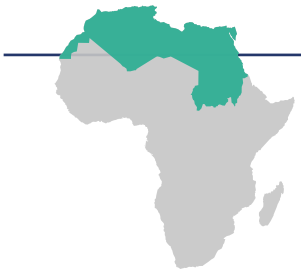
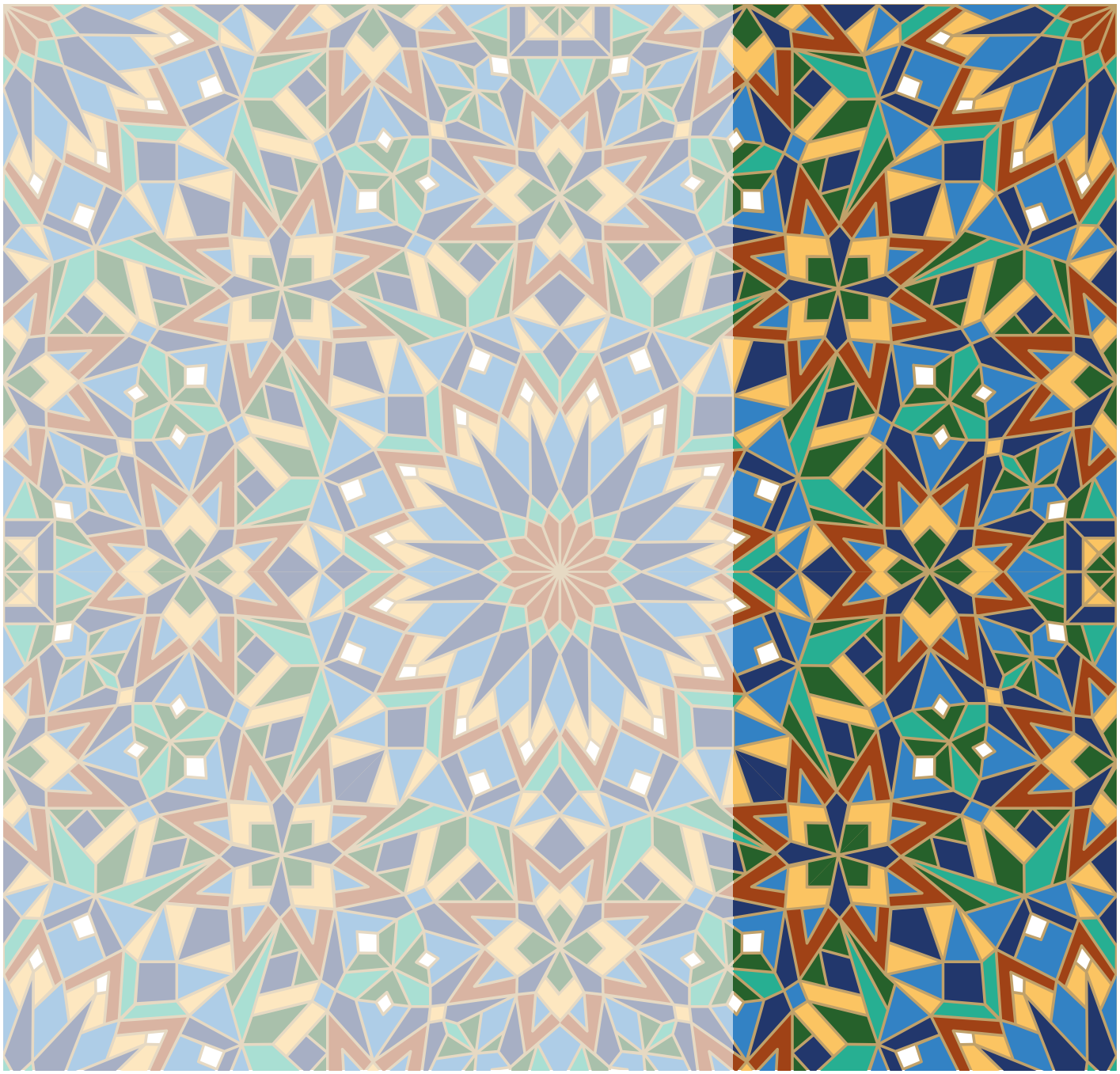
IRENA
International Renewable Energy Agency

NORTH AFRICA

POLICIES AND FINANCE FOR RENEWABLE ENERGY DEPLOYMENT





ISBN: 978-92-9260-547-6

CITATION: IRENA (2023), *North Africa: Policies and finance for renewable energy deployment,* International Renewable Energy Agency, Abu Dhabi.

ABOUT IRENA

The International Renewable Energy Agency (IRENA) serves as the principal platform for international co-operation, a centre of excellence, a repository of policy, technology, resource and financial knowledge, and a driver of action on the ground to advance the transformation of the global energy system. A global intergovernmental organisation established in 2011, IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security, and low-carbon economic growth and prosperity.

www.irena.org

ACKNOWLEDGEMENTS

This brief benefited from the valuable review of Radia Sedaoui and Sean Ratka (UN ESCWA), Nora Aboushady (IDOS and Cairo University) and Smail Khennas (independent expert).

IRENA is grateful to the Ministry of Economy, Trade and Industry of Japan for supporting the publication of this report.

For further information or to provide feedback: **publications@irena.org**.

Available for download: **www.irena.org/publications**.

Design by Myrto Petrou, based on a series concept by weeks.de Werbeagentur GmbH.

DISCLAIMER

TABLE OF CONTENTS

FIGURES, TABLES AND BOXES

FIGURES

TABLES

BOXES

01 INTRODUCTION

North Africa – Algeria, Egypt, Libya, Morocco, Tunisia and Sudan – is the African continent's largest energy market. Excluding Sudan, the region boasts relatively high rates of socio-economic development, industrialisation and access to modern energy. Meanwhile, the region's distinct energy landscape sets it apart from the rest of the continent. North Africa possesses significant renewable energy potential for utility-scale solar and wind power, beyond what has already been tapped, as well as a substantial amount of tapped hydropower capacity. It also has decentralised, off-grid solutions set up in remote areas, and large potential markets in countries where access to electricity is limited, notably Libya and Sudan. These factors could make North Africa one of the continent's most dynamic energy markets in the near future, including for renewable energy.

This report highlights North Africa's large renewable energy potential and explores its current policy environment to support the energy transition and the deployment of renewable energy in the coming years. It also highlights policies for a just transition in North Africa, specifically, a shift of the region's energy sectors away from fossil fuels and towards a more diversified, clean energy mix that supports the countries' socio-economic development objectives, including the Agenda 2030.

The report proceeds as follows: Chapter 2 provides a brief overview of the region's energy sector, focusing on the drivers and deployment of renewable energy. Chapter 3 outlines the policy landscape for renewable energy in the region, including enabling, integrating and deployment policies. Focus sections explore green hydrogen and the opportunities for regional power trading. Chapter 4 explores investment and finance trends in North Africa (mainly driven by the policy framework discussed in chapter 3). Chapter 5 discusses policies to prevent the most vulnerable populations from being further marginalised due to the structural transition away from fossil fuels and towards renewables. This is followed by a conclusion.

02 ENERGY SECTOR OVERVIEW

© 1001nights | gettyimages.ae

North Africa is set apart from Sub-Saharan Africa by its diverse yet distinct energy landscape and socio-economic development status. The region comprises middle-income countries, except Sudan, and has much higher socio-economic and human development rates than the rest of the continent. Its distinct geography facilitates trade ties with southern neighbours as well as with Europe via the Mediterranean Sea. The majority of North Africa – except for Libya and Sudan (whose economic and energy policies have been shaped by conflict and instability over the past decade) – has seen considerable economic and political stability over time, with evolving energy sector strategies that include increasingly ambitious goals for a more sustainable energy mix as well as climate action in some North African countries.

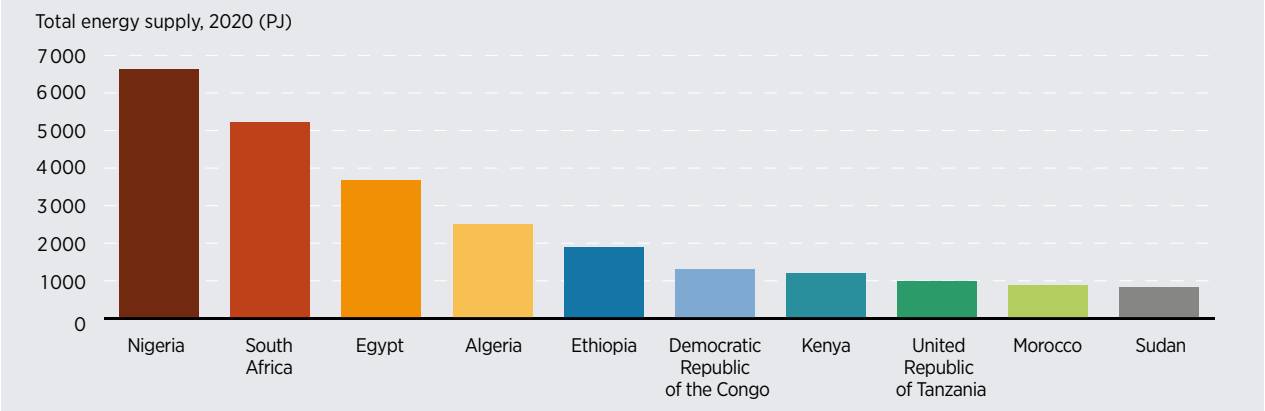
2.1 CURRENT ENERGY LANDSCAPE

Algeria, Libya, Egypt and Sudan are endowed with significant hydrocarbon resources, and they have been long-standing exporters of oil and natural gas. The fossil fuel industries in these countries have played a substantial role in their economic development, as fossil fuels constitute domestic sources of energy as well as commodities for export. By contrast, Morocco and Tunisia have few of their own oil or gas reserves, leading to historically significant energy import expenditures. In turn, they have the region's most diversified economies, based on agriculture, manufacturing, textiles, tourism and services. Morocco is also a significant producer of phosphate and phosphate rock, which are critical minerals, including for energy transition technologies.

North African countries, except Sudan, have achieved some of the highest rates of access to modern energy in Africa. Algeria, Egypt, Morocco and Tunisia have achieved virtually universal access to electricity and clean cooking fuels and technologies, even though the quality of access, affordability and stability of supply vary within and among them. Libya has fallen backwards since the onset of political instability in the 2010s. Electricity access, much of which remains unstable, is about 70% in the country. Electricity access is at 55% in Sudan, placing it among the African countries with the largest populations without basic electricity access (IEA *et al.*, 2022).

Egypt and Algeria stand out as major consumers of primary energy and electricity in Africa. This trend reflects their large populations, historically high rates of access to modern forms of energy, and energy-intensive industries. Egypt takes the lead as the largest electricity producer in North Africa, and is also one of the largest electricity markets on the Africa continent as a whole (Figure 1). Its capacity, in excess of 64 gigawatts (GW), serves a population of more than 100 million. Egypt is followed by Algeria (50 GW) and Libya (14 GW) (IRENA, 2023b), although Libya's electricity grid and power generation infrastructure has suffered significantly since the onset of political instability in the 2010s.

Figure 1 Africa's largest electricity markets, by total energy supply (PJ), 2020

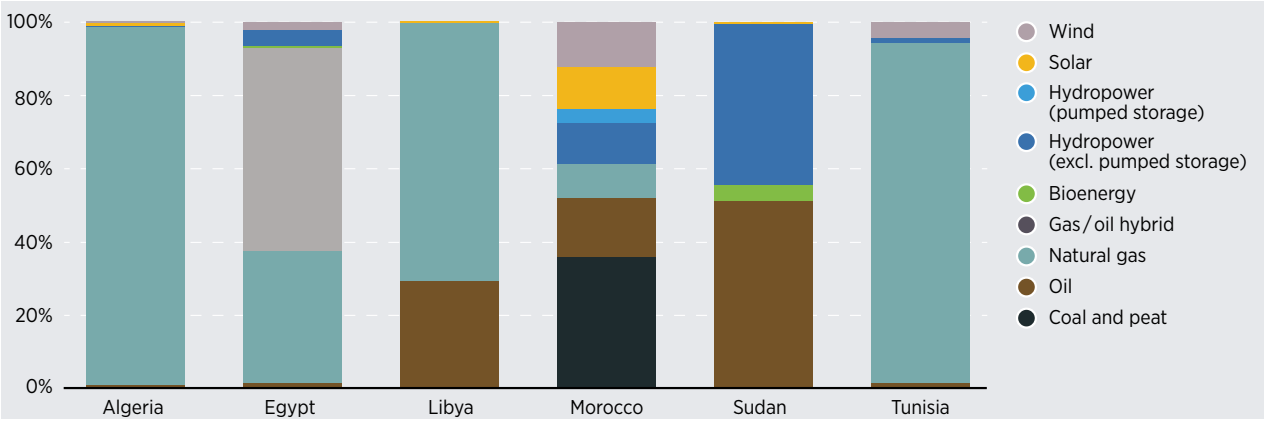


Source: IEA, 2023.
Note: PJ = petajoules.

Algeria, Egypt and Libya have traditionally relied on fossil fuels for virtually all their energy needs. The significant role hydropower has played in Egypt's power sector since the 1960s is a notable exception.

Morocco and Sudan have relatively diverse energy mixes, though their considerable use of coal and oil, respectively, renders their electricity mixes more carbon intensive than those of countries relying more on natural gas for power generation, such as Algeria, Egypt and Tunisia (Figure 2). The electricity sectors of these countries, however, have also relied on hydropower for decades, although Morocco more recently added some large wind and solar projects to its energy mix, while Sudan introduced the household use of traditional bioenergy.

Figure 2 North Africa's electricity generation capacity by country and source, 2020



Source: IRENA, 2023b.

2.2 DRIVERS FOR RENEWABLE ENERGY DEPLOYMENT

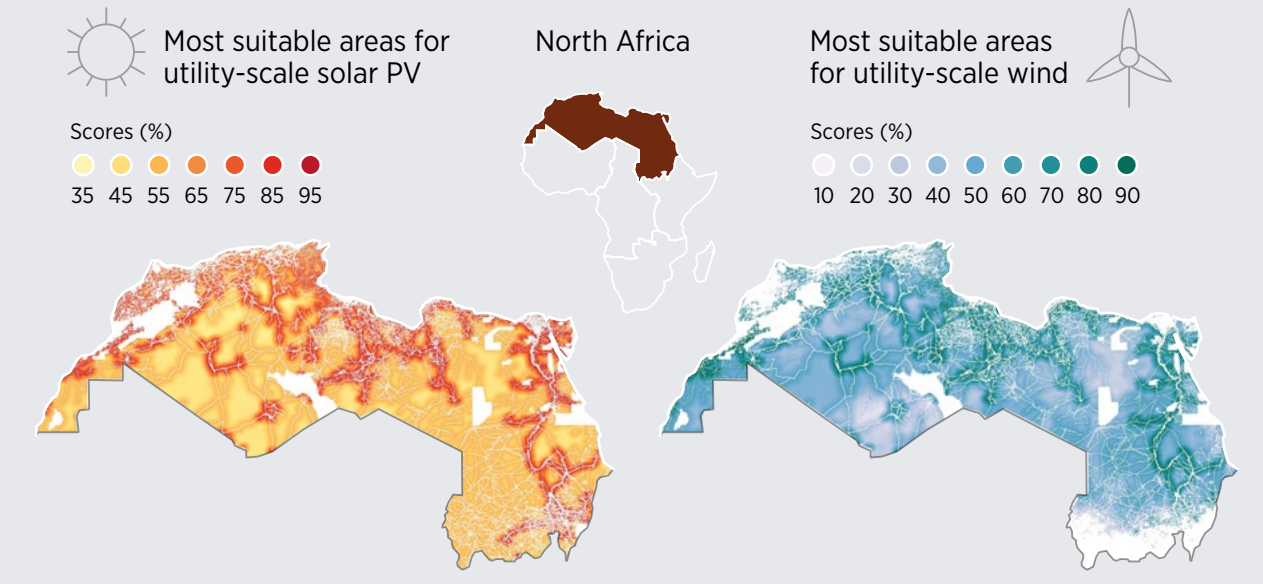
Climate vulnerability

North Africa's geography and the dependence of its economies on local ecosystems, including for agriculture, fishery and tourism, leave the region very vulnerable to climate change. The Intergovernmental Panel on Climate Change identifies North Africa as one of the regions where desertification and water stress will affect the largest number of people in the coming decades if global heating is not effectively mitigated (IPCC, 2019). Climate change in the region is also expected to cause more heat waves, dust storms and extreme weather events in the coming years and decades, affecting biodiversity, livelihoods and public health (IPCC, 2019). These effects, along with the growing issue of overextraction of groundwater and environmental pollution, pose perhaps the greatest challenge to North Africa's future stability and prosperity. Successful international climate mitigation is therefore crucial for the region, including renewable energy deployment.

Resource potential for renewable energy

North Africa's unique geography and climate make it a region with immense renewable energy potential, particularly of solar and wind power. Its annual average solar irradiation is high, at about 2 200 kilowatt hours per square metre, and high wind speeds average 7 metres per second, reaching 9.5 metres per second in Algeria and Libya (Figure 3). The International Renewable Energy Agency (IRENA) estimates North Africa's technical installable capacities at 2 792 GW and 223 GW for solar and wind, respectively, assuming a land utilisation factor of 1% for both renewable technologies. The Delft University of Technology further estimates untapped hydropower potential at 112 GW for the region (Hoes, 2014). Renewable energy thus holds immense potential in a region where growing populations and rising living standards will increase the demand for sustainable energy, and declining wind and solar costs have rendered renewable energy technologies cost competitive with all imported fuels (Box 1).

