

RENEWABLE ENERGY AND MOROCCO'S NEW GREEN INDUSTRIES

HOW MOROCCO'S GREEN ENERGY ECOSYSTEM CAN EXPAND WOMEN AND YOUTH EMPLOYMENT THROUGH SUSTAINABLE DEVELOPMENT

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Cover photo: A Moroccan flag flies next to a wind turbine on June 28, 2010, at a wind farm near Tangiers shortly after its inauguration by Moroccan King Mohammed VI. [Photo by ABDELHAK SENNA/AFP via Getty Images.](#)

CONTENTS

6	Introduction
8	Renewable Energy and Morocco's Green Energy Ecosystem
17	Green Manufacturing Entrepreneurship and the Evolution of Morocco's Start-up Ecosystem: Innovation and Expanding Beyond Innovation
23	The Green Energy Ecosystem and Employment: Overcoming the Challenges to Extending Employment Opportunities to Women, Youth, and Rural Populations
24	<i>The Green Energy Ecosystem and Employment for Highly Educated Women</i>
25	<i>The Green Energy Ecosystem and Urban Youth Employment</i>
28	<i>The Green Energy Ecosystem and Urban Women's Employment</i>
30	<i>The Green Energy Ecosystem and Employment Among Rural Populations</i>
33	Coordination between Green Energy Ecosystem and the Training Ecosystem
33	Current Attitudes Within MSMEs About Commercial Renewable Energy Use Outside the Green Energy Ecosystem
34	Conclusions



Photo above: Testing the quality of water from an experimental wastewater treatment plant at the Ain Chock Faculty of Science in Casablanca, Morocco, on Oct. 17, 2023. [Photo by MARTIN BERTRAND/Hans Lucas/AFP via Getty Images.](#)

Introduction

Morocco is a leader in the development of renewable energy among the countries of the Middle East and North Africa (MENA) region. The distinguishing feature of Morocco's renewable energy sector is that its accelerating growth is occurring through the kingdom's development of a dynamic green energy ecosystem, in which renewable energy is now starting to become incorporated into major sectors of the economy. Arising from a national strategic emphasis on creating sustainability in key economic sectors ranging from agriculture and mining to fertilizer production and electric vehicle (EV) manufacturing, renewable energy and the green energy ecosystem hold the potential to expand employment opportunities for women, youth, and rural populations. The expansion of green industrial manufacturing and agricultural production in Morocco could become the engine of sustainable human development more broadly.

In 2022, Morocco ranked as the world's most attractive renewable energy market for investment, according to the Renewable Energy Country Attractiveness Index (RECAI) published by international accounting firm EY (Ernst & Young), when normalized for GDP.¹ In 2023, Morocco retained its score but was ranked as the second most attractive market, following Denmark's legal advances concerning green hydrogen utilization.² No other MENA nation placed among the top 10 renewable energy markets in the 2023 RECAI rankings. No other Arab country ranked among the top 25 renewable energy markets, except for Jordan. Morocco's success in developing renewable power generation, storage, and transportation

1. The normalized score is obtained by taking the RECAI "raw" score and dividing it by the log of GDP. "Renewable Country Energy Attractiveness Index (RECAI), 60th edition," EY, November 2022, p. 20, https://assets.ey.com/content/dam/ey-sites/ey-com/en_us/topics/energy-resources/ey-recai-60-report-november-2022.pdf.

2. Arnaud de Giovanni and Ben Warren, "Are the global winds of change sending offshore in a new direction," EY, November 14, 2023, https://www.ey.com/en_gl/insights/energy-resources/are-the-global-winds-of-change-sending-offshore-in-a-new-direction.

infrastructure is the result of its emerging, multi-faceted green energy ecosystem that is giving rise to international renewable energy export supply chains based on the country's production of green hydrogen, in the form of green ammonia, as well as phosphates, other minerals and metals, fertilizers, agri-food products, and EVs — the production of which is increasingly powered, in part or entirely, using renewable energy resources.

Building on its accomplishments in the field of renewable energy, Morocco's government has placed a national focus on achieving a prosperous society through sustainable development with the explicit priority of expanding employment opportunities among women, youth, and rural populations. While renewable energy is playing an increasingly important role in the Moroccan economy as the foundation of efforts to make its industrial and agricultural production more sustainable, the question remains as to how renewable energy operating within the framework of Morocco's green energy ecosystem can create appropriate formal employment in the private sector. This case study explores the answer to this question by examining current and planned efforts to expand the kingdom's renewable energy sector and green energy ecosystem. It assesses the opportunities and challenges in using Morocco's new green industries as a driver of long-term employment, particularly among women, youth, and rural populations.

The study finds a synergistic convergence exists between Morocco's efforts to expand its already significant renewable energy sector and its objective of increasing the number of women and young people engaged in formal employment. In assessing how this convergence will expand employment opportunities, the study places special attention on micro, small, and medium enterprises (MSMEs). Although MSMEs are defined as firms with workforces of 250 employees or fewer, they account for about 95% of private sector activity in Morocco and 50% of job creation.³ The study's analysis rests on two sources of data: qualitative data from field research and quantitative survey data. Qualitative research on Morocco's renewable

3. The Innov Invest Fund in Morocco, 2023, <https://www.insme.org/the-innov-invest-fund-in-morocco/>.

energy sector, its green energy ecosystem, and its employment training ecosystem conducted by the author included on-site visits and extensive interviews with key stakeholders. Augmenting the qualitative research is quantitative data from a telephone survey of 1,008 MSMEs in Morocco conducted by the Economic Research Forum.⁴

Within Morocco's green energy ecosystem, climate-smart and green technologies are emerging as a foundation of its innovation ecosystem of start-up MSMEs and the incubators and accelerators to support them. This innovation ecosystem has formed the leading edge of the opportunity for MSMEs under the growing national focus on sustainable development. The push for sustainable solutions worldwide has led to a global focus on "deep technology," in which start-up companies engaged in what was formerly referred to as "high-tech" are expressly focused on developing and delivering extremely advanced technological solutions to overcome the substantial scientific and engineering challenges to meet the demands of sustainability. Even when successful, the employment opportunities in this part of the green energy ecosystem are inherently limited.

While the innovation ecosystem plays an important role overall in Morocco's green energy ecosystem, this study finds the majority of employment opportunities are to be found in green industrial manufacturing and the adjacent retail services and sales industries. Beyond providing employment opportunities, MSMEs in these segments of the green energy ecosystem can also provide and hone soft skills that are increasingly vital to long-term employment in Morocco's transition to renewable energy and sustainability. A wider economic transformation resulting in a greater scale of private sector employment could occur if support mechanisms for adjacent retail services and sales start-ups are included in initiatives to support sustainable development and green industrialization.

While employment opportunities are likely to greatly expand through renewable energy-driven green industrial

4. Telephone surveys and analysis of indicators performed by the staff of the Economic Research Forum.

manufacturing and sustainability solutions for green agricultural production, the means to ensure those employment opportunities benefit women, youth, and rural populations need to be clearly identified. The extent to which Morocco's current approach to achieving a prosperous society through sustainable development and the expanded employment of young people and women will succeed, according to this study's findings, also depends on the extent to which its green energy ecosystem encourages entrepreneurship among young people and women as a bottom-up phenomenon. Morocco's development success has been conducted through a state-directed, top-down approach. The creation of MSMEs for green industrial manufacturing and sustainable solutions that started at the beginning of the current decade represents a new third wave of development in Morocco's start-up ecosystem. In this new phase, the study finds that these top-down institutions need to adapt their approach to generate and support a self-sustaining, bottom-up dynamic where green industry and MSMEs in adjacent sectors create sufficient opportunities for employment and soft skill development to stimulate the growth of more MSMEs that will, in turn, do the same.

One of the major findings of this study is that in achieving the goal of generating and supporting a self-sustaining, bottom-up dynamic, Morocco's fertilizer manufacturing giant the OCP Group (originally, Office Chérifien des Phosphates) and its constellation of subsidiaries and associated entities play a central and critical role. The hub for most of these OCP-affiliated entities is the OCP-funded Mohamed VI Polytechnic University (UM6P), which houses sustainable development "next industries" investor and developer InnovX, the Green Energy Park platform for renewable energy testing, research, and innovation, and Al Moutmir organization for extension services to farmers, among several other smaller yet important initiatives such as the StartGate innovation and entrepreneurship laboratory and the 1337 school for coding. InnovX is emerging as a central coordinating mechanism as the company serves as the instrument to fulfill Morocco's ambition to become a global provider of sustainable development solutions. Reflecting InnovX's central role, the pioneering start-up support and venture capital

investor UM6P Ventures has been made a subsidiary of the holding company.

InnovX is also a central partner for Al Moutmir in the development and diffusion of technological innovation in the agricultural sector. Al Moutmir is a key institution in reaching women and young people in rural areas through its assistance to farmers with innovative technologies and best practices to transition to sustainable agriculture as well as by providing entrepreneurship training to encourage young people and women to run their own businesses through retail services and sales connected to the agricultural sector.

One positive indicator concerning the OCP/UM6P constellation's orientation toward expanding women and youth employment is that the qualitative field research conducted for this study found that OCP and its associated entities, many of which are now housed at UM6P, have registered impressive achievements for diversity and inclusion across the board in their own organizations, as will be discussed below. In 2019, just prior to OCP's reorganization of the constellation of affiliated entities to develop the company's green industrial manufacturing and sustainable solutions businesses, OCP had already raised the percentage of women in senior management positions to 32% across the company.⁵

As will be shown, the growth of the renewable energy sector, by empowering the green industrial manufacturing and sustainability solutions sectors, will expand employment opportunities in Morocco. The extent to which these opportunities will be extended to women, youth, and rural populations depends to a large extent on the coordination between the country's green energy and training ecosystems. To broadly expand employment opportunities through the new third wave of MSMEs created via the OCP constellation, other holding companies, or as independent start-up ventures will require training ecosystems that help overcome the particular challenges facing women and youth in low-income urban and rural areas.

5. "Fact Sheet Diversity & Inclusion," OCP, June 2021, https://ocpsiteprodsa.blob.core.windows.net/media/2021-06/K_OCP%20Factsheet%20Diversity%20&%20Inclusion_G.pdf.

Renewable Energy and Morocco's Green Energy Ecosystem

Morocco is at the forefront of renewable energy development in the MENA region. In 2022, when it was rated as the most attractive renewable energy investment market, renewable power accounted for 38% of the country's installed power generation capacity, far outpacing the other nations of the region. Solar and wind power accounted for a combined 21.3% of the kingdom's 2022 total installed capacity, with hydroelectric power comprising 16.7%.⁶ While Morocco's 2022 wind power capacity stood at 1.77 gigawatts (GW) and solar was at 1.43 GW, solar power capacity will soon surpass wind power in the kingdom. Morocco's solar power development program consists of a cluster of "Noor" solar power projects spread across the country, with its flagship Noor I, II, and III facilities projected to have a combined installed capacity of 1.6 MW.⁷ Morocco's wind power program is distributed over nine projects across the country.⁸ With an emphasis on solar power development, Morocco is slated to add about 6.5 GW of solar and wind power by 2027. The \$5.6 billion construction effort will help Morocco meet

6. "Renewable Energies," Ministry of Energy Transition and Sustainable Development, accessed September 2024, <https://www.mem.gov.ma/en/Pages/secteur.aspx?e=2>.

7. "RE Projects Map," MASEN, 2019, <https://www.masen.ma/en/projects>; "Noor Midelt I," MASEN, 2019, <https://www.masen.ma/en/projects/noor-midelt-i>; "Noor Ouarzazate: The world's largest concentrated solar power plant built in Morocco," ESFC, accessed September 2024, <https://esfccompany.com/en/articles/solar-energy/noor-ouarzazate-the-world-s-largest-concentrated-solar-power-plant-csp-built-in-morocco/>; "Morocco set to award new solar power deal: report," *Zawya*, August 2, 2023, <https://www.zawya.com/en/projects/utilities/morocco-set-to-award-new-solar-power-deal-report-cuf64g7u>; Ahmed Eljehtimi, Angus McDowall and Jonathan Oatis, "Morocco tenders for 400 MW solar plant in Atlas Mountains," *Reuters*, August 9, 2023, <https://www.reuters.com/business/energy/morocco-tenders-400-mw-solar-plant-atlas-mountains-2023-08-09/>.

