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Policy Study

N. 34

RENEWABLE ENERGY AND ELECTRICITY INTERCONNECTION MEGAPROJECTS IN NORTH AFRICA: PROSPECTS FOR EURO-NORTH AFRICA COOPERATION

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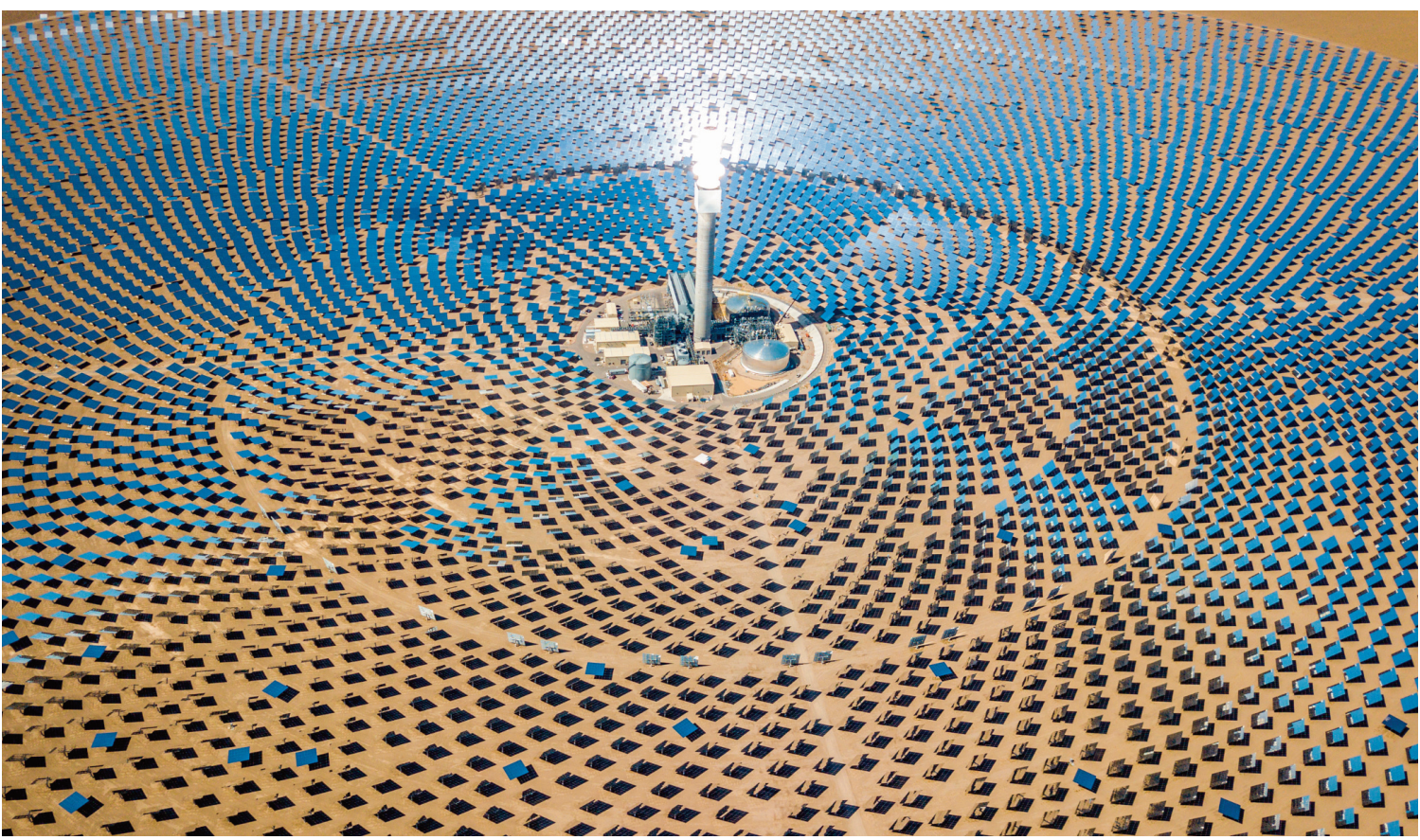

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POLICY STUDY

Published by the European Institute of the Mediterranean

Policy Peer Review: Anonymous
Academic Peer Reviewer: Anonymous

Editing: Marco Lagae Novković

Design layout Maurin.studio
Proofreading Neil Charlton
Layout Núria Esparza
Print ISSN 2938-446X
Digital ISSN 2696-7626
DL B 14129-2023
June 2024

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the authors and can in no way be taken to reflect the views of the European Union or the European Institute of the Mediterranean.

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Policy Study

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Executive Summary

This Joint Policy Study delves into North Africa's renewable energy landscape, examining the potential and challenges of megaprojects in the region. With a specific focus on renewable energy production and exports, it explores the intricacies of megaprojects in Morocco, Egypt, Algeria and Tunisia, assessing their successes, hurdles, and future potential. North Africa, especially the Sahara Desert, has vast potential for renewable energy production due to its exceptionally high solar irradiation levels, positioning it as an ideal site for solar energy projects. Economically and geopolitically, there is a strong rationale for Euro-North African collaboration to enhance North Africa's ability to generate and export renewable energy in a way that benefits both regions. However, despite this significant potential, North African countries have faced numerous geopolitical, economic, societal and infrastructural obstacles in fully capitalising on these resources.

The study finds that Morocco has been particularly successful in developing a robust green energy ecosystem, integrating renewable energy production with offtake mechanisms such as green ammonia and soon, electric vehicle battery manufacturing. Projects like the Noor solar power plants are pivotal in this ecosystem. Morocco's renewable energy exports, particularly green hydrogen and green ammonia are set to play a significant role in Europe's energy transition, as well as the current and future electric interconnections to Spain, Portugal and the Xlinks project, which would supply green energy to the United Kingdom.

In contrast, Egypt's early successes in renewable energy, exemplified by the development of several solar and wind farms, have been overshadowed by recent economic challenges. Rolling power cuts and a shift towards prioritising liquified natural gas (LNG) exports over domestic energy needs have stalled progress. Despite these setbacks, Egypt is focusing on green hydrogen projects, partnering with international firms to develop green ammonia production facilities. These efforts are part of a broader strategy to diversify Egypt's energy exports and reduce dependence on natural gas.

Algeria's renewable energy sector remains significantly underdeveloped, with solar and wind power contributing minimally to its energy mix. The country continues to rely heavily on natural gas exports. Algeria is concentrating on blue hydrogen, utilising its vast natural gas resources, and aims to capture a substantial share of the

European hydrogen market, collaborating closely with Italian and German firms. However, this approach may not sufficiently drive the development of renewable energy infrastructure. The technical and commercial viability of transporting hydrogen through existing natural gas pipelines is also questionable, potentially limiting Algeria's ability to capitalise on its renewable energy potential.

Tunisia has adopted a strategy of smaller, incremental renewable projects, attracting foreign investment through revised legal frameworks. The country's efforts to expand its renewable capacity have been revitalised by legal reforms designed to attract foreign direct investment (FDI) in renewable power development. Projects such as the Kairouan solar plant demonstrate initial success. Moreover, Tunisia's National Green Hydrogen Strategy aims to produce significant amounts of green hydrogen for export, leveraging its strategic position and partnership with Italy. Tunisia's approach contrasts with the megaproject strategies of its neighbours, focusing instead on multiple smaller-scale projects that collectively contribute to a substantial increase in renewable energy capacity.

This study finds that successful megaprojects require deliberate coordination between renewable power generation and offtake mechanisms. Countries must align their renewable energy production with export markets, integrating dedicated renewable power infrastructure with offtake facilities like green ammonia plants. Private sector participation is crucial in this endeavour. North African governments should cultivate relationships with private investors and create favourable legal and regulatory environments to attract foreign investment. For instance, Morocco's success can be attributed to its ability to align renewable energy projects with domestic industrial needs and international market demands, creating a holistic green energy ecosystem.

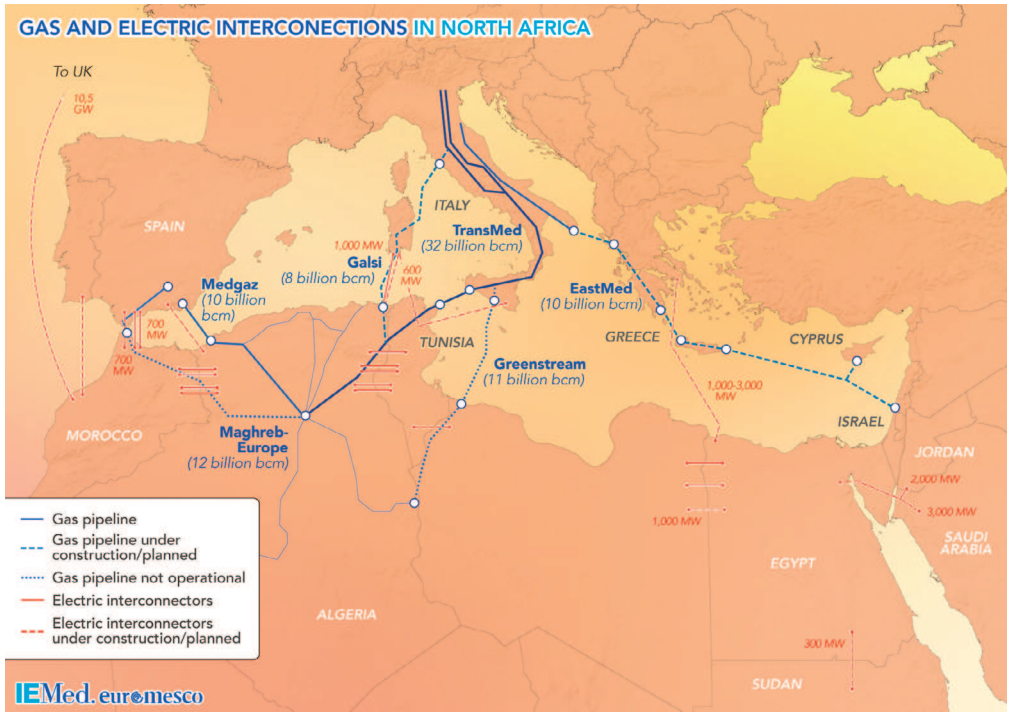
Developing green energy ecosystems can provide socioeconomic benefits to local populations and enable countries in North Africa to establish themselves in new markets. These ecosystems should include diverse renewable energy supply chains, ranging from agri-food and automotive exports to green hydrogen and ammonia production. Green hydrogen, particularly in the form of green ammonia, is emerging as a key export commodity. The integration of renewable energy into local industries not only boosts export potential but also ensures that the benefits of these projects are distributed more widely within the countries.

The study finds that energy megaprojects in North Africa could serve as a collaborative framework that enhances energy security, supports sustainable economic growth, and facilitates the transition to renewable energy sources across the Mediterranean.

However, while electric interconnections with Europe have the potential to attract essential investment in North Africa's green energy infrastructure, they also risk facing significant local opposition and criticism. Concerns such as green energy neocolonialism may emerge, highlighting fears of exploitation and unequal distribution of benefits between European Union (EU) and North African countries.

The first chapter of this Joint Policy Study provides a thorough introduction to green energy, international electrical interconnections, energy megaprojects, and the socioeconomic context in North Africa. The second chapter offers an in-depth analysis of energy megaprojects in Egypt, highlighting associated risks and opportunities, and presents a detailed overview of Egypt's socioeconomic landscape from an energy perspective. The third chapter focuses on Tunisia, examining its electricity interconnections and energy megaprojects, assessing the legal framework, emphasizing the importance of social consultations, and analysing institutional oversight mechanisms. The final chapter delves into the European Union's strategic objectives and challenges in North African countries. It includes detailed profiles of megaprojects in each North African country and explores EU initiatives and financial and policy instruments designed to support North Africa's green transition, such as the European Green Deal, the Global Gateway Initiative, green bonds, debt swaps, industrial cooperation and the EU's new Carbon Border Adjustment Mechanism. Lastly, the chapter reflects on the potential for future collaboration between the countries on both shores of the Mediterranean.

The Joint Policy Study provides a comprehensive overview of the current state and future potential of renewable energy megaprojects in North Africa. It emphasises the need for better coordination between renewable power projects and offtake mechanisms to enhance the effectiveness and socioeconomic benefits of megaprojects. The study finds that expanding legal reforms and incentives to attract more private sector investment in renewable energy projects is essential. Critical investments can be attracted through legal and regulatory reform, facilitated by public-private partnerships, and supported by export credit agency financing guarantees. Fostering the development of green energy ecosystems that integrate renewable energy production with diverse offtake markets, including green hydrogen and ammonia, can drive growth. Prioritising green ammonia production as a key component of renewable energy supply chains, leveraging existing industrial sectors like fertilisers, will be critical. Incorporating dedicated renewable power infrastructure into trans-Mediterranean interconnection projects will boost their success and scalability. The study recommends that North African countries place a greater emphasis on developing coordinated renewable energy projects that align with both local needs and export opportunities. By adopting a holistic approach that considers the entire energy ecosystem — from production to consumption — North African countries can ensure that their renewable energy projects are sustainable and economically viable in the long term.


GAS AND ELECTRIC INTERCONECTIONS IN NORTH AFRICA
To UK
10.5 GW
SPAIN
ITALY
TransMed
(32 billion bcm)
1,000 MW
Galsi
(8 billion bcm)
600 MW
Medgaz
(10 billion bcm)
700 MW
700 MW
EastMed
(10 billion bcm)
TUNISIA
GREECE
CYPRUS
Greenstream
(11 billion bcm)
1,000-3,000 MW
ISRAEL
MOROCCO
Maghreb-Europe
(12 billion bcm)
JORDAN
2,000 MW
3,000 MW
1,000 MW
SAUDI ARABIA
EGYPT
ALGERIA
300 MW
SUDAN
Gas pipeline
Gas pipeline under construction/planned
Gas pipeline not operational
Electric interconnectors
Electric interconnectors under construction/planned
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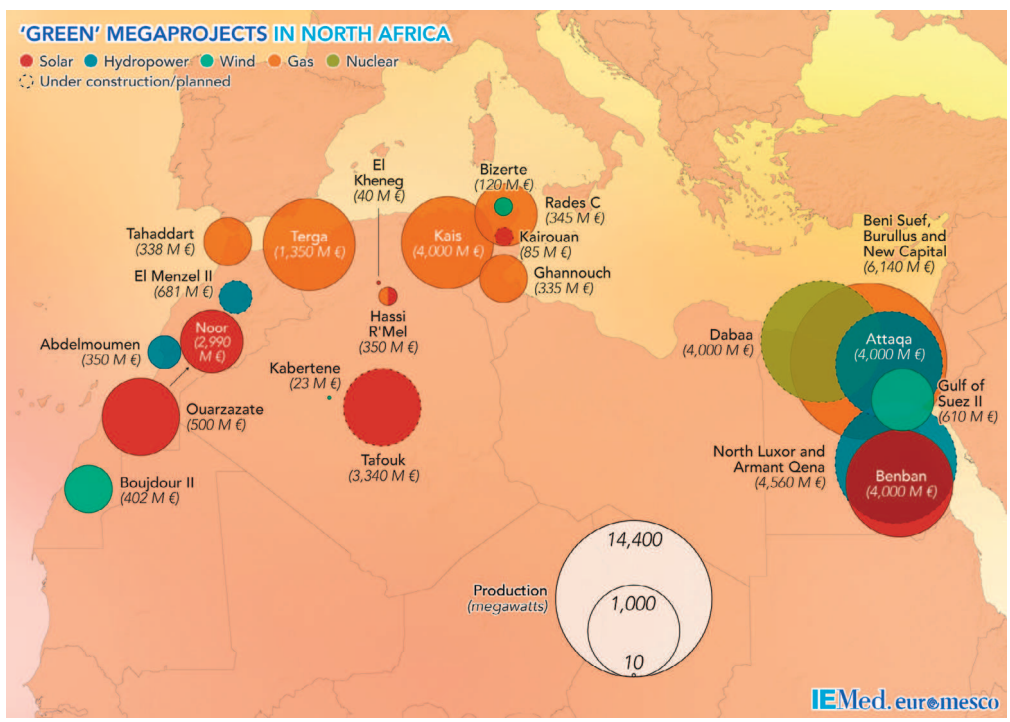
'GREEN' MEGAPROJECTS IN NORTH AFRICA
Solar
Hydropower
Wind
Gas
Nuclear
Under construction/planned
El Kheneg (40 M €)
Bizerte (120 M €)
Rades C (345 M €)
Kairouan (85 M €)
Ghannouch (335 M €)
Tahaddart (338 M €)
Terga (1,350 M €)
Kais (4,000 M €)
El Menzel II (681 M €)
Hassi R'Mel (350 M €)
Noor (2,990 M €)
Abdelmoumen (350 M €)
Kabertene (23 M €)
Ouarzazate (500 M €)
Tafouk (3,340 M €)
Boujdour II (402 M €)
Beni Suef, Burullus and New Capital (6,140 M €)
Dabaa (4,000 M €)
Attaqa (4,000 M €)
Gulf of Suez II (610 M €)
North Luxor and Armant Qena (4,560 M €)
Benban (4,000 M €)
Production (megawatts)
14,400
1,000
10
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List of Acronyms and Abbreviations