Figure 3 Most suitable areas in North Africa for utility-scale solar photovoltaic and wind



Source: Suitability scoring and areas: IRENA. Base map: UN boundaries.
Note: PV = photovoltaic.

Disclaimer: This map is provided for illustration purposes only. The boundaries and names shown on the map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area, or of its authorities, or concerning the delimitation of frontiers or boundaries.

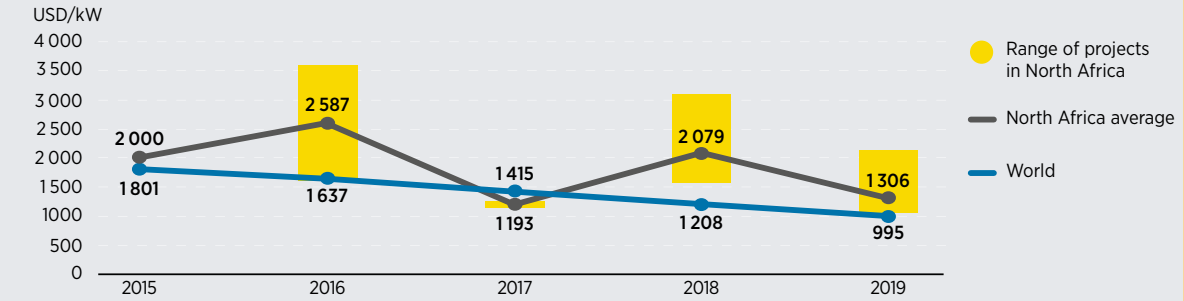
Box 1 Declining solar and wind power costs in North Africa

North Africa has witnessed a drastic decline in solar and wind technology costs in recent years, making a very strong business case for these renewables. As shown in Figure 4, the average installation cost for **solar photovoltaic** (PV) in North Africa declined from USD 2 000 /kilowatt (kW) in 2015 to USD 1 306 /kW in 2019 (Global Data, 2020). The data encompass 38 projects installed in North Africa, of which 34 were installed in Egypt, primarily in the Benban Solar Park area. Meanwhile, the weighted average installation cost for utility-scale solar PV fell by 82% globally between 2010 and 2021 (from USD 4 808 /kW to just USD 857 /kW in 2021) (IRENA, 2022d).

Recent tariffs reported in Tunisia for 50-200 megawatt independent power producer projects averaged at USD 30/megawatt hour (MWh) (Tunisian Ministry of Industry, Energy and Mines, 2019). The lowest tariff, TND 71.78 /MWh (approximately USD 24 /MWh), was proposed for the 200 MW solar plant in Tataouine. This is the lowest solar bid recorded in Africa on the award date and is among the lowest worldwide.

Concentrated solar power (CSP) plants, by contrast, remain costlier than solar PV plants, despite declining cost trends recently. For comparison, NOOR III, one of the CSP plants of the Noor-Ouarzazate complex, had a total installation cost of USD 5 367 /kW (MAZARS, 2016). However, offering storage options could help magnify CSP's contribution in support of solar PV deployment.

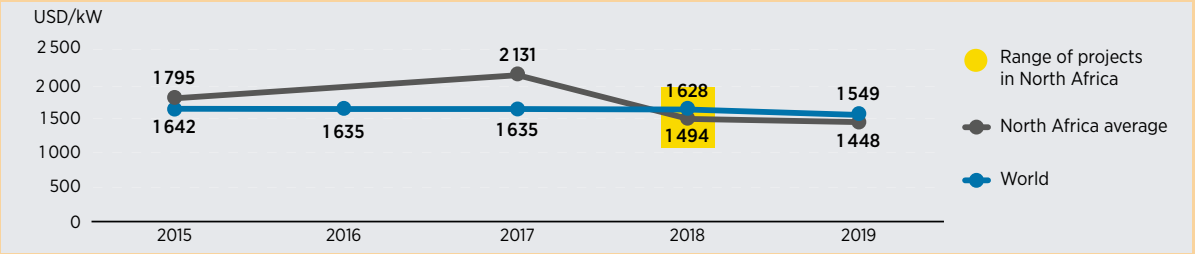
Figure 4 Evolution of average installation cost for solar PV projects in North Africa



Source: IRENA, 2023a, based on Global Data (2020) and IRENA (2020).
Note: kW = kilowatt.

The average installation cost for **wind energy** projects (Figure 5) also declined significantly within the region, from USD 1 795 /kW in 2015 to USD 1 448 /kW in 2019 (Global Data, 2020). The data encompass seven projects installed in North Africa between 2015 and 2019, four in Egypt and three in Morocco. In the same period, the global weighted average installation cost for onshore wind fell 35% between 2010 and 2021 (from USD 2 042 /kW to USD 1 325 /kW) and by 41% (from USD 4 876 /kW in 2010 to USD 2 858 /kW 2021) for offshore wind (IRENA, 2022d).

Figure 5 Evolution of average installation cost for onshore wind projects in North Africa



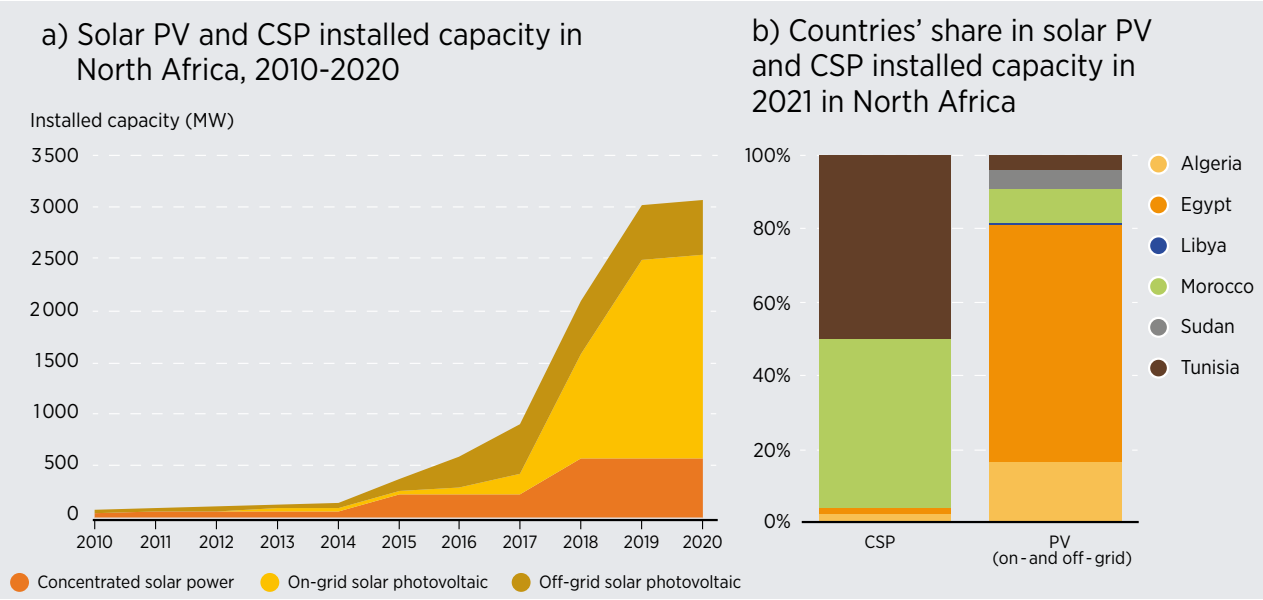
Source: IRENA (2023a) based on Global Data (2020) and IRENA (2020).
Note: kW = kilowatt.

2.3 RENEWABLE ENERGY DEPLOYMENT

Despite renewable energy's potential in North Africa, as well as the historical role of hydropower in parts of the region, renewables continue to have a small share of the electricity mix to date. IRENA data from 2020 indicate that hydropower accounts for about 7% of North Africa's total electricity generation (IRENA, 2023b). Hydropower's use is concentrated in Egypt, Sudan and Morocco, in that order; its share of total generation in these countries ranges from 12% in Morocco to 44% in Sudan. Meanwhile, Algeria, Libya and Tunisia have small or no hydro capacity at all due to a lack of resources. Other renewables account for some 6% of the electricity mix, with wind energy's contribution ranging from as high as 13% in Morocco to close to zero in Algeria, Libya and Sudan. Fossil-fuel-based thermal electricity generation accounts for close to 94% of the region's total electricity generation.

Despite the large reliance on fossil fuels, North Africa has seen an expansion of renewable generation capacity at an encouraging rate of 5% annually since 2011, albeit with substantial intra-regional differences. Egypt, Morocco and Algeria contributed to the substantial expansion of solar power in the region. Egypt and Algeria have invested significantly in PV power plants in recent years. PV power plants, which are mostly located in Egypt, represented 84% of total installed solar PV capacity in North Africa in 2020 (Figure 6). The majority of the installed solar power capacity is grid connected, whereas off-grid capacity is mostly found in southern Algeria's remote regions (IRENA, 2023c). Meanwhile, Morocco had over 90% of the region's concentrated solar power (CSP) capacity in 2020. This was primarily attributed to the 510 megawatt (MW) Noor-Ouarzazate plant – the world's largest CSP plant (Moroccan Agency for Sustainable Energy, 2016). Algeria and Egypt have also installed CSP plants, albeit on a smaller scale; both inaugurated CSP plants in 2011 – the ISCC Hassi R'mel plant (SolarPACES, 2011a) and the ISCC Kuraymat plant (SolarPACES, 2011b), respectively (both of 20 MW capacity). The Algerian government set a target of reaching 2 GW of CSP by 2030 in its 2015 Renewable Energy Roadmap (Ministère de l'Énergie et des Mines, Algérie, 2015).

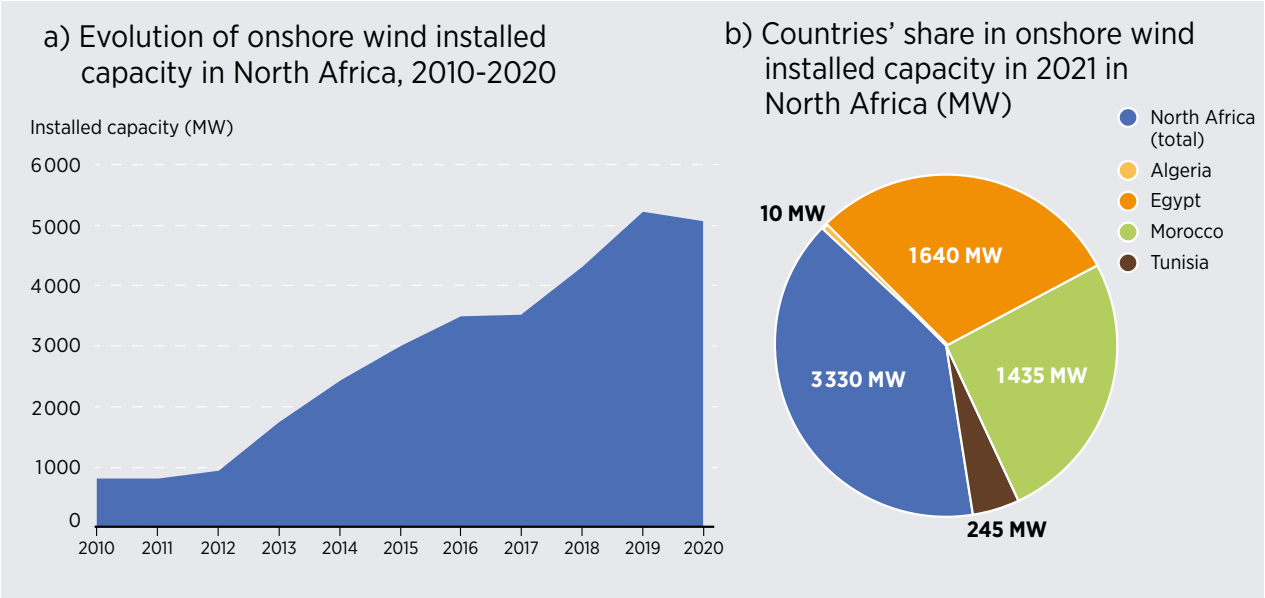
Figure 6 Concentrated solar power and solar PV installed capacity in North Africa, over time and by country share



Source: IRENA, 2023b.
Notes: CSP = concentrated solar power; MW = megawatt; PV = photovoltaic.

A similar increase in wind energy installed capacity can be discerned from last decade's data. The total installed wind capacity in the region (Figure 7; all of it onshore) was slightly above 3 000 MW at the end of 2020, representing 2.7% of the region's total power generation capacity (IRENA, 2023b). Egypt and Morocco are the main players in wind power, with 45% and 46% shares of total installed wind capacity in all of North Africa, respectively.

Figure 7 Onshore wind installed capacity in North Africa, over time and by country share



Source: IRENA, 2023b.
Notes: CSP = concentrated solar power; MW = megawatt.

North Africa leads the African continent in new utility-scale wind and solar. It is home to almost half of Africa's total installed wind power generation capacity, as well as a fifth of its grid-based solar power generation capacity. Notable renewable energy projects in North Africa in recent years include the 1.5 GW Benban Solar PV park and the 262.5 MW Ras Ghareb wind farm, both in Egypt; the 1.3 GW Merowe hydropower dam (2009) and the 320 MW Upper Atbara and Setit Dam Complex (2017) in Sudan; the 510 MW Ouarzazate solar power station (2016-2018) in Morocco; and the 301 MW Tarfaya wind farm (2014) in Morocco (IRENA, 2023b). Sudan is expected to commission the 100 MW Dongola Wind Farm in 2023 (Power Technology, 2022).

Morocco and Algeria rank second and third in grid-connected solar power generation in the African continent (734 MW and 448 MW, respectively). Morocco and Egypt are second and third in wind power production after South Africa, with 1.4 GW and 1.38 GW capacities, respectively (IRENA, 2023b).

03 ENERGY SECTOR OVERVIEW

© Starcevic | gettyimages.ae

Most deployment policies in North Africa continue to focus on power, with less attention to transport and heating and cooling. This reflects in part the sector's maturity, and its declining cost; by 2020, new solar PV and wind projects were undercutting even the cheapest and least sustainable of existing coal-fired power plants in some parts of the world (IRENA, 2023a). Other factors include the so far relative absence of systematic heating and cooling for household use in North Africa compared with regions such as Europe, North America or the Gulf Cooperation Council countries – a factor that has both climatic and income-related reasons – and limited policy focus on sustainable transport options across North Africa, due to their perceived novelty and potential costliness.

While prioritising power aligns with IRENA's vision of a future energy system where electricity accounts for more than half of the energy consumption by 2050 (IRENA, 2022a), it will be essential to introduce policies supporting renewables' direct use for heating, cooling and transport. Such policies will be crucial to support North Africa's emerging industrialisation plans and growing public transport needs, and to build its resilience to climatic changes in the coming decade, ultimately advancing its overall development goals. Policies would need to consider the requirements of sectors such as agriculture, fisheries and forestry, as well as the changing energy consumption patterns of a higher share of middle-income households in the face of unprecedented temperature and climate changes.

Notably absent throughout North Africa are renewable energy mandates, including for relatively effective solutions such as solar water heaters, which have already been implemented for new buildings, for example, in hospitality and services (IRENA, 2022b), in several countries. The region primarily relies on regulations, and fiscal and financial (tax) incentives for policy deployment, while there has also been an ongoing structural reform of electricity markets to allow for more market-based policy instruments to help diversify electricity supply. Renewable energy policy frameworks in North Africa have evolved considerably over the past decade, although their extent and effectiveness vary widely among countries. Renewable energy policies and legislation are also deeply integrated into each country's broader investment climate, which includes large differences in factors ranging from political stability to openness to foreign investment, and transparency in planning and deployment processes, among others. This chapter focuses on policies that support renewable energy including commitments and plans, regulatory measures thatcreate a market for renewable energy solutions and fiscal and financial incentives that make them more affordable, as well as measures to integrate them into the energy system.

Renewable energy policy frameworks in North Africa have evolved considerably over the past decade, although their extent and effectiveness vary widely among countries. Renewable energy policies and legislation are also deeply integrated into each country's broader investment climate, which includes large differences in factors ranging from political stability to openness to foreign investment, and transparency in planning and deployment processes, among others. This chapter focuses on policies that support renewable energy, including commitments and plans, regulatory measures thatcreate a market for renewable energy solutions and fiscal and financial incentives that make them more affordable, as well as measures to integrate them into the energy system.

3.1 COMMITMENTS AND PLANS

Several North African countries have been active participants in global climate fora and have been pushing ahead with increasingly ambitious renewable energy targets and deployment. Of particular mention are Egypt, Morocco and Tunisia. Morocco hosted the 2016 United Nations Climate Change Conference (COP22) in Marrakech, while Egypt hosted the COP27 in Sharm El-Sheikh in 2022. Renewable energy commitments have been made regionally as well as nationally in North Africa, recognising the role of renewable energy for sustainable development and industrialisation, and for realising their potential socio-economic benefits.

Regional plans

Several North African countries have actively participated in regional efforts to promote renewable energy, demonstrating their commitment within African and Arab country fora. All North African countries are members of the African Union and have committed to inclusive, sustainable economic growth and development in Agenda 2063: The Africa We Want (IRENA, KFW and GIZ, 2021), a strategic framework highlighting social and economic development, continental and regional integration, democratic governance, and peace and security, among other issues. It also emphasises African countries' commitment to participate in global climate mitigation efforts, as well as to "harness all African energy sources to ensure modern, efficient, reliable, cost-effective, renewable and environmentally friendly energy" to all (African Union, 2021).

North African countries have also joined other members of the League of Arab States in forming the Regional Center for Renewable Energy and Energy Efficiency. They also support in the Pan-Arab Strategy for the Development of Renewable Energy 2010-2030, which was expanded in 2018 to become the Pan-Arab Sustainable Energy Strategy 2030 and includes energy efficiency and energy access. The strategy aims at reaching a 12.4% renewable share in the Arab region's electricity mix and includes a commitment to fostering public and private investment; mitigating the risks associated with grid planning, expansion and operation; and integrating smart services and quality assurance schemes.