8. "RE Projects Map," MASEN; "Programme Eolien Intégré - 850 MW," ONEE, accessed September 2024, <http://www.onee.org.ma>.

its 2030 target of renewables comprising 52% of its power generation capacity.⁹

Beyond these projects, the development of newer renewable power mega-projects is being directly driven by the needs of Morocco's green energy ecosystem and international renewable energy supply chains. For example, Morocco's largest wind power facility is being developed by Total Eren, a wholly owned subsidiary of French energy giant TotalEnergies,¹⁰ as part of the company's \$10 billion green ammonia mega-project in Morocco's Guelmim-Oued Nour region. The dedicated 5 GW wind farm, along with a dedicated 5 GW solar power complex, will take advantage of the region's near constant nighttime winds to provide virtually 24/7 renewable power to the green ammonia plant.¹¹ Similarly, the ambitious Morocco-to-UK Xlinks interconnector involves the construction of 11.5 GW of dedicated renewable power. The \$20 billion project is developing 8 GW of solar power and 3.5 GW of wind power in the Guelmim-Oued Nour region to supply the United Kingdom with near 24/7 electricity via a 3.6 GW interconnector between the two countries.¹² Despite the technological challenges involved

9. Abdellah Erraji, "Morocco Has Invested \$5.6 Billion in Renewable Energy Projects," *Morocco World News*, July 28, 2023, <https://www.moroccoworldnews.com/2023/07/356723/morocco-has-invested-5-6-billion-in-renewable-energy-projects>.

10. Abdoullah Diop, "Energies renouvelables : après 5 années d'alliance stratégique, TotalEnergies acquiert entièrement Total Eren," *Agence Ecofin*, July 26, 2023, <https://www.agenceecofin.com/energies-renouvelables/2607-110644-energies-renouvelables-apres-5-annees-d-alliance-strategique-totalenergies-acquiert-entierement-total-eren>.

11. Jihane Rahhou, "Total Eren to Launch Green Hydrogen Megaproject in Morocco," *Morocco World News*, February 4, 2022, <https://www.moroccoworldnews.com/2022/02/346892/total-eren-to-launch-green-hydrogen-megaproject-in-morocco>; "The Status of Wind in Africa, GWEC, October 2023, <https://gwec.net/wp-content/uploads/2023/10/Status-of-Wind-in-Africa-Report-V4.pdf>.

12. "The Morocco - UK Power Project," Xlinks, 2024, <https://xlinks.co/morocco-uk-power-project/>; "The Status of Wind in Africa," GWEC, 2023.

with laying undersea, high-voltage cables that will need to traverse the formidable distance of 3,800 km, the Xlinks project is on track to be completed in 2030 and supply about 8% of the UK's power demand.¹³

Morocco's development of infrastructure for the generation and storage of power from renewable energy sources is conducted as an integral part of the country's efforts to develop sustainable and high-value-added industrial and agricultural production. Reflecting a holistic strategic vision, the four key state pillars of Morocco's efforts are managed under the Ministry of Energy Transition and Sustainable Development (formerly the Ministry of Energy, Mines, and the Environment): Morocco Agency for Sustainable Energy (MASEN); Institute for Research for Solar Energy and New Energies (IRESEN); National Office of Electricity and Potable Water (ONEE); and OCP, the world's largest producer of phosphate products and the world's fourth largest exporter of fertilizers.

With the exception of OCP, which was re-organized in 2008, the state institutional framework of Morocco's green energy ecosystem was initiated in 2010 with the creation of MASEN as a private company with public funding to oversee the development of the massive, multi-phase Noor solar energy power generation project. IRESEN was created in 2011 as the research arm of a national energy program across the entire spectrum of the value chains within Morocco's green energy ecosystem, including solar energy systems, green hydrogen systems, and electric mobility.¹⁴ IRESEN oversees a network of green energy research and innovation platforms and funds of applied research and collaborative innovation projects, helping to propel Morocco toward the forefront of next-generation green energy technology development.¹⁵ IRESEN's board includes members from the Ministry

13. Pramod Kumar, "Morocco invests \$5.6bn in clean energy projects," AGBI, July 31, 2023, <https://www.agbi.com/energy/2023/07/morocco-invests-6bn-in-clean-energy-projects/>.

14. "Qui sommes-nous?" IRESEN, accessed September 2024, <https://iresen.org/institut/>

15. "Qui sommes-nous ?" IRESEN, 2024.

of Energy Transition and Sustainable Development, MASEN, ONEE, and OCP, as well as several other key state institutions, including the mining sector's National Office of Hydrocarbons and Mines and the state-owned mining company Managem.¹⁶ IRESEN's flagship institute, the Green Energy Park, is located adjacent to the UM6P campus and is involved in supporting OCP's deployment of solar power infrastructure. Following IRESEN, ONEE was formed in 2012 through integration of the National Office of Electricity (created in 1963) and the National Office of Drinking Water (created in 1972), reflecting Morocco's ambition to manage its energy system to provide sufficient water for human consumption as well as its growing industrial and especially agricultural sectors. Several of the smaller solar projects across the kingdom were or are being developed by ONEE.¹⁷

Given the scale of Morocco's challenges in coping with extreme water stress, Rabat has prioritized water desalination, creating greater impetus for the deployment of renewable power generation infrastructure. Since agriculture accounts for upwards of 88% of water consumption in Morocco,¹⁸ the establishment of the country's green energy ecosystems has emerged through efforts to use renewable energy to ensure the resilience of agri-food production. To ensure sufficient water for agriculture as well as human consumption in the face of increasing water stress due to climate change, Morocco adopted a \$40 billion National Water Plan 2020-2050 that includes the construction of more desalination plants.¹⁹

16. "Qui sommes-nous ?" IRESEN, 2024.

17. "RE Projects Map," MASEN; ONEE, accessed September 2024, <http://www.one.org.ma>.

18. Susie Webb, "Morocco's Water-Intensive Crops Industry Faces Questions Amid Water Shortages," *Morocco World News*, April 23, 2023, <https://www.morocoworldnews.com/2023/04/355127/moroccos-water-intensive-crops-industry-faces-questions-amid-water-shortages>.

19. "Head of Government: 2020-2050 National Water Plan, Roadmap to Face Challenges for Next 30 Years," Maroc.ma, December 25, 2019, <https://www.maroc.ma/en/news/head-government-2020-2050-national-water-plan-roadmap-face-challenges-next-30-years>.

These additional desalination plants will ultimately require new power generation capacity from renewable energy sources (or possibly power). In 2024, OCP undertook an initiative to develop and deploy modular desalination plants to supply its operations and to provide drinking water to local populations.

Morocco's green energy ecosystem is anchored in the food-water-energy nexus, with OCP playing a central role because of its phosphate mining and fertilizer production operations. Morocco sits on 73% of the world's phosphate rock reserves from which the phosphorus used in synthetic fertilizers is derived.²⁰ Prior to the 2021 natural gas price shocks, OCP's total revenue in 2020 amounted to \$5.94 billion,²¹ accounting for about 20% of the kingdom's export revenues.²² Due to a global upsurge in demand, the fertilizer giant's 2023 revenue stood at \$9 billion. The sustainability of OCP's operations through achieving energy transition is a matter of national interest and has placed OCP in an increasingly prominent role in leading the development of Morocco's green energy ecosystem and capabilities as a global sustainable development solutions provider.²³

OCP covers 89% of the energy needs for its phosphate and phosphorus fertilizer production through co-generation (re-using exhaust energy to create cleaner

20. M. Garside, "Phosphate rock reserves worldwide in 2021, by country," Statista, March 15, 2022, <https://www.statista.com/statistics/681747/phosphate-rock-reserves-by-country/>.

21. "Sustainability Report 2020," OCP, August 2021, https://ocpsiteprodsa.blob.core.windows.net/media/2021-08/OCP-Sustainability_report_2020-GRI_certified.pdf.

22. "Fitch Revises Outlook on OCP to Stable; Affirms at 'BB+,'" *Fitch Ratings*, October 28, 2020, <https://www.fitchratings.com/research/corporate-finance/fitch-revises-outlook-on-ocp-to-stable-affirms-at-bb-28-10-2020>.

23. Michael Tanchum, "Morocco's New Challenges as a Gatekeeper of the World's Food Supply: The Geopolitics, Economics, and Sustainability of OCP's Global Fertilizer Exports," Middle East Institute (MEI), January 18, 2022, <https://www.mei.edu/publications/moroccos-new-challenges-gatekeeper-worlds-food-supply-geopolitics-economics-and>.



Photo above: Untreated phosphate being dropped off at the end of a conveyor belt at OCP’s Marca factory near Laayoune, the capital of Moroccan-controlled Western Sahara, on May 13, 2013. Photo by FADEL SENNA/AFP via Getty Images.

and cheaper power from fossil fuels) and renewable sources and is heading toward covering 100% of its energy needs in this manner.²⁴ To ensure its transition beyond fossil fuels, the company established OCP Green Energy SA in 2022 as a wholly owned subsidiary to develop the company’s renewable energy generation activities, committing an investment of \$13 billion during the period of 2023 to 2027.²⁵ Dedicated solar plants are being built in the mining towns of Benguerir

and Khouribga, home to Morocco’s largest phosphate reserves, as well as in other locations.

OCP’s central role in renewable energy and green tech development has been boosted by Morocco’s rise as a global leader in green hydrogen production, prompted by the objective of using its derivative green ammonia to supply the company’s lucrative fertilizer manufacturing. Morocco’s lack of natural gas reserves places a limiting factor on the resilience of OCP’s fertilizer production, which requires ammonia, now produced from natural gas-derived hydrogen. The process to produce conventional hydrogen from natural gas discharges considerable amounts of carbon dioxide (CO₂) into the atmosphere and is termed “gray” hydrogen. In contrast, green hydrogen is produced by using electricity generated from renewable sources to split water into its hydrogen and oxygen components, creating a carbon-free (hence, “green”)

24. Oumaima Latrech, “OCP Group: Green Hydrogen, Ammonia is the Future of Energy,” *Morocco World News*, June 23, 2022, <https://www.moroccoworldnews.com/2022/06/349881/ocp-group-green-hydrogen-ammonia-is-the-future-of-energy>.

25. “OCP Group launches a \$13 billion Green Investment Strategy,” OCP, December 16, 2022, <https://www.ocpgroup.ma/news-article/ocp-group-launches-its-new-green-investment-program-2023-2027>.

hydrogen that can then be combined with nitrogen from the atmosphere to produce green ammonia. Prior to the outbreak of the 2022 Russia-Ukraine war, OCP needed to import 1.5 to 2 million tons of ammonia per year to meet its production requirements.²⁶ Since the war, OCP is eyeing a 58% increase in its production capacity to fill European and global fertilizer supply shortfalls.²⁷ To create sustainable and resilient production for exports, Morocco will ultimately need to replace its imported ammonia made from gray hydrogen with green ammonia produced locally, powered by its solar and wind energy resources.

OCP made hydrogen import replacement one of its top priorities, announcing its plans in 2023 to construct a \$7 billion green ammonia plant to help the company replace its annual import of \$2 billion of gray ammonia.²⁸ With an initial annual production capacity of 200,000 tons by 2026, OCP is aiming to raise its own green ammonia production to 1 million tons by 2027 and reach 3 million tons by 2032.²⁹ In February 2024, InnovX launched its Hydrojeel subsidiary to develop OCP's green ammonia production to ensure the sustainability of its fertilizer manufacturing.³⁰

26. Julie Chaudier, "Will Hydrogen fuel Morocco's industrial projects of the future?" *The Africa Report*, September 6, 2021, <https://www.theafricareport.com/124184/will-hydrogen-fuel-moroccos-industrial-projects-of-the-future/>.

27. "Exportations d'engrais: une double opportunit  pour le Maroc," *Medias24*, 5 July 5, 2022, <https://medias24.com/2022/06/05/engrais-une-double-opportunit -pour-le-maroc/>.

28. Ahmed Eljechtmi, "Morocco's OCP plans \$7 billion green ammonia plant to avert supply problems," *Reuters*, June 20, 2023, <https://www.reuters.com/sustainability/climate-energy/moroccos-ocp-plans-7-mln-green-ammonia-plant-avert-supply-problems-2023-06-20/>.

29. Ahmed Eljechtmi, "Morocco's OCP plans \$7 billion green ammonia plant to avert supply problems," 2023.

30. "INNOVX announces the launch of Hydrojeel, a new subsidiary dedicated to green hydrogen and gen ammonia," InnovX, February 27, 2024, <https://innovx.ma/newsroom/innovx-announces-the-launch-of-hydrojeel-a-new-subsiary-dedicated-to-green->

hydrogen-and-green-ammonia/

Green hydrogen, when transported in the form of seaborne shipments of green ammonia, is a versatile energy carrier for the export of renewable energy. Green hydrogen may be used directly as a fuel or feedstock for industrial manufacturing processes or can provide on-demand, climate-smart power by reversing the electrolysis process in a fuel cell, which generates electric current by recombining green hydrogen and oxygen back into water. Beyond supplying fertilizer production, Morocco and its European partners are eyeing the export of green ammonia to Europe for industrial manufacturing processes and as fuel ammonia. In addition to the Total Eren green ammonia project, there are several other private sector development projects backed by Portugal, the Netherlands, and the European Union.³¹ Morocco's largest green ammonia project under development is the Irish-Portuguese HEVO facility, which is slated to have an initial annual capacity of 183,000 tons by 2026, equivalent to approximately 10% of OCP's production input requirements.³² Rabat signed a memorandum of understanding (MoU) with Dutch oil trading giant Vitol to market the green ammonia in Europe.³³ The Netherlands, the world's second largest food exporter and the EU's largest fertilizer consumer per hectare, itself provided loan guarantees in 2022 for the Dutch green hydrogen firm Proton Ventures to build a green ammonia plant at Morocco's Jorf Lasfar port.³⁴

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31. Michael Tanchum, "The Food-Energy Nexus and Italy-Morocco Cooperation," Istituto Affari Internazionali (IAI), March 6, 2023, <https://www.iai.it/sites/default/files/iaip2306.pdf>.