PNAE-DD	Action Plan for Environment and Sustainable Development 2035
ADB	Asian Development Bank
AFD	Agence Française de Développement
AfDB	African Development Bank
AFESD	Arab Fund for Economic & Social Development
ANME	National Agency for Energy Management
AU	African Union
BCM	Billion Cubic Metres
BOO	Build, Own, Operate
BP	British Petroleum
CAPMAS	Central Agency for Public Mobilization and Statistics
CBAM	Carbon Border Adjustment Mechanism
CCGT	Combined Cycle Gas Turbine
CDS	Credit Default Swap
CEF	Connecting Europe Facility
CFT	Clean Technology Fund
CO2	Carbon Dioxide
COFIDES	Compañía Española de Financiación del Desarrollo, S.A.
CCGT	Combined Cycle Gas Turbine plant
SCP-NAP	Consumption and Production National Action Plan
COP27	27th Conference of the Parties
CPI	Corruption Perceptions Index
CTF	Clean Technology Fund
CULLIAN	Moody's Investors Service
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
DNI	Direct Normal Irradiation
EBDIC	Egypt Basic Industries Corporation
EBRD	European Bank for Reconstruction and Development
EFD	Environmental Protection Measures
EGD	European Green Deal
EIB	European Investment Bank
ENP	European Neighbourhood Policy
ENTSO-E	European Network of Transmission System Operators for Electricity
ESFC	Energy Sector Fund for Competitiveness
ESG	Environmental, Social, and Governance
ESIA	Environmental and Social Impact Assessment
ETAP	Entreprise Tunisienne d'Activités Pétrolières
EU	European Union
EUR-Lex	European Union Law
EIP	European External Investment Plan
ENI	European Neighbourhood Instrument
FDI	Foreign Direct Investment
GC	Global Competitiveness Index
GDP	Gross Domestic Product
GIPI	Global Investor Protection Index
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
KfW	Kreditanstalt für Wiederaufbau
GIZ-GmbH	Gesellschaft mit beschränkter Haftung

GW	Gigawatts
HVDC	High Voltage Direct Current
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development
IEA	International Energy Agency
IMF	nternational Monetary Fund
IPRI	International Property Rights Index
IRENA	International Renewable Energy Agency
LFP	Lithium Iron Phosphate
LNG	Liquefied Natural Gas
M6FI	Mohammed VI Fund for Investment
MEG	Maghreb-Europe Gas Pipeline
MASEN	Moroccan Agency for Sustainable Energy
MERE	Ministry of Electricity and Renewable Energy
METSD	Ministry of Energy Transition and Sustainable Development
MoU	Memorandum of Understanding
MPC	Mediterranean Partner Countries
MWh	Megawatt-hour
NA	North African
NAP	National Adaptation Plans
SNE	National Strategy for the Environment
NDC	Nationally Determined Contributions
NIF	NEOM Investment Fund
NA	North African/North Africa
NRE	New and Renewable Energy
NREL	National Renewable Energy Laboratory
OCP	Office Chérifien des Phosphates
OGP	Open Government Partnership
ONEE	Office Nationale de l'Electricité et de l'Eau
OGP	Open Government Partnership
PST	Tunisia Solar Plan
RAP	Resettlement Action Plan
RO	Renewable Energy Obligation
ROSATOM	State Atomic Energy Corporation Rosatom
SCP-NAP	Sustainable Consumption and Production National Action Plan
SCZone	Suez Canal Economic Zone
SEFA	Sustainable Energy Fund for Africa
SEP	Stakeholder Engagement Plan
SIS	State Information Service
SNE	National Strategy for the Environment
STEG	Société Tunisienne de l'Electricité et du Gaz
SOE	State-Owned Enterprise
SEFA	Sustainable Energy Fund for Africa
TND	Tunisian Dinar
PST	Tunisian Solar Plan
TuNur	unisian Solar Power Export Project
UN	United Nations
UNIDO	United Nations Industrial Development Organization

WB	World Bank
WGI	Worldwide Governance Indicators
WSRW	Western Sahara Resource Watch
Xlinks	Morocco-UK Electricity Generation Facility

Pathways to Power: North Africa's Approaches to Renewable Energy Development and Exports

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Introduction

North Africa holds the potential to be the world's largest renewable energy-producing region. The Sahara Desert, which covers the majority of North Africa and extends partially into the adjacent Sahel region, receives the world's highest levels of solar irradiation and comprises a territory of 9 million square kilometres (sq. km), over twice the total area of the European Union (EU). If all of the solar energy striking the Sahara Desert were used for power generation, the amount of electricity produced would be 7,000 times greater than the entire EU electricity demand at any given moment (De Freitas, 2020). Even if North Africa was able to generate an amount of electricity from the Sahara's solar resources three orders of magnitude less than the theoretical potential, it would still be enough to make North Africa electricity self-sufficient and supply all of the EU's power demand. From an economic and geopolitical perspective, the logic of Euro-North African cooperation to develop North Africa's capacity to produce and transport renewable power in a mutually beneficial manner is compelling.

While the scale of the resources and the potential offtake markets would justify a megaprojects approach, North Africa's renewable power megaprojects and electricity interconnection megaprojects overall have met with mixed results. With the exception of Morocco, the renewable energy megaprojects that have been built, are under construction, and are under consideration have so far provided no clear pathway in each North African nation to secure their respective energy supplies, achieve economic uplift, and capture significant energy export market share in Europe and elsewhere. This survey of renewable energy development efforts across North Africa, including the development of offtake mechanisms for export, examines the successes and ongoing challenges in the region through a comparative lens to assess each country's current course and to suggest parameters for implementable measures to improve the effectiveness of North Africa's renewable energy development efforts. The measures also provide important guidelines for the successful cooperation between North Africa and international partners. After providing an overview of the region, the chapter examines Morocco, Egypt, Algeria and Tunisia individually before presenting its conclusions.

For the purposes of the volume on North African megaprojects for renewable energy production and export, in which this study is the opening chapter, megaprojects are defined as large-scale and complex infrastructure projects involving the collaboration of a number of public and private entities in a multiple-year timeframe. These projects are also usually characterised by high risk and complexity, as well as significant capital investment. Furthermore, megaprojects seek to achieve significant economic, social, and/or ecological impacts. While these projects typically cost at least $1 billion, a high risk, complex project costing less than $1 billion may be considered a megaproject depending on the magnitude of the transformational effects on the country in which they are developed. The North African country of Libya was not considered in this volume due to the divided nature of governance between the western and eastern halves of the country. Mauritania is also not considered because it is regarded as belonging to the Sahel region for the purposes of this volume.

The major finding of this chapter is that initiatives in North Africa require better and deliberate coordination between the development of renewable power projects

and the development of offtake mechanisms. This deliberate coordination is particularly required for megaprojects; the often-lacklustre results of mega-initiatives for renewable power development and electric interconnection development have stemmed from this lacuna. The diffusion of socioeconomic benefits of megaprojects to local residents is also more easily accomplished when this deliberate coordination occurs, a trend that is being witnessed with green hydrogen projects in several parts of Africa (Tanchum, 2020). As discussed below, this deliberate coordination best occurs through a green energy ecosystem, leading to a diversity of offtake mechanisms and robust renewable energy supply chains for export. Private sector participation is a key factor in the equation for success, requiring the careful cultivation and management of private sector relationships by North African governments and their international partners. Green hydrogen is rising in prominence as an export offtake mechanism for renewable power and is proving to be a fundamental element in the growth of green energy ecosystems in North Africa. Cross-border electricity interconnection, particularly trans-Mediterranean interconnection for North African power exports to reach the wider EU electricity market, remains an offtake mechanism with great potential. Several of the initiatives to develop trans-Mediterranean interconnections would benefit from more deliberate coordination between renewable power generation capacity and offtake mechanisms to serve export markets, suggesting incorporating more of a green energy ecosystem approach in interconnection development efforts.

Two paradigms of North African renewable energy development: oil and natural gas producers versus countries without significant hydrocarbon reserves

Large swathes of North Africa from Morocco to Egypt possess the world's largest photovoltaic (PV) power potential and concentrated solar power (CSP) potential, with direct normal irradiation (DNI) levels reaching or exceeding 2,300 kWh/m2 (World Bank, 2019a). For perspective, the sunniest region of Germany – North Africa's main European partner for renewable energy development – reaches only half that DNI level, with most of the country receiving even less (World Bank, 2019b). North Africa also possesses significant onshore, nearshore, and offshore wind power resources, especially along Morocco's Atlantic coast and Egypt's coasts along the Gulf of Suez.[1]

The potential of North Africa's vast renewable energy resources for electricity exports prompted the initiation of the ambitious Desertec project in Germany in 2009. The forward-looking project sought to create solar and wind power facilities across a 16,835 sq. km area of North Africa as well as the trans-Mediterranean electricity interconnections to supply about 15% of Europe's electricity demand. Visionary but faulty in conception, the Desertec project fell apart in 2014 (Reuters, 2014). Although public-private partnerships were involved,

[1] For an example of wind power in the region, see the discussion on Egypt's advances in wind power in Michaël Tanchum's article: Egypt's Prospects as an Energy Export Hub Across Three Continents (Tanchum, 2020).

Desertec evolved out of a development aid framework in which the private sector played a limited role and the goals of the project were not sufficiently attuned to the economic and political needs of North Africa itself. Consequently, Desertec faced accusations that it was laying the foundations for a green energy neo-colonialism. Desertec's demise dampened enthusiasm for renewable energy transmission via trans-Mediterranean undersea electric cables, casting doubts on its commercial feasibility.

Renewable energy remains virtually an unutilised resource in the region

In light of the scale of North Africa's enormous potential for renewable power production, renewable energy remains virtually an unutilised resource in the region. The 2022 installed solar power capacity of the four countries of Morocco, Algeria, Tunisia, and Egypt combined was five times less than that of France and 20 times less than Germany (Energy Institute, 2023). The state of wind power in North Africa parallels the state of solar power in the region. North Africa's dearth of renewable energy infrastructure reflects the difficulty among the nations of the region to attract investment and financing, with the exception of Morocco. In 2022, Morocco ranked as the most attractive renewable energy market for investment, according to the Renewable Energy Country Attractiveness Index (RECAI) published by international accounting firm EY (Ernst & Young), when normalised for gross domestic product (GDP).[2] Morocco also placed within the top 20 of the RECAI's "raw" score, ranking 19th while Egypt ranked in the top 30, at 29th place (EY, 2022).

Despite Desertec's[3] collapse, Morocco and Egypt continued with their plans to construct large, utility-scale solar and wind power facilities and are the two leading countries in North Africa for renewable power development. Both countries are engaged in the development of undersea interconnectors to Europe. Most significantly, Morocco's and Egypt's advances in the construction of renewable power generation infrastructure have laid the foundation for these nations to also become North Africa's trailblazers in the development of green hydrogen as an alternative carrier for renewable energy.

Morocco's growing success in developing renewable energy infrastructure is anchored in the country's development of a green energy ecosystem in which the development of utility scale renewable energy infrastructure is coordinated with the development of robust offtake markets and the establishment of commercially viable storage and transportation mechanisms to service those markets. As will be explained below, Morocco has anchored the development of renewable power production in its fertiliser and agri-food production sectors, both of which are two of Morocco's main export sectors. Now Rabat is eyeing the use of renewable energy in industrial manufacturing and mining, with an emphasis on electric vehicle (EV) production and metals processing for EV batteries. In this way, Morocco has created offtake markets that are generating renewable energy supply chains through "green" exports products produced, at least in part, with renewable power. In parallel, Rabat is eyeing direct renewable energy exports via both undersea high volt-

[2] The normalised score is obtained by taking the RECAI "raw" score and dividing it by the log of GDP (EY, 2022).

[3] Desertec is a renewable energy project aimed at harnessing solar power from deserts, particularly the Sahara, to provide sustainable electricity for Europe, the Middle East, and North Africa. Initiated in 2009, it failed due to economic infeasibility, political instability in the target regions, logistical challenges, and lack of cohesive international collaboration (Desertec Foundation, n.d.).

age direct current (HVDC) cables and seaborne shipments of green hydrogen in the form of its derivative green ammonia.

Egypt, which enjoyed success in renewable energy development during the second half of the previous decade, has recently stumbled (as will be discussed below and in the second chapter of this volume). Nevertheless, the foundations created by Egypt's successful renewable energy build-out from 2015-2019 remain, and a course correction based on the lessons learned from the country's current difficulties could enable Egypt to realise its potential as a major producer and exporter of energy produced from renewable resources. One important aspect of Egypt's pathway out of its current impasse is a greater emphasis on a green energy ecosystem approach. Egypt has made some recent advances in this direction with development of its own green hydrogen industry.

The differences between Morocco and Egypt also reflect the major economic division among North African nations between those nations without significant oil and natural gas reserves – Morocco and Tunisia – and those which are major oil and natural gas producers – Egypt, Algeria and Libya. Algeria and Egypt are Africa's top two natural gas producers, with 2022 output at 98.2 billion cubic metres (bcm) and 65.4 bcm respectively (Energy Institute, 2023). With a combined production greater than that of Australia, Algeria and Egypt are important supply sources for nearby Europe, which in the short-term is scrambling to replace its Russian natural gas imports with gas from alternative suppliers.

In the case of the North African natural gas producers, the use of a "gas-by-wire" approach to incentivise cross-border, and particularly trans-Mediterranean, electricity interconnections has so far not proven especially successful. Gas-by-wire can occur when it is more commercially viable to generate electricity from natural gas where it is produced and then sell the power through electricity interconnectors rather than to build pipeline interconnectivity to transport and sell physical volumes of natural gas. Once the electricity export offtake mechanism is established, power produced from renewables can replace power generated from natural gas, incentivising investment in additional renewable power production capacity. As the lack of a functioning Egypt-Europe interconnector demonstrates, the approach can face obstacles including the competition from liquified natural gas (LNG) exports and the need to have reliable surplus electricity from year to year.

As a result of global green transition efforts, the value of global LNG trade will be surpassed by the value of the clean hydrogen market by 2030, with the accelerated expansion of trade in green hydrogen (Mazzotta, 2023). By 2050, the clean hydrogen market will be worth an estimated $1.4 trillion (Tanchum, 2023a). Conventional natural gas-derived hydrogen, now referred to as "grey hydrogen", results from a process that discharges considerable amounts of carbon dioxide (CO2) into the atmosphere. In contrast, green hydrogen is produced by using electricity generated from renewable sources to split water into its hydrogen and oxygen components, creating a carbon-free (hence, "green") energy carrier. A versatile energy carrier, green hydrogen may be used directly as a fuel or can provide on-demand, climate-smart power by reversing the electrolysis process in a fuel cell, which generates electric current by recombining green hydrogen and oxygen back into

water. The most cost-effective way to store and transport green hydrogen is in the form of its derivative green ammonia. Since ammonia is one of the basic inputs for fertiliser manufacturing – currently accounting for about 70% of global ammonia consumption – there is already offtake demand for green ammonia, which can easily use existing ammonia storage and transportation infrastructure (IEA, 2021b).

In Morocco and Egypt, the construction of new renewable power generation infrastructure is increasingly being driven by the need for green ammonia production and other international renewable energy supply chains. In Morocco and in Egypt, to a lesser extent, the advent of green ammonia production is advancing the development of robust green energy ecosystems. Exemplars of two divergent paradigms for renewable power development in North Africa – non-hydrocarbon industry-based economies versus heavily hydrocarbon-based economies –, Morocco and Egypt each have highly developed fertiliser manufacturing sectors that have incentivised green ammonia development. This common pathway for the initiation of green energy ecosystems is also applicable for Algeria and Tunisia.

Morocco and Egypt each have highly developed fertiliser manufacturing sectors that have incentivised green ammonia development

Morocco has also undertaken an electricity interconnection project to the United Kingdom (UK) that deliberately coordinates the development of renewable power generation production with the development of the offtake mechanism that serves the export market. Discussed in the next section, this ambitious undersea interconnection initiative, known as the Xlinks project, mirrors aspects of the deliberate coordination of production capacity and offtake capacity seen in green ammonia development. Incorporation of these aspects into North Africa-Europe interconnector initiatives could prove beneficial to the timely completion and operation of trans-Mediterranean interconnection megaprojects.

Morocco: diversifying renewable energy export supply chains by growing a green energy ecosystem

In 2022, renewable power accounted for 38% of Morocco's installed power generation capacity, with solar and wind power accounting for a combined 21.3% of the Kingdom's total installed capacity and hydroelectric power comprising 16.7% (Ministry of Energy Transition and Development, 2022). Morocco's wind power capacity stood at 1.77 GW while solar was 1.43 GW. Morocco is slated to add about 6.5 GW of solar and wind by power 2027. With an emphasis on solar power development, securing the $5.6 billion for its construction will help Morocco meet its 2030 target of renewables, comprising 52% of its power generation capacity (Erraji, 2023). Currently, Morocco's solar power development programme consists of a cluster of "Noor" solar power projects spread across the country, with the flagship megaprojects of Morocco's build-out, Noor I, II, and III, to have a combined installed capacity of 1.6 megawatts (MW) (ESFC, n.d.; Kawach, 2023; Masen, n.d.-b; Reuters, 2023). Morocco's wind power programme is distributed over nine projects across the country (Masen, n.d.-a; ONEE, n.d.).

The development of more recent renewable power megaprojects is directly driven by the needs of Morocco's green energy ecosystem and international renewable energy supply chains. For example, Morocco's largest wind power facility is being developed by Total Eren, a wholly-owned subsidiary

of French energy giant TotalEnergies (Diop, 2023), as part of the company's $10 billion green ammonia megaproject in Morocco's Guelmim-Oued Nour region. The dedicated 5 GW wind farm, along with a dedicated 5 GW solar power complex, will take advantage of the region's near constant nighttime winds to provide virtually 24-7 renewable power to the green ammonia plant (GWEC, 2023; Rahhou, 2022).

The country's green energy ecosystem is anchored in the food-water-energy nexus, with Morocco's OCP (originally, Office Chérifien des Phosphates), the world's largest producer of phosphate products and the world's fourth largest exporter of fertiliser, playing a central role. Morocco sits on 73% of the world's phosphate rock reserves from which the phosphorus used in synthetic fertilisers is derived (Garside, 2022). Prior to the 2021 natural gas price shocks, OCP's total revenue in 2020 amounted to $5.94 billion (OCP, 2021), accounting for about 20% of the Kingdom's export revenues (Fitch Ratings, 2020). Due to a global upsurge in demand, the fertiliser giant's 2023 revenue stood at $9 billion. The sustainability of OCP's operations through achieving energy transition is a matter of Moroccan national interest (Tanchum, 2022a).