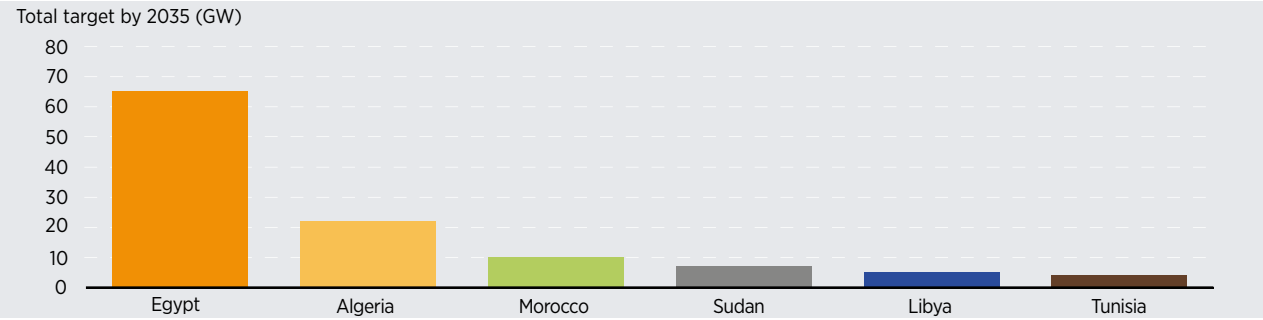
The tool for the implementation for renewables is the Arab Renewable Energy Framework, which offers guidelines for Arab states to develop their national renewable energy action plans based on a customised template, which serves as the baseline for annual progress reports (IRENA, League of Arab States and RCREEE, 2014).

National plans

Algeria, Egypt, Libya, Morocco, Sudan and Tunisia signed the **Paris Agreement** together with 189 other member states of the United Nations Framework Convention on Climate Change (UNFCCC) in 2016. Within this context, they are required to submit their **Nationally Determined Contributions (NDCs)** every five years, describing the mitigation and adaptation actions that they pledge to implement in order to stay in line with the agreement's objectives.1 Except Libya, which has yet to ratify the Paris Agreement, all North African countries submitted their first NDCs between 2016 and 2017. In 2021, Morocco, Sudan and Tunisia submitted their updated NDCs, while Egypt did so in July 2022 ahead of COP27. Meanwhile, Algeria did not yet submit an update. All the NDCs include both unconditional and conditional renewable energy capacity expansion targets for 2030 (Algeria and Egypt have no unconditional targets; see Table 1).

The policy ambitions of the North African countries indicate their desire to achieve a larger share of renewables in electricity generation (Figure 8). Most have actively integrated renewable energy targets into their national energy plans, along with the NDCs. These targets predominantly focus on the power sector, with renewable power targets in terms of installed capacity (MW) and share of renewables in the electricity mix. Plans vary in ambition and target timelines.

Figure 8 Renewable energy capacity expansion by 2035 according to set national targets



Source: IRENA, n.d.[a].
Note: CSP = GW = gigawatt.

Morocco has the most ambitious and detailed NDC in the region. By 2030, it aims to have 52% of installed capacity represented by renewable power plants. This target was originally set in its first NDC and has been maintained at the same level in the updated version. It is also reiterated in the country's "Stratégie Bas Carbone à Long Terme – Maroc 2050" (long-term low-emission development strategy or LT-LEDS). Almost half of Morocco's renewable energy targets are unconditional, whereas the remainder is conditional on external financial and policy support. If all conditions were met, Morocco's installed capacity for renewables would triple in this decade.

Ambitious renewable energy targets were also set in **Algeria**'s and **Tunisia**'s NDCs, which aim to reach 27% and 30% electricity generation from renewables by 2030, respectively, up from 1% and 4% currently (Table 1). However, almost all their renewable energy targets are conditional, and external conditions will influence their aim to bring about an over tenfold increase in their national renewable power generation capacity. **Libya**, however, has not submitted any NDC so far.

Egypt has a target of installing additional renewable energy capacity to reach a target of a 42% renewables' share in power generation by 2035 in its NDC, in line with its Integrated Sustainable Energy Strategy 2035 (Table 1). The country launched its 2050 National Climate Change Strategy in May 2022, which does not contain an emissions reduction target (Ahram Online 2022a). Sudan has adopted specific clean cooking targets, being the sole country with a deficit in clean cooking.

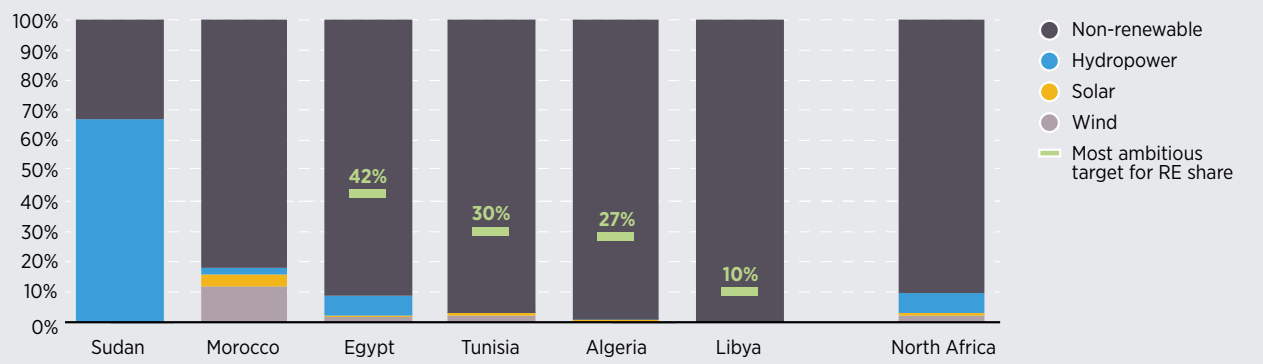
Table 1 Overview of national commitments to renewable energy

Country	Paris Agreement	Renewable energy target in NDCs/INDCs	Renewable energy target in national energy plan	Renewable energy target in rural electrification plan	National renewable energy target	Clean cooking target	EE target in NDCs/ INDCs	EE target in national energy plan	NDC submission date
Algeria	Ratified the Paris Agreement on 20 October 2016 (Non-Annex I Party).	Yes, focus on power	Yes, focus on power and heating	No	The NDC aims for a 7% (unconditional) to 22% (conditional) reduction in greenhouse gas emissions by 2030 compared with the business-as-usual scenario. The Renewable Energy and Energy Efficiency Development Plan 2016-2030 and the NDC set a conditional target of reaching 27% of electricity generation from renewables by 2030.	No	No	Yes, focus on power, buildings and industry	20/10/2016
Egypt	Ratified the Paris Agreement on 29 June 2017 (Non-Annex I Party).	Yes, focus on power	Yes, focus on power	No	The NDC defines "increased use of renewable energy as an alternative to non-renewable energy sources" as one of the five pillars of mitigation policies. Egypt's updated NDC reiterates the target mentioned in the Integrated Sustainable Energy Strategy 2035 to increase renewables' share in the electricity mix to 42% by 2035.	No	Yes, focus on power	Yes, focus on lighting, power, standards and labels, and buildings	07/07/2022 (updated)
Libya	Signed but not ratified the Paris Agreement. The country did not submit any NDC (Non-Annex I Party).	No	Yes, focus on power and heating	No	The Strategic Plan for Renewable Energies 2018-2030 sets a target of reaching 6.6 GW of renewable capacity by 2030.	No	No	No	No
Morocco	Ratified the Paris Agreement on 21 September 2016 (Non-Annex I Party).	Yes, focus on power and heating	Yes, focus on power	No	The NDC, updated in June 2021, aims for an 18.3% (unconditional) to 27.2% (conditional) reduction in greenhouse gas emissions by 2030 compared with the business-as-usual scenario. The renewable energy targets in the NDC include reaching a 52% renewables' share in installed power generation capacity by 2030, of which 20% is from solar, 20% is from wind and 12% is from hydropower.	No	Yes, focus on lighting, power, standards and labels, buildings and industry	Yes, focus on lighting, power, standards and labels, buildings and industry	22/06/2021 (updated)
Sudan	Ratified the Paris Agreement on 2 August 2017 (Non-Annex I Party).	Yes, focus on power	Yes, focus on power	Yes		Yes		No	22/09/2021 (updated)
Tunisia	Ratified the Paris Agreement on 10 February 2017 (Non-Annex I Party).	Yes, focus on power and heating	Yes, focus on power	No	The NDC, updated in October 2021, aims for a 27% (unconditional) to 18% (conditional) reduction in carbon intensity by 2030 compared with 2010 as the base year. The NDC includes reaching 30% renewable electricity by 2030 (up from 4% in 2015). The National Renewable Energy Action Plan 2018 targets 3.8 GW of renewable capacity by 2030.	No	Yes, focus on power, buildings and industry	Yes, focus on power, standards and labels, and buildings	10/10/2021 (updated

Source: Adapted from IRENA, 2023a; IEA, 2020; UNFCCC, 2021b.
Notes: EE = energy efficiency; GW = gigawatts; INDC = Intended Nationally Determined Contribution; NDC = Nationally Determined Contribution.

Figure 9 shows the most ambitious targets that North African governments have set for themselves in their currently enforced policies (as communicated in their NDCs or other strategy documents). These targets focus on the share of renewable resources in power generation. Most countries are still far below their targets and are heavily reliant on fossil fuels for generating electricity. However, given these targets, non-hydro renewable resources would be expected to increase significantly in importance in the years to come.

Figure 9 Share of energy sources in electricity generation, 2020, and most ambitious renewable energy targets (including hydropower) for North Africa



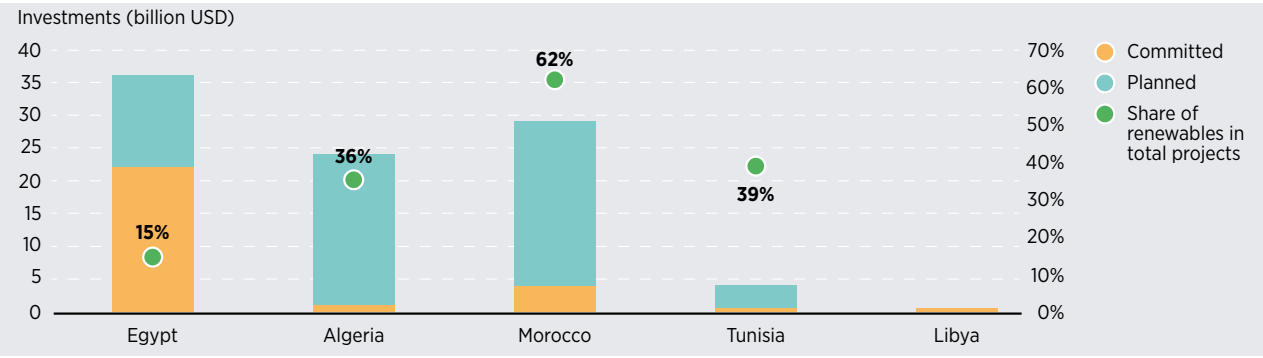
Source: Adapted from IRENA (2023a), based on IRENA (2023b), IRENA (2018), Ministry of Electricity and Renewable Energy of Libya (2013), Ministry of Energy and Mining of Algeria (2015), and Ministry of Environment and Sustainable Development of Tunisia (2015).

Note: Morocco has a target for installed renewable energy capacity, not for renewable energy's share in the electricity mix.

Figure 10 shows the committed and planned power investments in North Africa for the period 2021-2025. Egypt's committed and planned power investments (USD 36 billion) (including both generation and transmission) are the highest in the region, followed by Algeria (USD 23 billion) and Morocco (USD 12 billion). This does not include the latest announcement of June 2023, in which Egypt's New and Renewable Energy Authority signed an agreement worth USD 10 billion with a group of companies for a 10 GW wind farm, to become one of the largest wind farms in the world (The National, 2023).

Tunisia and Libya have committed and planned power investments of USD 3 billion and USD 0.3 billion, respectively (APICORP, 2021). Renewable energy represents a substantial proportion of these investments, that is, 62% for Morocco, 39% for Tunisia, 36% for Algeria and 15% for Egypt. These investments in North Africa need to reach a yearly average of about USD 15 billion during the period 2021-2025, from which about USD 5 billion would be dedicated to renewable energy.

Figure 10 Committed and planned power investments in North Africa, 2021-2025*



Source: Adapted from IRENA (2023a), based on APICORP (2021). No data are available for Sudan.

* Planned investments are pre-final investment decisions, that is, before a project's owner/operator officially approves its execution. Committed investments are post-final investment decisions, that is, projects that have entered the execution phase. No numbers are available for Sudan.

3.2 FOSSIL FUEL SUBSIDIES AND POWER SECTOR REFORMS

Phase-out of fossil fuel subsidies

Fossil fuels and electricity remain subsidised in many parts of North Africa, despite intensifying efforts for their reform. Many North African and Middle East countries have made energy subsidies an elemental part of their policy instruments along with food, transport and housing subsidies way back since the 1960s. These subsidies were aimed at protecting the poor, and making modern energy affordable to all, but they were not limited to this goal (Luciani, 1987; Fattouh and El-Katiri, 2012). Most North African countries have been implementing energy subsidy reforms gradually, including reforms on fossil fuels and electricity, as part of their post–Arab Spring reform packages financed by international financial institutions.

These reforms have succeeded to varying degrees in North African countries, but utility prices remain heavily politicised across the region. In more recent years, reform has also been complicated by the Ukraine crisis, as rising food and fuel prices partly eroded past reform success, for example, in Egypt (Ahram Online, 2022b). Current new reform plans involve the gradual phase-out of electricity subsidies in Egypt (Ahram Online, 2022b); a major social safety net reform to address general subsidies in the coming years (including a phase-out of butane subsidies) in Morocco by 2025 (The North Africa Post, 2023; IMF, 2023); and a further energy subsidy reform in Tunisia in 2023 under a USD 1.9 billion package with the International Monetary Fund (Reuters, 2023).

In 2021, North Africa was estimated to have total fossil fuel and electricity subsidies of USD 56 billion, almost triple the amount in 2020. Algeria and Egypt accounted for almost 90% of the total, despite the most recent subsidy reform in Egypt (Table 3; IEA, 2022). In Sudan, the cost of fuel subsidies (petrol, diesel, LPG) constituted 57% of fiscal spending and 10.6% of gross domestic product in 2019, highlighting the enormous fiscal burden such subsidies can turn into. Subsequent fuel price reforms in 2020 led to substantial savings of an estimated USD 3.5 billion annually in government spending (Jefferis, 2020).

Among the North African countries, those producing fossil fuels have the highest average subsidisation rates, whereas energy importers – Morocco and Tunisia – have been fiscally more pressurised to reform domestic energy prices and have thus been the most successful in this task. By contrast, Libya reached over 80% average subsidisation rates for fossil fuels and electricity in 2021 (Table 2). Fossil fuel reform has been included as policies in NDCs, including by Egypt and Morocco.

Table 2 Energy subsidies in North African countries with the highest subsidies, 2021

	Average subsidisation rate (%)	Subsidy per capita (USD/person)	Total subsidy as share of GDP (%)	Total subsidies (real 2021 million USD)
North Africa				
Algeria	73	528	11	23 577
Egypt	56	259	10	27 042
Libya	81	822	7	5 721

Source: IEA, 2022.
Note: GDP = gross domestic product.

The substantial fiscal burden imposed by fossil fuel subsidies, along with their regressive nature (particularly in poorer countries), is one of the key reasons behind the push for their reform (*e.g.* Coady, Flamini and Sears, 2015). Fossil fuel and electricity subsidies also have broader implications for energy markets: historically, they have favoured fossil fuels and energy-intensive industries, shaping domestic utility sectors and industrialisation efforts. While reducing the price of fossil fuels, they have absorbed significant fiscal resources that could have been used to support more energy-efficient technologies, or to directly flow into pro-poor sectors such as education and health. They have also distorted investment incentives and consumer preferences, and increased hurdles for alternative energy technologies, including renewables, which lack equivalent fiscal support. Finally, the regulation of utility prices has rendered many North African utilities financially incapable of recovering costs, thereby limiting the sector's capacity to invest in upgraded infrastructure and new energy technologies.

Power sector reforms

North Africa's power rectors have historically been dominated by large, state-run utilities, with the aim of providing affordable energy and water to citizens. However, in recent years, some North African countries have worked to facilitate increased private sector investment in the sector, including through the policies discussed in the following sections.

The majority of North Africa's power sectors underwent substantial changes in recent years to increase investment in, and encourage the deployment of, new energy technologies. Specifically, Egypt, Morocco and Tunisia have engaged in significant structural reform, including through facilitating private sector access, diversifying energy sources and reducing energy subsidy burdens. These reforms were also partly driven by the conditions set by development finance institutions (DFIs), including the World Bank Group's Clean Energy Facility and the International Bank for Reconstruction and Development, which played a critical role in financing renewable energy projects in all three countries (World Bank, 2015, 2016, 2019).

3.3 FISCAL AND FINANCIAL INCENTIVES

North African governments commonly employ fiscal policies to support renewable energy. Widespread among such policies are tax incentives (such as value added tax), customs and import duty exemptions, and capital depreciation/capital allowances. **Egypt's New Investment Law**, for instance, (published in 2017) provides investment incentives for renewable-energy-based projects, including a 30% deduction of net taxable profits for the first seven years of a project's lifetime and reduced customs duties from 5% to 2% on equipment and machinery (General Authority for Investment and Free Zones, 2017). Projects may also be eligible for an exemption from land taxes. In **Sudan**, there is no import duty or value added tax on PV components (MESIA, 2022), and the amended 2021 Investment Act provides further incentives to foreign investors (UNCTAD, 2021).

