the Power-to-People Operation, themed "Transmitting Funds from Hydrogen to Humanity." This initiative brought together the global PtX community to support earthquake victims, marking a unified effort to address immediate and enduring challenges affected communities face.

Conclusion

In conclusion, the 3rd World Power-to-X Summit, held resiliently in Marrakech post-earthquake, not only spotlighted Morocco's economic strength but also exemplified global solidarity. The Power-to-People Operation seamlessly integrated voluntary initiatives, showcased sustainable solutions, and initiated a donation campaign. From innovative projects presented at the solidarity ceremony to generous pledges supporting Morocco's recovery, this unified effort highlighted the summit's profound impact. Beyond advancing Power-To-X solutions, the event symbolized a harmonious fusion of technology, compassion, and sustainable development, leaving a lasting

imprint beyond its original scope. As we look forward to the next edition in October 2024, the Summit is a testament to the world's dedication to advancing the green hydrogen economy and overcoming obstacles through collective resilience and cooperation.

Author

SEDDIQ SEBBAHI

*Technology Intelligence Manager -
IRESEN*

As an engineer with 18 years' experience, Seddiq has successfully led projects encompassing solar, wind, batteries, power systems and transmission solutions for notable companies such as Huawei, ONEE, and Maroc Telecom. In parallel, Seddiq is pursuing a PhD in green hydrogen production and storage technologies at Chouaib Doukkali University of El Jadida, Morocco.