In 2022, OCP established its OCP Green Energy subsidiary to develop the company's renewable energy generation activities, committing an investment of $13 billion through 2027 (OCP, 2022). Dedicated solar plants are being built in the mining towns of Benguerir and Khouribga, home to Morocco's largest phosphate reserves, as well as in other locations. One of OCP's highest priorities is transitioning fertiliser production away from using ammonia synthesised from natural gas-derived grey hydrogen as its basic input to using the green hydrogen-derivative green ammonia whose production is powered by Morocco's solar energy and wind energy resources. In 2023, OCP announced plans to construct its own $7 billion green ammonia plant to help the company replace its annual import of $2 billion of grey ammonia with domestically produced green ammonia. With an initial annual production capacity of 200,000 tons by 2026, OCP is aiming to raise its own green ammonia production to 1 million tons by 2027 and reach 3 million tons by 2032 (Eljechtimi, 2023).

Morocco began its development of green hydrogen production in partnership with Germany in 2018 within a development aid framework with financing from the German development bank Kreditanstalt für Wiederaufbau (KfW) (Brown, 2018; Chaudier, 2021; Federal Ministry for Economic Affairs and Energy, 2020; MAP, 2020; OCP, 2021), but has since moved on to private sector development projects backed by Portugal, the Netherlands, Italy, and the EU (Tanchum, 2023d). The green ammonia project under construction by the Irish-Portuguese firm Fusion Fuel is slated to have an initial annual capacity of 183,000 tons by 2026, equivalent to approximately 10% of OCP's production input requirements (Tanchum, 2022a).

Rabat signed a memorandum of understanding (MoU) with Dutch oil trading giant Vitol to market the green ammonia in Europe (Sharpe, 2021). The Netherlands, the world's second largest food exporter and the EU's largest fertiliser consumer per hectare, itself provided loan guarantees in 2022 for the Dutch green hydrogen firm Proton Ventures to build a green ammonia plant at Morocco's Jorf Lasfar port (Benabdellah, 2022; Rianne, 2022). Also in 2022, the Netherlands initiated the development of a new green ammonia import terminal in Rotterdam's Maasvlakte port to handle green ammonia imports to Europe starting in 2026 (Energy Capital and Power, 2022). Further indicative of Europe's eager-

ness to import Moroccan green hydrogen are Total Eren's green ammonia project and a green ammonia plant possibly to be built by Saipem (controlled by Italian energy major Eni) and Italy-based Alboran Hydrogen (Kouamé, 2021).

Since fertilisers and hydrogen imports form two of the six initial sectors targeted under the EU's Carbon Border Adjustment Mechanism (CBAM) the development of green ammonia capacity is a matter of urgency for both Morocco and its EU member state customers

Beyond supplying fertiliser production, the green ammonia can also be exported to Europe for industrial manufacturing processes and as fuel ammonia. After the completion of the projects currently under development, Morocco could export over 1-3 million tons of green hydrogen or its green ammonia equivalent to Europe annually (Tanchum, 2023a). Since fertilisers and hydrogen imports form two of the six initial sectors targeted under the EU's Carbon Border Adjustment Mechanism (CBAM) (European Commission, 2024), the development of green ammonia capacity is a matter of urgency for both Morocco and its EU member state customers.

In addition to green hydrogen, Morocco's agri-food and automotive exports to Europe could form the basis of Morocco-to-Europe renewable energy supply chains, with production powered, in part or entirely, with electricity generated from renewable energy resources. Morocco's agri-food sector now accounts for 21% of its exports by value (European Training Foundation, 2021). Rabat's Green Generation 2020-2030 plan seeks to enhance the sustainability of agricultural production through the expanded production and use of renewable energy, particularly to power seawater desalination to provide sufficient water for the sector (Ministry of Youth, Culture, and Communication, 2019; Mokena, 2020). Seawater desalination typically requires 10 times the amount of energy to produce the same volume of water as conventional surface water treatment (Tanchum, 2023d), meaning additional desalination plants will require new power generation capacity from renewable energy sources or possibly nuclear energy (Tanchum, 2023c).

Morocco's automotive industry accounts for about 25% of the Kingdom's GDP (North Africa Post, 2023; Morocco Now, 2024). With the Kingdom's annual production capacity to top 1 million vehicles by 2025, Morocco is eyeing the production of 250,000 electric cars per year (Tanchum, 2022b). The European market accounts for 90% of Morocco's exports (Medias 24, 2022), with Europe's two best-selling car models – the Peugeot 208 and Renault's Dacia Sandero — made in Morocco (Warrick, 2024). The manufacture of their EV versions on Moroccan soil is a near-term likelihood (Tanchum, 2022b). Already, Germany's Opel and Italy's Fiat have begun the production of EV models in Morocco (Tanchum, 2023f).

The European Commission's July 2021 directive to phase out all fossil fuel-powered vehicles in the EU by 2035 makes green mobility another Moroccan national priority (Perkins, 2021). The use of renewable energy in any aspect of production would lower the carbon footprint of Moroccan EV exports. Morocco's rise as an EV manufacturing giant hangs on the local manufacture of lithium ion batteries, which represent 30% to 40% of the cost of the average EV (Tanchum, 2022b). Morocco's massive phosphate reserves again come into play as the EV industry is shifting away from lithium batteries using nickel, manganese, and cobalt to lithium iron phosphate (LFP) batteries.[4] By manufacturing LFP batteries, Morocco would enjoy a cost advantage of upward of 70% per kilogramme

[4] For example, Tesla announced in its Q3 2021 report, *For standard range vehicles, we are shifting to Lithium Iron Phosphate (LFP) battery chemistry globally* (2021).

(Quantum Scape, 2021). Morocco would need to expand its phosphate and phosphoric acid production to make LFP EV batteries, requiring OCP's additional output of phosphates and phosphoric acid to be powered by renewable energy sources. Morocco's renewable power also provides another competitive advantage as it helps automakers meet their own targets for reducing the carbon footprint of their operation. Renault, for example, has set carbon reduction goals for its EV batteries of 20% by 2025 and 35% by 2030, compared to 2020 levels (Tribune, 2022).

Morocco's electricity interconnections to Europe compete with alternative offtake mechanisms of seaborne green ammonia and renewable energy supply chains based on the export of green products from the fertiliser, agri-food and automotive sectors, all of which more deliberately coordinate renewable power production capacity with European markets than Morocco's interconnections with Europe's nearby Iberian Peninsula.

Morocco's existing two interconnections with Spain have a total exchange capacity of 800 MW, with a third interconnector of 700 MW expected to be operational by 2026 (Red Eléctrica, 2019). Morocco and Portugal are also advancing feasibility studies for the construction of an electricity connector (Ministry of Youth, Culture and Commuication, 2023). However, the Iberian Peninsula is a relatively isolated island in the EU electricity market, as Spain's 2020 exchange with the EU system was only 3% of its installed capacity, far below the then EU minimum standard of 10% and the current 15% (Fuente Cobo, 2023). Morocco's interconnections with Spain and Portugal will unlikely provide sufficient access to the wider EU electricity market to spur investments in additional renewable energy infrastructure nor establish renewable energy supply chains. The political tensions between Morocco and Algeria preclude the near-term likelihood of Morocco accessing the EU electricity market via trans-Mediterranean interconnection from the central Maghreb to Italy.

In contrast to Morocco's interconnections with Spain, the ambitious Morocco-to-UK Xlinks interconnector involves the construction of 11.5 GW of dedicated renewable power. The $20 billion project plans to develop 8 GW of solar power and 3.5 GW of wind power in the Guelmim-Oued Nour region, which would supply the UK with a near 24 hour-per-day supply of electricity via a 3.6 GW interconnector (Xlinks, 2024). The two 1.8 GW undersea cables will need to traverse the formidable distance of 3,800 km to supply about 8% of the UK's power demand, starting in 2030 if completed (Kumar, 2023). If the Xlinks initiative succeeds in manufacturing and installing its undersea electricity interconnection of unprecedented length, the project could set a precedent for Morocco, and perhaps elsewhere in North Africa, for future trans-Mediterranean interconnection megaprojects that include their own dedicated renewable power infrastructure.

Egypt: progress, impasse, and the way forward for renewable power

After a period of significant progress, Egypt's renewable energy development is at a crossroads. The deliberate coordination of renewable power infrastructure development with offtake mechanisms and markets will likely become a prominent feature in Egypt's future megaprojects in order to move the country forward again. The trend is already emerging with new green hydrogen megaprojects, reflecting the growing importance of a green energy ecosystem approach in Egypt. The disappearance of

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electricity surpluses means that Egypt's trans-Mediterranean interconnection to Europe will be delayed for a period of time, making the timeframe for robust exports of electricity generated from renewable sources indeterminable. With the logic of the gas-by-wire approach no longer applicable, the development of Egypt's trans-Mediterranean interconnection may also require the coordinated construction of dedicated renewable power infrastructure.

With the 2015 discovery of the Zohr offshore natural gas field, the Mediterranean's largest find, Cairo worked to ensure Egypt's energy security through Zohr's rapid development and the construction of three large gas-fired power plants. By 2019, Egypt achieved natural gas self-sufficiency and became a net energy exporter in the form of LNG. Concurrent with gas-fired power plants, Cairo built Egypt's flagship renewable power megaproject – the $4 billion Benban PV solar park, boasting a 1.8 GW installed capacity (New and Renewable Energy Authority & EcoConServ, 2016; NS Energy, 2016). Egypt also built the 580 MW Gabel el Zait wind farm near Ras Ghareb and the onshore coastal 262.5 MW Gulf of Suez I wind farm (Department of Economic and Social Affairs, n.d.; Energy Capital & Power, 2023; Nhede, 2019). By 2022, Egypt had reversed its 6 GW electricity generation capacity deficit into a surplus of 15 GW through concurrently developing natural gas and renewable resources (Farag, 2023).

Egypt's 2035 Integrated Sustainable Energy Strategy aims to boost power production from renewable sources to comprise 42% of the country's total installed capacity, requiring a 900% increase over its current renewable power capacity (Daily News Egypt, 2019). Formulated in 2019 after the five boom years of renewable energy development, the strategy calls for 32 GW from PV solar power, 12 GW from concentrated solar power, and 18 GW from wind power. Egypt's 2023 economic crisis has cast doubt on its ability to meet these targets. To cope with its dwindling foreign reserves, burdensome debt servicing and a surge in domestic demand, the government reintroduced rolling power cuts so more natural gas could be exported, earning $300 million per month for Egypt's cash-strapped treasury (Helal, 2023). The sustained absence of an electricity production surplus due to a lack of gas to fuel its thermal plants will hamper Egypt's prospects to establish a trans-Mediterranean interconnection that could serve to create a renewable energy supply chain to Europe.

Egypt hopes to access the wider EU electricity market by the proposed 2 GW Euro-Africa interconnector to transport electricity from Egypt to Europe via Cyprus and Greece or the proposed 3 GW direct Greece-Egypt (GREGY) interconnector (Todorović, 2023). Despite Egypt's progress in establishing interconnections on three continents, significant power exports will not occur unless Egypt returns to electricity surpluses. The soon to be operational $1.6 billion, 3 GW interconnection between Egypt and Saudi Arabia could be used to bolster the amount of electricity exports to Europe through Saudi or even Emirati green power exports that comply with CBAM (European Commission, 2024; IEA, 2022; Tanchum, 2020). The planned expansion of Egypt's interconnection with Jordan from 300 MW to 2 GW could enable Egyptian electricity exports to Jordan to also enter the under-served electricity markets of Lebanon, Syria, and Iraq (Arab Fund for Economic & Social Development, 2023). Egypt also made significant upgrades to its electricity interconnections with Africa (Daily News Egypt, 2020). As part of its 2019 exuberance and with an eye towards bolstering its geopolitical influence, Egypt announced that it was prepared to export 20% of its surplus electricity to African na-

tions at up to a 50% discount (Sabry, 2019). At the time of writing, Egypt has experienced sustained, continual power cuts. If the present power cuts persist, renewable energy supply chains via interconnection are unlikely to materialise soon unless the interconnections are accompanied by dedicated renewable power infrastructure.

Egypt's current dilemma shows that offtake for renewable energy by electricity interconnection alone is insufficient to incentivise a sustained renewable energy infrastructure build-out. Green hydrogen in the form of green ammonia could enable Egypt to access renewable energy markets in Europe as well as in Asia, given Egypt's geographic location and Asia's interest in replacing coal with fuel ammonia in its coal-fired power plants (Tanchum, 2023b). Egypt is the world's seventh largest ammonia producer (Statista, 2023). Already a major grey ammonia producer, the country can utilise its existing ammonia storage and transportation infrastructure for green ammonia.

Green ammonia is likely to form a central part of Egypt's low carbon hydrogen strategy for both domestic use and exports, as reducing the amount of natural gas required for its domestic ammonia production will also free up more natural gas to be sold as LNG. With natural gas supplies to Egypt's fertiliser sector having been reportedly cut by 30% during the current crisis to create more LNG for export (Khalid, 2023), green ammonia is vital for the sustainability of Egypt's market share in the fertiliser sector. Egypt is likely to develop green ammonia production concurrently with blue ammonia, which is produced like grey ammonia except with a carbon capture mechanism to lower the carbon footprint of the natural gas-derived hydrogen. Italy's Eni, one of Egypt's leading natural gas partners and Zohr's lead operator, is eyeing the possibility of using Egypt's depleted natural gas fields for the storage of CO2 produced by carbon capture. Egypt is currently the world's sixth largest producer of urea, also used in nitrogen-based fertilisers, and could relatively easily use the captured CO2 for urea manufacture (Egypt Today, 2021; Eni, 2021).

Egypt's estimated 2019 grey hydrogen production totalled 1.82 million tons (Habib & Ouki, 2021). To produce this amount as green hydrogen would require approximately 16.22 million cubic metres (mcm) of water. Given Egypt's annual water deficit of 30-35 bcm (Tanchum, 2023e), coastal green hydrogen production sites with dedicated water desalination units also powered by renewable energy are a necessity. To replace its entire grey hydrogen production with domestically produced green hydrogen, i Egypt would also need an estimated 21 GW of electrolyser capacity (Habib & Ouki, 2021), making Cairo likely to opt for some combination of green hydrogen and blue hydrogen as it seeks to capture market share in European and Asian markets. Ultimately, Cairo aims to capture 5-8% of the global market for green hydrogen. Egypt's trailblazing green hydrogen project is being developed by the Norwegian renewable energy company Scatec and the Dutch-Emirati fertiliser producer Fertiglobe, in partnership with the Sovereign Fund of Egypt. The facility, now in its pilot stage, is located at the Red Sea port of Ain Sokhna, near Fertiglobe's subsidiary Egypt Basic Industries Corporation (EBIC) (Scatec, 2021a). Scatec will operate the Ain Sokhna facility with Fertiglobe, enjoying a long-term off-take agreement for the plant's green hydrogen output as a feedstock for EBIC's green ammonia production (Scatec, 2021b). In November 2023, Fertiglobe made its first consignment of certified green ammonia from green hydrogen produced from the Scatec-operated plant's pilot electrolyser (Ahram Online, 2023b).

Egypt's current dilemma shows that offtake for renewable energy by electricity interconnection alone is insufficient to incentivise a sustained renewable energy infrastructure build-out

At the 2022 COP27 hosted by Egypt in Sharm El Sheikh, Egypt's Minister of Energy signed framework agreements with Australia's Fortescue Future Industries, India's ReNew Power, Dubai-based AMEA, Saudi project developer Alfanar, the London-headquartered Africa-focused green energy developer Globeleq, Total Energies, and EDF, as well as an MoU with Energy China (Lewis, 2022; SCZone, 2023). Most of the agreements concerned project development around the Ain Sokhna port and the Suez Canal Economic Zone (SCZone). The financing mechanisms of these green hydrogen and green ammonia projects form a key factor in determining whether Egypt will develop a robust green hydrogen industry. Financing through foreign direct investment (FDI) or other mechanisms that do not add to Egypt's debt burden is an essential requirement.

Among the most promising agreements signed at COP27 was the framework agreement signed by a consortium led by the Unites Arab Emirates (UAE)'s Masdar and including the Emirati-Egyptian joint venture Infinity Power, and Egypt's Hassan Allam Utilities for the construction of a 2 GW green hydrogen facility in the SCZone to be operational in 2026 (Masdar, 2022). The framework agreement follows two April 2022 agreements signed by Egypt with the Masdar-led consortium to construct two green hydrogen facilities with a combined electrolyser capacity of 4 GW. The other green hydrogen facility is to be built on Egypt's Mediterranean coast. The 2030 target for the combined output from both green hydrogen facilities will be 480,000 tons per year (Masdar, 2022). The same consortium signed an agreement for the development of a 10 GW wind project, potentially freeing up about $5 billion in natural gas cost per year (Masdar, 2023). The electric output would also be sufficient to power the green hydrogen production facilities while providing electricity for other industrial or residential power needs. A feature common to newer green hydrogen megaprojects in Africa, such as those in Mauritania, is the provision of renewable power or desalinated water to residents in regions where new megaprojects are located, which would help diffuse the benefits of renewable energy to the wider populace.

In August 2023, Egypt established a National Council for Green Hydrogen and its Derivatives to help ensure the country's regional and international competitiveness in the sector, particularly overcoming obstacles impeding the attraction of investments (Ahram Online, 2023a). Subsequently, Egypt's Minister of Finance announced that Cairo would offer tax incentives ranging from 33% to 55% and engage in other financing mechanisms to encourage green hydrogen investment in the heavily debt-burdened country (Egypt Today, 2023). The renewable power foundations that Egypt established remain, and they still can be utilised to great effect. Egypt's development of a green energy ecosystem that more deliberately connects renewable energy production to a diversity of designated offtake mechanisms could help provide the country a path out of its present impasse.