Several North African countries also provide public finance support, including through subsidies, grants and concessional loans, among others. Egypt provides soft loans at a 4% interest rate for residential projects up to 200 kilowatts (kW) and up to 8% interest rate for 200-500 kW projects. Since January 2016, Egyptian small and medium enterprises are eligible for loans at a 5% interest rate (El-Mazghouny, 2022).

Tunisia has a dedicated fund for renewable energy and energy efficiency activities – the **Energy Transition Fund** (Fonds de Transition Energétique). The fund was created in 2013 and broadened in scope in 2017, and it participates in renewable energy investments through financing and equity, in addition to the original function of grant support. While the fund's implementation still requires more transparent procedures and additional financial resources, it could be the basis for a future increase of renewable energy deployment, including in the decentralised market segment. The fund's dedicated financing structures enabled it to support most small-scale applications of solar water heaters and PV rooftop systems in the residential sector, which were developed under the **Prosol** and **Prosol électrique programmes** (IRENA, 2021a).

Throughout North Africa, the participation of development banks and financial institutions (DFIs) is crucial for access to affordable finance (chapter 5). This is because many of the region's financial and fiscal incentives alone are insufficient to overcome the more structural financial challenges to deploying large- and small-scale projects, including the greater involvement of, and the provision of appropriate financial products by, local commercial banks, and North African countries' evolving overall investment climate in the energy and utility sector.

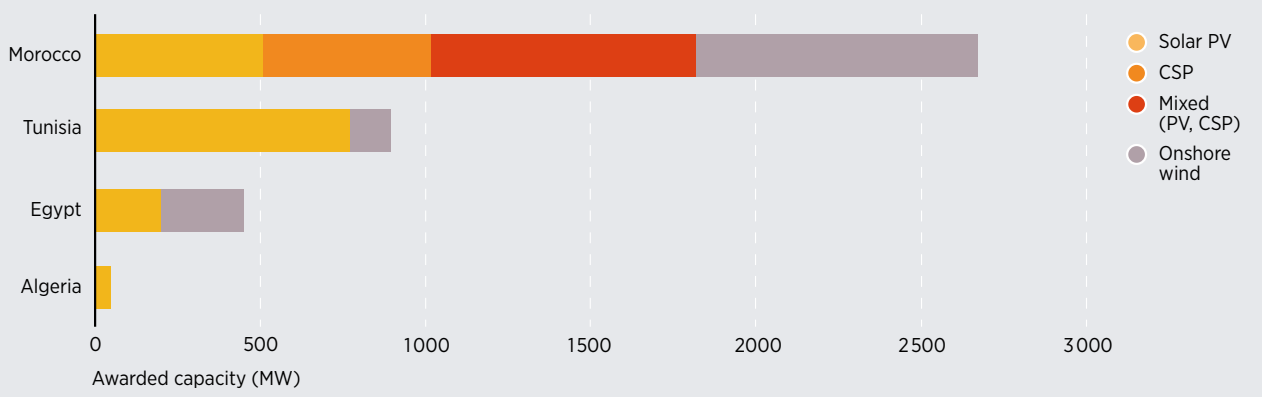
3.4 STRUCTURED PROCUREMENT AND OTHER POLICIES FOR RENEWABLE POWER

Structured procurement products, such as feed-in tariffs (FiTs) and competitive auctions, form part of some North African countries' evolving policy basket for the power sector.

Auctions

Auctions have been increasingly used as a primary mechanism to spur renewable energy investments in North Africa. Since 2010, auctions representing more than 4 500 GW of capacity have been announced in Algeria, Egypt, Morocco and Tunisia, of which over 4 000 GW have been awarded (Figure 11; see also Annex I). Morocco leads the region's auctioned capacity, with DFIs' support, and is second only to South Africa in the renewable energy capacity awarded in auctions in the entire African continent. Tunisia and Egypt, too, have awarded substantial renewable capacity through auctions. Virtually all the awards have been made for solar and wind power.

Figure 11 Renewable capacity awarded through auctions in North Africa, 2010-2021



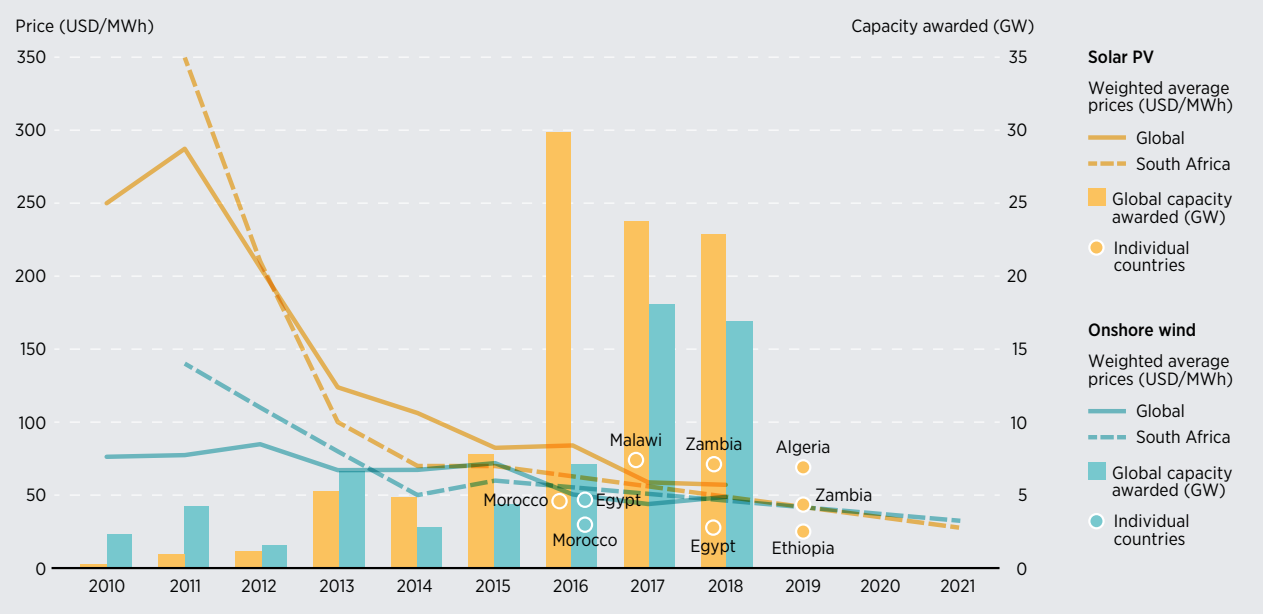
Source: IRENA, n.d.[c]; Power Futures Lab, 2021.

Notes: CSP = concentrated solar power; MW = megawatt; PV = photovoltaic.

Recent years have seen record-breaking prices being announced in North Africa

Competitive auctions have led to substantial price reductions for utility-size renewables in North Africa as well as worldwide. These reductions reflect declining technology costs and an improving business and investment climate for renewables. Solar auctions have realised prices that have repeatedly broken the price record for solar PV in Africa (Figure 12). In August 2019, Tunisia's Tataouine solar PV farm was awarded capacity at USD 25.34 /megawatt hour (MWh), which is less than half of the global weighted average of USD 56 /MWh for solar PV auctions in 2018. Onshore wind power auctions in Morocco, Egypt and Tunisia have resulted in awards leading to independent power producer (IPP) contracts (see also Annex I).

Figure 12 Results of selected auctions in Africa, and global weighted average prices resulting from auctions, 2010-2020



Source: IRENA, n.d.[c].

Auctions have also been designed to achieve objectives beyond price

Renewable energy auctions offer design flexibility and can cater to specific challenges and circumstances, such as high-risk environments, contributing to their success.[1] In North Africa, auctions have also proven effective in achieving objectives beyond price. Paramount in this regard are socio-economic development goals, as evidenced by experiences from Morocco (Box 2). Another objective of growing importance for the region is system integration as the share of variable renewable energy increases. Design elements include hybrid renewable auctions for dispatchable capacity. Morocco's innovative approach in combining solar PV with CSP in hybrid systems, as demonstrated in the Midelt project (Box 2) (IRENA, 2019), supports the integration of variable renewable energy into the power system.

1 *IRENA's upcoming report from the extensive series on Renewable Energy Auctions, which began in 2013, focuses on the design of auctions for high-risk environments.*

Box 2 Auctions in Morocco designed for socio-economic goals and system integration

Morocco's Noor Power Station was the first complex to combine solar photovoltaic (PV) and concentrated solar power (CSP) to use the latter's storage capacity and support system integration. The complex was auctioned in four rounds. The first three rounds for CSP totalled 510 MW: the 160 MW Noor I project and the 200 MW Noor II project use parabolic trough technology with storage capacity of three and seven hours, respectively, and Noor III, a 150 MW solar tower, has seven hours of storage capacity. These were followed by a fourth round of PV with 72 MW.

The 510 MW of CSP resulting from the first three rounds were supported with USD 435 million from the Climate Investment Funds, investments of about USD 700 million by the African Development Bank and the World Bank, and a part of foreign and multilateral investments that exceeded USD 3 billion. The support of both banks and the Climate Investment Funds was critical in driving down the cost of CSP in Morocco (CIF, n.d.).

The auction for the Noor-Ouarzazate solar complex sought to develop a domestic industry and create economic opportunities for local communities. People in neighbouring villages benefitted from the project, including women and children. Cash compensation for the land would have benefitted landowners, who are men. The community opted for investments in amenities and social services such as drainage, irrigation channels and community centres. The complex has offered employment opportunities to women.

Local labour and materials were encouraged in all four auction rounds, resulting in commitments from bidders that exceeded the specified thresholds in each round. The threshold was doubled in the fourth round, bringing employment to 6 430 Moroccans (70% of the total employed), with the Ouarzazate region being sourced a third of the jobs.

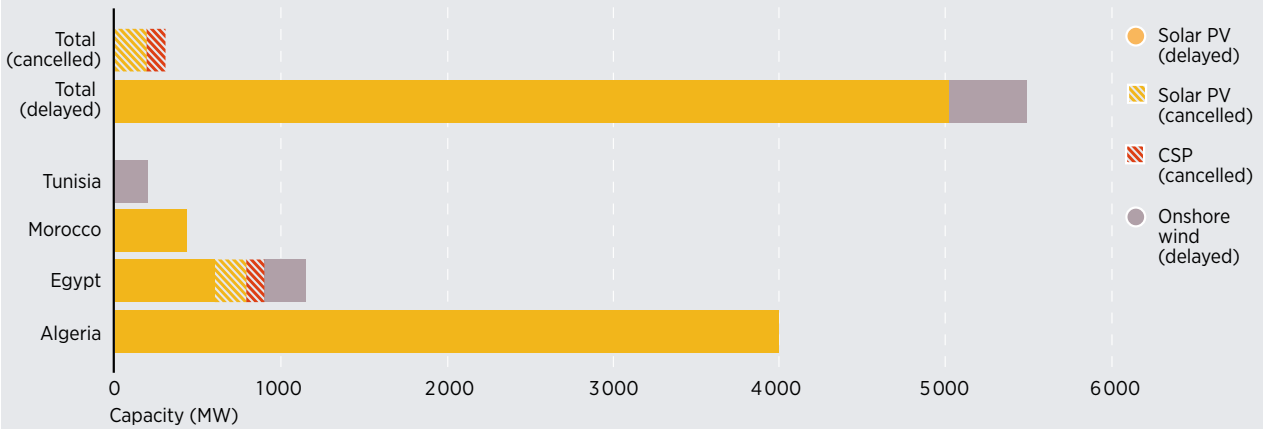
In May 2019, Morocco auctioned the world's first advanced CSP-PV hybrid. The 800 MW Noor Midelt project supplies dispatchable solar energy during the day and for five hours after sunset for a record-low tariff of MAD 0.68 per kilowatt hour (USD 70.3 per megawatt hour) during peak hours.* This will significantly support the integration of variable renewable energy into the power system.

Source: IRENA, 2019.

*USD 1 = MAD 9.6743 as of May 2019.

Considering many North African countries struggle with undercapacity, timely project completion is another crucial objective of energy auctions in the region. IRENA identifies key stages where auctions can underperform – starting with their announcement, and all the way through bidding, award, contracting, construction and asset operation, as specified in the power purchase agreement (PPA). A recent IRENA report (2019) contains details of the design elements to ensure efficiency at each of these stages. Auctions in North Africa have been faced with delays on a few occasions, especially in Algeria, where auctions worth over 4 000 MW capacity were delayed, as well as Egypt and Morocco (Figure 13; see also Box 3 below), with Egypt also seeing auctions for a small volume of solar cancelled.

Figure 13 Cancelled or delayed auctions in North Africa, 2010-2021



Source: IRENA, n.d.[c].

Note: CSP = concentrated solar power; MW = megawatt; PV = photovoltaic.

In the construction phase, the structured nature of auctions, especially those supported by DFIs, appears to have a ripple effect on the development of renewable energy projects. Notably, projects that enjoyed some form of DFI support and were contracted through an auction were built quicker (within about eight months of reaching financial closure) than those without DFI support and procured following direct negotiations (almost one year) (Power Futures Lab, 2021).

Box 3 Auction completion rates in Africa – highlights from North Africa

Tunisia has had notable success with auctions. In 2019, the Ministry of Energy, Mines and Renewable Energies awarded 500 megawatts (MW) of solar photovoltaic (PV) to three companies for several projects, with the lowest bid coming in at TND 71.83/megawatt hour (MWh) (USD 25.30/MWh)* and the highest bid at TND 97.92/MWh (USD 34.51/MWh) (Bellini, 2019). Seychelles also awarded its first utility-scale independent power producer and the region's first floating (4 MW) solar PV project through an auction in 2020 at USD 95/MWh.

Other countries that have seen competitively awarded renewable energy projects reach financial closure include **Egypt** (200 MW of solar PV, at USD 28/MWh [2021]; 250 MW of onshore wind, at USD 47/MWh [2017]), **Morocco** (177 MW of solar PV, at USD 46/MWh [2017]; 510 MW of concentrated solar power [2013-2015]; 270 MW of wind [2018-2019]) and Tunisia (10 MW of solar PV [2019]; 30 MW of onshore wind [2019]).

*USD 1 = TND 2.8377 on 20 December 2019.

Several successful auctions in Africa saw international and multilateral development partners play an important role (section 5). This support has had a noticeable impact on the tentative take-up of FiTs in North Africa, although with limited results so far.

Feed-in tariffs

FiTs have been implemented in North Africa, but have so far not been able to deliver on much investment. The lack of necessary regulatory and policy reforms and the absence of bankable contractual frameworks have been key reasons behind this inability. The region barely has private PV panel installations and associated FiT programmes for residential self-producers. So far, FiTs have resulted in meaningful utility-scale investments only in Egypt. These can be considered the most successful on the continent based on the number of developed projects and total installed capacity (Box 4).

Box 4 Experience with feed-in tariffs in Egypt

Despite Egypt's enormous renewable potential, fossil fuels have had a considerable share in its electricity mix for several decades. The launch of the Nubian Suns renewable energy feed-in tariff (REFiT) programme in 2014 marked a turning point for the country's electricity sector. It played a pivotal role in advancing the development of the Benban Solar Park, one of the largest solar complexes in the world. The USD 4 billion solar park, located in the Aswan governorate, comprises 41 solar photovoltaic installations as well as several small solar farms (IFC, 2017).

In 2017, all project developers allotted utility-scale solar capacity under the Nubian Suns REFiT programme signed their power purchase agreements with the government at a firm tariff of USD cents 8.4 /kilowatt hour. All projects reached financial closure in the same year, commencing commercial operations two years later.

The programme was backed by the Egyptian government and several development finance institutions, including the International Finance Corporation, the Multilateral Investment Guarantee Agency, and the European Bank for Reconstruction and Development. Nine international banks, led by the International Finance Corporation, provided construction loans for the projects, which totalled USD 653 million. The European Bank for Reconstruction and Development also provided similar loans to the tune of about USD 650 million. The Multilateral Investment Guarantee Agency issued USD 210 million worth of political risk insurance protection to the projects' sponsors and lenders.

The government provided the land for the mega project and built the transmission line linking the park to the grid in a timely manner (IFC, 2017). The success of Egypt's REFiT programme underscores the importance of regulatory and policy reforms and bankable contractual frameworks in attracting investments. These were unavailable in most other REFiT schemes in the continent.

Grid access, priority dispatch and other forms of generation/consumption

Renewable energy deployment requires open and non-discriminatory grid access to allow the injecting of renewable electricity. This is usually required by law (often referred to as "obligation to take") in most of Europe, North America and parts of Asia. Although North African countries initially included this provision in their regulations to support renewables and eliminate relevant risks, this measure is not yet implemented widely in the region, and only a few countries have such regulations. However, providing priority dispatch or preferential grid access can indeed support renewable energy development.

Clear rules for power generation and sales, including for self-consumption, can also promote renewable energy development. For example, in Tunisia, producers have the right to sell excess renewable electricity generated for self-consumption to the Tunisian Electricity, Gas and Renewable Energies Company. Law No. 2015-12 sets the framework for renewable energy proliferation, which encompasses renewable electricity generation, transporting the generated electricity to consumption points via the national grid and sale of excess renewable electricity

to STEG (Société Tunisienne de l'Electricité et du Gaz) at fixed prices within the limits of the maximum rate. This introduced for the first time IPPs in renewable energy technologies. Law No. 2015-12 (2015) was amended by Law 2019-47 (2019) to allow for corporate PPAs. This gives companies adopting renewables for self-production the right to sell electricity to other consumers or to companies that have subscribed power exceeding the Ministry of Energy, Mines and Energy Transition's electricity threshold by 30% and to use the national grid network to transport electricity (IRENA, 2021a).