32. Tanchum, "Morocco's New Challenges as a Gatekeeper," 2022.

33. Ruth Sharpe, "Morocco outlines plans for new green ammonia project," *Argus Media*, July 20, 2021, <https://www.argusmedia.com/en/news/2235820-morocco-outlines-plans-for-new-green-ammonia-project>.

34. Yahya Benabdellah, "Le projet pilote de production d'ammoniac vert ouvre de grandes perspectives pour le Maroc," *Medias24*, September 4, 2022, <https://medias24.com/2022/09/04/le-projet-pilote-de-production-dammoniac-vert-ouvre-de-grandes-perspectives-pour-le-maroc/>; Rianne, "UM6P and Proton Ventures sign an agreement for the

Also in 2022, the Netherlands initiated the development of a new green ammonia import terminal in Rotterdam's Maasvlakte port to handle green ammonia imports to Europe starting in 2026.³⁵ With the completion of the projects currently under development, Morocco could export over 1-3 million tons of green hydrogen or its green ammonia equivalent to Europe annually.³⁶ Since fertilizers and hydrogen imports form two of the six initial sectors targeted under the EU's Carbon Border Adjustment Mechanism (CBAM),³⁷ the development of green ammonia capacity is a matter of urgency for both Morocco and its EU member state customers.

On April 8, 2024, OCP signed a joint venture agreement with Fortescue Energy, the green hydrogen arm of Australian energy, mining, and metals processing giant Fortescue, to partner in the development of "large-scale integrated green ammonia and green fertilizer production capacity" in Morocco to supply Morocco, Europe, and other international markets.³⁸ The agreement also articulates the goal to develop facilities in Morocco for "manufacturing

construction of the Green Ammonia Pilot in Jorf Lasfar," Proton Ventures, July 25, 2021, <https://protonventures.com/press-release/um6p-and-proton-ventures-sign-an-agreement-for-the-construction-of-the-green-ammonia-pilot-in-jorf-lasfar/>.

35. Elliot Connor, "Chariot's \$3.5 Billion Mauritania-based Green Hydrogen Project Secures European Export Route," *Energy Capital & Power*, May 5, 2022, <https://energycapitalpower.com/chariots-3-5-billion-mauritania-based-green-hydrogen-project-secures-european-export-route/>.

36. Michael Tanchum, "Africa's maritime hydrogen highways could enrich the continent and save the world," *The National*, December 13, 2023, <https://www.thenationalnews.com/opinion/comment/2023/12/13/africas-maritime-hydrogen-highways-could-enrich-the-continent-and-save-the-world/>.

37. "Carbon Border Adjustment Mechanism," European Commission, accessed September 2024, https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en#sectoral-information.

38. "OCP and Fortescue to partner to develop green energy, hydrogen and ammonia in Morocco," Fortescue, April 8, 2024, <https://fortescue.com/news-and-media/news/2024/04/08/ocp>.

of green technology and equipment" with the involvement of OCP-affiliated InnovX. Observing that the agreement "intend[s] to create in Morocco one of the world's leading integrated renewable energy, manufacturing, and technology enterprises," Fortescue Energy's CEO asserted that the joint-venture partnership will create "thousands of jobs and industries in Morocco."³⁹

In addition to green hydrogen, Morocco's agri-food and automotive exports to Europe could form the basis of Morocco-to-Europe renewable energy supply chains, with production powered, in part or entirely, by electricity generated from renewable energy resources. Morocco's agri-food sector now accounts for about 21% of its exports by value.⁴⁰ Rabat's Green Generation 2020-2030 plan seeks to enhance the sustainability of agricultural production through the expanded production and use of renewable energy, particularly to power seawater desalination to provide sufficient water for the sector.⁴¹ Seawater desalination typically requires 10 times the amount of energy to produce the same volume of water as conventional surface water treatment,⁴² meaning additional desalination plants will require new power generation capacity from renewable energy sources or possibly nuclear energy.⁴³ The basic inputs for Morocco's

39. "OCP and Fortescue to partner," Fortescue, 2024.

40. European Training Foundation, "Summary Note – The future of skills: A case study of the agri-food sector in Morocco," European Training Foundation, 2021, <https://www.etf.europa.eu/en/publications-and-resources/publications/future-skills-case-study-agri-food-sector-morocco>.

41. Lahcen Mokena, "Morocco's King Launches 'Green Generation 2020-2030'," *Asharq al-Awsat*, February 15, 2020, <https://english.aawsat.com/home/article/2132676/moroccos-king-launches-green-generation-2020-2030>; "Head of Government: 2020-2050 National Water Plan, Roadmap to Face Challenges for Next 30 Years," Kingdom of Morocco, December 25, 2019, <https://www.maroc.ma/en/news/head-government-2020-2050-national-water-plan-roadmap-face-challenges-next-30-years>.

42. Tanchum, "The Food-Energy Nexus," 2023.

43. Michael Tanchum, "Morocco's nuclear option: Russian vs US technological cooperation to power its water scarcity solutions,"



Photo above: Factory employees work on a car assembly line at the Renault-Nissan Tangier Car Assembly Plant in Melloussa, Morocco, east of the port city of Tangiers, on March 12, 2018. [Photo by FADEL SENNA/AFP via Getty Images.](#)

agri-food production — water and fertilizer — will be increasingly produced using renewable energy, greening its agri-food exports to Europe and elsewhere.

Green mobility, in the form of EV manufacturing, constitutes a rising industrial pillar of Morocco's green energy ecosystem. The automotive industry accounts for about 25% of the kingdom's GDP.⁴⁴ With annual

production capacity to top 1 million vehicles by 2025,⁴⁵ Morocco is eyeing the production of 250,000 electric cars per year.⁴⁶ European automakers Groupe Renault and Groupe PSA (now part of the Stellantis conglomerate) operate manufacturing plants in the kingdom that are supplied by 250 international firms from the United States, Europe, Japan, China, and elsewhere, each operating their own local manufacturing plants to supply automotive components. Some of the specialty component factories are SMEs. The European market accounts for 90% of

Middle East Institute (MEI), August 10, 2023, <https://www.mei.edu/publications/moroccos-nuclear-option-russian-vs-us-technological-cooperation-power-its-water>.

44. "Morocco's Neo Motors launches its cars in the market," *North Africa Post*, December 4, 2023, <https://northafricapost.com/73455-moroccos-neo-motors-launches-its-cars-in-the-market.html>; "Automotive," *Morocco Now*, accessed September 2024, <https://www.morocconow.com/automotives>.

45. Michael Tanchum, "Morocco's green mobility revolution: The geo-economic factors driving its rise as an electric vehicle manufacturing hub," Middle East Institute (MEI), August 26, 2022, <https://www.mei.edu/publications/moroccos-green-mobility-revolution-geo-economic-factors-driving-its-rise-electric>.

46. Tanchum, "Morocco's green mobility revolution," 2022.

Morocco's exports,⁴⁷ with Europe's two best-selling car models — the Peugeot 208 and Renault's Dacia Sandero — made in Morocco.⁴⁸ The manufacture of their EV versions on Moroccan soil is a near-term likelihood.⁴⁹ Already, Germany's Opel and Italy's Fiat have begun the production of EV models in Morocco.⁵⁰

The European Commission's July 2021 directive to phase out all fossil fuel-powered vehicles in the EU by 2035 makes green mobility another Moroccan national priority.⁵¹ The use of renewable energy in any aspect of production would lower the carbon footprint of Moroccan EV exports. The kingdom's rise as an EV manufacturing giant hangs on the local production of lithium ion batteries, which represent 30% to 40% of the cost of the average EV.⁵² Morocco's massive phosphate reserves again come into play as the EV industry is shifting away from lithium batteries using nickel, manganese, and cobalt to lithium iron phosphate (LFP) batteries.⁵³ By manufacturing LFP

batteries, Morocco would enjoy a cost advantage of upward of 70% per kilogram.⁵⁴ Morocco would need to expand its phosphate and phosphoric acid production to make LFP EV batteries, especially to avoid demand pressure competition from fertilizer production requiring OCP's additional output of phosphates and phosphoric acid to be powered by renewable energy sources. Morocco's renewable power also provides another competitive advantage as it helps automakers meet their own targets for reducing the carbon footprint of their operations. Renault, for example, has set carbon reduction goals for its EV batteries of 20% by 2025 and 35% by 2030, compared to 2020 levels.⁵⁵

To expand the Chinese presence in the Moroccan automotive ecosystem and expand market share in the European EV market, several Chinese EV manufacturers have made substantial investments in local EV battery production facilities. In early June 2024, China's Gotion High Tech signed an agreement with the Moroccan government to build the kingdom's first EV battery gigafactory.⁵⁶ The \$1.3 billion facility, to be built near Peugeot's plant in Kenitra, will have initial battery capacity of 20 gigawatt hours (GWh) with a future expansion to 100 GWh that would raise the total investment to \$6.5

47. "Voici à Quoi Pourrait Ressembler la Première Gigafactory de Batteries au Maroc," *Medias24*, August 10, 2022, <https://medias24.com/2022/08/10/voici-a-quoi-pourrait-ressembler-la-premiere-gigafactory-de-batteries-au-maroc/>.

48. Jack Warrick, "Best-selling cars in Europe," *Autocar*, February 15, 2024, <https://www.autocar.co.uk/car-news/new-cars/best-selling-cars-europe-2022>.

49. Tanchum, "Morocco's green mobility revolution," 2022.

50. Michael Tanchum, "Why North Africa is a natural choice for Brics expansion," *The National*, August 25, 2023, <https://www.thenationalnews.com/weekend/2023/08/25/brics-north-africa/>.

51. Robert Perkins, "EU set to sideline ICE vehicles by 2035 with tougher car emissions proposal," *S&P Global*, July 14, 2021, <https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/071421-eu-set-to-sideline-ice-vehicles-by-2035-with-tougher-car-emissions-proposal>.

52. Tanchum, "Morocco's green mobility revolution," 2022.

53. For example, Tesla announced in its Q3 2021 report, "For standard range vehicles, we are shifting to Lithium Iron Phosphate (LFP) battery chemistry globally." SEC, October 20, 2021, https://www.sec.gov/Archives/edgar/data/1318605/000156459021051307/tsla-ex991_85.

htm#:~:text=The%20third%20quarter%20of%202021,margin%20in%20low%20teens%E2%80%9D.

54. "Lithium Iron Phosphate on the QuantumScape Solid-State Lithium-Metal Platform," QuantumScape, September 7, 2021, <https://www.quantumscape.com/resources/blog/lithium-iron-phosphate-on-the-quantumscape-solid-state-lithium-metal-platform/>.

55. "Voiture électrique: Renault sécurise ses approvisionnements de cobalt au Maroc," *LaTribune*, June 2, 2022, <https://www.latribune.fr/entreprises-finance/industrie/automobile/voiture-electrique-renault-securise-ses-approvisionnement-de-cobalt-au-maroc-920283.html>.

56. "China's Gotion High Tech to set up \$1.3 billion EV battery gigafactory in Morocco," *Reuters*, June 6, 2024, <https://www.reuters.com/business/autos-transportation/chinas-gotion-high-tech-set-up-13-billion-ev-battery-gigafactory-morocco-2024-06-06/>.

billion.⁵⁷ In addition to complete batteries, the plant will also produce cathode and anode components for export, further cementing Morocco's position in the EV battery supply chain.

The Gotion deal follows the May 2024 announcements by Chinese auto battery manufacturers Hailiang and Shinzoom of their respective plans to set up two separate plants in the Tangier automotive manufacturing region. Hailiang plans to build a \$450 million copper plant spanning 30 hectares while Shinzoom will construct a \$460 million anode plant over a 20-hectare region.⁵⁸ These plans were preceded by Chinese electric battery maker BTR New Material Group's agreement with the Moroccan government to build a \$300 million cathode manufacturing plant with an annual production capacity of 50,000 tons, with an initial production phase of 25,000 tons to become operational in September 2026.⁵⁹ BTR's EV cathode factory is expected to employ 2,500 Moroccans.⁶⁰ Subsequently in August 2024, BTR agreed to open a second \$364 million plant in Tangier to produce 60,000 tons of anodes.⁶¹

The spate of 2024 agreements builds on the foundational September 2023 agreement between China's CNGR

Advanced Materials and Morocco's Al Mada holding company to form a comprehensive joint venture to produce cathode active material (CAM) precursors for EV batteries as well as LFP batteries and to recycle black mass from used batteries.⁶² With Al Mada holding a 50.03% stake and CNGR holding a 49.97% stake, phased production is slated to begin in Q4 2024 and ultimately reach an annual production of 120,000 tons of CAM precursors, 60,000 tons of LFP, and 30,000 tons of black mass recycling.⁶³

Morocco's recycling of end-of-life EV batteries can significantly reduce the carbon footprint of EV battery production. In 2022, global mining and metal trading giant Glencore entered into a partnership with Morocco's mining company Managem, a subsidiary of Al Mada, to produce recycled cobalt from disused lithium-ion batteries at Managem's hydrometallurgical refining facilities operated by its subsidiary Compagnie de Tifnout Tighanimine (CCT).⁶⁴ Glencore will provide CCT with black mass processed from dismantled and shredded Li-ion batteries. In addition to cobalt, the partnership is also seeking to extract lithium carbonate from the black mass supplied by Glencore. If the recycling processes of any of Morocco's black mass recycling partnerships are powered with renewable energy, the country could further reduce the carbon footprint of its manufactured Li-ion batteries to achieve a significant market advantage.

