ISC3
International Sustainable Chemistry Collaborative Centre

PtX in Morocco

Stakeholder Dialogue - Results for a Sustainable Implementation

Abstract

The International Sustainable Chemistry Collaborative Centre ISC3 and PtX Hub asks the question: How can the chemical industry use energy from renewable sources in a sustainable way and vice versa: how can Sustainable Chemistry be used for the advancement of a sustainable energy supply?

In a consultative process, ISC3 and the International PtX Hub assisted MTEDD and further key stakeholders from Morocco (ONEE, MASEN, IRESEN and others) in analysing the country's strategy in relation to the energy transition towards hydrogen and its derivatives, taking into consideration possible social, economic and environmental impacts. In a workshop in Rabat on 9 December 2022, key elements of international best practices were presented, and the participants discussed what needs to be taken into account in Morocco in order to avoid negative side effects of PtX and guarantee sustainable development.

On 22 November 2022, King Mohammed VI called for accelerating the development of renewable energies, with the key objective of generating over 52% of electricity by solar and wind power in Morocco by the year 2030 in order to reduce its dependency on energy imports and to reduce CO2 emissions. His Majesty also mandated the development of an operational incentive "Morocco Offer", covering the entire value chain of the green hydrogen sector in Morocco, including the regulatory and institutional framework and plans for the necessary infrastructures.

Status quo and challenges

Morocco, like many other countries, is currently still heavily dependent on energy imports.

According to IRENA, Morocco had an energy self-sufficiency of 11% in 2019, meaning that most of its energy demand is imported (net trade was -861.4 TJ). About 38% of the installed electricity generation capacity could be attributed to renewable energies in 2022 (figure 1, power capacity; compare with generated power in figure 3). However, most of the electricity is generated by fossil fuels and other non-renewable power plants.

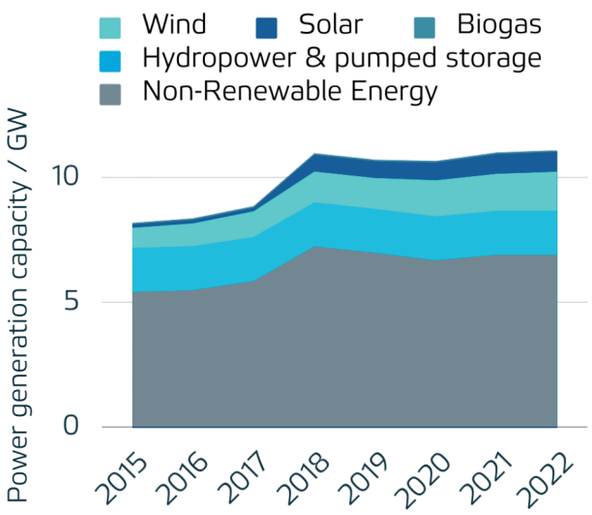

Figure 1: Power generation capacity in Morocco by source.
Source: IRENA (2023)

Renewable energy

About 20% of the electricity generated in 2021 came from renewable energy sources, as can be seen in Figure 2. Onshore wind farms accounted for 12% while the share from solar power was below 5%. Hydropower and pumped storage contributed almost 3% to total power generation in Morocco (Figure 3).

Wind

Morocco has excellent onshore wind resources in the southern part of the country and also in the region of the Atlas Mountains. The technical potential is estimated to be a further 6,000 GW of wind power installation enabling an annual power production of 11,500 TWh (GouvMa (2021)). In addition, there is huge untapped potential for offshore wind along Morocco's Atlantic coast.

Solar

Excellent solar irradiation values in Morocco make photovoltaic (PV) and concentrated solar power (CSP) projects attractive by allowing low Levelised Cost of Electricity (LCOE). With less than 5% of electricity generation coming from solar energy in 2020, the market for self-supply through PV and CSP is still at an early stage, and there is huge untapped potential. The technical potential is about +20,000 GW solar capacity with a potential annual power production of 49,000 TWh (based on IRENA 2014 calculations).