Morocco has also implemented specific regulations for self-consumption. These regulations allow the sale of surplus electricity to the national utility as well as allowing self-generators access to the transmission network to transport electricity generated for self-consumption between production and consumption points.

Net metering

Distributed generation may be supported by net metering. Egypt, Morocco and Tunisia are incentivising self-generation through national net metering regulations, although their implementation and impacts have so far been limited. Egypt introduced a net metering scheme in 2013 to promote distributed solar. The scheme allows small-scale residential, industrial and commercial renewable energy projects with 20 MW maximum capacity to feed electricity into the low-voltage grid. Under the scheme, surplus solar PV generation that is fed back into the grid is credited against users' bills for grid consumption. The calculation method employed credits surplus electricity only in consumers' highest tariff bracket (Sakr et al., 2017).

Morocco introduced Law No. 58-15 in 2016, amending the renewable energy law and introducing a net metering scheme for solar PV and onshore wind plants. The law applies to power plants connected to the high-voltage grid and private generators who may sell up to 20% of their production to the grid (IEA, 2016).

Tunisia followed in 2020 with a decree that allows private companies to produce renewable energy for self-consumption. Under this decree, excess power is to be sold to the utility STEG under net metering rules, and private companies have the right to sell electricity to large energy consumers. The new rules also set out the conditions under which projects may use the national grid infrastructure to sell electricity to third-party customers through bilateral PPAs (Bellini, 2020).

3.5 POLICIES FOR THE DIRECT USE OF RENEWABLES: HEATING, COOLING AND TRANSPORT

North Africa lacks comprehensive policies supporting investments in renewables in sectors beyond power generation (solar water heaters [SWHs] are an exception). Yet the region does have relevant initiatives, pilot schemes and scalable programmes that could be expanded in the coming years, given greater political interest.

Heating and cooling

Despite being capital-intensive, well-designed district heating and cooling networks could be among the most cost-efficient and technically feasible solutions to meet North Africa's growing heating and cooling needs, especially in densely populated areas. While small-scale district heating and cooling networks service large buildings or groups of buildings (*e.g.* university campuses or hospitals) globally, they remain a largely untapped opportunity in the region. Egypt was the first African country to build a district cooling plant (located in Cairo and built by GASCOOL, the Egyptian Company for Energy and Cooling) (GASCOOL, 2004).

By contrast, solar water heating policies are relatively common in North Africa. Typically, they offer subsidies to support SWHs. Tunisia's PROSOL programme was more comprehensive, however. It allowed consumers to purchase SWHs at lower upfront costs through investment subsidies on a five-year loan. Working alongside banks, the programme reduced risks by involving the electricity utility as the debt collector and increasing the availability of financing for SWHs (Innovation for Sustainable Development Network, 2019; see Box 5).

Box 5 Tunisia's PROSOL programme

Tunisia's PROSOL programme was introduced as far back as 2005. It provides capital grants along with value added tax exemptions, reduced custom duties and low-interest loans that are repaid through electricity bills (Solar thermal world, 2017). The programme transformed the Tunisian SWH market: by 2008, the annual installed area for residential SWHs had increased to more than ten times the pre-PROSOL average.

A programme specific to the commercial and industrial sectors was launched in 2009. Under the programme, named Tertiary PROSOL, solar collectors had been installed on an area of approximately 28 000 square metres by the end of 2016. This programme has, however, not experienced the same dynamic as in the residential sector. End users in the tertiary sector are discouraged from availing the loan, whose payback period is rendered unattractive due to competition from heavily subsidised natural gas. However, the number of suppliers, installation companies and equipment models sold on the Tunisian market has risen substantially over the past two decades owing to the expansion of the Tunisian residential market (IRENA, 2021a).

Transport

North Africa's transport sector has lagged behind in the use of renewable energy, although there exists significant potential, given the enormous urban population growth, and, thus, the need for more sustainable transport options. As of 2022, no North African country has biofuel mandates. This absence may be linked to the region lacking its own biofuel production. By contrast, electric mobility has attracted increasing interest from policy makers and consumers in recent years. Electric vehicles (EVs) find a market as high-end products among North Africa's sizeable upper-middle-income and high-income groups, despite lagging infrastructure development (Mousjid, 2022; UNDP, n.d.). Further infrastructure development would likely expand the market for EVs, and electrified public transport may be an attractive option for regional governments and cities, provided electricity capacity and finance become available.

Several Moroccan cities, for instance, have already invested in electrified public transport. This includes investments in tramways and improved electric rail links, and investments in bus rapid transit lines in Casablanca, Marrakech and Rabat (UNFCCC, 2016). Egypt has been exempting imported, used EVs from customs duties since March 2018 in a bid to promote their adoption in the market. In 2020, it announced customs tariff discounts on imported components for EV charging stations. The country's electric public transport system has also been expanded significantly. The first electric bus line in Cairo was launched in 2019, and the country signed a USD 4.5 billion contract for its first high-speed electrified rail line (Takouleu, 2021; Bailey, 2021).

Green hydrogen

With its substantial renewable energy resources, land availability and geographical proximity to the European market (with ample demand for low-carbon energy and green hydrogen), North Africa holds significant potential to emerge as a green hydrogen producer and exporter. Existing pipelines between North Africa and Europe could be used to transport hydrogen, reducing transport costs (see also Box 6) (IRENA, 2022e). Over the past years, North African countries have entered into agreements with several other countries as well as private companies to explore green hydrogen production and initiate pilot projects, of which many are export oriented (Table 3).

Morocco and Tunisia, for instance, signed co-operation agreements with Germany in 2020. The agreements include establishing international partnerships and alliances on green hydrogen. On 27 November 2021, SNAM and Eni launched a partnership on gas pipelines between Algeria and Italy. This move of the companies was to show their interest in acquiring stakes in the existing hydrogen transport infrastructure (Jewkes, 2021).

Some North African countries have also included hydrogen in their national energy strategies. Morocco even published a National Strategy on green hydrogen in August 2021, after the creation of a National Hydrogen Commission in 2019 (MEM, 2021a). The Moroccan Ministry of Energy, Mines and the Environment estimates that the country could capture up to 4% of the global green hydrogen demand by 2030 (MEM, 2021b). In 2021, Morocco announced a tender for a 100 MW green hydrogen electrolyser project for 2022, and a project to produce 183 000 tonnes of green ammonia by 2026 – with production capacity of 31 000 tonnes of green hydrogen a year (Technical Review Middle East, 2021).

In 2021, Egypt announced the preparation of an integrated strategy for hydrogen production, as well as a review of the Energy Strategy 2030 to include green hydrogen (Ahram Online, 2021). In March 2022, the Egyptian Ministry of Electricity and Renewable Energy, and the Ministry of Petroleum and Mineral Resources signed a memorandum of understanding with the European Bank for Reconstruction and Development to establish a framework for assessing the potential of low-carbon hydrogen supply chains. The assessment will inform the creation of guidelines for the national low-carbon hydrogen strategy (Zgheib, 2022). Egypt's Sovereign Fund, the Norwegian company Scatec and Fertiglobe (a leading ammonia producer) signed an agreement to produce green hydrogen in quantities ranging from 50 to 100 MW as a feedstock to produce green ammonia (Zawya, 2021).

Hydrogen development in North Africa will be challenged by the risk of unsustainable water withdrawal and groundwater depletion. These are major considerations, given the region is under acute water stress, which is likely to compound with increasing climate change impacts (IPCC, 2019). Sustainable green hydrogen production will require an effective policy framework mandating sound water management, within and outside the hydrogen sector, including appropriate water pricing, and water saving technologies, in addition to systematic investment in desalination.

Box 6 Potential for green hydrogen trade between North Africa and Europe

Europe will be North Africa's primary market for green hydrogen. The European Commission's REPowerEU Plan targets 20 million tonnes (Mt) of renewable hydrogen by 2030, of which 10 Mt would be imported (European Commission, 2022a). In May 2022, the Commission published the EU External Energy Strategy (European Commission, 2022b). It announced that it is working on a Mediterranean Green Hydrogen Partnership with countries in the southern Mediterranean. The partnership will begin with the EU-Egypt Hydrogen Partnership, and work on an EU-Morocco Green Partnership has already commenced. The import of 10 Mt of the target 20 Mt of green hydrogen represents a slight increase over what was previously considered under the Global Ambition Scenario published in the ENTSO-E and ENTSOG Ten Year Network Development Plan 2022 (released in October 2021), which considered import of 9 Mt of green hydrogen in 2030, of which 2.5 Mt would be by North Africa (ENTSOG and ENTSO-E, 2021), and an increase in North Africa's hydrogen imports to 7.8 Mt in 2040.

Source: IRENA, 2023a.

Table 3 Hydrogen projects in North Africa

Country	Project/agreements	Date of agreement	Characteristics and targets	Source
Morocco	Agreement between the Ministry of Energy, Mines and the Environment; Fusion Fuel Green Plc and the Consolidated Contractors Company for the development of an ammonia and green hydrogen project (HEVO Ammonia Morocco).	July 2020	Green ammonia: 3 650 t in 2022, 60 000 t in 2025 and 2026 Hydrogen: 616 t in 2022, 3 472 t in 2023, 6 940 t in 2024, 10 411 t in 2025 and 2026 Investment: EUR 865 million	Fusion Fuel Green PLC, 2021
	A partnership agreement between Moroccan and German governments on green hydrogen.	June 2020	100 MW renewable energy plant to produce green hydrogen in Morocco.	Afrik 21, 2020
	Agreement between Morocco and Portugal for the development of green hydrogen.	February 2021		Masen, 2021
	The Moroccan Agency for Sustainable Energy (Masen) plans to develop a hybrid photovoltaic/wind power plant to supply a green hydrogen plant.	November 2020	Electrolysis capacity: 100 MW 2022: Finalisation of the feasibility study and the tendering process 2024-2025: Commercial launch of the site	Masen, 2020
Egypt	Memorandum of understanding (MoU) between the Egyptian Minister of Electricity and Renewable Energy and Siemens.	January 2021	Assess green hydrogen production in Egypt and the implementation of a pilot project.	IRENA, 2023a
	Co-operation agreement between Egypt's Ministries of Electricity and Petroleum and the Egyptian Navy, and DEME (Belgium).	March 2021	Commence studies on green hydrogen production in Egypt and its export.	Daily News Egypt, 2021
	Agreement between Eni, the Egyptian Electricity Holding Company (EEHC) and the Egyptian Natural Gas Holding Company.	July 2021	Conduct a study to assess the feasibility of projects to produce green and blue hydrogen in Egypt.	Eni, 2021a
	MoU between Siemens and EEHC.	August 2021	Launch a green hydrogen pilot project with electrolysis capacity of 100-200 MW.	Siemens, 2021
	Partnership between Scatec (Norway), the ammonia company Fertiglobe and the Sovereign Wealth Fund of Egypt.	October 2021	Develop a 100 MW green hydrogen plant for ammonia in Egypt.	S&P Global Platts, 2021
	MoU between the Egyptian Ministry of Electricity and Renewable Energy, the Ministry of Petroleum and Mineral Resources, and the European Bank for Reconstruction and Development to assesses the potential of low-carbon hydrogen in Egypt.	March 2022	Assessment to produce guidelines for the national low-carbon hydrogen strategy.	Zgheib, 2022
Tunisia	MoU between Tunisia and Germany.	December 2020	Establish a Tunisian-German green hydrogen alliance.	Tunisian Ministry of Industry, Energy and Mines, 2020
Algeria	MoU between the state-owned oil company Sonatrach and Eni	March 2020	Develop a pilot project to produce green hydrogen in Algeria.	Eni, 2021b; Reuters, 2021
	MoU between Algeria and Germany.	December 2022	Build a 50 MW hydrogen plant.	Arab News, 2022

Source: IRENA, 2023a

Note: MW = megawatt; t = tonne.

3.6 INTEGRATING POLICIES

Secure supply by power grids requires continuous balancing of supply and demand. Trade across North Africa, and with neighbouring regions, could help increase the proportion of variable renewable energy that can be deployed in each North African country. This could also enhance grid stability and reduce electricity prices for final consumers. Further, once North African producers surpass their domestic electricity requirements, they could earn revenue by exporting electricity (El-Katiri, 2023).

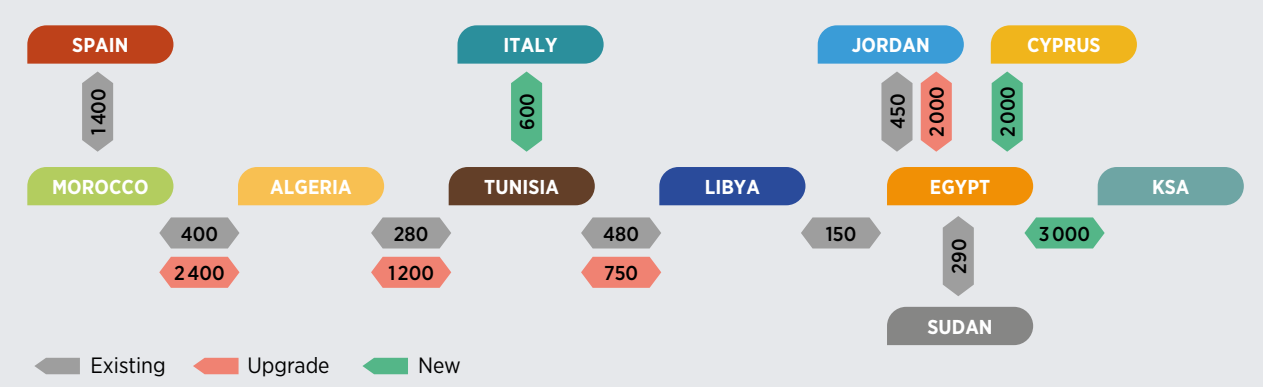
All North African countries are interconnected by power lines, which also connect them with other neighbouring countries and regions. The Maghreb Electricity Committee (COMELEC) connects Morocco, Algeria, Tunisia, Libya and Egypt, and connects Sudan and Egypt bilaterally (Figure 14). Meanwhile, existing lines between Morocco and Spain connect North Africa to Europe, which are also connected via the planned interconnections between Tunisia and Italy. Further, Egypt is interconnected with Jordan and Sudan, and thus to the Eastern Africa Power Pool (Med-TSO, 2020), via existing interconnections. It is also connected with Saudi Arabia via a planned high-voltage direct current interconnection to be completed in 2026. Morocco is also linked to the West African Power Pool.

The Tunisia-Libya interconnection has been facing technical issues and has been used primarily when Libya's eastern and western grids were disconnected. In fact, a stability issue occurs when trying to synchronously connect Libya-Egypt-Jordan-Syria with Tunisia-Algeria-Morocco and Europe's electricity market. The latest test of such interconnection was in 2010. It indicated the possibility of utilising the Tunisia-Libya interconnection when Libya and Egypt are disconnected (IRENA, 2023a).

Algeria, Morocco and Tunisia share their reserve margin required to stabilise the system. It should, however, be noted that some of the existing interconnection lines appear to not be operating at the designed capacity. This could be due to multiple reasons, for example, delays in connecting projects, national reinforcement of power systems or inadequately developed regulatory frameworks. The existing 1 310 MW interconnection lines among North African countries are being upgraded significantly in capacity, to 4 500 MW.

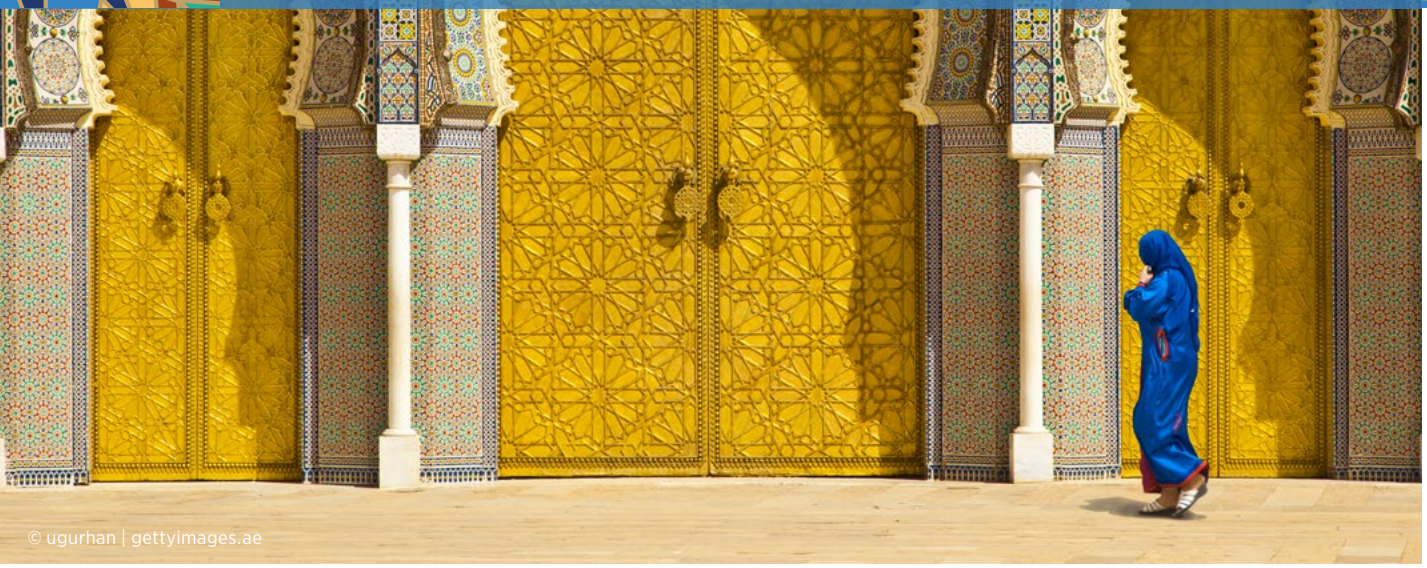
North Africa lacks a market mechanism governing interconnections. ONEE, the Moroccan power utility, is an actor in the Spanish electricity market and can, thus, purchase and sell electricity via the Morocco-Spain interconnection. In some cases, countries set up contracts for electricity import/export at fixed prices (Redouane *et al.*, 2018).