Algeria: gas first, green second, and the gamble on piped hydrogen

Despite its enormous potential, Algeria's renewable energy sector is arguably the least developed in North Africa

Despite its enormous potential, Algeria's renewable energy sector is arguably the least developed in North Africa. Renewable power accounts for less than 1% of the Algeria's electricity generation (IEA, 2021a). In 2022, Algeria's installed capacity for solar power was 460 MW, while its hydroelectric and wind power capacities stood at 228 MW and 10 MW respectively

(Galal, 2023; IRENA, 2023). The 2030 target of Algeria's Renewable Energy and Energy Efficiency Development Plan is 22 GW of installed renewable power generation capacity (Ministry of Energy and Mines, n.d.). Announced in 2011, the plan would now require Algeria to achieve a 3,000% renewable power capacity increase in six years, with solar power capacity reaching 15.58 GW and wind power reaching 5.01 GW. With less than 1 GW of solar and wind power capacity combined, Algeria is very far from realising the plan's ambition to use a designated 10 GW of the anticipated renewable power production capacity for exports (Nachmany et al., 2015).

As Africa's largest natural gas exporter, Algeria's oil and gas sector dominates the economy, earning 94% of its export revenues (World Bank, 2022). Like the difficulties that have often plagued Algeria's efforts to develop other industries outside the hydrocarbon sector, the development of Algeria's solar power sector has been set back by institutional challenges that have hampered foreign private sector engagement (Tanchum, 2021). Renewable energy development could be incentivised through Algeria's widespread use of renewable power to lower the carbon footprint of oil, gas and petrochemicals production. In 2018, Eni and Algeria's state-owned energy company Sonatrach built a 10 MW PV plant to power the capture of greenhouse gases in the Bir Rebaa North upstream oil and gas operations (Eni, 2018).

In 2020, Algeria began preliminary work on installing a 3.04 GW rooftop solar power system at Oran's Ahmed Ben Bella International Airport. Supplying about 30% of the airport's electricity when completed, the project will contribute to Algeria reaching its 2030 target 15.58 GW solar power capacity (Fimer, 2020). Algeria's flagship renewable energy megaproject, the $3.6 billion, 4 GW Tafouk1 solar power complex, has floundered for lack of foreign investment, despite Algiers suspending its requirement to cap foreign stakeholders at 49%. In 2023, Algeria issued a new tender for 15 solar PV projects with an aggregate capacity of 2 GW (Takouleu, 2023), hoping to emulate neighbouring Tunisia's approach of opting for multiple, small scale independent power projects.

While Algeria eyes capturing 10% of the European hydrogen market, Algiers has placed its focus on blue hydrogen, declaring the eventual development of a green hydrogen as a long-term goal (Embassy of Algeria to Croatia, 2022). In March 2023, Algeria unveiled its first hydrogen roadmap. Although formulated in cooperation the German development agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (Algerian Press Service, 2023), the 30-year framework contains no target commitments to specific hydrogen types. Four months prior in December 2022, Algeria signed a declaration of intent with Germany's VNG, a subsidiary of German utility EnBW, to develop a pilot green ammonia plant. Although Germany's KfW agreed to finance the 50 MW pilot green hydrogen facility (Ivanova, 2023), the agreement appears to have been a precursor to clearing a path for German purchases of Algerian natural gas. In early February 2024, VNG – previously a main purchaser of Russian natural gas for German businesses – signed a landmark deal with Sonatrach to become the first German company to buy Algerian pipeline gas (Burgess & Elliot, 2024).

Algeria eyes capturing 10% of the European hydrogen market, Algiers has placed its focus on blue hydrogen

North Africa-Europe natural gas pipeline connectivity may prove the greatest impediment to Algerian renewable energy supply chains based on green hydrogen.

Italy, Germany, and Austria are seeking to create the "SoutH2 Corridor", which envisions using the undersea natural gas pipeline interconnection between Tunisia and Italy and Italy's gas transmission system to transport hydrogen produced primarily in Algeria to Italy and Central Europe (South H2 Corridor, 2024). However, the technical and commercial viability of a trans-Mediterranean pipeline of hydrogen is questionable (Tanchum, 2024).

In contrast to significantly larger natural gas molecules, the small hydrogen molecules severely degrade the hard steel of undersea natural gas pipelines, permeating the micro-fissures that develop in the pipe (Barnard, 2022), leading to an emission rate much higher than the 3.5% leakage rate for methane (Burgess, 2021). The escaped hydrogen would have a global warming potential 7.9 times that of the CO2 it is intended to replace (WARWICK et al., 2022). Being 8.5 less dense than natural gas, hydrogen is more difficult to move, requiring 200% more energy to compress than natural gas for same quantity of heat energy, requiring the pipeline network to have compressor units three times as powerful, with three times the suction displacement – in addition to special capabilities to prevent the smaller hydrogen molecules from leaking. The resulting capital expenditures and operating costs of transportation make hydrogen exports transported via pipeline over three times more expensive than Algeria's piped gas exports to Europe (Martin, 2020).

The extent to which Algeria and its international partners succeed in the attempt to ship blue hydrogen via undersea pipelines will determine the fate of Algeria's green hydrogen industry

The proposal of transporting a blend of 20% hydrogen and 80% natural gas would not sufficiently resolve the transportation problems. Even if green hydrogen were used, the 80-20 blend would not be even "20% green". The 80-20 proportion is by volume, and contains only 86% of the energy content of the same amount of natural gas alone. The 80-20 blend requires 14% more of the blend to produce the same amount of energy as natural gas, making the greenhouse gas reduction of a blend with 20% green hydrogen lower than 6% when accounting for the 13% more energy required to compress the 80-20 blend (Martin, 2020).

The extent to which Algeria and its international partners succeed in the attempt to ship blue hydrogen via undersea pipelines will determine the fate of Algeria's green hydrogen industry, unless Algiers and its European partners can be convinced to also develop Algerian exports of green ammonia. Barring a policy shift by Algiers, the absence of a robust green hydrogen sector means that a gas-by-wire approach could be the only option for establishing Algeria-to-Europe renewable energy supply chains, placing a spotlight on trans-Mediterranean interconnection megaprojects. Absent the rapid development of the proposed 2 GW Algeria-Italy interconnector via the Italian island of Sardinia (Bongarrà, 2022), Algeria's only near-term export offtake option for renewable energy production is trans-Mediterranean electricity interconnection to Italy via Tunisia.

Tunisia: scaling up to meet ambitious green energy targets

In 2022, Tunisia possessed 472 MW of installed capacity of power generation from renewable sources, accounting for 8% of Tunisia's total installed capacity (IEA, 2021c). Tunisia's wind power capacity stood at 244 MW, while its solar power capacity was 166 MW and its hydroelectric power 62 MW. Tunisia has set a 2030 target for renewable power to comprise 35% of total power generation capacity (Global Forum on Sustainable Energy, n.d.). In seeking to achieve an almost 900% in-

crease in its renewable power capacity, the Tunisian government has steered away from megaprojects in favour of attracting foreign companies to build a large number of smaller renewable facilities as independent power projects. In 2023, Tunisia initiated a tender round for 18 projects with combined capacity 1.7 GW – ten 100 MW solar power projects and eight 75 MW wind power projects (Enerdata, 2023; Sambidge, 2023). Given Tunisia's relatively small population, these projects collectively could form the foundation upon which to develop international renewable energy supply chains, but would not be sufficient by themselves.

Tunisia's efforts to expand its renewable capacity have been revitalised by the 2015 revision of its legal framework to attract FDI in renewable power development (Jenayah, 2023). Still in its early days, the new concessions regime has met with initial success. In 2023, the Emirati renewable power developer AMEA reached its final close on a 120 MW solar power plant in Tunisia's Kairouan governate (AMEA Power, 2023), being the first solar project to do so under the new concessions regime. Beyond the revision of its legal framework for concessions and authorisations, Tunisia needs to repair the financial health and transparent functioning of the state-owned energy production and distribution company STEG (Société Tunisienne de l'Electricité et du Gaz), which oversees the development of offtake mechanisms for renewable energy exports, whether green hydrogen or electricity interconnection. As observed by the World Bank's Infrastructure Program Leader for the Maghreb, STEG's achievement of greater accountability in bills payment and a workable balance of tariffs, revenue requirements, and subsidies will greatly impact Tunisia's ability to work with international financial institutions and investors (Cherif, 2023).

Tunisia's National Green Hydrogen Strategy aims to produce 8.3 million tons of green hydrogen, 6 million of which are slated for export (Tunur, 2023). Although Tunisia has a strong potential for green hydrogen production, the limited efforts to develop the sector have occurred within a development aid framework. In December 2020, Germany kickstarted Tunisia's green ammonia development with a $36 million development grant for the construction of a pilot green hydrogen project now known as H2 Vert (Smaoui & Rich, 2021). While a development aid approach can initiate the development of a previously non-existent sector, both the SoutH2 Corridor project and green ammonia development in the central Maghreb are hampered by this limitation. The concept of the SoutH2 Corridor builds on a 2021 study published by GIZ assessing the potential of Tunisia's hydrogen industry that did not address the previously discussed challenges involved in transmitting hydrogen through the undersea natural gas pipelines ((Terrapon-Pfaff et al., 2021). Spearheading Tunisia's green hydrogen programme is TuNur, a joint venture between Tunisian investment group Top Group and UK-based firm Nur Energie, which came to prominence through the endorsement of the Desertec project (Szakal, 2014).

The H2 Vert project was officially launched in June 2022, and the proof-of-concept plant is slated to produce 1,500 tons of green ammonia per year, with GIZ designated to oversee the implementation of the project (Zawya, 2022). The economic logic for Tunisia to develop a green ammonia industry linked to fertiliser production, along lines similar to Morocco's engagement with foreign private sector investors, is compelling and a viable pathway for scaling up green ammonia production and the renewable power capacity and desalination capacity it requires. Tunisia can only satisfy 25% of its domestic fertiliser demand (FAO, 2024). Replacing imported grey am-

Tunisian government has steered away from megaprojects in favour of attracting foreign companies to build a large number of smaller renewable facilities

monia with locally produced green ammonia would boost Tunisia's domestic fertiliser industry. With a population three times smaller than that of Morocco, Tunisia would be well-positioned also to develop an export industry for surplus green ammonia or possibly higher value-added fertiliser. Green ammonia production with dedicated desalination infrastructure and renewable power infrastructure would also facilitate the provision of affordable green electricity and desalinated water produced from renewable power to local residents.

Trans-Mediterranean interconnection forms an important offtake mechanism for Tunisia, which is partnering with Italy to interconnect their electricity grids with 192 km-long, 600 MW undersea cable between Tunisia and Sicily (Industry Europe, 2019). Known as the ElMed interconnector, the project was scheduled for completion in 2025, but now is on track to be completed in 2028 thanks to the financial infusions of €308 million and $268 million respectively by the European Commission and the World Bank (Enerdata, 2022; World Bank, 2023). In contrast to Morocco's interconnections with Spain and Portugal, Tunisia's interconnection with Italy will enable power exports to the wider EU electricity market.

Conclusions

Energy production, power generation and electricity transmission megaprojects have been means by which nations have secured their energy supplies and economic uplift. Possessing the world's largest solar energy resources supplemented by ample wind energy resources, North Africa can achieve these objectives through the development of renewable power generation capacity. The region's renewable resources are so enormous that the countries of North Africa could become electricity self-sufficient as well as leading exporters of renewable power. Profits from exports would provide the return on investment that would attract the foreign private sector partnerships necessary for the required infrastructure build-out. Since nearby Europe is the major export market for North African renewable energy supply chains, Euro-North African cooperation to develop North Africa's capacity to produce and transport renewable power in a mutually beneficial manner is a geopolitical and economic imperative.

The major finding of this chapter is that renewable energy megaprojects in North Africa require better and deliberate coordination between the development of renewable power generation infrastructure and the development of offtake mechanisms for the service of clearly identified domestic and especially export markets. The offtake mechanisms can take the form of electricity interconnection, green hydrogen, the green hydrogen-derivative green ammonia, or agri-food and manufactured products produced using renewable power. This deliberate coordination occurs most directly with the construction of dedicated renewable power generation infrastructure as part of the offtake mechanism development. The diffusion of socioeconomic benefits of megaprojects to local residents is also more easily accomplished with dedicated renewable power generation infrastructure. This has been seen in the growing trend in green ammonia production projects, in which part of the renewable power generation capacity is used to supply affordable green electricity to local residents or affordable drinking water is provided by the desalination units of the green ammonia facility that use renewable power.

Private sector participation is an essential factor in the equation for success, requiring the careful cultivation and management of private sector relationships by North African governments and their international partners. Morocco has demonstrated strong success

in this regard, and serves as a model. Recent legal reforms in Tunisia and private sector incentives in Egypt have met with initial success and should be expanded.

Green hydrogen is rising in prominence as an export offtake mechanism for renewable power and is proving to be a fundamental element in the growth of green energy ecosystems in North Africa. Morocco is on track to produce 1-3 million tons of green ammonia per year, sufficient to replace imported natural gas-derived ammonia for its fertiliser industry and to become a major exporter of renewable energy as seaborne shipments of green ammonia. Egypt's green ammonia sector is attracting significant foreign investment, with multiple projects under development that will help lift Egypt's renewable energy sector out of its current impasse. These projects will help Egypt's already developed fertiliser industry to become more resilient to fluctuations in the amount of natural gas supplied to the sector by Egypt's natural gas industry, which is under pressure to export natural gas to earn foreign exchange. If the multiple megaprojects for which each has signed framework agreements are developed and become operational, Cairo will be on track to reach its target of capturing 5-8% of the global green hydrogen market.

Seaborne green ammonia export would also provide Tunisia with increased flexibility as it is slated to rely on its pipeline interconnection with Italy to transport hydrogen gas in conjunction with natural gas-rich Algeria, which is focusing on piped shipments of blue hydrogen. Not requiring pipeline interconnection, seaborne green ammonia shipments would also allow Tunisia to participate in green hydrogen trade flows with either Morocco or Egypt. Green ammonia could also revitalise Tunisia's fertiliser industry, which currently cannot even supply its own domestic demand.

Natural gas-rich Algeria is focused almost entirely on the development of blue hydrogen exports, primarily transported as hydrogen gas through existing cross-border natural gas pipelines. The commercial and technical feasibility of this transport mechanism has not been adequately addressed by Algiers nor its EU member state partners. With its emphasis on blue hydrogen gas shipments and secondarily blue ammonia exports, Algeria has set no hard targets for green hydrogen development, and therefore green hydrogen is unlikely to spur the development of renewable power generation capacity, barring a policy shift by Algiers. Employing renewable power to lower the carbon footprint of Algeria's oil, natural gas, and petrochemicals operations could incentivise the development of renewable energy infrastructure.

The absence of a robust green hydrogen sector means that Algeria's only way of establishing renewable energy supply chains for export is through electricity interconnection, primarily trans-Mediterranean interconnection megaprojects to Europe either directly via the Italian island of Sardinia or indirectly to Italy via Tunisia. Algeria is the sole country in North Africa currently capable of succeeding in a gas-by-wire approach that would create trans-Mediterranean interconnection infrastructure. This infrastructure could subsequently be used for electricity exports generated by renewable power, but is unlikely to be sufficient to incentivise investment in the development of renewable power generation capacity.

Cross-border electricity interconnection, particularly trans-Mediterranean interconnection for North African power exports to reach the wider EU electricity market, remains an offtake mechanism with great

potential. Across the region, the gas-by-wire approach has not succeeded in creating sufficient North Africa-to-Europe electricity interconnection to incentivise investment in a large-scale build-out of renewable power generation capacity. Several of the initiatives to develop trans-Mediterranean interconnections would benefit from the construction of dedicated solar power and wind power infrastructure as part of the interconnection projects. The Morocco-to-UK Xlinks mega-interconnector may serve as a model of how to enhance trans-Mediterranean interconnection megaprojects that have struggled to progress in their development.

A green energy ecosystem, in which intermediate and finished products are produced using renewable energy, serves as the foundation for the formation of diverse and robust renewable energy export supply chains. In the case of Morocco and to a more limited extent Egypt, green energy ecosystems emerged from the production of green hydrogen, in the form of green ammonia, to service each country's fertiliser export industries. Algeria and Tunisia have the potential to follow a similar course of development. Since fertilisers and hydrogen imports form two of the six initial sectors targeted under the EU's Carbon Border Adjustment Mechanism, the development of green ammonia capacity is a matter of urgency for Morocco and potentially the other North African states. The matter is also critical for North Africa's European customers who seek to ensure the security of their supplies under the tightening carbon tax regimes.

The production of low carbon export products could incentivise the development of additional renewable power generation capacity, particularly through construction of dedicated solar and wind power infrastructure. Morocco's considerable agri-food and automotive exports to Europe could form the basis of Morocco-to-Europe renewable energy supply chains. Tunisia's automotive components export industry could similarly export lower carbon footprint components through manufacturing that uses renewable power. Egypt could do the same with home appliance manufacturing, which is emerging as an important finished goods export sector. Egypt and Tunisia could lower the carbon footprint of their agricultural exports, particularly through water desalination and irrigation powered with electricity generated from renewable sources. Mining and metals processing in each of the five North African countries is another sector that could incentivise the development of dedicated renewable power generation capacity in the cases in which the size of exports to Europe warrant the investment.

Conventional development aid framework approaches to the construction of renewable power megaprojects and interconnection megaprojects will have decreasing utility in moving North Africa's green energy transition forward. Private sector investments are proving to be an effective engine of growth for green energy sectors in Morocco, Egypt, and Tunisia. Such investments can be attracted through legal and regulatory reform and facilitated by public-private partnerships and export credit agency financing guarantees. EU and EU member state instruments are adept at achieving these outcomes.

By focusing more on the deliberate coordination of renewable power generation infrastructure and offtake mechanisms for clearly defined export markets, Europe and North Africa can cooperate to develop North Africa's capacity to produce and transport renewable power in a win-win manner that furthers global energy transition and diffuses economic benefits to citizens on both shores of the Mediterranean.

Recommendations

- **Better and deliberate coordination between power production and offtake mechanisms**

  Initiatives in North Africa require better and deliberate coordination between the development of renewable power projects and the development of offtake mechanisms, whether green hydrogen or electricity interconnection.

- **More emphasis on dedicated renewable power generation as part of offtake mechanism development**

  The deliberate coordination occurs most directly with the construction of dedicated renewable power generation infrastructure as part of offtake mechanism development.