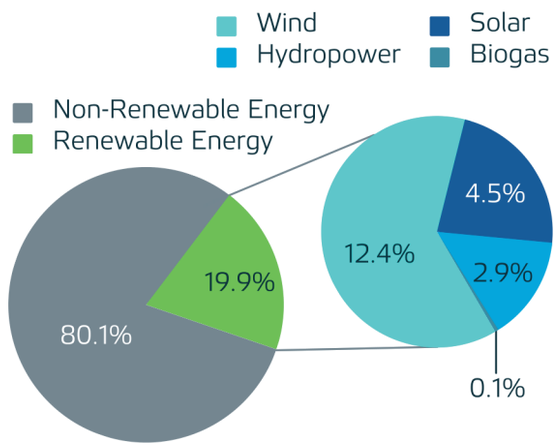

Figure 2: Electricity generation in Morocco for year 2021 by Source (Total generation: 41 GWh)
Source: IRENA (2022)

Biomass

Biomass is currently not relevant for the electricity production, and just 40 GWh were generated from biogenic fuels in 2021. Scarcity of fresh water might be the limiting factor, and predatory competition between the production of biogenic energy sources and food must be avoided at all times.

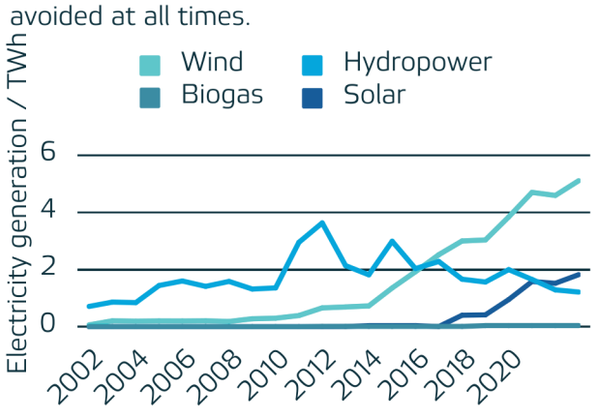

Figure 3: Electricity generation in Morocco from renewable energy sources.
Source: IRENA (2022)

On 9 December 2022, a transfer workshop took place in Rabat to identify critical issues and define next steps. This workshop was organised by ISC3 together with GIZ Morocco, following the training measure implemented by the International PtX Hub. In a World Café format, the following "Existing conditions", "Needs" and "Possible next steps" were identified at four theme tables.