Beyond EV battery metals, Morocco could also develop other green metal production for automotive components and car bodies. In December 2022, steelmaker Sonasid, jointly owned by ArcelorMittal and Al Mada, produced the country's first consignment of green steel with 100%

57. "China's Gotion High Tech," *Reuters*, 2024.

58. Ahmed Eljechtimi, "China's Hailiang, Shinzoom to build auto battery plants in Morocco," *Reuters*, May 15, 2024, <https://www.reuters.com/business/autos-transportation/chinas-hailiang-shinzoom-build-auto-battery-plants-morocco-2024-05-15/>.

59. "China EV battery maker BTR to build cathode plant in Morocco," *Reuters*, March 29, 2024, <https://www.reuters.com/business/china-ev-battery-maker-btr-build-cathode-plant-morocco-2024-03-29>.

60. Safaa Kasraoui, "China's BTR Group Announces \$366 Million Lithium-ion Battery Plant in Morocco," *Morocco World News*, April 15, 2024, <https://www.morocroworldnews.com/2024/08/364587/chinas-btr-group-announces-366-million-lithium-ion-battery-plant-in-morocco>.

61. Latifa Babas, "BTR to invest \$363.5 million in new anode materials plant in Morocco," *Yabiladi*, August 15, 2024, <https://en.yabiladi.com/articles/details/153079/invest-million-anode-materials-plant.html>.

62. "CNGR to Build Battery Materials Factory in Morocco," *Battery News*, September 21, 2023, <https://battery-news.de/en/2023/09/21/cngr-to-build-battery-materials-factory-in-morocco/>.

63. "CNGR to Build Battery Materials Factory," *Battery News*, 2023.

64. "Glencore & Managem set up partnership for Moroccan production of cobalt from recycled battery materials," Glencore, January 26, 2022, <https://www.glencore.com/media-and-insights/news/glencore-and-managem-set-up-partnership>.

of the material recycled in Morocco and 85% of the processing powered by renewable energy.⁶⁵ While Morocco has not yet produced green aluminum, it has advanced in aluminum recycling with the 2024 inauguration of an aluminum waste recovery plant.⁶⁶

Green mining, metals processing, and manufacturing powered by renewable energy will require components and equipment that can be manufactured by SMEs or serviced by them. Similarly, the components involved in the storage and transport of green hydrogen and green ammonia, such as short-distance pipes, compressors, pumps, and heat exchangers, can be manufactured or serviced by SMEs in Morocco. As will be discussed below, SMEs have already started to undertake the manufacture of components for solar power production and utilization to start solar cell and solar panel manufacturing in Morocco. These developments indicate that adjacent sectors of retail services, such as installation and maintenance, as well as retail sales will become a robust source of employment opportunities as part of the new third wave of development of Morocco's start-up ecosystem.

Green Manufacturing Entrepreneurship and the Evolution of Morocco's Start-up Ecosystem: Innovation and Expanding Beyond Innovation

The expansion of renewable energy-related green manufacturing, as well as the growth of related retail services and sales businesses, has prompted the

65. "Fibre en acier," Sonasid, accessed September 2024, <https://www.sonasid.ma/fr/fibre-en-acier>; S. BA. "Sonasid, premier sidérurgiste marocain à obtenir la certification EPD," *Le Matin*, December 8, 2023, <https://lematin.ma/economie/sonasid-premier-siderurgiste-marocain-a-obtenir-la-certification-epd/203911>.

66. "Metal Waste Recovery Alucop Inaugurates a New Plant in Morocco," *Afrik21*, May 7, 2024, <https://www.afrik21.africa/en/metal-waste-recovery-alucop-inaugurates-a-new-plant-in-morocco/>.

current third wave of development of Morocco's start-up ecosystem toward sustainable solutions providers that can service both domestic and international markets. The government of Morocco has been forward-leaning and proactive in improving business conditions for MSMEs and start-ups over the past 20 years, witnessing waves of initiatives and various public-private partnerships that have spurred three phases of advancement in the development of Morocco's innovation ecosystem. These advancements serve as the foundation for the holistic effort to expand employment through building a green ecosystem and establishing Morocco as a global sustainable development solutions provider. Building on the accomplishments over the past two decades, the third wave is seeking to leverage the advantages of deep-tech innovation while focusing more broadly on green industrial manufacturing and agri-food production.

Morocco's innovation ecosystem began at the start of the 21st century with a primary focus on developing start-ups in the information and communication technology (ICT) sector in Casablanca, with additional attention paid to the nascent green tech and cultural sectors. One of the oldest pillars of the ecosystem is TechnoPark, founded in 2001 in Casablanca, which came into existence as a result of a public-private partnership that created the Moroccan Information TechnoPark Company (MITC) with the mission to lay the foundations for a cohesive innovation ecosystem. MITC currently operates TechnoPark in four out of Morocco's 12 regions, with aspirations to expand to every region. Since its founding, TechnoPark has supported more than 3,000 start-ups, resulting in the creation of over 15,000 direct and indirect jobs, according to Lamiae Benmakhlof, the company's first female CEO.⁶⁷

The first decade of Morocco's start-up ecosystem also witnessed the establishment of a governmental apparatus to support start-up MSMEs. Shortly after TechnoPark's inception, the Moroccan government created the National Agency for the Promotion of Small and Medium Enterprises (ANPME) within the Ministry of

67. Lamiae Benmakhlof, "Word from Lamiae Benmakhlof," Technopark Maroc, 2022, <https://www.technopark.ma/mot-de-lamiae-benmakhlof/>.

Industry and Trade to regulate and support small and medium enterprises, defined as firms employing fewer than 250 employees.⁶⁸ In 2008, a state agency program contract was implemented to support the competitive modernization of enterprises. During the period 2009-2020, several amendments were made to the state agency contractual framework giving support to business competitiveness and entrepreneurship.⁶⁹ Renamed Maroc PME, the agency developed an additional focus on start-ups and MSMEs “through support, advice and technical assistance actions and targeted and tailor-made investment support that generates added value and employment,” offered through support and guidance programs that are implemented as public-private partnerships with other start-up support entities.⁷⁰

In 2010, Morocco moved forward in the financing of new technology start-ups with the inception of the Maroc Numeric Fund (MNF). An institutional fund with public and private investors that include Tamwilcom (then called Casse Centrale de Garantie or CCG), Attijariwafa Bank, Banque Centrale Populaire, the Bank of Africa (formerly Banque Marocaine du Commerce Extérieur, BMCE), and MITC,⁷¹ the MNF focused on innovative and high-growth potential start-ups in the ICT sector, with a maximum of 20% of its capital invested in other innovative deep technologies, including the biotechnology and green technology sectors.⁷² These green technology developments occurred concurrently with the advent of Morocco’s consolidation of its drive for industrial-scale renewable power production with the 2010 creation of MASEN and the 2011 formation of IRESEN.

The MNF has invested in 17 ventures.⁷³ In 2016, MITC Capital, the management company of the MNF and the OCP Entrepreneurship Network, created MNF Angels to better support technological innovation.⁷⁴ In 2018, the Maroc Numeric Fund II (MNF II) was established with an additional focus on innovative deep technology start-ups with international reach, an early indication of Morocco’s evolving ambition to become a global sustainable development solutions provider.⁷⁵ The MNF II has made six investments in ventures in artificial intelligence (AI) as well the FinTech, LegalTech, and EdTech sectors.⁷⁶ In 2023, MNF II announced it would also fund start-up ventures founded outside Morocco by Moroccans residing abroad.⁷⁷ The decision reflected an awareness of the important role of highly skilled individuals in the Moroccan diaspora in supporting the country’s innovation ecosystem as well as a recognition of the critical need to develop foreign markets for innovation and an incipient sustainability solutions sector.

Morocco’s strategy for developing its innovation ecosystem is also embedded in its economic and soft power engagement with sub-Saharan Africa, with Africa holding great potential as a market for Moroccan sustainability solutions. The orientation reflects OCP’s own success in deeply engaging with the agricultural sectors in numerous nations in sub-Saharan Africa,⁷⁸ as well as UM6P’s

68. “Missions and Values,” MarocPME, 2023, <https://marocpme.gov.ma/missions-valeurs/>.

69. “Missions and Values,” MarocPME, 2023.

70. “Missions and Values,” MarocPME, 2023.

71. “Services,” Maroc Numeric Fund, accessed September 2024, <https://mnf.ma/en/>.

72. “Investment Strategy,” Maroc Numeric Fund, accessed September 2024, <https://mnf.ma/mnf/investment-strategy/#1549646084078-fcd8f581-2544>.

73. “Investment Strategy,” Maroc Numeric Fund, 2024.

74. “MNF Angels,” Maroc Numeric Fund, July 14, 2016, <https://mnf.ma/category/mnf-angels/>; “Business Angels: Un nouveau virage s’amorce,” *Finances News Hebdo*, September 11, 2018, <https://fnh.ma/article/actualite-financiere-maroc/business-angels-un-nouveau-virage-s-amorce>.

75. “Investment Strategy,” Maroc Numeric Fund, 2024.

76. “MNF II announces the extension of its investment strategy to include startups from the Moroccan diaspora,” Maroc Numeric Fund, January 2, 2023, <https://mnf.ma/mnf-ii-announces-the-extension-of-its-investment-strategy-to-include-startups-from-the-moroccan-diaspora/>.

77. “MNF II announces the extension of its investment strategy,” Maroc Numeric Fund, 2023.

78. Tanchum, “Morocco’s New Challenges as a Gatekeeper,” 2022.



Photo above: People attend the 2024 GITEX Africa Tech and Startup show in Marrakech, Morocco, on May 30, 2024. Photo by AFP via Getty Images.

substantial role in educating sub-Saharan Africa’s future scientists, engineers, technicians, and entrepreneurs. The orientation is a growing part of Morocco’s innovation ecosystem as reflected in the activities of Moroccan incubator Impact Lab, which began to expand its activities to the rest of Africa in 2018, and the 2017 founding of the Casablanca-based OutlierZ as an early-stage venture capital fund to support African tech start-ups.⁷⁹ Morocco’s outsized position in Africa’s innovation sector is evident in its annual hosting of GITEX Africa in Marrakech, the largest tech and start-up show on the African continent.⁸⁰

79. “About Us – Accelerating African Innovation for Sustainable Impact,” ImpactLab, 2024, <https://impactlab.africa/about-us/>; “Backing founders reinventing Africa – Africa-focused Seed VC firm,” OutlierZ Ventures, 2023, <https://www.outlierzventures.com/>.

80. GITEX Africa derives from the Dubai-hosted GITEX Global show, with the acronym GITEX derived from Gulf Information

With the patronage of King Mohammed VI, GITEX Africa is under the authority of the minister of digital transition and administrative reform.

Entities such as MNF II, Impact Lab, and OutlierZ were part of Morocco’s second wave of start-up development that emerged in the middle of the previous decade with advances in the global digital marketplace. In parallel, Morocco’s renewable power sector was reaching greater maturity. This period of development serves as the immediate basis for the current holistic approach to develop Morocco’s green energy ecosystem that characterized the third wave of start-up development. Rabat assisted a second wave of start-up development in several ways, most notably through its proactive efforts to improve financing for innovation MSMEs. Access to financing was a serious limitation to start-up creation,

Technology Exhibition, <https://www.gitexafrica.com/>.

despite the relative openness and competitiveness of the Moroccan financial system. Bank loans represent the primary funding source for approximately 68% of Morocco's MSMEs.⁸¹ The Moroccan government and business community have both taken significant action to address the issue.

Morocco's Ministry of Economy and Finance entered into a strategic partnership in 2016 with the country's central guarantee fund, the CCG, to create the Innov Invest Fund, which provided the fund with a mandate to offer seed, early-stage, and venture capital financing services.⁸² To fulfil this function, the CCG transformed in 2021 into a state-owned national company for guarantee and financing of entrepreneurship under the commercial name of Tamwilcom.