- **Dedicated renewable power generation infrastructure should include the supply of affordable power or affordable desalinated drinking water to local populations**

  The diffusion of socioeconomic benefits of megaprojects to local residents is also more easily accomplished with dedicated renewable power generation infrastructure. This has been seen in the growing trend in green ammonia production projects, in which part of the renewable power generation capacity is used to supply affordable green electricity to local residents or affordable drinking water is provided by the desalination units of the green ammonia facility that use renewable power.

- **Greater focus on offtake mechanism through green energy ecosystems that produce low carbon exports products with renewable energy**

  The production of low carbon export products could incentivise the development of additional renewable power generation capacity, particularly through construction of dedicated solar and wind power infrastructure. Morocco's considerable agri-food and automotive exports to Europe could form the basis of Morocco-to-Europe renewable energy supply chains. Automobile components manufacturing in Tunisia and home appliance manufacturing in Egypt provide additional promising North Africia-to-Europe renewable energy supply chains.

- **Greater focus on green ammonia and fertiliser production as entry industries for renewable energy supply chains**

  Green ammonia and fertiliser production are entry industries for the development of green energy ecosystems and renewable energy supply chains. Highly developed fertiliser manufacturing sectors have incentivised green ammonia development, as seen in Morocco. This developing trend should be further facilitated in Egypt. This pathway should be incorporated into investment plans for renewable energy in Algeria and Tunisia, helping each country to meet its own domestic fertiliser demand. Seaborne green ammonia export would also provide Tunisia with increased flexibility as it is slated to rely on its pipeline interconnection with Italy as its only offtake mechanism.

- **North Africa-Europe electricity interconnection project should include dedicated renewable power infrastructure**

  The development of robust trans-

Mediterranean electricity interconnection can be boosted by the coordinated construction of dedicated renewable power infrastructure.

- **Use renewable power to "green" oil, gas, and petrochemical operations, particularly in Algeria**

For the hydrocarbon energy producers of North Africa, the use of renewable power to lower the carbon footprint of oil, gas and petrochemicals operations could form an element in catalysing the development of a green energy ecosystem, particularly in the case of Algeria.

References

AHRAM ONLINE. (2023a). Egypt establishes 'National Council For Green Hydrogen' to boost green investment. https://english.ahram.org.eg/News/507526.aspx

AHRAM ONLINE. (2023b). Fertiglobe exports world's first certified green ammonia from Egypt. https://english.ahram.org.eg/News/512552.aspx

ALGERIAN PRESS SERVICE. (2023). *Hydrogen development roadmap: supplying the European market with 10% of its needs by 2040*. People's Democratic Republic of Algeria. https://www.aps.dz/economie/153601-feuille-de-route-de-developpement-de-l-hydrogene-fournir-au-marche-europeen-10-de-ses-besoins-a-l-horizon-2040

AMEA POWER. (2023). *AMEA Power Reaches Financial Close on the 120MW Solar Power Plant in Tunisia.* https://www.ameapower.com/amea-power-reaches-financial-close-on-the-120mw-solar-power-plant-in-tunisia/

ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT. (2023). *Arab Regional Projects: Electricity.* https://www.arabfund.org/default.aspx?pageId=454

BARNARD, M. (2022). *Paul Martin Talks H2 Science Coalition & More Problems With Hydrogen.* Clean Technica. https://cleantechnica.com/2022/03/01/paul-martin-talks-h2-science-coalition-more-problems-with-hydrogen/.

BENABDELLAH, Y. (2022). Le Project Pilote de Production d'Ammoniac Vert Iyvre de Grandes Perspectives por le Maroc. *Medias 24*. https://medias24.com/2022/09/04/ le-projet-pilote-de-production-dammoniac-vert-ouvre-de-grandes-perspectives-pour-le-maroc/

BONGARRÀ, F. (2022). Submarine cable to link Algeria, Italy. *Arab News.* https://www.arabnews.com/node/2088571/business-economy

BROWN, T. (2018). *OCP's Green Ammonia pilot plant, and the African Institute.* Ammonia Energy Association. https://www.ammoniaenergy.org/articles/ocps-green-ammonia-pilot-plant-and-the-african-institute-for-solar-ammonia/;

BURGESS, J. & ELLIOT, S. (2024). *Germany's VNG to begin Algerian gas imports under mid-term deal with Sonatrach.* S&P Global. https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/020924-germanys-vng-to-begin-algerian-gas-imports-under-mid-term-deal-with-sonatrach

BURGESS, J. (2021). *Blue hydrogen 20% worse for GHG emissions than natural gas in heating: study.* S&P Global. https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/081221-blue-hydrogen-20-worse-for-ghg-emissions-than-natural-gas-in-heating-study.

CHAUDIER, J. (2021). Will Hydrogen fuel Morocco's industrial projects of the future? *The Africa Report.* https://www.theafricareport.com/124184/will-hydrogen-fuel-moroccos-industrial-projects-of-the-future/

CHERIF, M. (2023). *Tunisia's energy sector can become an engine of green growth.* World Bank Blogs: Arab Voices. https://blogs.worldbank.org/en/arabvoices/tunisias-energy-sector-can-become-engine-for-greengrowth#:~:text=The%20government%20aims%20to%20increase,solar%20or%20wind%20power%20plants

DAILY NEWS EGYPT. (2019). How does Egypt plan to produce 42% of its electricity from renewables by 2035. https://dailynewsegypt.com/2019/12/17/how-does-egypt-plan-to-produce-42-of-its-electricity-from-renewable-sources-by-2035/

DAILY NEWS EGYPT. (2020). Egypt-Sudan Electricity Interconnection Officially Operates at 70mw Capacity. https://dailynewsegypt.com/2020/04/05/egypt-sudan-electricity-interconnection-officially-operates-at-70mw-capacity/

DE FREITAS, W. (2020). *Could the Sahara turn Africa into a solar superpower?* World Economic Forum. https://www.weforum.org/agenda/2020/01/solar-panels-sahara-desert-renewable-energy/

DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS. (n.d.). *Gabel El Zeit Wind farm complex.* United Nations. https://sdgs.un.org/partnerships/gabel-el-zeit-wind-farm-complex-ensuring-access-affordable-reliable-and-modern-energy

DESERTEC FOUNDATION. (n.d.). Desertec: Sustainable Wealth for Every Human on Earth. https://desertec.org/en/

DIOP, A. (2023). Energies renouvelables : après 5 années d'alliance stratégique, TotalEnergies acquiert entièrement Total Eren. Agence Ecofin. https://www.agenceecofin.com/energies-renouvelables/2607-110644-energies-renouvelables-apres-5-annees-d-alliance-strategique-totalenergies-acquiert-entierement-total-eren

EGYPT TODAY. (2021). Egypt 6th in world in urea production, produces 7.8M tons of nitrogen fertilizers. https://www.egypttoday.com/Article/3/111326/Egypt-6th-in-world-in-urea-production-produces-7-8M

EGYPT TODAY. (2023). Egypt to provide new Incentives for green hydrogen production. https://www.egypttoday.com/Article/3/127641/Egypt-to-provide-new-Incentives-for-green-hydrogen-production

ELJECHTIMI, A. (2023). Morocco's OCP plans $7 billion green ammonia plant to avert supply problems. Reuters. https://www.reuters.com/sustainability/climate-energy/moroccos-ocp-plans-7-mln-green-ammonia-plant-avert-supply-problems-2023-06-20/

EMBASSY OF ALGERIA TO CROATIA. (2022). *Hydrogen Production: Algeria in a Position to Play Leading Regional Role.* https://www.ambalgzagreb.com/hydrogen-production-algeria-in-position-to-play-leading-regional-role/.

ENERDATA. (2022). *The EU grants €307m for a 600 MW Italy-Tunisia power interconnection project.* https://www.enerdata.net/publications/daily-energy-news/eu-grants-eu307m-600-mw-italy-tunisia-power-interconnection-project.html

ENERDATA. (2023). *Tunisia launches tender for 1.7 GW of renewables*. https://www.enerdata.net/publications/daily-energy-news/tunisia-launches-tender-17-gw-renewables.html

ENERGY CAPITAL & POWER. (2022). *Chariot's $3.5 billion Mauritania Based Green Hydrogen Project Secures European Export Route.* https://energycapitalpower.com/chariots-3-5-billion-mauritania-based-green-hydrogen-project-secures-european-export-route/

ENERGY CAPITAL & POWER. (2023). *Largest Operating Renewable Projects in Egypt.* https://energycapitalpower.com/biggest-solar-energy-wind-projects-egypt/

ENERGY INSTITUTE. (2023). *Statistical Review of World Energy 2023* (72nd Edition). https://www.energyinst.org/statistical-review

ENI. (2018). *Eni and Sonatrach inaugurate the 10 MW Bir Rebbaa North Photovoltaic Plant and sign agreements in the renewable energy sector.* https://www.eni.com/en-IT/media/press-release/2018/11/eni-and-sonatrach-inaugurate-the-10-mw-bir-rebaa-north-photovoltaic-plant-and-sign-agreements-in-the-renewable-energy-sector.html

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

ERRAJI, A. (2023). Morocco Has Invested $5.6 Billion in Renewable Energy Projects. Morocco World News. https://www.moroccoworldnews.com/2023/07/356723/morocco-has-invested-5-6-billion-in-renewable-energy-projects

ESFC. (n.d.). *Noor Ouarzazate: the world's largest concentrated solar power plant built in Morocco.* https://esfccompany.com/en/articles/solar-energy/noor-ouarzazate-the-world-s-largest-concentrated-solar-power-plant-csp-built-in-morocco/

EUROPEAN COMMISSION. (2024). *Carbon Border Adjustment Mechanism.* https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en#sectoral-information

EUROPEAN TRAINING FOUNDATION. (2021). *The future of skills: A case study of the agri-food sector in Morocco.* https://www.etf.europa.eu/en/publications-and-resources/publications/future-skills-case-study-agri-food-sector-morocco

EY. (2022). *Renewable Country Energy Attractive Index (RECAI)* (60th edition). https://assets.ey.com/content/dam/ey-sites/ey-com/en_us/topics/energy-resources/ey-recai-60-report-november-2022.pdf

FAO. (2024). *GIEWS - Global Information and Early Warning System – Country Briefs: Tunisia.* https://www.fao.org/giews/countrybrief/country.jsp?code=TUN

FARAG, M. (2022). Could Egypt make use of its energy surplus? Daily News Egypt. https://www.dailynewsegypt.com/2022/07/27/could-egypt-make-use-of-its-energy-surplus/

FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY. (2020). *The National Hydrogen Strategy.* Federal Republic of Germany. https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.pdf?__blob=publicationFile&v=6;

FIMER. (2020). *FIMER chosen for largest solar PV airport installation in Africa.* https://www.fimer.com/fimer-chosen-largest-solar-pv-airport-installation-africa

FITCH RATINGS. (2020). *Fitch Revises Outlook on OCP to Stable; Affirms at 'BB+'.* https://www.fitchratings.com/research/corporate-finance/fitch-revises-outlook-on-ocp-to-stable-affirms-at-bb-28-10-2020

FUENTE COBO, I. (2023). *¿Puede Marruecos Convertirse En Un Proveedor Energético Para Europa?* Atalayar. https://www.atalayar.com/en/articulo/economy-and-business/could-morocco-become-energy-provider-europe/20230308134149182087.html#google_vignette

GALAL, S. (2023). *Renewable energy in Algeria - statistics & facts*. Statista. https://statista.com/topics/10656/renewable-energy-in-algeria/#topicOverview

GARSIDE, M. (2022). *Phosphate rock reserves worldwide in 2021, by country.* Statista. https://www.statista.com/statistics/681747/phosphate-rock-reserves-by-country/

GLOBAL FORUM ON SUSTAINABLE ENERGY. (n.d.). Renewable Energy in Tunisia. https://www.gfse.at/news/renewable-energy-in-tunisia#:~:text =The%20Tunisian%20Solar%20Plan%20foresees,amounts%20in%20solar%20and%20Hydropower

GWEC. (2023). *Status of Wind in Africa.* https://gwec.net/wp-content/uploads/2023/10/Status-of-Wind-in-Africa-Report-V4.pdf

HABIB, A & OUKI, M. (2021). *Egypt's Low Carbon Hydrogen Development Prospects.* Oxford Institute for Energy Studies. https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2021/11/Egypts-Low-Carbon-Hydrogen-Development-Prospects-ET04.pdf.

HELAL, H. (2023). President Al-Sisi: Power Cuts Save 300 billion Dollars Monthly. *Shorouk News.* https://www.shorouknews.com/news/view.aspx?cdate=30092023&id= 281db9fd-88dd-4bbd-aa23-bd10351d5aea

https://english.ahram.org.eg/NewsContent/3/12/511318/Business/Economy/Egypt-lowers-gas-supply-to-fertilizer-companies-am.aspx

IEA. (2021a). *Algeria.* https://www.iea.org/countries/algeria

IEA. (2021b). *Ammonia Technology Roadmap.* https://iea.blob.core.windows.net/assets/ 6ee41bb9-8e81-4b64-8701-2acc064ff6e4/AmmoniaTechnologyRoadmap.pdf

IEA. (2021c). *Tunisia.* https://www.iea.org/countries/tunisia

IEA. (2022). *Egypt-Saudi Electricity Interconnection Project*. https://www.iea.org/ policies/14291-egypt-saudi-electricity-interconnection-project

INDUSTRY EUROPE. (2019). Italian-Tunisian Elmed Interconnector Given Go-Ahead. https://industryeurope.com/italian-tunisian-elmed-interconnector-given-go-ahead/

IRENA. (2023). *Energy Profile: Algeria.* https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Africa/Algeria_Africa_RE_SP.pdf

IVANOVA, A. (2023). *Germany to back 50 MW green hydrogen project in Algeria. Renewables Now.* https://renewablesnow.com/news/germany-to-back-50-mw-green-hydrogen-project-in-algeria-837675/

JENAYAH, A. (2023). *Unlocking Solar and Wind Potential: Streamlining Authorization for Foreign Investors in Tunisia's Renewable Energy Sector.* Legal Community MENA. https://legalcommunitymena.com/unlocking-solar-and-wind-potential-streamlining-authorization-for-foreign-investors-in-tunisias-renewable-energy-sector/

KAWACH, N. (2023). *Morocco set to award new solar power deal.* Zawya. https://www.zawya.com/en/projects/utilities/morocco-set-to-award-new-solar-power-deal-report-cuf64g7u

KHALID, M. (2023). Egypt lowers gas supply to fertilizer companies amid severe shortage. *Ahram Online.*

KOUAMÉ, M. (2021). Production d'hydrogène vert Saipem et Alboran Hydrogen s'activent. *Les Ecos.* https://leseco.ma/business/production-dhydrogene-vert-saipem-et-alboran-hydrogen-sactivent.html

KUMAR, P. (2023). Morocco Invests $5.6bn in Clean Energy Projects. *Arabian Gulf Business Insight (AGBI).* https://www.agbi.com/energy/2023/07/morocco-invests-6bn-in-clean-energy-projects/

LA TRIBUNE. (2022). Voiture Électrique: Renault Sécurise ses Approvisionnements de Cobalt au Maroc. https://www.latribune.fr/entreprises-finance/industrie/automobile/voiture-electrique-renault-securise-ses-approvisionnements-de-cobalt-au-maroc-920283.html

LEWIS, A. (2022). Egypt signs framework deals in bid to launch hydrogen industry. *Reuters.* https://www.reuters.com/world/middle-east/egypt-signs-framework-deals-bid-launch-hydrogen-industry-2022-11-15/

MAP. (2020). *Morocco, Germany Sign Green Hydrogen Cooperation Agreement.*

Kingdom of Morocco. https://www.maroc.ma/en/news/morocco-germany-sign-green-hydrogen-cooperation-agreement

MARTIN, P. (2020). *Is hydrogen the best option to replace natural gas in the home? Looking at the numbers.* Clean Technica. https://cleantechnica.com/2020/12/14/can-hydrogen-replace-natural-gas-looking-at-the-numbers/

MASDAR. (2022). *Masdar Led Consortium Strengthens Partnership.* https://news.masdar.ae/en/press-Release?News/2022/11/16/08/41/Masdar-led-consortium-strengthens-partnership

MASDAR. (2023). *UAE and Egypt Advance Development of Africa's Wind Farm.* https://news.masdar.ae/en/Press-Release?News/2023/06/06/16/36/UAE-and-Egypt-Advance-Development-of-Africas-Wind-Farm

MASEN. (n.d.-a). *Projects Map.* https://www.masen.ma/en/projects

MASEN. (n.d.-b). *Projects: Noor Midelt I.* https://www.masen.ma/en/projects/noor-midelt-i

MAZZOTTA, M. (2023). E*merging green hydrogen market set to help reshape global energy map by end of decade, creating US$1.4 trillion market by 2050.* Deloitte. https://www.deloitte.com/global/en/about/press-room/new-deloitte-report-emerging-green-hydrogen-market.html

MEDIAS 24. (2022). Voici à Quoi Ressembler la Première Gigafactory de Batteries au Maroc. https://medias24.com/2022/08/10/voici-a-quoi-pourrait-ressembler-la-premiere-gigafactory-de-batteries-au-maroc/

MINISTRY OF ENERGY AND MINES. (n.d.). *New, Renewable Energies and Energy Management.* People's Democratic Republic of Algeria. https://www.energy.gov.dz/?rubrique=energies-nouvelles-renouvelables-et-maitrise-de-lrenergie#:~:text=Le%20programme%20des%20%C3%A9nergies%20renouvelables%20dans%20sa%20version%20actualis%C3%A9e%2C%20consiste,conditions%20du%20march%C3%A9%20le%20permettent

MINISTRY OF ENERGY TRANSITION AND DEVELOPMENT. (2022). *Key indicators.* Kingdom of Morocco. https://www.mem.gov.ma/en/Pages/secteur.aspx?e=2

MINISTRY OF YOUTH, CULTURE AND COMMUICATION. (2019). *Head of Government: 2020-2050 National Water Plan, Roadmap to Face Challenges for Next 30 Years.* Kingdom of Morocco. https://www.maroc.ma/en/news/head-government-2020-2050-national-water-plan-roadmap-face-challenges-next-30-years