Figure 14 Existing and planned interconnection capacity in North Africa (MW)



Source: Adapted from IRENA (2023a).
Note: KSA = Kingdom of Saudi Arabia.

04 INVESTMENT AND FINANCE



© ugurhan | gettyimages.ae

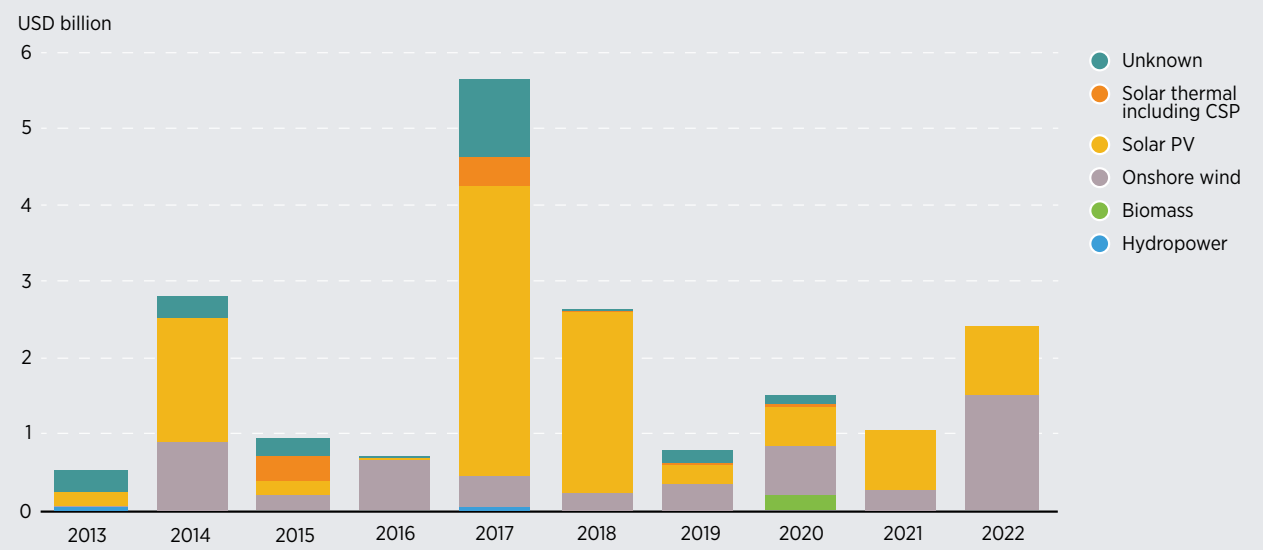
4.1 RENEWABLE ENERGY INVESTMENTS BY TECHNOLOGY

Global investments in renewable energy have grown rapidly over the past two decades. Yet, of the USD 2.8 trillion invested globally between 2000 and 2020, only 2% went to Africa (IRENA, 2022b), despite the continent's enormous potential for renewable energy generation. Southern Africa received the largest investments on the continent (about USD 17.5 billion in 2010-2020 – or 32% of the total investments for the decade), followed by North Africa, where they were concentrated in Morocco and Egypt. Investments were steady between 2010 and 2020. They peaked at USD 5.7 billion in 2017 before dropping in subsequent years. Investments recovered to USD 2.4 billion in 2022.

Investments in North Africa between 2013 and 2022 were concetrated in solar PV and solar thermal energy (60%) and in wind (27%), with the remainder going to bioenergy (Figure 15). Meanwhile hydropower received virtually no new investment, despite its important role in Egypt's and Morocco's electricity mix. This reflects the fact that the most suitable sites have already been spoken for.

© Farouk Nbikha | gettyimages.ae

Figure 15 Annual investments in North Africa by technology, 2013-2022 (USD billions)



Source: IRENA and CPI, 2023; CPI, 2022; BNEF, 2021
Notes: CSP = concentrated solar power; PV = photovoltaic.

Investment trends in North Africa are predominantly driven by individual large-scale projects, which account for a significant share of each year's investments, especially in the solar and wind sectors. For example, in 2010, Egypt's USD 885 million investment in new wind power alone accounted for almost one-third of Africa's total renewable energy investments (IRENA, 2022b). In June 2023, Egypt's New and Renewable Energy Authority announced the signing of an agreement with a group of companies, including the United Arab Emirates' Masdar, worth USD 10 billion, for a 10 GW wind farm, which would make it one of the world's largest wind farms (The National, 2023).

In the 2010s, Morocco received the largest share of the continent's solar energy investments. In 2018 alone, it received almost half of the total USD 5.2 billion in solar investments for the entire African content (AfDB, 2019). Those investments included USD 2.4 billion for the Midelt-based Noor PV-CSP hybrid plant (about 300-390 MW in capacity). The project was previously expanded to an additional 350 MW of generation capacity through a USD 2.1 billion investment in 2015, following the financial closure of the Ouarzazate-based Noor CSP project (160 MW) in 2012 (BNEF, 2021).

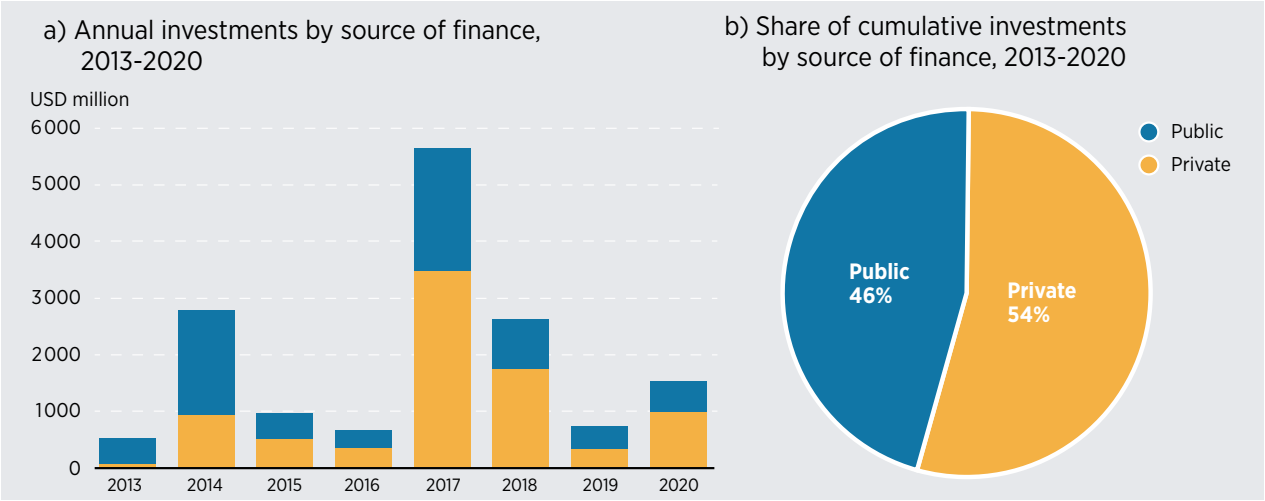
Multilateral and bilateral development banks have been instrumental in generating the necessary finance. The Moroccan Agency for Sustainable Energy (Masen) has been using concessional finance and issued green bonds to finance the debt for 100 MW of Noor PV 1 projects in competitive auctions. Also, approximately 1 GW of onshore wind in Morocco was financed with contributions from the German Development Bank (KfW) and the European Investment Bank (IEA, 2020). In April 2023, the country's state-owned phosphates and fertiliser producer, OCP, signed an agreement with the International Finance Corporation for a USD 110 million loan to finance four solar plants to power its industrial operations (IFC, 2023).

Supportive policies and financing mechanisms in Morocco and Egypt are mainly responsible for these two countries' investment success. Investment trends demonstrate that renewable energy investments tend to flow to countries that offer higher returns and lower risks owing to their policy and institutional environment, regulations, access to multilateral development finance and market attributes (*e.g.* size, prospects and stability). These enabling factors may not be as strongly present in less advanced economies, giving rise to political, financial, legal, operational and credit risks. The lack of well-structured projects with attractive risk-return profiles thus affects capital flow to countries that need it the most. In North Africa, this is especially true for Libya and the Sudan.

4.2 RENEWABLE ENERGY INVESTMENTS BY SOURCE AND FINANCIAL INSTRUMENT

Globally, renewable energy has been financed predominantly by the private sector. Public finance accounted for just 24% of direct investments in renewable energy assets between 2013-2020, with DFIs accounting for the majority (IRENA and CPI, 2023). But in North Africa, it plays a more important role. Between 2013 and 2020, public sector made up 46% of the total investments for renewable energy (Figure 16). Multilateral development banks, DFIs (including export credit agencies), guarantee funds and private reinsurance have provided a plethora of financing instruments, including risk-mitigation structures. The continent has been the stage for financial creativity – from partial risk guarantees to liquidity facilities and breach-of-contract provisions – preparing the ground for the next wave of projects.

Figure 16 Annual investments in North Africa by source, 2013-2020 (USD million)



Source: IRENA and CPI, 2023; CPI, 2022.

Guarantees have played an increasing role in recent years. Egypt's West Bakr Windfarm (250 MW), for example, which was funded by multiple investors, included guarantees of up to USD 122 million to help manage non-commercial risk (IFC, 2019).

The mobilisation of public funds has facilitated private investments. Thanks to power sector reforms, Egypt and Morocco have attracted considerable private financing through IPPs – privately developed, financed, built, owned and operated utility-scale (5 MW+) greenfield generators. Structured procurement programmes, such as FiTs and auctions, were used to mobilise the financing. The combined result of these deveopments was that renewable energy projects received USD 8.9 billion (40% of North Africa's total IPP investment in energy between 2010 and 2020) (Power Futures Lab, 2021; World Bank, 2021).

Many of these projects have benefited from development support in the form of loans or grants, often combined with technical assistance. DFIs and multilateral development banks can also support IPPs through direct investments (equity and debt), and through risk-mitigation and structured procurement programmes combining all such financial instruments. The provision of bespoke financing and risk-mitigation packages effectively increases the bankability of contracts in these programmes and makes the bidding process more competitive.

For example, the private sector provided three-quarters of the renewable investment for Morocco's approximately 1.75 GW of installed solar PV and wind capacity by the end of 2020. DFI support was critical in the early stages to help structure the country's renewable energy programme, as well as provide mainly debt finance – in turn helping to mobilise private capital (IEA, 2020). Morocco's Ouarzazate solar power complex was financed with a EUR 345 million loan from the European Investment Bank (EIB, 2015). Egypt, too, financed projects under its FiT scheme with USD 653 million from the International Finance Corporation and a consortium of nine international banks (IEA, 2020).

Egypt's renewable energy sector has been supported through various initiatives. For instance, in 2021 the European Bank for Reconstruction and Development provided a USD 25 million loan to the National Bank of Kuwait Egypt to fund green energy projects. Fifteen percent of the total loan amount was co-financed by the Green Climate Fund. The European Union in turn agreed to support the above financing with up to EUR 2 560 000 of funds for incentive payments to projects that were implemented and verified successfully, and to provide a comprehensive technical assistance package of up to EUR 6.2 million for all participating financial institutions and their clients, as well as for policy dialogue (Zgheib, 2021).

Public funds flowing from the Global North to the Global South play a role, although a majority of such agreements remain non-specific to renewable energy. For instance, data released by Egypt's Ministry of International Cooperation in February 2022 reveal that in 2021, the country signed development financing agreements for a total of USD 1.04 billion with multilateral and bilateral development partners including Germany, the Swedish International Fund (Sida), the European Bank, Japan, the African Development Bank, the World Bank and Agence Française de Développement (AFD) for projects related to electricity, renewable energy and petroleum, and the environment (Egypt Today, 2022).

These agreements include a grant worth USD 10 million from Germany to finance energy efficiency projects, a grant worth USD 1 million from the Swedish International Fund for projects to improve electrical networks' efficiency, an agreement with the European Union for USD 50 million as additional funding for Reconstruction and Development as part of the Energy Efficiency and Upgrade Programme for the Suez Oil Processing Company, and, as the most significant contribution to Egypt's renewable energy sector, a grant worth USD 17 million from Germany for a project to upgrade hydroelectric stations (Egypt Today, 2022).

05 STRUCTURAL POLICIES FOR A JUST AND INCLUSIVE TRANSITION

© Mohammed Lagha | gettyimages.ae

Policies that promote structural change need to consider how regions depend on resources, commodity trade and other economic attributes. Structural policies also need to include measures to ensure more local value creation, be it through labour markets, education systems or industry development. A just and inclusive transition must also focus on improving livelihoods and economic benefits, increasing social inclusion and job creation, and promoting women's economic empowerment and gender equality in North African communities through addressing energy, poverty reduction, water scarcity, vulnerability to climate change and other natural resource challenges. The extent to which countries succeed in implementing such policies will be critical to not only generating actual benefits to North Africa's populations but also driving the required political support for those more direct policies mentioned in chapter 3.

5.1. LABOUR MARKETS AND EDUCATION

Renewable energy creates two to five times more jobs than fossil fuels for each dollar invested (IRENA, 2022b). Other investments for a green economy (*e.g.* climate adaptation, conservation agriculture, public transport and energy-efficient building retrofits) create up to 25 times more jobs than fossil fuel investments (OCI, 2021). These benefits weigh heavily in the politics of North Africa, with its large, and comparably well-educated populations, including in the sciences. Labour market and education policies will thus be critical instruments to help North African countries benefit from the job creation potential from deploying renewable energy (IRENA, 2022c).

In the coming years, North Africa will require a greater emphasis on technical and vocational education and training to expand skills and technology know-how in the renewable energy sector, including along the supply chain for some components that can be manufactured locally. Phosphate and cobalt resources in parts of the region, especially in Morocco, could help contribute to building new industry branches along the green business chain, including in related sectors such as electrical vehicles and battery manufacturing (see Morocco's example below). Some of the resulting training facilities may also involve reskilling of existing labour, for instance, of those currently employed in the oil and gas sector.

Industry innovation and job creation will also be linked to the region's ability to establish new public-private mechanisms to deliver sectoral technical and vocational education and training programmes. Morocco uses public-private partnerships to train workers through Delegated Management Institutes (IGDs, or Institutes à Gestion Déléguée). The costs of specialised training courses are covered by the state, while the private sector leads the management (World Bank, 2020). Of the ten IGDs established to date, three IGDs – located near large installations in Oujda, Tangier and Ouarzazate – train for the renewable energy sector.

Technology standards will need to be matched by skill standards, since the expansion of utility-scale renewable energy plants and solar home systems in North Africa will depend on a network of trained technicians for installation and maintenance. Introducing and developing national standards requires industry to co-operate with educational institutions, labour associations and governments. North Africa already has a number of specialised think tanks, university departments and government agencies (many of them English or French speaking) that can assist in designing competitive curriculum standards along with the accreditation of training institutions to ensure they can train workers and issue standardised assessments and certifications.

Egypt launched such a training centre to build national expertise. The training centre helps in designing a stronger energy-engineering curriculum, sponsoring joint research, and establishing scholarships and internships (USAID, 2021). The United States Agency for International Development also partnered with the Egyptian government to develop a renewable energy curriculum for technical schools training young people for work in the solar and wind sectors (Farouk, 2018). In Morocco, institutions such as Masen and the Research Institute for Solar Energy and New Energies (IRESEN) can and do help further develop stricter national standards, including for education and training professionals in the renewable energy industry.

Meanwhile, regulatory barriers can be major obstacles for formal firms. However, small enterprises in the renewable energy value chain would lower barriers and increase access to information, banking and small loans; improve energy and digital products; and offer fiscal incentives. Morocco has created a legal "self-employer" status, which supports entrepreneurs through reduced taxes when annual sales fall below a threshold and helps them access social protection and financing. Such mechanisms need not be specific to firms operating in the renewable energy business, but they could contribute significantly to improving the business environment for decentralised renewable energy applications, such as solar home systems.

5.2. INDUSTRIES AND LOCAL VALUE ADDITION

North African countries could significantly benefit from becoming energy transition champions within the Arab region as well as in the context of Africa. Morocco and Egypt have ambitious industrial policies that add value to the renewable energy sector. Supplier development programmes could boost the capabilities of local suppliers through building stronger intra-industry relationships, modelling best practices and quality standards, and communicating information about the requirements of a changing market.[2]

Morocco has also pushed for the development of an EV sector, attracting the African continent's first electric car manufacturing plant in Kenitra under the German automaker Opel in 2021 (Tanchum, 2021). Egypt, too, looked to investment in EV manufacturing, having signed a framework agreement with the Chinese automaker Donfeng to jointly produce EVs domestically (Al Bawaba, 2021).

Research and development could become an essential tool in North Africa's energy transition, especially for countries desiring to shift from mere technology consumers to producers and innovators. Business activities such as in-house research and development, quality certification, incubation, technology transfer and diffusion are needed for not only functioning national renewable energy markets but also creating new jobs (Anadon et al., 2016; Barrett, 2009; Conchado et al., 2016; Mercure et al., 2016). North Africa has a growing number of renewable energy research centres, which are typically affiliated to national research centres and national agencies.

For instance, in Egypt, the New and Renewable Energy Authority has developed affiliations with the National Academy for Scientific Research, Ain Shams University, the British University in Egypt, and the Arab Academy for Science and Technology and Maritime Transport, among others. In Tunisia, the National Agency for Energy Conservation has affiliations with the École Nationale d'Ingénieurs de Carthage and University of Sfax, among others. In Morocco, IRESEN specialises in PV and CSP, particularly in the development of PV modules; new generation, development and testing of CSP air condensers with low water consumption; and sizing and optimisation of solar power plants.