StartUp Maroc, founded in 2011 as a start-up accelerator, became certified by the CCG as part of the Innov Invest Fund in 2016, with operations across 17 cities in Morocco providing training and acceleration programs.⁸³ The organization has engaged with over 15,000 aspiring entrepreneurs at the conception phase, resulting in support for more than 300 entrepreneurs from proof of concept to commercialization.⁸⁴ In partnership with Innov Invest, StartUp Maroc now operates its StartUp Maroc 2030 incubator initiative with a mandate to help develop high-potential start-ups and align their business trajectories with Morocco's 2030 sustainable human development goals.⁸⁵ The shape and trajectory of Morocco's start-up ecosystem during the current decade has been highly influenced by

81. "The Innov Invest Fund in Morocco," INSME, accessed September 2024, <https://www.insme.org/the-innov-invest-fund-in-morocco/>.

82. "Faits Marquants," Tamwilcom, accessed September 2024, <https://www.tamwilcom.ma/>.

83. "Increasing the Number of Fundable Startups," StartUp Maroc, accessed September 2024.

84. "Increasing the Number of Fundable Startups," StartUp Maroc, 2024.

85. "Startup Maroc 2030," StartUp Maroc, 2019, <https://www.startupmaroc.org/startup-maroc-2030>.

the activities of the early-stage venture capital firm UM6P Ventures founded in 2019. Transitioning deep-tech and digital start-up projects to established businesses, UM6P Ventures represents both the apex of the second wave of development of the start-up ecosystem in Morocco and part of the foundation of the third wave of development toward sustainable solutions and green manufacturing. Benefitting from the institutional and human capital at UM6P, the firm leveraged its large network of domestic and especially foreign investors, including venture capitalists, business angels, and international programs, for start-up investment. With an investment portfolio that includes ventures in green energy, agriculture, and chemicals, UM6P ventures helped start-ups with advanced talent sourcing, subject domain expertise, and access to specialized equipment and infrastructure, in addition to capital. To provide a high level of assistance, UM6P Ventures partnered with initiatives such as MIT's Sandbox Innovation Fund Program and the Silicon Valley-based Plug and Play.⁸⁶

The third wave of development, characterized by its highly intentional orientation toward industrial-scale green manufacturing and sustainable solutions business, was heralded by the 2022 formation of the OCP-linked company InnovX, brought into existence to rationally and efficiently utilize the resources already developed in Morocco's green energy and start-up ecosystems to create multibillion-dollar green industries.⁸⁷

InnovX has combined start-up investment and venture-builder activities developed during the first and second development phases of Morocco's start-up ecosystem with industrial company management and development. Functioning also as a holding company, InnovX seeks to develop its own SMEs to reach industrial-scale green manufacturing and contribute to the provision of turn-key sustainable solutions. Accordingly, UM6P Ventures itself has been made into a subsidiary of InnovX so that high-potential start-ups in next-generation technologies can

86. "Offers and Programs," UM6P Ventures, 2021, <https://um6pventures.com/offers-and-programs>.

87. "Pioneering the Next Industries," InnovX, 2024, <https://innovx.ma/about-us/>.

be supported in their development as well as feed into InnovX's industrial companies.

InnovX begins with the advantage of having OCP as its in-house customer. The company is technically a subsidiary of UM6P and is charged with utilizing UM6P's assets to support OCP in meeting its net-zero objectives. From this basis, InnovX's ambition is to become one of the world's premier sustainability solutions providers with a focus on five sectors: 1) green energy – developing renewable energy production and power-to-X technologies (i.e., carbon-neutral methods to convert, store, and reconvert/use surplus renewable energy, primarily green hydrogen and green ammonia in this instance);⁸⁸ 2) agritech and water tech – developing climate-resilient agriculture through innovative models and non-conventional water solutions;⁸⁹ 3) chemicals – developing co-product-based materials to support the energy transition (including EV battery materials);⁹⁰ 4) digital – developing digital innovations for sustainability solutions;⁹¹ and 5) social innovation – developing community development challenges through innovation and the creation of “social business” platforms.⁹²

InnovX seeks to capitalize on Morocco's drive to increase its photovoltaic (PV) solar power generation capacity through the end-to-end production of industrial-scale battery storage. InnovX's Mera Batteries is aiming to manufacture 1 GWh of high-quality LFP batteries by 2026.⁹³ A similar approach will be taken by InnovX's new

88. “Energy,” InnovX, accessed September 2024, <https://innovx.ma/sectors/energy/>.

89. “Agriculture and Water,” InnovX, accessed September 2024, <https://innovx.ma/sectors/agriculture-water/>.

90. “Chemicals,” InnovX, accessed September 2024, <https://innovx.ma/sectors/chemicals/>.

91. “Digital,” InnovX, accessed September 2024, <https://innovx.ma/sectors/digital/>.

92. “Social Innovation,” InnovX, accessed September 2024, <https://innovx.ma/sectors/social-innovation/>.

93. “Mera Batteries,” InnovX, accessed September 2024, <https://innovx.ma/businesses/mera-batteries/>.

green hydrogen and green ammonia subsidiary Hydrojeel that, in addition to developing large-scale projects, will also include the co-development of proprietary technologies.⁹⁴ InnovX's chemicals subsidiaries, such as FluorAlpha, are developing production facilities that will create inputs to assist EV battery manufacturing.⁹⁵ Similar endeavors are being conducted in InnovX's agritech and water tech subsidiary, while its digital and social innovation subsidiaries are providing important services that will also help other SMEs.

Through its ecosystems approach to in-house technological development, InnovX seeks to de-risk its operations as it eyes becoming a turn-key sustainable solutions provider on the global market. A similar, although not identical, approach has been successfully used by Sweden's Vargas Holding, which has created the global-scale, low-carbon EV battery manufacturer NorthVolt, battery energy storage system manufacturer Polarium, and cutting-edge green steel manufacturer H2 Green Steel.⁹⁶

To realize its ambitions as a sustainable solutions provider, InnovX will require a sufficiently large skilled workforce to staff its green manufacturing and industrial project development operations. To meet this need, the OCP/UM6P constellation is in the process of revamping OCP's hands-on training centers in the African Academy for Industrial Training (AAIT), headquartered at the UM6P campus in Benguerir.⁹⁷ AAIT currently offers programs in mining operations; chemical operations; industrial maintenance; health, safety, and the environment; supply chain and quality management; and soft skills and project management,⁹⁸ with continuous

94. “Energy,” InnovX, 2024.

95. “Fluoralpha,” InnovX, accessed September 2024, <https://innovx.ma/subsidiaries/fluoralpha/>.

96. “Our Companies,” Vargas Holding, accessed September 2024, <https://www.vargasholding.com/our-companies>.

97. “Nos Valeurs,” African Academy of Industrial Training - UM6P, accessed September 2024, <https://aait.um6p.ma/nos-valeurs/>.

98. “African Academy of Industrial Training,” University Mohammed VI Polytechnic, accessed September 2024, <https://>



Photo above: Mohammed VI Polytechnic University (UM6P) in Rabat, Morocco, in April 2024. Photo by HATIM KAGHAT/BELGA MAG/AFP via Getty Images.

training and certification occurring in the four main geographical locations of OCP's industrial operations: Jorf Lasfar, Safi, Khourigba, and Benguerir. Utilizing the existing training infrastructure, the AAIT is in the process of creating an Agriculture, Green Energy, and Water Institute to develop the training programs for technicians to install, operate, and maintain InnovX's green manufacturing and sustainable solutions businesses.

In addition to InnovX's massive integrated undertaking, the Green Innov Industry Investment holding company, known as Gi3, takes a similar but more limited third wave approach. The senior management of the recently established private holding company brings a record of public sector service in Morocco's renewable energy development with its executive president having served as the managing director of IRESEN and its general

manager having served as the former director of the Green Energy Park.⁹⁹ Gi3 confines its focus to manufacturing components and equipment related to renewable power production, storage, and use in four domains: thermal solar energy use, PV solar power generation, renewable energy storage (including green hydrogen), and green mobility.¹⁰⁰ Gi3 operates an 8,000 sq meter development and manufacturing facility located in the Ain Johra Industrial Park in Tiflet, one hour's drive from Rabat and Kenitra, for solar power-related manufacturing under the MySol brand. In 2023, MySol CES, an SME with about 100 employees, operated the largest solar water heater production facility in Africa. MySol CES has a current annual capacity of 40,000 units with a planned expansion

99. "Management," Gi3, accessed September 2024, <https://gi3.ma/index-en.html#team>.

100. "Holding," Gi3, accessed September 2024, <https://gi3.ma/index-en.html#holding>.

www.um6p.ma/en/african-academy-industrial-training.

to 90,000 units.¹⁰¹ Gi3's MySol PV company is in the process of establishing three production lines for PV solar power components and anticipates an initial annual production capacity for 800 MW of wafers and cells each and 1,000 MW of PV solar modules.¹⁰²

As in the previous two waves of start-up development, the robustness of the third wave ecosystem — one oriented toward green industrial manufacturing within the framework of sustainability — will be influenced by the availability of financing. This is particularly true for new ventures that operate outside the constellation of OCP-affiliated entities. CDG Invest, the investment arm of Caisse de Dépôt et de Gestion (CDG) that manages long-term savings in Morocco, is playing an important pioneering role in developing the third wave, green industrial manufacturing ecosystem. CDG Invest's general mandate is to invest in export industries where there is a gap in private equity funding. Concurrent with the creation of UM6P Ventures in 2019, CDG Invest created the 212 Founders Fund, which accelerated approximately 100 innovation ventures during its four years of activity and invested in 25 of them.¹⁰³ Reflecting the shift toward green industrial manufacturing within the framework of sustainability that also witnessed the OCP-driven creation of InnovX, CDG Invest created a new fund, Generation d'Entrepreneur, for industry and services.¹⁰⁴ In line with the third wave need for financing for new green industrial manufacturing and services ventures, CDG Invest is looking to use the Generation d'Entrepreneur Fund to achieve a demonstration effect by proving that there is a use case for such investments. Working with a 5-10 year time horizon, CDG Invest seeks to also determine the

101. "News," Gi3, accessed September 2024, <https://gi3.ma/index-en.html#news>.

102. Gi3conference presentation, June 11, 2024.

103. "212 Founders," CBInsights, accessed September 2024, <https://www.cbinsights.com/investor/212-founders>; "212 Founders," 212 Founders, accessed September 2024, <https://www.212founders.co/en/212-founders-startups>.

104. "CDG Invest lance le programme 'Génération Entrepreneurs'" Génération Entrepreneurs, accessed September 2024, <https://www.generation-entrepreneurs.ma/>.

correct scale of investment required. Having fielded about 200 applications to date, the Generation d'Entrepreneur Fund functions as both gatekeeper and quality assurance mechanism of the third wave start-up ecosystem. While other financing mechanisms will be necessary to ensure robust participation in the green industrial manufacturing ecosystem, the Generation d'Entrepreneur Fund is a promising development and could serve as a precedent to emulate. The extension of financing for adjacent retail services and sales MSMEs will be important to expand private sector employment opportunities more broadly.

The Green Energy Ecosystem and Employment: Overcoming the Challenges to Extending Employment Opportunities to Women, Youth, and Rural Populations

During the first decade of the 21st century, Morocco's rapid economic transformation witnessed an accelerating rate of income convergence with advanced economies.¹⁰⁵ The positive economic impacts from rapid industrialization, as exemplified by the growth of Morocco's automotive manufacturing sector, began leveling off during the following decade. Although the rate of income convergence has slowed, economic development has continued to advance through 2023. However, the benefits of that advance have not reached significant segments of Morocco's population — primarily young people and women, as reflected in their high unemployment rates and the widespread nature of the informal economy. The expansion of employment opportunities needs to target three distinct segments of the Moroccan population: women with higher education, particularly in science, technology, engineering, and mathematics (STEM); women and youth with lower levels

105. *Morocco's Quest for Stronger and Inclusive Growth*, eds. Roberto Cardarelli and Taline Koranchelian, International Monetary Fund, October 9, 2023, <https://www.elibrary.imf.org/display/book/9798400225406/9798400225406.xml?cid=525734-com-dsp-crossref>.

of education and training in urban areas; and women and youth with lower levels of education and training in rural areas. According to one International Monetary Fund (IMF) study, closing the gender gap in Morocco's labor force participation over the next 50 years would increase income levels by about 20%.¹⁰⁶

Morocco's shift to green industrial manufacturing within the framework of sustainability has been attuned to the need to expand the proportion of citizens engaged in formal, long-term employment. Recognizing that a fundamental shift from its previous development path was required to solve the problems of employment, Rabat promulgated its New Model of Development. The 2021 report of the Royal Commission on the New Model of Development explicitly acknowledged that "[l]arge sections of the population, particularly women and young people, suffer from low participation and exclusion due to a lack of access to opportunities of empowerment and support."¹⁰⁷ The report further affirmed that "[e]conomic transformation must generate more growth and quality jobs to increase the creation of value and ensure the integration of the active population, especially women and young people."¹⁰⁸

To achieve its objectives for women and youth employment, the Royal Commission's report established a series of quantitative targets, which include: doubling by 2035 both GDP per capita and women's labor force participation rate; reducing the share of informal jobs from 60% to 20%; and increasing renewable energy's share of Morocco's total energy consumption from 11% to 40%.¹⁰⁹ In accomplishing these goals, the New Development Model envisions a synergistic convergence between energy transition and women and youth employment.