MINISTRY OF YOUTH, CULTURE AND COMMUICATION. (2023). *COP28: Morocco, Portugal Sign Joint Declaration on Electricity Interconnection Project.* Kingdom of Morocco. https://www.maroc.ma/en/news/cop28-morocco-portugal-sign-joint-declaration-electricity-interconnection-project

MOKENA, L. (2020). Morocco's King Launches 'Green Generation 2020-2030'. *Asharq al-Awsat.* https://english.aawsat.com/home/article/2132676/moroccos-king-launches-green-generation-2020-2030

MOROCCO NOW. (2024). *The World's Fastest Growing Automotive Hub.* https://www.morocconow.com/automotives/?_gl=1*xd72og*_up*MQ..*_ga*ODA1NDQ5OTU1LjE3MDU3MzIzNDU.*_ga_7X4V48JH6W*MTcwNTczMjM0NC4xLjEuMTcwNTczMjcxNi4wLjAuMA

NACHMANY, M., FANKHAUSER, S., DAVIDOVÁ, J., KINGSMILL, N., LANDESMAN, T., ROPPONGI, H., SCHLEIFER, P., SETZER, J., SHARMAN, A., SINGLETON, C. S., SUNDARESAN, J., & TOWNSHEND, T. (2015). *Climate Change Legislation - Algeria.* Grantham Research Institute. https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/05/ALGERIA.pdf

NEW AND RENEWABLE ENERGY AUTHORITY & ECOCONSERV ENVIRONMENTAL SOLUTUIONS. (2016). *Benban 1.8GW PV Solar Park Final Report.* New and Renewable Energy Authority. https://www.eib.org/attachments/registers/ 65771943.pdf

NHEDE, N. (2019). *Egypt's largest wind energy farm is now operational. Smart Energy International.* https://www.smart-energy.com/renewable-energy/egypts-largest-wind-energy-farm-is-now-operational/

NORTH AFRICA POST. (2023). Morocco's Neo Motors Launches Its Cars in the Market. https://northafricapost.com/73455-moroccos-neo-motors-launches-its-cars-in-the-market.html

NS ENERGY. (2018). *Benban Solar Park.* https://www.nsenergybusiness.com/ projects/benban-solar-park/

OCP. (2021). *Sustainability Report 2020.* https://ocpsiteprodsa.blob.core.windows.net/media/2021-08/OCP-Sustainability _report_2020-GRI_certified.pdf

OCP. (2022). *OCP Group launches a $13 billion Green Investment Strategy.* https://www.ocpgroup.ma/news-article/ocp-group-launches-its-new-green-investment-program-2023-2027

ONEE (NATIONAL OFFICE OF ELECTRICITY AND POTABLE WATER). (n.d.). *Programme Eolien Intégré* - 850 MW. http://www.one.org.ma/

PERKINS, R. (2021). EU Set to Sideline ICE Vehicles by 2035 With Tougher Car Emissions Proposal. *S&P Global.* https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/071421-eu-set-to-sideline-ice-vehicles-by-2035-with-tougher-car-emissions-proposal

QUANTUM SCAPE. (2021). *Lithium Iron Phosphate on the QuantumScape Solid-State Lithium-Metal Platform.* https://www.quantumscape.com/resources/blog/lithium-iron-phosphate-on-the-quantumscape-solid-state-lithium-metal-platform/

RAHHOU, J. (2022). Total Eren to Launch Green Hydrogen Megaproject in Morocco. *Morocco World News.* https://www.moroccoworldnews.com/2022/02/346892/total-eren-to-launch-green-hydrogen-megaproject-in-morocco

RED ELÉCTRICA. (2019). *Spain and Morocco Agree on The Development of a Third Interconnection Between Both Countries.* https://www.ree.es/en/press-office/news/press-releases/2019/02/spain-and-morocco-agree-development-third-interconnection-between-both-countries

REUTERS. (2014). Desertec shareholders jump ship as solar project folds. https://www.reuters.com/article/germany-desertec/desertec-shareholders-jump-ship-as-solar-project-folds-idUSL6N0S535V20141014.

REUTERS. (2023). Morocco tenders for 400 MW solar plant in Atlas Mountains. https://www.reuters.com/business/energy/morocco-tenders-400-mw-solar-plant-atlas-mountains-2023-08-09/

RIANNE. (2022). *UM6P and Proton Ventures sign an agreement for the construction of the Green Ammonia Pilot in Jorf Lasfar.* Proton Ventures. https://protonventures.com/press-release/um6p-and-proton-ventures-sign-an-agreement-for-the-construction-of-the-green-ammonia-pilot-in-jorf-lasfar/

SABRY, A. (2019). Sisi: Egypt is ready to transfer 20% of electricity to Africa at half the price. *Almal News.* https://almalnews.com/%d8%a7%d9%84%d8%b3%d9%8a%d8%b3%d9%8a-%d9%85%d8%b5%d8%b1-%d9%85%d8%b3%d8%aa%d8%b9%d8%af%d8%a9-%d9%84%d9%86%d9%82%d9%84-20-%d9%85%d9%86-%d8%a7%d9%84%d9%83%d9%87%d8%b1%d8%a8%d8%a7%d8%a1-%d9%84%d8%a3/

SAMBIDGE, A. (2023). *Tunisia steps up solar ambitions with launch of new tenders.* https://www.agbi.com/energy/2023/01/tunisia-steps-up-solar-ambitions-with-launch-of-new-tenders/

SCATEC. (2021a). *Scatec's Green Hydrogen Consortium in Egypt selects Plug Power for delivery of 100 MW Electrolyser.* https://scatec.com/2021/11/24/scatecs-green-hydrogen-consortium-in-egypt-selects-plug-power-for-delivery-of-100-mw-electrolyser/.

SCATEC. (2021b). *Scatec partners with Fertiglobe and the Sovereign Fund of Egypt to develop green hydrogen as feedstock for ammonia production in Egypt.* https://scatec.com/2021/10/14/scatec-partners-with-fertiglobe-and-the-sovereign-fund-of-egypt-to-develop-green-hydrogen-as-feedstock-for-ammonia-production-in-egypt/.

SCZONE. (2023). *Sczone converts 7 billion mou with energy china into a framework agreement soon.* https://sczone.eg/sczone-converts-7-billion-mou-with-energy-china-into-a-framework-agreement-soon/

SHARPE, R. (2021). Morocco Outlines Plans for New Green Ammonia Project. *Argus.* https://www.argusmedia.com/en/news/2235820-morocco-outlines-plans-for-new-green-ammonia-project

SMAOUI, A. & RICH, D. (2021). *Green Hydrogen & Ammonia Opportunities in Tunisia* [PowerPoint]. Tunur. https://www.tunur.tn/wp-content/uploads/2021/06/TuNur-PtX-Dialogue-VF2.pdf

SOUTH H2 CORRIDOR. (2024). General description of the SoutH2 Corridor. https://www.south2corridor.net/south2

STATISTA. (2023). *Ammonia production worldwide in 2023, by country.* https://www.statista.com/statistics/1266244/global-ammonia-production-by-country/

SZAKAL, V. (2014). *Under the Tunisian Sun: Expanding Solar Energy Production for Auto Consumption and Export.* Nawaat. https://nawaat.org/2014/08/22/under-the-tunisian-sun-expanding-solar-energy-production-for-autoconsumption-and-export/#:~:text=%C2%ABThe%20DESERTEC%20Foundation%20is%20endorsing,model%2Dfor%2Dthe%2Drest.

TAKOULEU, J.M. (2023). *ALGERIA: Sonelgaz launches a call for tenders for 15 solar power plants of 2 000 MWp.* Afrik21. https://www.afrik21.africa/en/algeria-sonelgaz-launches-a-call-for-tenders-for-15-solar-power-plants-of-2-000-mwp/

TANCHUM, M. (2020). *Egypt's Prospects as an Energy Export Hub Across Three Continents.* Istituto per gli Studi di Politica Internazionale (ISPI). https://www.ispionline.it/ en/pubblicazione/egypts-prospects-energy-export-hub-across-three-continents-27408.

TANCHUM, M. (2021). *Europe–Africa Connectivity Outlook 2021: Post-Covid-19 Challenges and Strategic Opportunities.* Istituto Affari Internazionali. https://www.iai.it/sites/default/files/iaip2120.pdf.

TANCHUM, M. (2022a). *Morocco's New Challenges as a Gatekeeper of the World's Food Supply: The Geopolitics, Economics, and Sustainability of OCP's Global Fertilizer Exports.* Middle East Institute. https://www.mei.edu/publications/moroccos-new-challenges-gatekeeper-worlds-food-supply-geopolitics-economics-and

TANCHUM, M. (2022b). *Morocco's Green Mobility Revolution: the Geo-Economic Factors Driving Its Rise as an Electric Vehicle Manufacturing Hub.* Middle East Institute. https://www.mei.edu/publications/moroccos-green-mobility-revolution-geo-economic-factors-driving-its-rise-electric

TANCHUM, M. (2023a). Africa's maritime hydrogen highways could enrich the continent and save the world. The National News. https://www.thenationalnews.com/opinion/comment/2023/12/13/africas-maritime-hydrogen-highways-could-enrich-the-continent-and-save-the-world/

TANCHUM, M. (2023b). *Can Singapore unlock Africa's green hydrogen potential*? Nanyang Technological University. https://www.ntu.edu.sg/cas/news-events/news/ details/can-singapore-unlock-africa-s-green-hydrogen-potential

TANCHUM, M. (2023c). *Morocco's Nuclear Option: Russian Vs US Technological Cooperation To Power Its Water Scarcity Solutions.* Middle East Institute. https://www.mei.edu/publications/moroccos-nuclear-option-russian-vs-us-technological-cooperation-power-its-water

TANCHUM, M. (2023d). *The Food-Energy Nexus and Italy–Morocco Cooperation.* Istituto Affari Internazionali. https://www.iai.it/sites/default/files/iaip2306.pdf

TANCHUM, M. (2023e). *The Russia-Ukraine war forces Egypt to face the need to feed itself: Infrastructure, international partnerships, and agritech can provide the solutions.* Middle East Institute. https://www.mei.edu/publications/russia-ukraine-war-forces-egypt-face-need-feed-itself-infrastructure-international

TANCHUM, M. (2023f). Why North Africa Is a Natural Choice for BRICS Expansion. *The National News.* https://www.thenationalnews.com/weekend/2023/08/25/brics-north-africa/

TANCHUM, M. (2024). Green hydrogen production in North Africa: Challenges and opportunities. In K. Young & K. Wolff (Eds.), *Energy transitions in the Middle East – Opportunities and challenges.* Bloomsbury Publishing. https://www.bloomsbury.com/us/energy-transitions-in-the-middle-east-9780755650378/

TERRAPON-PFAFF, J., PRANTNER, M., ZELT, O., MISSAOUI, R., GHEZAL, A., & TOUMI, M. (2021). *Study on the Opportunities of "Power-to-X" in Tunisia.* Deutsche Gesellschaft Fur Internationale Zusammenarbeit. https://energypedia.info/images/0/0c/Potential_Study_PtX_in_Tunisia_2021.pdf

TESLA. (2021). *For standard range vehicles, we are shifting to Lithium Iron Phosphate (LFP) battery chemistry globally.* https://tesla-cdn.thron.com/static/TWPKBV_TSLA_ Q3_2021_Quarterly_Update_SI1AKE.pdf?xseo=&response-content-disposition=inline %3Bfilename%3D%22TSLA-Q3-2021-Quarterly-Update.pdf%22

TODOROVIĆ, I. (2023). EU adds Greece-Egypt power interconnection project to PCI/PMI list proposal. *Balkan Green Energy News*. https://balkangreenenergynews.com/eu-adds-greece-egypt-power-interconnection-project-to-pci-pmi-list-proposal/

TUNUR. (2023). *Tunisia's National Green Hydrogen Strategy.* https://www.tunur.tn/tunisias-national-green-hydrogen-strategy/

WARRICK, J. (2024). *Best-Selling Cars in Europe.* Autocar. https://www.autocar.co.uk/ car-news/new-cars/best-selling-cars-europe-2023

WARWICK, N., GRIFFITHS, P., KEEBLE, J., ARCHIBALD, A., PYLE, J., & SHINE, K. (2022). *Atmospheric implications of increased hydrogen use. Government of the*

United Kingdom. https://assets.publishing.service.gov.uk/government/uploads/system/ uploads/attachment_data/file/1067144/atmospheric-implications-of-increased-hydrogen-use.pdf

WORLD BANK. (2019a). *Middle East and North Africa. Global Solar Atlas.* https://globalsolaratlas.info/download/middle-east-and-north-africa

WORLD BANK. (2019b). *Germany. Global Solar Atlas.* https://globalsolaratlas.info/download/germany

WORLD BANK. (2022). *Algeria MPO.* https://thedocs.worldbank.org/en/doc/65cf93926fdb3ea23b72f277fc249a72-0500042021/related/mpo-dza.pdf.

WORLD BANK. (2023). *World Bank Approves $268 Million Project Linking Tunisia's Energy Grids with Europe.* https://www.worldbank.org/en/news/press-release/2023/ 06/22/world-bank-approves-268-million-project-linking-tunisia-s-energy-grids-with-europe

XLINKS. (2024). *The Morocco - UK Power Project.* Retrieved for https://xlinks.co/morocco-uk-power-project/

ZAWYA. (2022). Tunisia launches H2Vert project to develop green hydrogen industry. https://www.zawya.com/en/business/energy/tunisia-launches-h2vert-project-to-develop-green-hydrogen-industry-mk5bnmid

Energy Megaprojects in Egypt: Navigating Economic Gains and Risks

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Introduction

During the past decade, the Egyptian government has invested billions of dollars in the energy sector, mostly in a small number of megaprojects, and celebrated achieving a significant surplus in electricity generation capacity as a result. Surprisingly, Egypt has been hit with persistent rolling power cuts since mid-2023, undermining the recent progress and harkening back to the period of chronic power outages a decade before.

These contradictory developments, further compounded by announced plans to export surplus electricity via electricity interconnections with neighbouring countries, are less confusing when the nature of energy investments in Egypt is examined, side by side with their economic spillovers, in the context of the country's larger economic constraints.

By examining energy megaprojects in Egypt during the last decade, along with projects planned for the near future, this chapter assesses the compatibility of megaprojects and their intended outcomes. After mapping the projects, highlighting their cost, generation capacity, and financing schemes, the chapter evaluates the risks associated with these mega investments, and whether their cost is justified by their actual contribution to alleviating Egypt's energy deficit in energy production. Finally, the chapter also sheds light on potential geopolitical gains from energy investments. It assesses whether Egypt's megaprojects enhance the prospects of regional energy cooperation with Egypt serving as the hub, particularly in the present period, when both Egypt and its neighbours are facing a pressing need for such mutual energy cooperation.

Mapping energy megaprojects in Egypt

Since 2014, as President Abdel Fattah Al-Sisi consolidated power, the Egyptian state has increasingly relied on megaprojects as a developmental model to boost economic growth and employment (SIS, 2022b). During the previous decade, several infrastructure megaprojects have been completed or launched, including a bypass to the Suez Canal, a monorail, a high-speed electric rail, and a new administrative capital, costing over $80 billion (Suleiman, 2022). Concurrently, the state has also invested in several megaprojects in the energy sector, motivated to ameliorate an electricity deficit that persisted from the late 2000s, and peaked in 2014. Egypt suffered a daily deficit in electricity production of 2,000-3,000 megawatts (MW) during seasonal peaks between 2008 and 2011, approximately 10% of annual maximum load (peak demand) in this period. The deficit increased to 4,310 MW in 2012, and peaked at 6,050 MW daily in the summer of 2014 (23% of maximum load) (MERE, 2024), leading to frequent rolling power cuts during these peak periods (MERE, 2018).

At that time, at least 90% of electricity generation in Egypt relied upon natural gas and fuel oil to supply thermal power plants, with natural gas accounting for the vast majority of Egypt's fuel supply mix (MERE, 2018). The deficit in electricity generation between 2012 and 2014 took place in a time of shortage of fuel supplies to the power plants, as a result of a sharp decline in fuel imports in 2013 and 2014 (OPEC, 2024), and a concurrent fall in Egypt's gas production between 2012 and 2016, which led in 2015 to Egypt becoming a net importer of natural gas, ending a decade of net exports (BP, 2020).

Fuel shortage during these years persisted despite assistance provided by Arab Gulf countries after Egypt's military ousted President Mohamed Morsi in July 2013. In the financial year (FY) 2013-2014, Gulf countries provided the Egyptian state with grants worth 95.8 billion Egyptian pounds, equivalent to $13.7 billion, and an additional 25.4 billion pounds ($3.4 billion) in 2014-2015 (MoF, 2018), the majority of which was to finance fuel imports for electricity generation (Butter, 2020). Fuel shortage, and subsequently electricity deficit and blackouts, which were partly eased by the Gulf countries' assistance, were largely ended in 2015 as fuel imports recovered, surging to record levels (OPEC, 2024).

In addition to efforts to secure fuel supplies, the Egyptian state also took emergency measures and undertook projects to boost electricity production capacities in 2014 and 2015. Eight power plants were established in 8.5 months with a total cost of $2.7 billion, adding 3,636 MW of installed capacity. In addition, six more plants that were launched before 2014 were completed, at a total cost of $4 billion, adding an additional 4,250 MW by the end of 2015. Furthermore, maintenance, which had lagged during the peak deficit years, was accelerated. In FY 2014-2015, around 27,303 MW of electricity generation capacity were subject to maintenance work (MERE, 2018). These urgent measures significantly boosted generation capacities in Egypt, even before the megaprojects started to materialise.