	Existing conditions	Needs	Possible next steps
Certification and Regulation	**Political** • Political will/leadership **Regulatory** • Regulatory and institutional framework already in place **Experience-based factors** • Accumulated experience in RE development	**Regulatory and Institutional Framework** • Clear governance, clear mandate • An internationally agreed and recognised organisation • Regulatory coverage **Certification and Standards** • Certification for green electricity (GO) • Moroccan certification recognised by the EU, once developed • Meeting EU export requirements **Technological and Logistical Challenges** • Smart metering • Transport of green energy **Financial Aspects** • Financing	**Regulatory Development** • Establish a regulatory framework for this sector • Develop regulation to check the sustainability of the value chain **Capacity Building** • Built capacities (national) **Cooperation** • Strengthen cooperation with leading countries • Support international cooperation for the development of the registration framework
Commercialisation	**National** • Proximity to EU (as an export market) • High potential of renewable energies (favourable conditions for solar & wind) • Local ammonia market • Research project on recycling • High level of political will • Certification of RE under investigation (study) • Offtaker industry: car + fertiliser • Training platform **International** • Focus on export + ammonia • EU / DE – MAR agreement	**Environmental** • Availability of renewable energy • Additionality of RE • Safe management of chemicals • Carbon tax certification **Economic** • First success stories • Known hydrogen market price • Known cost of local production • Extensive infrastructure for scattered offtakers **Social** • Identified beneficiaries of energy transition • Access to electricity grid • Local job creation **Governance** • Regulatory framework • Local manufacturing of PtX machinery	**Government Implementation Strategy** • Elaborate regulatory framework for private sector • Develop roadmaps for each sector • Set up agreements with EU markets • Develop strategy for RE – Tech at end-of-life • Set up infrastructure • Create local demand (mid-term) **Education and R&D** • Develop skills for offtake industry • Assign cost simulations • Develop Scenarios **Industry** • Extend pipelines • Build pilot projects
Power Infrastructure and Grid Stability	**Strategic Planning and Policy** • Hydrogen roadmap • Government commitment **Initiatives and Projects** • H_2 cluster • Pilot project under development **Resource Management and Experience** • Zoning solar and wind • Accumulation of experience in energy	**Infrastructure** • Increased electricity storage capacity; for example with pumped hydro power • Grid extension • Choice of a production site **Finance** • Tailored Financing infrastructure • Affordable & sufficient electricity tariffs **Strategic planning** • Pathways and boundaries	**Infrastructure Analysis** • Asign feasibility study about electricity grid (with variable Renewable Energy systems and electrolysers) **Regulatory and Strategic Planning** • Identify/set priorities • Activate the regulatory framework • Create of the high-level bodies (for steering the process) **Market and Private Sector Integration** • Foster market flexibility • Integrate the private sector
Research	**Infrastructure** • Some pumped storage power plants available **Market Demand and Private Sector Involvement** • Existence of a need (off-taker market for ammonia) • The private sector is involved **Education and Knowledge Sharing** • Flexibility of the education system • Green H2A platform	**R&D in Energy Storage** • Research for energy storage • Knowledge exchange • Pilot plant **Finance** • Allocated Budget for R&D	**National** • Establish a R&D platform • Install H_2 laboratories for research and education • Set up pilot projects in storage and transport **International** • Form international R&D partnerships

The International Sustainable Chemistry Collaborative Centre (ISC3) aims to foster the transition of the chemical and chemical-related sectors to Sustainable Chemistry, promoting a circular economy that is striving to implement multifaceted aspects of sustainability at every step of the life cycle of products and changing all stakeholders' behaviour. The centre therefore takes a multi-stakeholder approach, targeting policymakers, the public and private sectors, academia and civil society. ISC3 contributes globally to the international chemicals policy, develops professional and academic training measures, offers advisory services, fosters innovations, supports entrepreneurship and conducts research. ISC3 is hosted by GIZ in cooperation with Leuphana University Lüneburg as ISC3 Research & Education Hub and DECHEMA Society for Chemical Engineering and Biotechnology (DECHEMA e. V.) as ISC3 Innovation Hub. The centre was founded in 2017 on the initiative of the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the German Environment Agency (UBA). In addition to educational measures for entrepreneurs and academics, the centre deliberately targets vocational training – especially the strengthening of capacities in developing and emerging economies.

Table 1: Key stakeholders in Morocco

Acronym	French name	English translation
ANRE	Autorité nationale de régulation de l'électricité	National Electricity Regulatory Authority
IRESEN	Institut de Recherche en Énergie Solaire et Énergies Nouvelles	Tesearch Institute for Solar Energy and New Energies
MAScIR	Fondation marocaine pour les sciences avancées, l'innovation et la recherche	Moroccan Foundation for Advanced Science, Innovation and Research
MASEN	Agence Marocaine de l'Énergie Solaire	Moroccan Agency for Solar Energy
MTEDD	Ministère de la Transition Énergétique et du Développement Durable	Ministry of Energy Transition and Sustainable Develoment
OCP	Office Chérifien des Phosphates	OCP Group
ONEE	Office National de l'Électricité et de l'Eau Potable	National Office of Electricity and Drinking Water
ONEP	Office National de l'Eau Potable	National Office for Drinking Water Supply
ONHYM	Office National des Hydrocarbures et des Mines	National Office of Hydrocarbons and Mining
UM6P	Université Mohammed VI Polytechnique	Mohammed VI Polytechnic University

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