With effective cross-regional integration, North African countries could also establish economies of scale in the renewable energy sector, with or without a dedicated partnership with Europe. The benefits include greater market access, regional clustering and the consequent ability to localise more of the region's industrial value chains, cost reduction and productivity enhancement (Lebdioui and Morales, 2021). This is especially relevant in North Africa, where industry clusters, such as for automobiles, are emerging and potential exists to locally manufacture at least part of the supply chains for simpler renewable energy technologies, such as SHSs. Regionally harmonised renewable energy technology and component standards could reduce technology costs while improving the quality of components entering North Africa's markets.

2 *The integration of firms in such programmes in the Malaysian energy sector has enabled them to strengthen their capabilities, gain exposure to international markets and expand internationally, and stabilise their contracts, which used to be set on an ad hoc basis, making expansions difficult to plan (Lebdioui, 2019).*

06 CONCLUSIONS AND RECOMMENDATIONS

© Heckepics | gettyimages.ae

North Africa is at an economic crossroads. The region's enormous energy resources – beyond just fossil fuels – equip it well for a sustainable energy future. This is encouraging for current energy importers as well as fossil fuel exporters. Renewable energy also has the potential to contribute significantly to regional socio-economic development by creating new areas for industry and supply chain development. Further, North Africa's proximity to Europe means the region could become an important new exporter of clean hydrogen to Europe. This creates a possibility for some North African economies to open important new revenue streams.

North Africa has only recently begun to exploit the enormous opportunities for renewable energy, with the notable exception of hydropower. The potential differs substantially intra-regionally. Egypt, Morocco and Algeria have invested significantly in renewable energy in recent years, and the first two have also made wind energy investments. While these investments involve exploiting just a small fraction of these countries' wind and solar potential, they have paved the ground for future investments. Tunisia, too, has shown significant interest in exploring renewable energy and has begun to deploy projects. However, Libya and the Sudan have yet to start their renewable energy industries. Both countries also hold the potential for remotely accessing solar energy, which is especially relevant in the Sudan, to address its persistent energy access issue. Any further delay of development here implies a major opportunity lost.

Morocco and the Sudan are the North African countries with the most ambitious, non-conditional plans for renewable energy currently. As per their NDCs, Morocco and the Sudan have more than 4 GW and almost 3 GW of planned renewables-based electricity generation capacity, respectively, through 2030. Tunisia is another North African country with ambitious conditional capacity addition plans. This means that almost all North African countries are looking to invest significantly in renewable energy in the coming years, provided that financing and competitively priced technology are available. This opens a substantial opportunity for external investors and companies along

the renewable energy supply chain, especially solar energy. Further, North Africa presents ample opportunities also in sectors other than power, which is the predominant focus of current renewable energy targets. Such sectors include transport (through transport electrification), and heating and cooling.

All these factors make North Africa an attractive candidate for renewable energy development in the coming years. However, this potential will be influenced by the region's policy making, which will play a crucial role. Each country in the region has its own, unique policy environment, where country-wide reforms are underway to make renewable energy investments more attractive. While competitive auctions are now becoming the norm in the region and a primary vehicle for deploying renewable energy in power generation, there is much potential for future policy additions, such as net metering, FiTs and priority grid access, to drive investment growth. This is in addition to the increasing role of renewable energy and climate action in North Africa's politics, which is evident in Egypt hosting COP27 in Sharm El-Sheikh.

With so much potential, it is only a question of time until renewable energy occupies a larger share of North Africa's energy mix, provided it receives continued political commitment.

REFERENCES

AfDB (2019), *NOOR Midelt Solar Complex Project: Phase I (NOORM I AND NOORM II Solar Plants): Morocco: Project Appraisal Report*, African Development Bank, Abidjan, Cote d'Ivoire, www.afdb.org/en/documents/document/morocco-noor-midelt-solar-complex-project-phase-i-noorm-i-and-noorm-ii-solar-plants-appraisal-report-109576.

African Union (2021), "African Union launches world's largest single electricity market (AFSEM)", https://au.int/en/pressreleases/20210604/african-union-launches-worlds-largest-single-electricity-market-afsem.

Afrik 21 (2020), "Morocco: Partnership with Germany for green hydrogen", www.afrik21.africa/en/morocco-partnership-with-germany-for-green-hydrogen/.

Ahram Online (2022a), "Egypt launches National Strategy for Climate Change 2050 ahead of COP27", https://english.ahram.org.eg/NewsContentP/1/466533/Egypt/Egypt-launches-National-Strategy-for-Climate-Chang.aspx.

Ahram Online (2022b), "Egypt to spend EGP 55 billion in annual diesel subsidies despite raising fuel prices: PM", https://english.ahram.org.eg/NewsContent/1/1235/471494/Egypt/Urban--Transport/Egypt-to-spend-EGP--billion-in-annual-diesel-subsi.aspx.

Ahram Online (2021), "Egypt's president urges establishing integrated strategy for producing green hydrogen", https://english.ahram.org.eg/NewsContent/3/12/416914/Business/Economy/Egypt%E2%80%99s-president-urges-establishing-integrated-st.aspx.

Al Bawaba (2021), "Egypt tests Chinese EVs ahead of local production", www.albawaba.com/business/egypt-tests-chinese-evs-ahead-local-production-1443691#:~:text=Egypt%20has%20begun%20testing%20China,Manufacturing%20Company%20starting%20mid%2D2022.

Anadon, L. D., Chan, G., Harley, A. G., Matus, K., Moon, S., Murthy, S. L. and Clark, W. C. (2016), "Making technological innovation work for sustainable development", Proceedings of the National Academy of Sciences (PNAS), Vol. 113/35, pp. 9682-9690.

APICORP (2021), MENA Energy Investment Outlook 2021-2025, Arab Petroleum Investments Corporation, Dammam, Saudi Arabia, www.apicorp.org/wp-content/uploads/2021/12/MENA-Energy-Investment-Outlook-2021-2025.pdf.

Arab News (2022), "Algeria, Germany sign MoU to build 50MW hydrogen plant", Arab News, 20 December, www.arabnews.com/node/2219361/business-economy.

Bailey, S. (2021), "Egypt is building a $4.5 billion high-speed rail line", CNN Travel, 17 December, https://edition.cnn.com/travel/article/egypt-high-speed-train-spc-intl/index.html.

Barrett, S. (2009), "The coming global climate-technology revolution", Journal of Economic Perspectives, Vol. 23/2, pp. 53-75.

Bellini, E. (2020), "Tunisia introduces new rules for self-consumption, net metering", PV Magazine, 28 February, www.pv-magazine.com/2020/02/28/tunisia-introduces-new-rules-for-self-consumption-net-metering/.

Bellini, E. (2019), "Winners and prices of Tunisia's 500 MW PV tender", PV Magazine, 20 December, www.pv-magazine.com/2019/12/20/winners-and-prices-of-tunisias-500-mw-pv-tender/.

BNEF (2021), "Renewable assets" (database), Bloomberg New Energy Finance, www.bnef.com/projects/search (subscription required).

CIF (n.d.), "Ouarzazate: Lighting up the sky", Climate Investment Funds, www.climateinvestmentfunds.org/CIF10/morocco/ouarzazate.

Coady, D., Flamini, V. and Sears, L. (2015), "The unequal benefits of fuel subsidies revisited: Evidence for developing countries." IMF Working Paper 15/250, International Monetary Fund, Washington, DC.

Conchado, A., Díaz Anadón, L., Linares Llamas, P. and López-Peña Fernández, Á. (2016), "Benefits of investing in energy R&D and portfolio optimization: The case of Spain", EAERE-FEEM-VIU European Summer School on Uncertainty, Innovation and Climate Change, Venice, Italy.

Climate Policy Initiative (CPI) (2022), *Global Landscape of Climate Finance database*, www.climatepolicyinitiative.org/.

Daily News Egypt (2021), "Egypt, DEME sign cooperation agreement to start green hydrogen production studies", 4 March, www.dailynewsegypt.com/2021/03/04/egypt-deme-sign-cooperation-agreement-to-start-green-hydrogen-production-studies/.

Egypt Today (2022), "Egypt's development financing agreements in renewable energy, electricity, petroleum worth $1B", www.egypttoday.com/Article/3/112483/Egypt-s-development-financing-agreements-in-renewable-energy-electricity-petroleum.

EIB (2015), "Tackling the energy challenge in Africa", European Investment Bank, Luxembourg, www.eib.org/attachments/country/energy_challenge_africa_en.pdf.

El-Katiri, L. (2023), "Sunny side up: Maximising the European Green Deal's potential for North Africa and Europe", European Council on Foreign Relations (ECFR), https://ecfr.eu/publication/sunny-side-up-maximising-the-european-green-deals-potential-for-north-africa-and-europe/.

El-Mazghouny, D. (2022), "The Renewable Energy Law Review: Egypt", The Law Reviews, 26 July, https://thelawreviews.co.uk/title/the-renewable-energy-law-review/egypt.

Eni (2021a), "Eni signs an agreement to produce hydrogen in Egypt", www.eni.com/en-IT/media/press-release/2021/07/cs-eni-firma-accordo-produzione-idrogeno-egitto.html.

Eni (2021b), "Meeting between the CEO of Sonatrach, Toufik Hakkar, and the general manager of Eni – natural resources, Alessandro Puliti", press release, https://www.eni.com/en-IT/media/press-release/2021/07/cs-eni-firma-accordo-produzione-idrogeno-egitto.html.

ENTSOG and ENTSO-E (2021), *Scenario Building Guidelines*, European Network of Transmission System Operators for Gas and European Network of Transmission System Operators for Electricity, Brussels, Belgium, www.entsog.eu/sites/default/files/2021-10/entsos_TYNDP_2022_Scenario_Building_Guidelines_211007_1.pdf.

European Commission (2022a), "Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions REPowerEU plan", https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483 (accessed 19 May 2022).

European Commission (2022b), "Joint communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU external energy engagement in a changing world", https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=JOIN%3A2022%3A23%3AFIN&qid=1653033264976 (accessed 19 May 2022).

Farouk, M. (2018), "Egypt launches renewable energy curriculum to boost promising sector", www.al-monitor.com/originals/2018/02/egypt-launches-renewable-energy-curriculum.html#ixzz5FfXczpH1 (accessed 14 September 2021).

Fattouh, B. and El-Katiri, L. (2012), "Energy subsidies in the Arab world", Arab Human Development Report Research Paper Series, United Nations Development Programme, Regional Bureau for Arab States, www.undp.org/arab-states/publications/energy-subsidies-arab-world.

Fusion Fuel Green PLC (2021), "Press release – Fusion Fuel announces HEVO ammonia Morocco project, aims to produce 183,000 Tons of green ammonia by 2026", www.globenewswire.com/en/news-release/2021/07/14/2263073/0/en/Fusion-Fuel-Announces-HEVO-Ammonia-Morocco-Project-Aims-to-Produce-183-000-Tons-of-Green-Ammonia-by-2026.html.

GASCOOL (2004), "GASCOOL district cooling/heating plant at smart village", Egyptian Company for Energy and Cooling Projects, Egypt, www.gascool-eg.com/index.php/en/projects-en/dcps/45-project1-en#.

General Authority for Investment and Free Zones (2017), "Law No. 72 of 2017: Promulgating the Investment Law", www.gafi.gov.eg/English/StartaBusiness/Laws-and-Regulations/PublishingImages/Pages/BusinessLaws/Investment%20Law%20english%20ban.pdf.

Global Data (2020), "Power", www.globaldata.com/industries-we-cover/power/ (accessed 7 July 2021).

Hoes (2014), "Global potential hydropower locations", 4TU.ResearchData, Dataset, https://doi.org/10.4121/uuid:99b42e30-5a69-4a53-8e77-c954f11dbc76.

IEA (2023), "Africa", International Energy Agency, Paris, www.iea.org/regions/africa.

IEA (2022), "Fossil fuel subsidies database", International Energy Agency, Paris, www.iea.org/data-and-statistics/data-product/fossil-fuel-subsidies-database#subsidies-database.

IEA (2020), *Clean Energy Transitions in North Africa*, International Energy Agency, Paris, https://iea.blob.core.windows.net/assets/b9c395df-97f1-4982-8839-79f0fdc8c1c3/Clean_Energy_Transitions_in_North_Africa.pdf.

IEA (2016), "Morocco net-metering legislation (Law n°58-15)", International Energy Agency, Paris, www.iea.org/policies/5976-morocco-net-metering-legislation-law-n058-15.

IEA, IRENA, UNSD, WHO and World Bank (2022), Tracking SDG 7: The Energy Progress Report, International Energy Agency, International Renewable Energy Agency, United Nations Statistics Division, World Health Organization and World Bank, Washington, DC, https://trackingsdg7.esmap.org.

IFC (2023), "IFC and OCP Group partner to build solar plants, green fertilizer production in Morocco", International Finance Corporation, https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=27486.

IFC (2019), "IFC and MIGA to support landmark wind farm on Egypt's Gulf of Suez", International Finance Corporation, Cairo, Egypt, https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=18488.

IFC (2017), "A new solar park shines a light on Egypt's energy potential", International Finance Corporation, Washington, DC, www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/cm-stories/benban-solar-park-egypt.

IMF (2023), "Morocco: 2022 Article IV consultation-press release and staff report", International Monetary Fund, www.imf.org/en/Publications/CR/Issues/2023/01/23/Morocco-2022-Article-IV-Consultation-Press-Release-and-Staff-Report-528514.

Innovation for Sustainable Development Network (2019), "PROSOL: Financing solar water heating in Tunisia", www.inno4sd.net/prosol-financing-solar-water-heating-in-tunisia-454.

IRENA (2023a), *Planning and prospects for renewable power: North Africa*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2023b), "IRENA statistics database", International Renewable Energy Agency, Abu Dhabi. www.irena.org/Data.

IRENA (2023c), "IRENA off-grid statistics database", International Renewable Energy Agency, Abu Dhabi. www.irena.org/Data/Downloads/IRENASTAT.

IRENA (2022a), *World Energy Transitions Outlook: 1.5°C Pathway*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2022b), *Renewable Energy Market Analysis: Africa and Its Regions*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2022c), *Renewable Energy and Jobs – Annual Review 2022*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2022d), *Renewable Power Generation Costs in 2021,* International Renewable Energy Agency, Abu Dhabi.

IRENA (2022e), *Global Hydrogen Trade to Meet the 1.5°C Climate Goal: Part I – Trade Outlook for 2050 and Way Forward*, International Renewable Energy Agency, Abu Dhabi, www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jul/IRENA_Global_hydrogen_trade_part_1_2022_.pdf.

IRENA (2021a), *Renewables Readiness Assessment: The Republic of Tunisia*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2021b), *World Energy Transitions Outlook: 1.5C Pathway*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2020), "Global trends dashboard", International Renewable Energy Agency, Abu Dhabi, www.irena.org/Data/View-data-by-topic/Costs/Global-Trends (accessed 7 July 2021).

IRENA (2019), *Renewable energy auctions: Status and trends beyond price*, International Renewable Energy Agency, Abu Dhabi.

IRENA (2018), *Renewable Energy Outlook: Egypt*, International Renewable Energy Agency, Abu Dhabi.

IRENA (n.d.[a]), "IRENA's renewable energy targets database", International Renewable Energy Agency, Abu Dhabi.

IRENA (n.d.[b]), "IRENA's policy and measures database", International Renewable Energy Agency, Abu Dhabi.

IRENA (n.d.[c]), "IRENA's repository of knowledge: RE Auctions (quantitative)", International Renewable Energy Agency, Abu Dhabi.

IRENA and CPI (2023), *Global landscape of renewable energy finance, 2023*, International Renewable Energy Agency, Abu Dhabi.

IRENA, KFW and GIZ (2021), *The Renewable Energy Transition in Africa: Powering Access, Resilience and Prosperity*, International Renewable Energy Agency, Abu Dhabi; KfW Development Bank, Frankfurt and Deutsche Gesellschaft für Internationale Zusammenarbeit, Eschborn, www.irena.org/publications/2021/March/The-Renewable-Energy-Transition-in-Africa.

IRENA, League of Arab States and RCREEE (2014), *Pan-Arab Renewable Energy Strategy 2030*, Regional Center for Renewable Energy and Energy Efficiency and International Renewable Energy Agency, Abu Dhabi, www.irena.org/publications/2014/Jun/Pan-Arab-Renewable-Energy-Strategy-2030-Roadmap-of-Actions-for-Implementation.

Jefferis, K. (2020), "Macro-economic policy reform options for Sudan", policy brief, International Growth Centre, London, UK, www.theigc.org/collections/macroeconomic-policy-reform-options-sudan.

Jewkes, S. (2021), "Snam buys stake in Algerian gas pipelines to pave way for hydrogen highway", Reuters, November 27, www.reuters.com/business/eni-agrees-sell-snam-499-stake-algeria-gas-pipelines-385-mln-euros-2021-11-27/.

Lebdioui, A. and Morales, M. (2021), "The Latin American experience in designing local content policies in the oil and gas sectors: Strengths, limitations, and future perspectives", in Olawuyi, D. S. (ed.), Local Content and Sustainable Development in Global Energy Markets, pp. 280-299, Cambridge University Press.

Lebdioui, A. (2019), *Local content in extractive industries: Evidence and lessons from Chile's copper sector and Malaysia's petroleum sector*, The Extractive Industries and Society, 7(2), 341-352.

Luciani, G. (1987), "Allocation vs. production states: A theoretical framework", in Beblawi, H. and Luciani, G. (eds.), The Rentier State, pp. 63-82, Croom Helm, London.