The first of the spate of energy megaprojects after 2014 started early in 2015 when Egypt signed a contract with the German company Siemens and local contractors to construct three 4,800 MW each "combined cycle" power plants, which were then the world's largest. This type of power plant relies on hydrocarbon fuel, mainly natural gas, in addition to steam turbines, to generate electricity more efficiently and cleanly compared to "simple cycle" gas-fired plants. In combined cycle plants, waste heat from the gas turbines is used to generate additional electricity via the steam turbines, producing significantly more electricity using the same fuel as a simple cycle plant. Construction of the three plants started in December 2015, and they were completed and became operational in a record 2.5 years in mid-2018, a similar period to what it takes to construct a single combined cycle power plant block with a 1,200 MW capacity (SIEMENS, 2018). Each of the three 4,800 MW plants – in Beni Suef, Burullus, and the New Capital, respectively – contributed to a combined total of 14,400 MW. The total cost of the project was €6 billion (about $6.6 billion in 2015 dollars), and was agreed upon as an EPC+Finance contract (Engineering, Procurement, Construction, and Financing) (MERE, 2018), meaning that Siemens secured funding for the project, mainly from German banks, as a loan to the Egyptian government that owns and operates the plants, and not as foreign direct investments (FDI).

Urgent measures significantly boosted generation capacities in Egypt, even before the megaprojects started to materialise

Completion of the three new plants came very shortly after the production of the first gas from the giant offshore Zohr natural gas field in December 2017. The Zohr field, which was discovered in August 2015, is the largest gas discovery in the Mediterranean Sea to date, with estimated reserves of around 850 billion cubic metres. The development of the field, in which Italian energy major Eni is the lead operator, has so far required investments of around $12 billion (SIS, 2022d), which are expected to rise to $15 billion in the next few years for further development (Kandil, 2023). Such a huge gas discovery contributed significantly to overturning Egypt's power deficit, since the majority of the country's electricity generation capacity, including the three new plants, relies on

natural gas. The discovery of the Zohr field in 2015, the same year Egypt became a net importer of natural gas, led to self-sufficiency of gas in a few years, and to a return to net exports by 2019 (BP, 2020).

Another megaproject that is still underway in its early stages is the Attaqa pumped storage hydroelectric power plant. The $2.7 billion project was initially agreed upon in 2018 with the Chinese company Sinohydro and was planned to be financed through an EPC+Finance contract, and would be owned and operated by the state. However, there have been issues with the contractual details, and both Sinohydro and the financing mechanism are reportedly being reconsidered for alternatives by the Egyptian government (Al-Arabiya, 2024). The Attaqa plant, which is projected to be completed seven years from kick-off, will use treated sewage water for operation, and is planned to have an installed capacity of 2,400 MW when completed, through eight units of 300 MW of capacity each. Two additional 2,000 MW each pumped storage hydro power plants were also planned, and are subject to studies according to the Ministry of Electricity, in Luxor and Qena provinces, southern Egypt, with an estimated cost of around $2.5 billion each, according to the initial estimates (MERE, 2018).

Egypt's costliest energy megaproject is the nuclear power plant in the El-Dabaa region of northwest Egypt. Contracted with Russia's ROSATOM in 2017, the El-Dabaa facility will be the first major nuclear power plant in Africa. The state-owned and operated plant will have a total installed capacity of 4,800 MW from four 1,200 MW reactor units. Construction began on the facility in 2022 and it is expected to be fully operational by 2029-2030 with an operational lifetime of 60 years. Most of the nuclear plant's $29.4 billion cost is being financed by a $25 billion loan provided by Russia (SIS, 2023b).

Another megaproject that was planned, but then deferred indefinitely, was a coal-fired power plant. The project, which was planned to be constructed in Al-Hamrawein, east Egypt, was agreed upon in 2018 with a Chinese consortium to be completed in six years; it was supposed to generate 6,000 MW of electricity when completed, making it one of the largest coal-fired plants worldwide. The project was estimated to cost $4.4 billion to be financed by an EPC+Finance contract and owned by the state (MERE, 2018), and was part of an initial energy strategy that was launched in 2015, aiming to expand the use of coal in the energy mix for its cost effectiveness, and to rely on it for generating 29% of electricity in Egypt by 2030. The project was soon shelved in 2020 by the government, citing the surplus in energy generation achieved due to the projects completed between 2015 and 2020, and the Zohr gas discovery, in addition to environmental concerns that prioritise renewable energy projects moving forward (Salem, 2020). Furthermore, the energy strategy was later updated to rely more on renewable energy, with an objective of generating 42% of electricity from renewable sources by 2035 (NREA, 2022), and in 2021 the Ministry of Electricity announced that the use of coal would be completely terminated going forward, as part of the new strategy (Saleh, 2021).

Benban Solar Park, one of the largest solar energy projects worldwide, is financed, developed and operated by dozens of private companies through BOO

Deferring this large coal-fired project aligned with launching a mega renewable energy project: Benban Solar Park, one of the largest solar energy projects worldwide. The solar farm that extends over 37 square kilometres became operational in 2019 and has an installed capacity of 1,465 MW, which can be expanded to 2,000 MW. The farm, unlike the other energy megaprojects listed above, which are state-owned and operated, is financed, developed and operated by dozens of private com-

panies through BOO (Build, Own, Operate) contracts, each managing its own solar plant(s), with total investments in the park amounting to around $2 billion (MERE, 2018).

More recently, the Egyptian authorities have also been actively planning to encourage the development of a green hydrogen industry in the country. In 2022, Egypt hosted the COP27 summit, at which Egyptian officials signed 20 memorandums of understanding (MoUs) with companies for green hydrogen and green ammonia plants worth $83 billion to produce 15 million tons of green ammonia and other green hydrogen derivatives (SIS, 2023a). Nevertheless, such MoUs should not all be taken for granted. Prior experience with similar summits suggests caution about such official optimism – notably most of the MoUs representing over $30 billion of FDI that were signed at the much-celebrated 2015 economic conference in Egypt, which resulted in signed MoUs that never materialised (Atlantic Council, 2015). While the specific details of why each MoU failed to progress further might vary from one to another, it seems that the Egyptian government has a general tendency to sign as many MoUs as possible in these summits, with very few details included, and once actual negotiations take place concerning financing schemes, timeframes, regulations and other details, most of these MoUs fall through.

It is worth highlighting that a handful of the COP27 MoUs have later been subject to some official follow-ups, and might thus be more likely than the rest to witness some actual progress. For example, there has been some official follow-up on an MoU with the Chinese company Energy China about a potential green hydrogen/green ammonia megaproject in the Suez Canal economic zone, involving investments estimated at $7 billion for a production complex with annual capacity of 1.2 million tons of green ammonia and 210,000 tons of green hydrogen (SCZ, 2023b). Another potential project, based on an MoU with the Indian company ReNew Power, aims to establish a green hydrogen plant in the Suez Canal economic zone as well, with an $8 billion in a facility to produce one million tons of green ammonia and 220,000 tons of green hydrogen annually (SCZ, 2023a).

Potential private investments in green hydrogen are a promising step towards encouraging this industry in Egypt. However, it will also be necessary to factor-in the need for complementary investments in supporting infrastructure. Production of green hydrogen for example relies on large supplies of fresh water, which is a scarce resource in Egypt, and hence will require additional investments in desalination facilities (Tanchum, 2022). In fact, water desalination itself, whether for green hydrogen facilities or for meeting growing demand for fresh water in Egypt, is an energy-intensive process in turn, which also needs to be factored in for future domestic energy demand in Egypt, and consequently for planned investments. Developing a green hydrogen industry will face additional challenges as well. Ensuring efficient production will be necessary for cost-effectiveness and competitiveness; it will also be crucial to develop efficient infrastructure for storage, transport and distribution of hydrogen; an export-oriented green hydrogen industry will additionally require certification and standardisation processes for trade, export infrastructure such as terminals and shipping facilities, and relevant regulations and trade agreements; the industry will also need extensive research and development investments and capability-building to address anticipated technical and operational challenges (Dargin, 2023).

The Egyptian government has a general tendency to sign as many MoUs as possible in these summits, with very few details included, and once actual negotiations take place concerning financing schemes, timeframes, regulations and other details, most of these MoUs fall through

Energy Megaprojects in Egypt since 2014

Project	Type	Status	Cost (USD)	Production	Funding	Ownership
Beni Suef, Burullus, and New Capital plants	3 combined cycle power plants	Completed	6.6 billion	14,400 MW	EPC+Finance	State
Benban park	Solar power park	Completed	2 billion	1,465 MW	BOO	Private
El Dabaa plant	Nuclear power plant	Under construction	29.4 billion	4,800 MW	Loan	State
Attaqa plant	Pumped storage hydroelectric power plant	Planned	2.7 billion	2,400 MW	-	State
North Luxor and Armant Qena plants	Pumped storage hydroelectric power plants	Planned	4.9 billion	4,000 MW	-	State
Al-Hamrawein	Coal-fired power plant	Deferred	4.4 billion	6000 MW	EPC+Finance	State

Elaborated by author, sourced from Arab Fund for Economic and Social Development (2024); IEA (2023); Ministry Of Electricity And Renewable Energy (2018, 2023).
Total capacity of completed megaprojects: 15,865 MW. Total capacity of megaprojects under construction: 4800 MW.

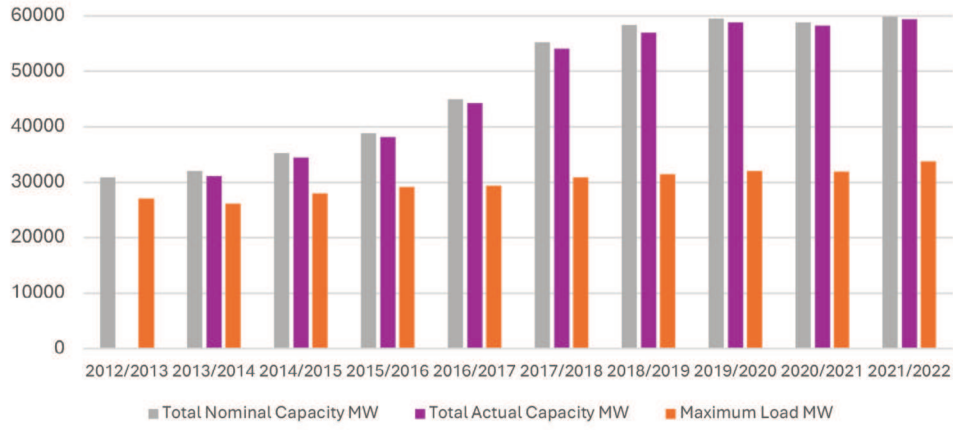
Shortcomings and Risks

Since 2014, there have been three power generation megaprojects that were either completed or are under construction, in addition to the planned ones and the MOUs. The three megaprojects are the combined cycle power plants, the Benban solar park, and the Dabaa plant. These projects' combined cost is around $38 billion, $2 billion of which are private investments for the Benban park, while $31.6-$36 billion (depending on the financing scheme for the rest of El Dabaa plant investment cost) are financed through foreign loans to the state. Given their significant costs and the resulting debt burden, which contributed to a looming sovereign debt crisis in Egypt, these mega energy projects were not justified, based on Egypt's power generation capacity and needs.

Egypt already had surplus generation capacities in the early 2010s, based on the data concerning total capacity for electricity generation, both nominal and actual, in addition to the maximum electricity load during the last decade, shown hereafter in Figure 1. Furthermore, prior to launching the megaprojects, the urgent smaller plants that were completed, and were mostly also financed through EPC+Finance contracts, added around 6,886 MW in 2015. These smaller plants, in combination with maintenance investments (MERE, 2018), were already more than enough to create a sustainable surplus in generation capacity for years to come. The two completed megaprojects have added 15,865 MW to Egypt's total installed capacity,

and the one under construction will add additional 4,800 MW once completed. It is argued, mainly by the state, that these energy megaprojects, particularly the combined cycle plants, were justified since they have overturned the electricity deficit that peaked in summer 2014 into a surplus. Prime Minister Mostafa Madbouly has even gone as far as claiming in 2023 that, without such projects, power cuts would be lasting for more than 20 hours daily (Mohammed, 2023). Nevertheless, given the surplus capacities already in place, the deficit did not stem from a shortage in generation capacity, but mainly from the shortage of fuel supplies to power plants.

Figure 1. Electricity Generation Capacity and Maximum Load in Egypt 2012-2013 to 2021-2022



Elaborated by author, sourced from Electricity Holding Company (2013-2022).

As the figure shows, total electricity generation capacity, whether nominal or actual, with the difference being a slight drop due to older facilities having less operational capacity than supposed, already surpassed the maximum load in 2013-2014, with an actual surplus capacity of 5,009 MW. From 2013-2014 to the latest data in 2021-2022, maximum load has grown by 29.3%, while actual capacity has grown by 90.6%. Hence, by 2021-2022 the surplus generation capacities reached 25,560 MW, with an average efficiency rate of power plants at 48.6% (EHC, 2013:2022).

These surplus idle generation capacities have cost billions of dollars in foreign loans, and have contributed to the surge of Egypt's external debt along the last decade, which was largely caused by other low-return non-urgent infrastructure megaprojects, including a new administrative capital with an estimated cost of $58 billion, a monorail for the new capital, with a cost of $4.5 billion, an $8.5 billion high-speed electric rail (SIEMENS, 2022b), and an $8 billion USD to Suez Canal, among others (Suleiman, 2022).

The large appetite for such megaprojects, in infrastructure and energy, financed largely by foreign sovereign borrowing, has led to a surge of Egypt's external debt from $45.8 billion by the end of 2013 (15% of GDP) to $164.5 billion by September 2023 (42.4% of GDP). Furthermore, the composition of external debt has also shifted to a far less-sustainable mix, relying more on short-term debt, which reflects tighter financing options and rising debt stress,

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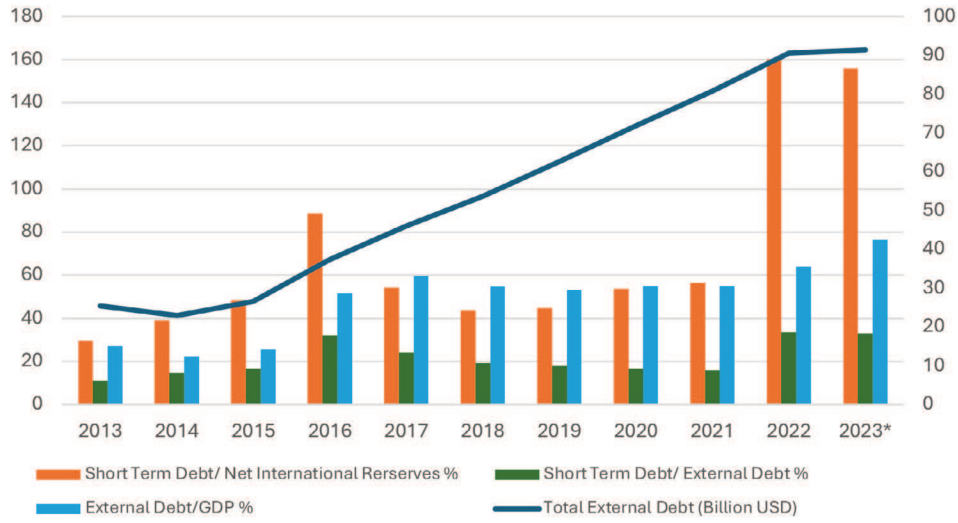
particularly since 2022 as the Ukraine War triggered capital outflows from Egypt of more than $20 billion in a few months, leading to large foreign reserves loss (IMF, 2023). Short-term debt to total external debt rose during the decade from 6.2% to 18.4%, and short-term debt to net international reserves, which is probably one of the most important indicators of vulnerability to default risks, rose from 16.5% in 2013 to 86.6% in September 2023 (CBE, 2013:2023), as shown in Figure 2. Consequently, various rating agencies have been devaluing Egypt's sovereign credit rating, including several times in 2023 (MOODY's, 2023), which exacerbates the crisis by raising the cost of financing Egypt's sovereign debt.

Figure 2. Total External Debt and Vulnerability Indicators in Egypt 2013 to September 2023



Elaborated by author, sourced from Central Bank of Egypt (2013-2023).

According to latest figures of September 2023, Egypt is supposed to pay $54.3 billion in external debt service in 2024 and 2025, more than its total debt stock in 2013, and to pay an additional $37.9 billion in 2026 and 2027 (CBE, 2013:2023). In an attempt to raise funds for these large due payments, the government has embarked on a programme to privatise several public assets. Among the targeted assets is one of the three combined cycle plants completed in 2018, the Beni Suef plant; negotiations are underway with the German banks that have financed construction of the plants to approve the sale, since the construction loans have not even been fully repaid yet (Salah, 2023).

In 2022, prior to the government's asset sell-off, Cairo sought to maximise natural gas export volumes and generate more revenue in foreign currencies, exploiting record global gas prices to ease the debt stress. Between FY 2013-2014 and FY 2020-2021, revenues from Egypt's exports of petroleum products, which include natural gas exports, ranged from a low of $2.1 billion USD to a high of $6.7 billion. In 2022, these exports jumped to $15.5 billion, $10 billion of which were natural gas exports, but declined again to $2.3 billion in the first half of 2023, as global prices declined (CAPMAS, 2013:2023). To boost exports of natural gas in 2022, which was relied upon for generating 83%

of electricity in Egypt in 2021, the government took measures to reduce natural gas consumption in power generation, including relying more on oil-fired generation, with fuel oil burn averaging above 100 kb/d in the first nine months of 2022, its highest level in four years. Furthermore, in August 2022 the government adopted electricity rationing measures to reduce lighting and air conditioning in administrative buildings, commercial and leisure facilities, as well as for street lighting (IEA, 2023).

Then, starting from summer 2023, and as summer constitutes the peak electricity consumption period in Egypt, rolling power cuts hit all over the country again, for several hours per day, to the point that the government published a schedule for blackouts for provinces and neighbourhoods. At the time of writing, the power cuts are ongoing. Government officials initially justified the return of rolling power cuts — after a decade of multibillion-dollar investments in the energy sector — blaming it on a surge in electricity consumption due to heat waves, which caused stress on the grid and required decreasing the load (SIS, 2023c). However, President Al-Sisi in a September 2023 live speech admitted that the rolling power cuts are to save natural gas for export in order to bring in a purported additional $300 million per month (Helal, 2023). This was made even more evident by the government cut-back on natural gas supplies to fertiliser companies that rely heavily on it for production, with some companies later being instructed to shut down production temporarily (Khalid, 2023).