106. *Morocco's Quest*, IMF, 2023.

107. "The New Development Model – Releasing energies and regaining trust to accelerate the march of progress and prosperity for all – General Report," Kingdom of Morocco, April 2021, https://www.csmmd.ma/documents/CSMD_Report_EN.pdf.

108. "The New Development Model – General Report." Kingdom of Morocco, 2021.

109. "The New Development Model – General Report." Kingdom of Morocco, 2021.

The Green Energy Ecosystem and Employment for Highly Educated Women

The production of and transition to renewable energy through Morocco's green energy system is emerging as a key contributor to high-quality job creation. The expansion of the green industrial manufacturing and sustainable solutions sectors is at the threshold of becoming a driver for more expansive high-quality job creation. Every year, 24,000 young engineers and technicians graduate from Morocco's technology-focused schools.¹¹⁰ Women account for 42.2% of the tertiary education graduates in engineering, and Morocco is among the countries with the highest rate of female engineering graduates worldwide.¹¹¹ For those with high levels of STEM education, large-scale manufacturing has not provided enough jobs, especially to compensate for job losses in the public sector. Even though women's enrollment in secondary and tertiary education has markedly increased in Morocco during the past 20 years, there has been no positive improvement of a commensurate magnitude in the participation of highly educated women in labor markets. The qualitative field research suggests that the private sector deep tech start-ups and the innovation and sustainability sectors more broadly are providing important employment opportunities for women with higher education in STEM fields. For example, the head of research at the Green Energy Park's Thin Film Photovoltaic Laboratory, which is responsible for advancing the development of next generation PV solar cells, is a woman.

The initial results of Morocco's third wave shift toward green industrial manufacturing and sustainability solutions indicate promising employment opportunities for the highly educated, although often those with higher-level STEM training find positions as senior executives and managers due to a general lack of research positions. Overall female representation in the composition of the

110. "Introducing the new global hub for hi-tech engineering," *Morocco Now*, 2022, <https://morocco.country-reports.net/engineering/>.

111. "Introducing the new global hub," *Morocco Now*, 2022.

senior staffs of Morocco’s incubators, accelerators, and capital funds is relatively high. The CEOs of Impact Lab and OutlierZ Ventures, in addition to TechnoPark, are women, while at least 50% of the senior management staff of the MNF and UM6P Ventures are women. UM6P Ventures reflects the wider success in gender inclusion throughout senior management at InnovX as well as most other OCP-affiliated entities. InnovX’s director of strategy and the directors of several of its business divisions are women, as is the director of the AAIT’s new Agriculture, Green Energy, and Water Institute. At Al Moutmir, which has the most active and direct engagement with farmers and rural communities (see discussion below), a woman heads up its “farmer centricity” initiatives. While observably significant, the exact nature of the employment of highly educated women in Morocco’s green energy ecosystem as a whole requires detailed quantitative investigation.

The Green Energy Ecosystem and Urban Youth Employment

Green industrial manufacturing driven by renewable energy has significant potential to hire individuals with low levels of education in urban areas, provided they are able to acquire technical vocational training through an appropriate expansion of Morocco’s training ecosystem in coordination with the needs of the country’s green energy ecosystem. InnovX and the rest of the constellation of OCP-affiliated entities have and will continue to develop their own internal training ecosystem to achieve this end. The various entities involved with the management and further development of this training ecosystem have been consolidated under UM6P with the AAIT’s Agriculture, Green Energy, and Water Institute being one of the most recent additions. UM6P’s innovation and entrepreneurship lab StartGate and its 1337 coding school feed into other parts of the constellation’s ecosystem.¹¹²

112. “StartGate a accueilli la journée inaugurale de la Semaine d’Immersion Globale,” University Mohammed VI Polytechnic (UM6P), May 19, 2024, <https://um6p.ma/fr/startgate-accueilli-la-journee-inaugurale-de-la-semaine-dimmersion-globale>; “Ecole

For MSMEs outside of the OCP constellation — whether developed through holding companies such as Gi3 or as independent start-up ventures — the coordination of the training ecosystem is an even more pressing issue. The issue goes beyond the important matter of technical skills training when considering the need to engage a wider segment of young people and women through the expansion of programs to develop entrepreneurial and soft skills for start-ups MSMEs in retail services and sales sectors adjacent to the green industrial manufacturing. The Moroccan economy, like many other MENA economies, is characterized by a large proportion of young people who are unemployed, outside the educational system, or not engaged in any skill training — a population commonly referred to as NEETs (not in employment, education, or training). The green energy ecosystem will improve urban employment by expanding the training and entrepreneurial support ecosystems to provide the NEET population with skills appropriate for green industrial manufacturing and adjacent retail service and sales sectors.

In 2019, prior to the impact of the COVID-19 pandemic, the youth unemployment rate was at 22.6%.¹¹³ Following a spike in joblessness during the pandemic, Morocco’s 2023 youth unemployment stood at 22.61%, indicating a continuation of the overall rising trend in youth unemployment.¹¹⁴ In 2019, 28.5% of Morocco’s youth were NEETs.¹¹⁵

In Morocco, as elsewhere, labor market success is not exclusively linked to an individual’s human capital, but also is highly influenced by the individual’s social capital and soft

1337,” University Mohammed VI Polytechnic (UM6P), accessed September 2024, <https://www.um6p.ma/en/ecole-1337>.

113. “Morocco: Youth unemployment rate from 2004 to 2023,” Statista, 2024, <https://www.statista.com/statistics/812261/youth-unemployment-rate-in-morocco/>.

114. “Morocco: Youth unemployment rate,” Statista, 2024.

115. Toms Dumpis, “ONDH: 28.5% of Young People Are Not in Education, Employment, Training,” *Morocco World News*, January 29, 2021, <https://www.morocroworldnews.com/2021/01/333680/ondh-28-5-of-young-people-are-not-in-education-employment-training>.

skills. Social capital consists of resources and connections derived from family and social networks, originating with the individual's socio-economic background and place of residence. Soft skills have been defined in the literature as "personal competencies that allow one to harmonize relationships with others and to live well and confidently at work in a spirit of cooperation, to be enterprising in the broadest sense, and to be able to take initiatives in order to accomplish the objectives of the employment relationship."¹¹⁶ Critical thinking, resilience, and the ability to constructively interact with a complex professional environment comprise key elements of soft skills.

With increasing technological change and automation in Morocco, soft skills are becoming increasingly paramount for employment. Soft skills function to a certain extent as an equalizer, compensating in part for a lack of social capital. Outside of the technical skills positions, MSMEs in green industrial manufacturing and adjacent retail services and sales require individuals who can perform open-ended tasks that require flexibility, creativity, and judgment. Soft skills are increasingly fundamental for the transition from education to employment and for sustained employment. The ability of individuals to avoid falling into the NEET population or to transition out of it is heavily influenced by whether or not they possess soft skills. These are a gatekeeper for entry into the third wave ecosystem for those without technical skills.

Soft skills are often learned or honed through working in start-up MSMEs. Incubators and accelerators need to focus on developing soft skills, while all components of the training ecosystem should be encouraged to develop internships as a method of diffusing their acquisition. While attention to skills requirements occurs in incubators and accelerators, there is a natural bias toward technological innovation. Entrepreneurial and soft skills need to be made more widely available to promote retail services and sales.

Morocco already boasts successful private-sector based programs in its training ecosystem, and such programs should be harnessed through active and deliberate

coordination with the emerging green industrial manufacturing and sustainable solutions sectors. Two of these programs are INJAZ Al-Maghrib and Education for Employment-Maroc (EFE-Maroc). INJAZ Al-Maghrib was created in 2007 as a public-private partnership to contribute to improving the performance of the education system. INJAZ Al-Maghrib is a public utility association that mobilizes private sector volunteers to foster business skills among high school and university students to contribute to the emergence of a new generation of entrepreneurs and operates in at least 18 regions of Morocco.¹¹⁷ The success of the program stems in part from the fact that INJAZ Al-Maghrib private sector partners are members of the association and not simply sponsors.

During the 2021-2022 school year, INJAZ Al-Maghrib conducted 14 training programs in schools and universities that involved 92,061 young people, with 52% of participants being women.¹¹⁸ Of this number 50,032 were beneficiaries of INJAZ Al-Maghrib's own programs while 46,029 were beneficiaries of the partner training courses through IBM and Microsoft. The association's online conferences and social network events had 30,270 participants. Involving 511 schools and 42 institutions of higher learning, the total student contact hours of INJAZ Al-Maghrib programs amounted to 4,022,451 hours.¹¹⁹ The association has also launched a pilot program for high schools with vocational training programs. A proactive approach would be to bring in green industrial manufacturing and sustainable solutions firms as private sector partners. Important skillset "cross-pollination" would occur by involving private sector entities from the OCP affiliated-constellation.

Another model of success in Morocco's training ecosystem is Education for Employment-Maroc (EFE-

116. Aomar Ibourk and Karim El Aynaoui, "Career Trajectories of Higher Education Graduates: Impact of Soft Skills," *Economies* 2023, 11(7), <https://www.mdpi.com/2227-7099/11/7/198>.

117. "INJAZ Al-Maghrib" Resume Project, accessed September 2024, <https://www.resumeproject.eu/bonnes-pratiques-2/leducation-la-formation-et-la-mobilite-au-service-de-lentrepreneuriat/injaz-al-maghrib/>.

118. "Annual Report 2021-2022," INJAZ Al-Arab, 2022, <https://injazalarab.org/annualreport2022/>.

119. "Annual Report 2021-2022," INJAZ Al-Arab, 2022.



Photo above: A student uses a computer in a computer lab at the “1337” information technology training center in Khouribga, Morocco, on Nov. 17, 2020. Photo by FADEL SENNA/AFP via Getty Images.

Maroc). Created in 2008 as an association under Moroccan law, EFE-Maroc addresses the issue of youth unemployment by engaging young job seekers in the enhancement of their hard and soft skills to match the needs of the labor market. As an affiliate of the Education for Employment network, EFE-Maroc is able to leverage considerable foreign financing for its programs in Casablanca, Rabat, and Tangiers, as well as in Tetouan, Al Hoceima, Fes, Meknes, Marrakech, and Safi.¹²⁰ Since its inception, more than 70,000 young people have graduated from EFE-Maroc programs, 82% of which found an employment placement.¹²¹ As

120. “Welcome to Education for Employment-Maroc: Take Action for Youth Employment,” Education for Employment-Maroc (EFE-Maroc), 2023, <https://efemaroc.org/en/>.

121. “Welcome to Education for Employment-Maroc” EFE-Maroc, 2023.

of 2023, the female participation rate in EFE-Maroc’s programs is 54%.¹²²

Supporting Morocco’s economic transformation of the previous decade, graduates of EFE-Maroc’s programs have found employment in high-demand sectors such as automotive, aeronautics, ICT, agribusiness, and the offshoring of business processes, as well as in tourism, retail, banking, and insurance. The organization manages a network of over 500 certified trainers and maintains a network of more than 400 employment partners.¹²³ Since EFE-Maroc’s activities are driven by demand from the private sector, a proactive approach should promote

122. “Welcome to Education for Employment-Maroc” EFE-Maroc, 2023.

123. “Welcome to Education for Employment-Maroc” EFE-Maroc, 2023.

coordinated interaction between private sector firms in green industrial manufacturing and sustainable solutions as partners. The inclusion of private sector firms from the OCP affiliated-constellation would further enhance the overall robustness of Morocco's third wave training ecosystem.

While the active coordination between green industrial manufacturing and sustainable solutions firms is necessary to fulfill the mandate of the New Model of Development, such coordination should not be taken for granted. The qualitative research conducted for this study found that communication and coordination does not occur at a sufficient level, although not for lack of willingness. A closed conference convened in June 2024 in Casablanca as a consultation on the preliminary findings of this study demonstrated enthusiasm for dialogue and coordination between participants from the major entities of Morocco's training ecosystem and key stakeholders in the country's green industrial manufacturing and sustainability sectors, including those from the OCP constellation.

The Green Energy Ecosystem and Urban Women's Employment

The situation for women in Morocco's workforce is likewise concerning, with women having experienced a net loss of about 500,000 jobs between 2014 and 2021.¹²⁴ In 2023, the female participation rate in Morocco's labor force was 19.8%, according to the World Bank.¹²⁵ Intersectionality is a factor as women are affected by structural changes in the Moroccan economy whose adverse effects are

124. Elhadj Ezzahid, "Sectoral Potential for the Creation of Female Jobs and Proposed Avenues to Achieve Gender Equality on the Labour Market – A Moroccan Perspective," International Labour Organization, August 2023, <https://www.ilo.org/media/520821/download>.