Masen (2021), "Le Maroc s'allie au Portugal pour développer l'hydrogène vert", Moroccan Agency for Sustainable Energy, www.masen.ma/fr/actualites-masen/le-maroc-sallie-au-portugal-pour-developper-lhydrogene-vert.

Masen (2020), "Masen prépare un méga projet dans l'hydrogène vert, une 1ère en Afrique", Moroccan Agency for Sustainable Energy, www.masen.ma/fr/actualites-masen/masen-prepare-un-mega-projet-dans-lhydrogene-vert-une-1ere-en-afrique.

MAZARS (2016), "Moroccan Agency for Solar Agency S.A.: Rapport d'audit sur les etats financiers du projet de centrale solaire d'Ouarzazate (Noor III). Periode du 1er Janvier 2015 au 31 Decembre 2015", https://documents1.worldbank.org/curated/en/713041542814208881/pdf/Morocco-Noor-Solar-Power-Project-audited-financial-statement-January-1-2015-December-31-2015.pdf.

Med-TSO (2020), "Deliverable 2.2.A: 'Candidates for pilot projects'", Mediterranean Transmission System Operators, www.med-tso.com/publications/Deliverable_2.2.A_Candidates_for_Pilot_Projects.pdf.

Mercure, J., Knobloch, F., Pollitt, H., Lewney, R., Rademakers, K., Eichler, L., van der Laan, J. and Paroussos, L. (2016), "Policy-induced energy technological innovation and finance for low-carbon economic growth – Study on the macroeconomics of energy and climate policies", European Commission, Brussels, https://energy.ec.europa.eu/publications/policy-induced-energy-technological-innovation-and-finance-low-carbon-economic-growth-study_en.

MESIA (2022), Solar Outlook Report 2022, Middle East Solar Industry Association, Dubai, www.mesia.com/research_papers/solar-outlook-report-2022/.

MEM (2021a), "Strategie nationale de l'hydrogene vert", Ministry of Energy, Mines and Environment, Rabat, Morocco, www.mem.gov.ma/Lists/Lst_rapports/Attachments/28/Stategie%20nationale%20de%20l%20Hydrogene%20vert.pdf.

MEM (2021b), Feuille de Route: Hydrogène Vert, Ministry of Energy, Mines and Environment, Rabat, Morocco, www.mem.gov.ma/Lists/Lst_rapports/Attachments/36/Feuille%20de%20route%20de%20hydrog%C3%A8ne%20vert.pdf.

Ministère de l'Énergie et des Mines, Algérie (2015), "Energies nouvelles, renouvelables et maitrise de l'energie", www.energy.gov.dz/?rubrique=energies-nouvelles-renouvelables-et-maitrise-de-lrenergie (accessed 8 July 2021).

Ministry of Electricity and Renewable Energy of Libya (2013), "Libya renewable energy strategic plan 2013-2025", www.iea.org/policies/5908-libya-renewable-energy-strategic-plan-2013-2025.

Ministry of Energy and Mining of Algeria (2015), "Renewable energy and energy efficiency development plan 2015-2030", www.iea.org/policies/6103-renewable-energy-and-energy-efficiency-development-plan-2015-2030.

Ministry of Environment and Sustainable Development of Tunisia (2015), "Intended nationally determined contribution of Tunisia", www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tunisia%20First/INDCTunisia-English%20Version.pdf.

IPCC (2019), *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*, Intergovernmental Panel on Climate Change, www.ipcc.ch/srccl/chapter/chapter-3/.

Mousjid, B. (2022), "Morocco is forcibly transitioning to electric vehicles", The Africa Report, 29 August, www.theafricareport.com/234745/morocco-is-forcibly-transitioning-to-electric-vehicles/.

The North Africa Post (2023), "World Bank expects Morocco's economy to grow by 3.1% in 2023", https://northafricapost.com/65328-world-bank-expects-moroccos-economy-to-grow-by-3-1-in-2023.html.

OCI (2021), "The sky's limit Africa: The case for a just energy transition from fossil fuel production in Africa", Oil Change International, 14 October, https://priceofoil.org/2021/10/14/the-skys-limit-africa/.

Power Futures Lab (2021), "Private database", Power Futures Lab, University of Cape Town.

Power Technology (2022), "Power plant profile: Dongola Wind Farm, Sudan", www.power-technology.com/marketdata/dongola-wind-farm-sudan/.

Redouane, A., Masaki, M., Meijer, M. and Essakkati, H. (2018), *Business Opportunities Report for Morocco's Renewable Energy Sector*, Netherlands Enterprise Agency (RVO), Ultrecht, The Netherlands, www.rvo.nl/sites/default/files/2018/06/Business-opportunities-report-for-moroccos-renewable-energy-sector.pdf.

Reuters (2023), "Tunisia seeks to cut fiscal deficit to 5.5% in 2023, led by economic reforms", Reuters, 23 December, www.reuters.com/world/africa/tunisia-expects-economic-growth-18-2023-economy-ministry-2022-12-23/.

Reuters (2021), "Eni teaming up with Sonatrach for production of hydrogen in Algeria", www.reuters.com/business/energy/eni-teaming-up-with-sonatrach-production-hydrogen-algeria-2021-07-07/.

S&P Global Platts (2021), "Scatec partners with Fertiglobe on 100-MW Egypt green hydrogen plant for ammonia", www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/101421-scatec-partners-with-fertiglobe-on-100-mw-egypt-green-hydrogen-plant-for-ammonia.

Sakr, D., Huenteler, J., Matsuo, T. and Khanna, A. (2017), "Scaling up distributed solar in emerging markets: The case of the Arab Republic of Egypt", Policy Research Working Paper WPS 8103, World Bank Group, Washington, DC, https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-8103.

Siemens (2021), "Siemens Energy supports Egypt to develop Green Hydrogen Industry", https://press.siemens-energy.com/mea/en/pressrelease/siemens-energy-supports-egypt-develop-green-hydrogen-industry.

SolarPACES (2011a), "Algeria", www.solarpaces.org/csp-technologies/csp-potential-solar-thermal-energy-by-member-nation/algeria/ (accessed 8 July 2021).

SolarPACES (2011b), "ISCC Kuraymat CSP project", https://solarpaces.nrel.gov/iscc-kuraymat (accessed 8 July 2021).

Solar thermal world (2017), *Tunisia: National Subsidy Scheme Prosol Extended to 2020*, www.solarthermalworld.org/news/tunisia-national-subsidy-scheme-prosol-extended-2020.

Takouleu, J. (2021), "Nigeria: Federal government to solarise 304 hospitals and schools", Afrik 21, 5 May, www.afrik21.africa/en/nigeria-federal-government-to-solarise-304-hospitals-and-schools/.

Tanchum, M. (2021), "Morocco's "first in North Africa" electric car production is a European manufacturing gain over China", Middle East Institute, 3 September, www.mei.edu/publications/moroccos-first-north-africa-electric-car-production-european-manufacturing-gain-over.

Technical Review Middle East (2021), "Morocco aims to tender green hydrogen project in 2022", Technical Review Middle East, 8 December, www.technicalreviewmiddleeast.com/power-a-water/renewables/morocco-aims-to-tender-green-hydrogen-project-in-2022.

The National (2023), "UAE and Egypt sign agreement to advance $10bn wind project", 7 June, www.thenationalnews.com/business/energy/2023/06/07/uae-and-egypt-sign-agreement-to-advance-10bn-wind-project/?utm_medium=Social&utm_source=Twitter#Echobox=1686125775.

Tunisian Ministry of Industry, Energy and Mines (2020), "Signature MoU alliance tuniso-allemande sur l'hydrogène", www.energiemines.gov.tn/fr/tc/actualites/news/signature-mou-alliance-tuniso-allemande-sur-lhydrogene/?tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail&cHash=122be77299a093545f88b662e74bf558.

Tunisian Ministry of Industry, Energy and Mines (2019), "Concession regime for renewable energy", www.energiemines.gov.tn/fr/themes/energies-renouvelables/projets-et-programmes/regime-des-concessions/ (accessed 7 July 2021).

UNCTAD (2021), "Publication of Investment Encouragement Act, 2021", United Nations Conference on Trade and Development, https://investmentpolicy.unctad.org/investment-policy-monitor/measures/3729/sudan-publication-of-investment-encouragement-act-2021.

UNDP (n.d.), "Planetary pressures–adjusted Human Development Index (PHDI)", www.hdr.undp.org/en/content/planetarypressures-adjusted-human-development-index-phdi.

UNFCCC (2021a), "All LT-LEDS", Long-Term Strategies Portal, United Nations Framework Convention on Climate Change, https://unfccc.int/process/the-paris-agreement/long-term-strategies (accessed 25 June 2021).

UNFCCC (2021b), "All NDCs", NDC Registry, United Nations Framework Convention on Climate Change, www4.unfccc.int/sites/NDCStaging/Pages/All.aspx (accessed 25 June 2021).

UNFCCC (2021c), "End of coal in sight at COP26", United Nations Framework Convention on Climate Change, https://unfccc.int/news/end-of-coal-in-sight-at-cop26 (accessed 4 November 2021).

UNFCCC (2016), "A new mobility approach In Morocco: Electric mobility in public sector", United Nations Framework Convention on Climate Change, presentation at the Technical expert Meeting in Germany/Boon on 23 May 2016, https://unfccc.int/sites/default/files/sustainable_mobility_in_morocco_-_may_2016.pdf.

USAID (2021), "Climate Response", United States Agency for International Development, Washington, DC, www.usaid.gov/egypt/climate-response (accessed 12 June 2023).

World Bank (2021), "Private Participation in Infrastructure (PPI) Project Database", World Bank Group, https://ppi.worldbank.org/en/ppidata.

World Bank (2020), *Poverty and Shared Prosperity 2020: Reversals of Fortune*, World Bank, Washington, DC, www.worldbank.org/en/publication/poverty-and-shared-prosperity-2020.

World Bank (2019), *Country Partnership Framework for the Kingdom of Morocco for the Period of FY19-FY24*, World Bank, Washington, DC, https://openknowledge.worldbank.org/entities/publication/da5b9b1b-df0a-5a33-9e45-7efb48b43b20.

World Bank (2016), *Tunisia – Country Partnership Framework for the Period FY 2016-2020*, World Bank, Washington, DC, https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/253011468180259354/tunisia-country-partnership-framework-for-the-period-fy-2016-2020.

World Bank (2015), *International Bank for Reconstruction and Development, International Finance Corporation, Multilateral Investment Guarantee Agency Country Partnership Framework for the Arab Republic of Egypt for the Period FY 2015-2019*, World Bank, Washington, DC, https://documents1.worldbank.org/curated/en/773051468197407822/pdf/94554-REVISED-R2015-0231-PUBLIC-disclosed-12-21-15-Box394824B.pdf.

Zawya (2021), "Egypt introduces green hydrogen in 2035 Energy Strategy", Zawya, 24 October, www.zawya.com/mena/en/business/story/Egypt_introduces_green_hydrogen_in_2035_Energy_Strategy-SNG_254912502/.

Zgheib, N. (2022), "EBRD assesses low-carbon hydrogen in Egypt", European Bank for Reconstruction and Development, 7 March, www.ebrd.com/news/2022/ebrd-assesses-lowcarbon-hydrogen-in-egypt.html (accessed 19 May 2022).

Zgheib, N. (2021), "EBRD promotes energy efficiency and renewable energy in Egypt", European Bank for Reconstruction and Development, 9 September, www.ebrd.com/news/2021/ebrd-promotes-energy-efficiency-and-renewable-energy-in-egypt.html.

ANNEX I.

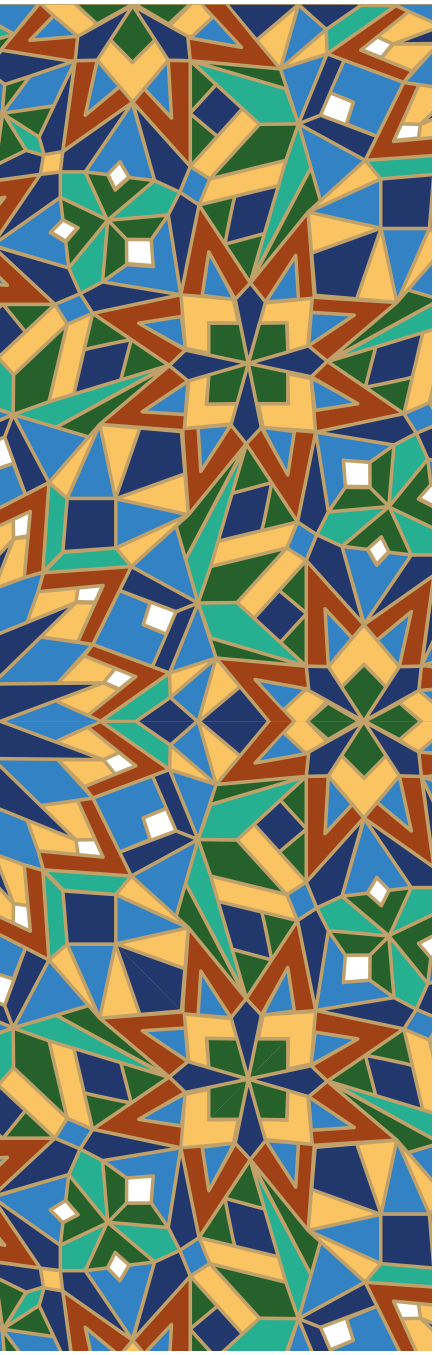
Table A.1 Recent awarded renewable energy auctions in North Africa, 2010-2021

Country	Auction name	Auctioned volume (MW)	Technology specificity	Technology	Technology band	Auction announcement date	Bids received (MW)	Awarded capacity (MW)	Payment currency	Average price (payment currency)/MWh	Converted average price to USD/MWh	Conversion rate and date
Algeria	Algeria 150 MW Solar auction	150	Technology specific	Solar PV	Not specified	2018	90	50	DZD	8 280	69	USD 1 = DZD 120 in October 2019
Egypt	Egypt 250 MW Wind BOO auction	250	Technology specific	Onshore wind	Not specified	2009		250	USD	47		
Egypt	Egypt 200 MW Kom Ombo solar PV auction	200	Technology specific	Solar PV	Not specified	2018		200	USD	27.5		
Morocco	Morocco Noor PV II auction	400	Technology specific	Solar PV	Not specified	2021		333		Not available		
Morocco	Morocco Noor Midelt CSP-PV Hybrid auction	800	Technology specific	Solar CSP-PV hybrid	Not specified	2018		800	MAD	680	71	USD 1 = MAD 9.58 in May 2019
Morocco	Morocco Noor PV I auction	177	Technology specific	Solar PV	Not specified	2015		177	MAD	460	46	USD 1 = MAD 10 in November 2016
Morocco	Morocco Noor Ouarzazate I CSP auction	160	Technology specific	Solar CSP	Not specified	2012		160	MAD	1 620	190	USD 1 = MAD 8.53 in September 2012
Morocco	Morocco Noor Ouarzazate II CSP auction	200	Technology specific	Solar CSP	Not specified	2013		200	MAD	1 360	148	USD 1 = MAD 9.19 in January 2015
Morocco	Morocco Noor Ouarzazate III CSP auction	150	Technology specific	Solar CSP	Not specified	2013		150	MAD	1 420	154.5	USD 1 = MAD 9.19 in January 2015
Morocco	Morocco ONEE Onshore Wind auction	850	Technology specific	Onshore wind	Not specified	2012		850	MAD	300	30	USD 1 = MAD 10 in March 2016
Tunisia	Tunisia Authorisation Regime Auction Round 1	70	Technology specific	Solar PV	1 MW	2017		4	TND	212	85	USD 1 = TND 2.50 in May 2018
Tunisia	Tunisia Authorisation Regime Auction Round 1	70	Technology specific	Solar PV	10 MW	2017		60	TND	160	64	USD 1 = TND 2.50 in May 2018
Tunisia	Tunisia Authorisation Regime Auction Round 2	70	Technology specific	Solar PV	1 MW	2018		10	TND	211	70.1	USD 1 = TND 3.01 in April 2019
Tunisia	Tunisia Authorisation Regime Auction Round 2	70	Technology specific	Solar PV	10 MW	2018		60	TND	135	45	USD 1 = TND 3.01 in April 2019
Tunisia	Tunisia Authorisation Regime Auction Round 2	130	Technology specific	Onshore wind	30 MW	2018		120	TND	129	43	USD 1 = TND 3.01 in April 2019
Tunisia	Tunisia Authorisation Regime Auction Round 3	70	Technology specific	Solar PV	1 MW	2019		10	TND	202	71.63	USD 1 = TND 2.82 in June 2020
Tunisia	Tunisia Authorisation Regime Auction Round 3	70	Technology specific	Solar PV	10 MW	2019		60	TND	128	45.39	USD 1 = TND 2.82 in June 2020
Tunisia	Tunisia Authorisation Regime Auction Round 4	70	Technology specific	Solar PV	1 MW	2020		10	TND	180	65.93	USD 1 = TND 2.73 in March 2021
Tunisia	Tunisia Authorisation Regime Auction Round 4	70	Technology specific	Solar PV	10 MW	2020		60	TND	118	43.22	USD 1 = TND 2.73 in March 2021
Tunisia	Tunisia Concessions Regime Auction	500	Technology specific	Solar PV	Not specified	2018		500	TND	80.16	28.23	USD 1 = TND 2.84 in December 2019

Source: IRENA
Note: BOO = build-own-operate; CSP = concentrated solar power; MW = megawatt; MWh = megawatt hour; PV = photovoltaic.

NORTH AFRICA

POLICIES AND FINANCE FOR RENEWABLE ENERGY DEPLOYMENT



IRENA
International Renewable Energy Agency