125. According to the World Bank, the female participation rate in Morocco's labor force is 19.8%; "Gender Data Portal – Morocco," World Bank, 2024, <https://genderdata.worldbank.org/en/economies/morocco#:~:text=In%20Morocco%2C%20the%20labor%20force,labor%20force%20participation%20has%20decreased>.

most greatly felt among urban populations with low education and in rural areas. The NEET population is disproportionately female, with some estimates ranging as high as almost 75%.¹²⁶

The structural obstacles to the participation of women in Morocco's labor market involve cultural factors relating to gender norms that have been documented in research literature.¹²⁷ Among these cultural factors is a preference for hiring men over women, performed as a social duty since men are normatively viewed as the principal breadwinners of the family. Another primary factor is the cultural expectations of women's at-home responsibilities, particularly their roles in maintaining the household and childcare. Studies in Morocco have shown that a high number of women exit the labor market after marriage because of family commitments, especially after the birth of their first child. Women with low education levels in low-income families often have fewer resources to overcome these challenges than their more affluent counterparts.

For less educated, low-income women, childcare services need to be of sufficient quality as well as affordable and in comfortably manageable proximity. Transportation is an important factor for increasing participation of women

126. Zineb El Ouazzani Touhami, "Review of the NEET (neither in employment nor in education or training) rate," International Statistical Institute (ISI), accessed September 2024, https://www.isi-next.org/media/abstracts/ottawa-2023_9eb129f3994aa638c4c2add931b55755.pdf.

127. See the following and sources cited therein: Mina Balamoune, "Trade and the Persistence of the MENA 'Gender Equality Paradox'" Policy Center for the New South (PCNS), February 2024, https://www.policycenter.ma/sites/default/files/2024-02/PB_06-24_Mina%20Balamoune2.pdf; Aomar Ibourk & Zakaria Elouaouri, "Revitalizing Women's Labor Force Participation in North Africa: An Exploration of Novel Empowerment Pathways," *International Economic Journal*, June 28, 2023, <https://doi.org/10.1080/10168737.2023.2227161>; Maria Ana Lugo et al., "Women's Economic Participation in Iraq, Jordan, and Lebanon," World Bank, 2020, <https://documents1.worldbank.org/curated/en/933641600751429640/pdf/Middle-East-and-North-Africa-Women-s-Economic-Participation-in-Iraq-Jordan-and-Lebanon.pdf>.

in the workforce. Most work opportunities are far from where the majority of low-income women live, and the public transportation network is expensive, often requiring inordinate wait times to travel even within a 25 km radius. Already a constraint, extremely long travel times exacerbate the difficult balancing of work-family obligations.

Morocco's technological advancements in both agricultural production and industrial manufacturing arguably have had a disproportionately negative impact on women's employment. Agricultural modernization and the rise of agribusiness have resulted in the release of women by the agricultural sector who previously contributed as workers on family farms. Moving to urban areas with low levels of education and limited technical skills, these women had limited employment opportunities in manufacturing, finding employment in lower-skilled, labor-intensive manufacturing sectors, such as sewing in the textile and apparel industry and its automotive manufacturing equivalent of wiring harness production. Increased automation and the advancement to more sophisticated manufacturing processes, especially in the automotive industry, has seen a reduction in the availability of such lower-skilled, labor-intensive positions.

Morocco's ongoing industrial transformation will continue introducing disruptive technologies that will alter the labor market. Female entrepreneurship should therefore be regarded as a social insurance policy. Entrepreneurship, which can assume many forms, can be conducive to the economic empowerment of women by choosing forms of work that fit with their personal preferences, skills, and constraints. Priority should be placed on providing the support needed to facilitate the creation, development, and management of businesses, including mentoring and internships, with more support services offered through the life cycle of the business. While anchored in the green energy ecosystem, start-ups led by women in the service and sales sectors, as well as auxiliary service sectors such as MSMEs that provide child care, food delivery, or transportation services for employees in the green industrial manufacturing and sustainability sectors, could similarly be supported by an array of start-up services from incubation to financing.

For women from the most destitute segments of society, long-term employment requires a more holistic approach that provides basic levels of training while focusing on family systems and socio-economic integration. The qualitative research for this study found a uniquely successful example of this approach in the Oum Keltoum Social Complex operated by the El Ghali Berrada Foundation in Sidi Moumen, a working-class district of over 450,000 in the east of Casablanca.¹²⁸ Open to the entire community, the Social Complex with its associated health clinic and cultural center provides a full range of services to poor and illiterate women and their families. The complex provides literacy courses and vocational training that ranges from sewing, embroidery, and culinary arts to accounting, computer graphics, and information technology.¹²⁹ The vocational courses are mostly certificate-based and facilitate entry into the job market.

The Social Complex also supports the families of these women by offering a nursery, preschool, daycare, and academic tutoring for school-age children as well as psychological support and legal advice for the women themselves. Focused on the cultivation of the next generation, the cultural center provides music, dance, arts, and sports activities for children and young adults as well. Through these and other activities, the El Ghali Berrada Foundation develops life skills that help ensure the next generation does not enter the NEET population. The program has assisted over 4,400 adults to become literate and graduated over 4,000 adults with vocational

128. "Complexe social Oum Keltoum," Fondation Oum Keltoum, accessed September 2024, <https://www.association-oumkeltoum.com/complexe-social-oum-keltoum/>.

129. "Alphabétisation," Fondation Oum Keltoum, accessed September 2024, <https://www.association-oumkeltoum.com/service/alphabetisation/9/>; "Couture et broderie," Fondation Oum Keltoum, accessed September 2024, <https://www.association-oumkeltoum.com/service/couture-et-broderie/11/>; "Art culinaire," Fondation Oum Keltoum, accessed September 2024, <https://www.association-oumkeltoum.com/service/art-culinaire/12/>; "Cou Formation au métier de gestion (comptabilité, informatique)," Fondation Oum Keltoum, accessed September 2024, <https://www.association-oumkeltoum.com/service/formation-au-metier-de-gestion-comptabilite-informatique/13/>.



Photo above: A woman empties roasted argan nuts into a basket as she makes oil at her home near Essaouira, Morocco, on Oct. 15, 2022. Photo by FADEL SENNA/AFP via Getty Images.

training certificates.¹³⁰ Concurrently, the Social Complex has engaged over 5,700 children through its nursery, preschool, and daycare services.¹³¹

The Green Energy Ecosystem and Employment Among Rural Populations

Morocco's Green Generation Plan 2020-2030, promulgated within the same time frame as the New Model of Development, similarly envisions a synergistic convergence between energy transition and women and

130. "Fondation Oum Keltoum au Service d'une Transformation Sociale Durable," French Language brochure of the Oum Keltoum Social Complex, undated.

131. "Fondation Oum Keltoum au Service," brochure of the Oum Keltoum Social Complex.

youth employment as the country incorporates advanced green technologies to develop sustainable high-value-added agricultural production. The plan seeks to use the new wave of agricultural development to offset dislocations caused by the previous development wave's success in modernizing agricultural production. The Green Generation Plan identifies the "human element" and the "sustainability of agricultural development" as its two foundations. The plan declares, "The human element [is] at the heart of its concerns. It aims under this first foundation, to contribute to the emergence of an agricultural middle class, to energize rural youth, to develop human capital and to further structure farmers around efficient agricultural organizations. The development of the human element is indeed a sine qua non for the pursuit of the modernization of the sector and the consolidation of achievements."¹³²

132. <https://www.agriculture.gov.ma/fr/ministere/generation-green-2020-2030>; "Nouvelle stratégie du secteur

The Green Generation Plan seeks to advance the achievements in agricultural production through the use of renewable energy and green technologies to simultaneously ensure Morocco's water and food security. The plan declares that its second foundation of the sustainability of agricultural development "aims to consolidate the achievements of the Green Morocco Plan [in effect from 2010 to 2020], while making a qualitative and technological leap, through specific actions on agricultural sectors, distribution chains, quality, and innovation, as well as in terms of preserving natural resources and strengthening the resilience of the sector." While affirming that the sustainability of agricultural development is "strongly linked to the human element," the plan also asserts that "[p]romoting competitiveness and creating wealth are the guarantors of economic and social growth."¹³³

Morocco has the largest proportion of its population engaged in farming among all nations in the Mediterranean basin, with agriculture accounting for 39% of formal employment.¹³⁴ Despite advances in agritech and modernization, farming in Morocco is still primarily a small business, with 71% of farms being less than 5 hectares.¹³⁵ Achieving the Green Generation Plan's goal of elevating 400,000 of these farming households into the middle class while enhancing the resilience and sustainability of agricultural production for export and domestic consumption will depend greatly on the large-scale expansion of renewable power production for water desalination and green ammonia for fertilizer production.¹³⁶

agricole," Ministère de l'agriculture, de la pêche maritime, du développement rural et des eaux et forêts, accessed September 2024, https://www.maroc.ma/en/system/files/documents_page/nouvelle_strategie_agricole_-_generation_green_2020-2030.pdf.

133. "Nouvelle stratégie du secteur agricole," Ministère de l'agriculture, de la pêche maritime, du développement rural et des eaux et forêts, 2024.

134. "Al Moutmir Activity Report 2021-2022," Al Moutmir, May 2023, https://www.almoutmir.ma/sites/default/files/2023-05/RA_AL_MOUTMIR_VEng_Web_110523_0.pdf.

135. "Al Moutmir Activity Report 2021-2022," Al Moutmir, 2023.

136. Michael Tanchum, "The Fragile State of Food Security in the Maghreb: Implication of the 2021 Cereal Grains Crisis in Tunisia,

The provision of desalinated water for crop irrigation is essential for the continuation of both Morocco's agri-food export revenues and its domestic food security. In 2019, 75% of Morocco's agricultural exports were generated from irrigated land.¹³⁷ At the same time, only about 16% of the country's agricultural land was under irrigation, causing production of domestic consumer crops such as cereal grains to be vulnerable to drought and other severe weather events. In conjunction with increasing the supply of water available for greater irrigation coverage through renewable-powered water desalination, expanding precision drip irrigation would help to boost the sector's water use efficiency. Precision irrigation can reduce agricultural water consumption by as much as 60%, while resulting in 30% to 90% crop yield increases.¹³⁸ Under the Green Morocco Plan, the kingdom put a total of 542,000 hectares under drip irrigation systems, quadrupling the area of agricultural land under drip irrigation.¹³⁹ The need to expand drip irrigation prompted the 2023 opening of a manufacturing plant for precision irrigation systems in Morocco by international precision irrigation firm Netafim,

Algeria, and Morocco," Middle East Institute (MEI), November 9, 2021, <https://www.mei.edu/publications/fragile-state-food-security-maghreb-implication-2021-cereal-grains-crisis-tunisia>.

137. Tanchum, "The Fragile State of Food Security in the Maghreb," MEI, 2021.

138. Jennifer Chu, "Watering the world – New design cuts costs, energy needs for drip irrigation, bringing the systems within reach for more farmers," MIT NEWS, April 19, 2017, <https://news.mit.edu/2017/design-cuts-costs-energy-drip-irrigation-0420#:~:text=Drip%20irrigation%20can%20reduce%20a,%243%2C000%20per%20acre%20to%20install;Michael> Tanchum, "The Russia-Ukraine war forces Egypt to face the need to feed itself: Infrastructure, international partnerships, and agritech can provide the solutions," Middle East Institute (MEI), July 25, 2023, <https://mei.edu/publications/russia-ukraine-war-forces-egypt-face-need-feed-itself-infrastructure-international>.

139. "Main achievements of the green Morocco Plan," Agence Pour Le Développement Agricole, accessed September 2024, https://www.ada.gov.ma/en/main-achievements-green-morocco-plan?_cf_chl_jschl_tk__=pmd_5_T1iNuZ2i36vzVanGP2dL.k0AVJ4Jnu2nRXHjwZyVA-1629456009-0-gqNtZGzNAPCjcnBszQcl.

employing 200 Moroccans.¹⁴⁰ The domestic manufacture and use of solar-powered irrigation systems would further Morocco's position in green industrial manufacturing and sustainable solutions.

Renewable energy can similarly boost small farmer crop yields by facilitating the availability of more affordable fertilizer-produced green ammonia. Although Morocco is the world's fourth largest exporter of fertilizer, domestic use is low when compared to Europe. Using 2021 as a baseline since it is the year preceding the outbreak of the Russia-Ukraine war, Morocco's use of fertilizer was 55.3 kg per hectare of arable land, while the rate in France was almost three times higher at 153.3 kg.¹⁴¹ Al Moutmir began in 2018 as an OCP initiative to expand domestic fertilizer use. By 2022, it evolved into an organization providing a full range of end-to-end extension services for farmers and rural populations, including market connections and capacity building in fertilizer-related retail sales and spin-off businesses. With a business-to-business model that envisions OCP selling its products indirectly to farmers via distributors, Al Moutmir is involved in creating and supporting a network of local independent retail businesses that will in turn sell products to small farmers. Through its direct agronomic support for small farmers and work in developing retail businesses as well as marketing and sales cooperatives for agricultural products, Al Moutmir is one of the most significant support organizations for MSME growth among rural populations.

The backbone of Al Moutmir is its team of agronomists who live in the farming communities they serve. With an emphasis on customizing its engagement to specific local needs, each agronomist focuses on an area of

140. "Orbia's Precision Agriculture Business Netafim Opens First Manufacturing Plant in Morocco to Boost Sustainable Agriculture in Key African Agribusiness Hub," Netafim, March 2, 2023, <https://www.netafim.com/en/news-and-events/news/orbias-precision-agriculture-business-netafim-opens-first-manufacturing-plant-in-morocco/>.

141. "Fertilizer consumption (kilograms per hectare of arable land) - Netherlands, Morocco, Germany, France, United Kingdom," World Bank, accessed September 2024, <https://data.worldbank.org/indicator/AG.CON.FERT.ZS?locations=NL-MA-DE-FR-GB>.

approximately 200 farmers. By doing so, Al Moutmir has developed a comprehensive knowledge base of local soil conditions as well as social and economic needs of rural communities across Morocco. With an ethos of "farmer centricity" that emphasizes listening to and partnering with farmers in crafting solutions, Al Moutmir has built a large reservoir of good will and trust in rural communities that enables the successful implementation of new solutions.

Al Moutmir's ElleMoutmir outreach program for women is illustrative of the organization's wider activities.¹⁴² ElleMoutmir provides agronomic support to women farmers and peer-to-peer knowledge-sharing and networking across Morocco's agricultural regions. ElleMoutmir's Women Agri-Retailers Program supports retail small businesses owned and managed by women in the fertilizer sector with technical support, equipment, digitalization, skill-building, and business networking. The program empowers smart blending businesses that can better optimize fertilizer formulations for local soil conditions. In addition, ElleMoutmir Women Cooperatives Program provides cooperatives with equipment and training in technical, business, and soft skills to market agricultural and local land products as sustainable businesses. Al Moutmir was able to leverage capabilities at InnovX to develop higher-value products from locally produced quinoa as well as aromatic and medicinal plants to achieve better marketing and sales.

Al Moutmir has become the conduit that bridges the OCP constellation of green industrial manufacturing and sustainable solutions businesses and Morocco's rural farming communities, enabling the successful adoption of renewable energy-powered technologies to improve the agricultural economy. One example is the effort by Al Moutmir and InnovX to deploy solar-powered storage units in communities of small farmers. Because of a lack of affordable storage, small farmers typically sell their yield immediately, often at below-market prices. With access to affordable storage units powered by solar energy, farmers would be empowered to

142. "A Multi-Target Capacity Building Program," Al Moutmir, accessed September 2024, <https://www.almoutmir.ma/index.php/en/capacity-building-offer>.

become market makers, achieving greater value for their crops. The widespread diffusion of such units, in turn, would create demand for the manufacture of these units and for small businesses to service them.

The use of renewable energy to power water desalination, green ammonia-based fertilizer production, water irrigation, and food storage can directly enhance the efficiency and output value of small farms, by far the largest number of MSMEs among Morocco's rural populations. Higher-value green agri-food production will also stimulate more green industrial manufacturing by requiring the production of climate-smart irrigation and food storage systems. More affordable green ammonia-based fertilizers and green agricultural equipment will also promote the expansion of retail services and retail sales MSMEs.

Coordination between Green Energy Ecosystem and the Training Ecosystem

INJAZ Al-Maghrib, EFE-Maroc, and the Oum Keltoum Social Complex have emerged as non-governmental initiatives concerned with developing Morocco's human capital. Registered as associations under Moroccan law, these organization developed outside of the OCP constellation of affiliated entities and developed themselves through public-private partnerships. The overall efficiency of the training ecosystem would benefit from the development of constructive interaction between the AAIT and the wider OCP/UM6P constellation and these initiatives. The Human Capital Commission of the Confédération Générale des Entreprises du Maroc (CGEM), the main private sector representation to Morocco's public authorities,¹⁴³ could form one conduit. CGEM's other permanent commissions, particularly those relating to renewable energy, green hydrogen, innovation, and sustainable development, could provide conduits for coordination among a wide spectrum of stakeholders across Morocco's green energy ecosystem.

143. "Qui Sommes Nous," Confédération Générale des Entreprises du Maroc (CGEM), accessed September 2024, <https://cgem.ma/qui-sommes-nous/#la-cgem>.

Current Attitudes Within MSMEs About Commercial Renewable Energy Use Outside the Green Energy Ecosystem

Although the expansion of renewable power generation capacity through Morocco's green energy ecosystem is giving rise to numerous MSMEs in the green industrial manufacturing and sustainability sectors, a certain hesitancy about renewable energy use among current MSMEs outside these sectors was discovered by this study's quantitative survey research. Since MSMEs providing retail services and sales adjacent to the green industrial manufacturing and sustainability sectors represent a large potential source of private sector employment, the seeming lack of enthusiasm for renewable energy among MSMEs needs to be understood and addressed.

According to the survey data, the age composition of MSMEs had no impact on the favorability of renewable use. There was no correlation between the percentage of workers aged 18 to 29 in the firm and an increased favorability toward renewable energy use by the firm. The lack of differing attitudes among this cohort is noteworthy since this generation came of age when Morocco's development of industrial-scale renewable energy had become more prominent. The data suggests the public has not yet recognized a significant positive impact from renewable energy on their daily lives. Similarly, there was no important difference in views between firms in urban areas compared to those in rural regions.

The overall gender composition of MSMEs also showed no relation to the views held on renewable power use. However, the survey did show a significant positive correlation between the top manager being a woman and the adoption of renewable energy. MSMEs led by women held the view that renewable energy technologies would improve their respective firm's overall energy use and reduce the firm's energy costs.

The positive correlation between female management and a favorable view toward the use of renewable energy does

not seem related to education levels. Higher education and especially higher levels of digital skills within MSMEs were correlated with less favorable views of the use of renewable energy. Counter-intuitively, firms with a greater proportion of highly educated workers were less likely to view renewable energy technologies as enhancing their daily operations. While further, more fine-grained investigation is required, the presumably higher level of digital skills in firms with a greater proportion of highly educated workers may have been a contributing factor to the results. Firms that use mobile banking services and those that bought or sold online did not view renewable energy as improving their respective firm's overall energy efficiency or enhancing daily operations. They also did not regard renewable energy as reducing energy costs. Interestingly, only those firms that paid their electricity bills at the bank or post office — in contrast to those that paid by e-wallets or mobile banking — had a positive view of the impact of renewable energy on their firm's operations and energy costs. The difference may indicate a concern over the reliability of the power transmission system as the operative factor.

The other data from the survey suggests that attitudes toward renewable energy among MSMEs are being influenced by each firm's experience with the electricity transmission system. Those firms that experienced maintenance or service problems, received unexpectedly high bills, viewed their power costs as too expensive, or did not trust the supplier saw no benefits to their firms from the adoption of renewable energy. The same result was found for MSMEs that were unable to power heavy appliances.

Tellingly, the experience of power outages was correlated with either positive or negative views toward renewable energy adoption depending on the durability of the firm's products and the damage suffered to machinery and operations. Firms that experienced damage to their machinery or appliances from a power outage held a positive view of the energy efficiency benefits of renewable energy, presumably assuming that renewable energy use would lead to greater reliability in the energy supply. The same holds true for those firms whose general operations experienced interruption. The data suggests that MSMEs

that produce green industrial components or provide installation and maintenance services for renewable energy and sustainable solutions infrastructure are already positively predisposed to renewable energy use.

The survey data also found that those MSMEs that experienced wasted perishable products or discarded damaged goods held a negative view of renewable energy adoption, presumably assuming that renewable energy use would lead to even less reliability in the energy supply. Since the agri-food industry forms a large segment of the retail sales sector and depends on reliable power supplies for cold storage to maintain perishable goods, the data further confirms that perceptions of the effect of renewable energy on the reliability of power supplies form a principal factor in the adoption of renewable energy by MSMEs.

Conclusions

The renewable energy sector provides a critical foundation for Morocco to ameliorate employment conditions among young people and women through the kingdom's green energy ecosystem. Within this ecosystem, green industrial manufacturing involving or related to renewable power generation is emerging as an important driver of expanded employment opportunities in Morocco's urban areas. In a parallel manner, green agricultural production utilizing desalinated water and green ammonia-based fertilizer produced with renewable energy will become an important driver of expanded employment opportunities in rural regions. These opportunities are growing as Morocco's green energy ecosystem develops international renewable energy export supply chains based on the country's production and export of green hydrogen and green ammonia as well as marine fuel, phosphates, fertilizers, minerals and metals, steel, EVs, and agri-food products — the production of which will be increasingly powered, in part or entirely, using renewable energy resources.

While deep tech innovation is important for maintaining the dynamism of Morocco's green energy ecosystem and as a source of employment of women with higher education, particularly in STEM fields, the main engine of employment



Photo above: A worker standing in front of solar mirrors at the Noor 1 Concentrated Solar Power plant, some 20 km outside of Ouarzazate, Morocco, on Oct. 17, 2015. [Photo by Fadel Senna/AFP via Getty Images.](#)

will be MSMEs in the green industrial manufacturing and sustainable solutions sectors along with a ripple-effect creation of MSMEs in adjacent retail service and sales based on those sectors or MSMEs that provide auxiliary services.

MSME creation in the green industrial manufacturing and sustainable solutions sectors represents a new third wave of start-up formation in Morocco. It is occurring through the OCP-constellation holding company InnovX, other more narrowly focused holding companies like Gi3, or as independent ventures. Retail services and sales MSMEs, along with auxiliary service sector MSMEs, primarily emerge as independent ventures. In rural regions, Al Moutmir, in conjunction with InnovX and its sister entities based at UM6P, is the primary facilitator of retail sales MSMEs.

The extension of these employment opportunities in urban areas will depend in large part on whether Morocco's

training ecosystem can provide appropriate technical skills training as well as entrepreneurial and soft skills to young people and women from all demographics, particularly those who have fallen into the NEET population. The diffusion of entrepreneurial and soft skills are critical to achieving the ripple effect of promoting retail services and sales MSMEs. The acquisition of these skills is also required by auxiliary service sector MSMEs that provide child care services, food delivery services, or transportation services for employees in the green industrial manufacturing and sustainability sectors.

MSME start-up ventures in these auxiliary service sectors are particularly important in helping lower-educated, lower-income women overcome structural exclusion arising from socio-economic constraints and cultural norms concerning women's at-home responsibilities, particularly their roles in maintaining the household and

providing childcare. The auxiliary service sector start-ups can be conducive to the economic empowerment of these women by enabling a choice of work that fits with their preferences, skills, and personal constraints. Although a third-order effect derived from the expansion of renewable energy, this form of women's entrepreneurship can serve as a social insurance policy and therefore may be regarded as a component of sustainable human development.

The success of all of these ventures depends on the extent to which Morocco's green energy ecosystem encourages entrepreneurship among young people and women as a self-sustaining, bottom-up phenomenon in which green manufacturing and sustainable solutions MSMEs and MSMEs in adjacent sectors create sufficient opportunities for employment and soft skill development to stimulate the establishment of more MSMEs that will, in turn, do the same. In addition to the availability of financing, the development of this phenomenon fundamentally requires close and constructive coordination between key actors within Morocco's green energy ecosystem and its training ecosystem, including both those within the OCP constellation and those outside of it, especially successful training organizations such as INJAZ Al-Maghrib, EFE-Maroc, and the Oum Keltoum Social Complex.

As the survey data has shown, a certain hesitancy about adopting renewable energy seems to exist among some established Moroccan MSMEs. The main finding from the data is that the hesitancy seems to be heavily influenced by the perception of the reliability of the transmission system. Although further, more fine-grained investigation is required, such concerns need to be addressed as Morocco's green energy ecosystem gives rise to more green industrial manufacturing and sustainable solutions sectors MSMEs and especially an increasing number of more independent, smaller MSMEs in adjacent retail services and retail sales as well as in the auxiliary service sector. Addressing renewable energy's ability to provide reliable power for the secure operation of machinery and the preservation of perishable goods are the primary concerns for many retail service and sales enterprises.

The synergistic convergence of renewable energy, sustainable development, and expanded employment

envisioned by Morocco's New Model of Development and its Generation Green Plan is becoming manifest through Morocco's green energy ecosystem. With appropriate oversight and coordination with Morocco's training ecosystem, the country's new third wave of start-up development led by the green industrial manufacturing and sustainable solutions sectors can significantly expand employment opportunities among women, youth, and rural populations. In this manner, renewable energy will further contribute to the realization of Morocco's national ambition to become a more prosperous society through sustainable human development.



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