This decade-long cycle, wherein fuel-shortage-induced rolling power cuts motivated mega public investments in surplus capacities that contributed to a mounting external debt, which led to over-exporting natural gas for debt-servicing and consequently bringing Egypt back full circle to fuel-shortage-induced power cuts, is a model of policy mismanagement. It is a snapshot of an economy-wide problem of the megaproject-led developmental strategy of the Al-Sisi era.

Unsustainable megaprojects strategy

Public energy megaprojects in Egypt cannot be understood separately from the larger strategy of reliance on megaprojects in the country for the last decade to generate employment and economic growth. Such an unsustainable strategy was pushed as an alternative to encouraging large private sector investments, which necessarily required deep institutional reforms that were deemed politically undesirable. These reforms include curbing the economic role of the military and state-enterprises, controlling corruption, protecting property rights, ensuring regulatory stability and impartial legal process, removing barriers to trade, and the like of politically-sensitive issues.

As summer constitutes the peak electricity consumption period in Egypt, rolling power cuts hit all over the country again

The socioeconomic consequences of this developmental strategy went far beyond the return of rolling blackouts and have been recorded since the strategy's early years. In 2016, Egypt was hit with foreign exchange shortage – a problem that turned out to be recurring in the following years – shortly after completing the first of many megaprojects, the Suez Canal bypass. This pushed the Egyptian government to seek a bailout from the International Monetary Fund (IMF), and a provisional loan was secured in 2016 worth $12 billion. Egypt had to devalue its currency as one of the conditions in the IMF package; the Egyptian pound was devalued in November of the same year to around 18 pounds per U.S. dollar, from 8.9 pounds a couple of weeks earlier; consequently, inflation soared in Egypt and exceeded 20% on an annual basis for the following two years.

With each further hit to the valuation of the Egyptian currency and hence to living standards, and with no end in sight to this policy-induced crisis, political instability risks are expected to grow further

This cycle has persisted for the following years, and deteriorated since 2022. Mounting external debt, with large annual debt service payments, has continued to put immense pressure on foreign exchange reserves, and led to steep devaluation of the Egyptian pound from 15.8 pounds to U.S. dollar by the end of 2021 to almost 50 pounds to the dollar in 2024. This has led to record high inflation rates for the past years, reaching 36% by February 2024 in official data (CAPMAS, 2023), and 100% earlier in 2023, according to independent estimates (France24, 2023), with expected consequences of soaring poverty rates, of which official data has not been released since FY 2019-2020, when it stood at 29.7%, rising from 26.3% in FY 2012-2013. Nevertheless, independent estimates put poverty rates in mid-2023 at 35.7%, which is record poverty to date (Al-Laithy, 2023).

Such an economic crisis, manifested in a looming sovereign debt crisis, currency devaluation, soaring inflation, and rising poverty, is posing serious political instability risks. Presidential elections that were scheduled to be held by the end of 2024's first quarter were hastily brought forward to December 2023. The early elections were reportedly because the Egyptian administration was avoiding another round of currency devaluation before the elections (El-Tablawy, 2023), fearing public uproar, while it was also under pressure, mainly from the IMF, to devalue as soon as possible (Sguazzin, 2023). In fact, Egypt was supposed to devalue its currency further in the first quarter of 2023, before an IMF review, as a part of a 46-month $3 billion loan agreement in December 2022 (IMF, 2022), but it has been delaying this step fearing public reaction in the months leading to the elections, and managed to agree with the IMF to merge the review with the next one (Reuters, 2023), which is now due after the elections.

With each further hit to the valuation of the Egyptian currency and hence to living standards, and with no end in sight to this policy-induced crisis, political instability risks are expected to grow further, regardless of whether the expected measures are taken before or after elections.

Potential Gains: regional integration prospects

Egypt's large surplus in electricity generation capacity prompted the Egyptian government to attempt exporting electricity to neighbouring countries to bring in additional revenue to ease the severe foreign currency shortage. Nevertheless, since such expansion of generation capacities was not well-planned, grid interconnections were not established or ready for electricity exports. Until 2020, Egypt's grid was only interconnected to Jordan's and Libya's grids through low-capacity links established in the late 1990s. Then, in 2020, Egypt interconnected its grid to Sudan as well, to open an additional market for its electricity (EHC, 2021).

Between 2014 and 2019, Egypt's exports of electricity were stable, at $58 million in 2014, and $53 million in 2019. As exports to Sudan started in 2020, total electricity exports increased to $64 million in 2020. Electricity export revenues continued to rise reaching $71 million in 2021, $109 million in 2022, and $109.3 million in the first 10 months of 2023 (CAPMAS, 2013:2023).

To boost electricity export revenues, the Egyptian government is seeking to export electricity to more neighbouring countries in Africa, Asia and Europe, and hence has embarked on projects to extend electricity interconnections with more countries, and expanding ones that already exist.

One major project in this context is an electricity interconnection between Egypt and Saudi Arabia that has been approved, and a consortium has already been awarded a contract to construct the project. The interconnection will connect the power grids of the two countries along 1,350 km, using overhead power lines and subsea cable across the Red Sea. The project will allow Egypt and Saudi Arabia to exchange up to 3,000 MW of power, and will be a connection with the rest of Gulf countries as well through their already established interconnection with the Saudi grid. The project is expected to start operations partially in late 2024 (IEA, 2022), and is estimated to cost $1.6 billion (MERE, 2018).

A similar project is also being developed with Jordan. Egypt and Jordan already have their grids linked with a 300 MW interconnection (AFESD, 2023). Cairo and Amman are seeking to establish a 2,000 MW interconnection, which will allow Egypt to export electricity to Syria, Lebanon and Iraq as well (MERE. 2018). Syrian and Jordanian grids are already linked, as are the Syrian and Lebanese grids l, in addition to an established link between Iraq and Syria (AFESD, 2023), and a recent interconnection between Iraq and Jordan directly.

Egypt is also planning to extend its interconnection West. Egypt has an established electric interconnection with Libya with a capacity of 170 MW (AFESD, 2023), which is also planned to be expanded to up to 2,000 MW (SIS, 2022c). The Libyan grid in turn is linked to the Tunisian grid, which is linked to the Algerian, which is in turn linked to the Moroccan grid (AFESD, 2023).

Egypt has also completed an interconnection with Sudan, which became operational in 2020, with a capacity of 80 MW, and is planned to be expanded to 300 MW (SIS, 2022c).

Furthermore, in 2019, Egypt, Cyprus and Greece agreed to connect their electric grids. The planned interconnection, the Euro-Africa Interconnector, will extend from Egypt to Cyprus, then to Greece through Crete, with a total length of 1,396 kilometres – 498 km from Egypt to Cyprus, and 898 km from Cyprus to Crete, with the lowest sub-sea point at 3,000 metres below sea level. The planned interconnection will have an initial transmission capacity of 1,000 MW, with an estimated cost of €2.5 billion euros for the first stage (EuroAfrica Interconnector, 2023); a perceived second and third stages of the interconnection would increase transmission capacity to up to 3,000 MW (SIS, 2022a). The first stage of the electricity interconnection is planned to commence in 2028-2029, for both connections between Egypt-Cyprus, and Cyprus-Crete (EuroAfrica Interconnector, 2023). These ambitious electricity exporting plans have an obvious problem nevertheless. It is easy to notice now that surplus generation capacities alone cannot enable electricity exports, if actual generation is not even enough to sustain domestic demand due to fuel shortage. In other words, as electricity generation in Egypt is still largely reliant on natural gas, then Egypt cannot generate surplus electricity for exports if it is already exporting natural gas to the point that domestic rolling power cuts are normalised again. Hence, only renewable-energy generating capacities could provide enough surplus electricity for exports, which means that further large investments in renewable generation capacities are necessary, making the extant costly surplus thermal capacities not very useful.

Mega renewable energy projects for exporting electricity are already taking prom-

ising steps in Egypt and neighbouring countries in North Africa. A planned project by the Greek Copelouzos Group, the "GREGY Interconnector", seeks to invest in constructing and operating 9,500 MW of renewable energy generation capacities in Egypt. Generated electricity will be transmitted to Greece through a perceived 950 km electricity interconnection between Egypt and Greece, which will have a transmission capacity of 3,000 MW, and an estimated cost of €4.2 billion (Copelouzos Group, 2023b). Two thirds of the transmitted electricity will be consumed in Greece, while a third will be exported to neighbouring European Union (EU) countries, making the project an access point to exporting electricity from Egypt to the large EU energy market, that has been suffering since the Ukraine War its lowest energy supplies and highest electricity prices for over a decade (Eurostat, 2024a, 2024b). The project has already grabbed the attention of the European Commission, and is reportedly a candidate for inclusion in its list of Projects of Common Interest (PCI) and Projects of Mutual Interest (PMI) (Copelouzos Group, 2023a), which are key energy infrastructure projects that contribute to the EU's energy and climate objectives, and thus benefit from streamlining of procedures and potential grants (European Commission, 2023).

The potential GREGY megaproject to generate and transmit green electricity from Egypt to the EU offers a different promising model for energy megaprojects and integration in Egypt

The potential GREGY megaproject to generate and transmit green electricity from Egypt to the EU offers a different promising model for energy megaprojects and integration in Egypt. Instead of relying on scarce public resources to fund mega renewable energy projects and cross-border interconnections, whether directly or through borrowing, hence contributing to a mounting external debt, private investments should be encouraged to generate and transmit clean energy to neighbouring countries. Projects like the Benban solar park, or the private wind farms by Egypt's eastern coast, similarly offer a model for private investments in renewable energy to meet domestic demand of electricity by funding, constructing, owning, and operating the facilities, and selling green electricity to the national grid. Potential green hydrogen private investments could also serve both purposes, where private companies would invest in producing green hydrogen and its derivatives for domestic consumption and exporting. Green hydrogen could serve as a storage medium for other renewable sources, and could be exported via pipelines and shipping. In addition, it is becoming increasingly possible to replace natural gas with green hydrogen, in fuelling gas-fired powered plants, following investments in technical modifications (SIEMENS, 2022a); this could enable relying on it domestically to fuel the gas-fired power plants that cost billions of dollars and have been underutilised due to shortage of natural gas supplies.

It is understood that large infrastructure investments by the private sector would require incentives and guarantees domestically, and at both ends of the energy transmission for exporting, including for example long-term fixed-price contracts for energy supplies, stable regulations and tax breaks, in order to decrease the risks. However, such incentives, or even some state contribution to infrastructure cost, will be less costly than entire public financing of such large investments, particularly amid current economic crises such as the one in Egypt. Furthermore, foreign investments in green energy generation and transmission would most likely require less financial support from the Egyptian side, and might turn for that — if needed — to the importing countries, or the EU in the case of the GREGY project, with the potential inclusion in the PCI/PMI list, if eligibility conditions are met. Regu-

latory and institutional incentives are probably what the Egyptian authorities would need to provide. Deep and comprehensive policy and institutional reforms would be necessary to streamline the various stages of such megaprojects, and to attract more investments for this type of energy integration private projects.

Egypt could draw inspiration from the reforms in Morocco during the last decade, which have been credited for the surge in renewable energy investments in this country during the last decade since adopting the National Energy Strategy in 2009. Laws were promogulated to liberalise the energy market and move away from the state's monopoly in generation, transport and distribution of electricity in order to encourage private producers to enter the market. Exporting electricity was also facilitated and encouraged by passing laws allowing any private producer to export as long as renewable sources were utilised. Furthermore, public agencies and institutions were set up to improve the renewable energy market framework, support renewable energy research, and provide funding. For domestic market large-scale projects, public-private partnerships (PPPs) were the financing mechanism of choice to derisk such projects given the limited public financing capabilities, and low-cost green loans from international organisations were relied upon if needed to finance the public contribution to the investments (United Nations, 2018).

Egypt could also find inspiration in the non-financial benefits granted by the EU to the PCI/PMI. Megaprojects for generating and exporting energy could be granted priority status and streamlined procedures with a binding time limit to granting the permits. Furthermore, environmental assessments that could require years should be improved and streamlined, and a one-stop-shop could also be adopted to coordinate all necessary procedures for these projects in order to bypass the discouraging maze of the bureaucracy (European Commission, 2023).

Nonetheless, these sector-specific, or even project-specific, reforms cannot replace the need for deeper reforms to the institutions and business environment in Egypt to encourage private investments in the renewable energy industry and the various sectors. Such reforms should include limiting the distorting economic role of the military and state-enterprises, including in the energy market, controlling corruption, ensuring regulatory stability, and removing barriers to trade. Avoiding these reforms was the driving force behind relying on public megaprojects as an alternative developmental model to create growth and employment during the last decade. Consequences of this model are now evident in the current economic crisis and its social and political spillovers in Egypt, and only by adopting such necessary reforms would the state be able to encourage private investments, including in the energy sector to produce, supply and export green energy for the benefit of the Egyptian economy, and neighbouring countries as well.

Egypt could draw inspiration from the reforms in Morocco during the last decade, which have been credited for the surge in renewable energy investments

Conclusion

During the last decade, mega energy projects in Egypt have led to costly misallocation of resources, resulting in large surplus electricity generation capacities, with weak exporting infrastructure, which proved to be unfit for meeting domestic demand or earning foreign export revenues, once fuel supplies declined due to over-exporting of natural gas.

Two key lessons could be drawn going forward from the Egyptian experience with energy megaprojects in the last decade. The first is that only renewable energy in-

vestments could help Egypt secure sustained uninterrupted energy supplies for domestic consumption, and also benefit from exporting energy to neighbouring countries. The second is that private investments or PPPs should be the choice to implement renewable energy projects, particularly megaprojects, rather than entire public financing or sovereign borrowing, in order to minimise fiscal burden on the already debt-stressed Egyptian economy.

It is likely that the private companies investing in various-sized renewable energy projects for the domestic market could require some financial incentives, including grants, subsidies, tax exemptions, and public partnership, to encourage more companies to enter the domestic market in order to boost competition and production, and to promote growth of a supporting local supply chain. Larger corporations, on the other hand, embarking on multibillion-dollar megaprojects to generate and export green energy to neighbouring markets would be less expecting, or in need for such incentives from the Egyptian state. Instead, Egypt should prioritise regulatory and institutional reforms related to renewable energy industry and exports, in order to attract renewable energy megaprojects. Lessons could be drawn from relevant measures elsewhere, including from reforms and non-financial incentives in Morocco and the EU.

References

AL-ARABIYA. (2024). Egypt Intends to Reinvite Tenders for A Pumped Storage Plant. https://www.alarabiya.net/aswaq/special-stories/2024/01/03/%D9%85%D8%B5%D8%B1-%D8%AA%D8%B9%D8%AA%D8%B2%D9%85-%D8%A7%D8%B9%D8%A7%D8%AF%D8%A9-%D8%B7%D8%B1%D8%AD-%D9%85%D8%AD%D8%B7%D8%A9-%D9%84%D8%AA%D9%88%D9%84%D9%8A%D8%AF-%D8%A7%D9%84%D9%83%D9%87%D8%B1%D8%A8%D8%A7%D8%A1-%D8%A8%D8%AA%D9%82%D9%86%D9%8A%D8%A9-%D8%A7%D9%84%D8%B6%D8%AE-%D9%88%D8%A7%D9%84%D8%AA%D8%AE%D8%B2%D9%8A%D9%86

AL-LAITHY, H. (2023). *Open Panel Discussion at APS on Poverty Figures in Egypt: An Inflation-Driven Increase.* Alternative Policy Solutions, American University in Cairo. https://aps.aucegypt.edu/en/events/110/open-panel-discussion-at-aps-on-poverty-figures-in-egypt-an-inflation-driven-increase

ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT. (2023). *Arab Regional Projects: Electricity.* https://www.arabfund.org/default.aspx?pageId=454

ATLANTIC COUNCIL. (2015). *What Was Pledged at Egypt's Investment Conference?* https://www.atlanticcouncil.org/blogs/menasource/what-was-pledged-at-egypt-s-investment-conference/

BRITISH PETROLEUM. (2020). *Statistical Review of World Energy 2020* - 69th edition.

BUTTER, D. (2020). *Egypt and the Gulf: Allies and Rivals.* Chatham House, Middle East and North Africa Programme.

CENTRAL AGENCY FOR PUBLIC MOBILIZATION & STATISTICS. (2013:2023). *Monthly Bulletin of Foreign Trade Data.*

CENTRAL AUTHORITY FOR PUBLIC MOBILISATION AND STATISTICS. (2023). *Monthly Bulletin of Consumer Price Index (CPI) February 2024.*

CENTRAL BANK OF EGYPT. (2013:2023). External Position of the Egyptian Economy Reports.

COPELOUZOS GROUP. (2023a). *"GREGY" Interconnector.* https://www.copelouzos.gr/en/service/gregy-interconnector/

COPELOUZOS GROUP. (2023b). *Copelouzos Group Presented the Strategic Project of the Electrical Interconnection between Egypt and Greece "GREGY" in Washington D.C.* https://www.copelouzos.gr/en/news/copelouzos-group-presented-the-

strategic-project-of-the-electrical-interconnection-between-egypt-and-greece-gregy-in-washington-d-c/

DARGIN, J. (2023). *Positioning Egypt as a Global Green Hydrogen Leader.* Carnegie Endowment for International Peace.

ELECTRICITY HOLDING COMPANY. (2013:2022). *Annual Reports.* Ministry of Electricity and Renewable Energy.

ELECTRICITY HOLDING COMPANY. (2021). *Annual Report 2020/2021.* Ministry of Electricity and Renewable Energy.

EL-TABLAWY, T. (2023). Egypt Calls December Presidential Vote as Economic Woes Mount. *Bloomberg*. https://www.bloomberg.com/news/articles/2023-09-25/egypt-to-hold-presidential-vote-in-december-as-devaluation-looms?embedded-checkout=true

EUROAFRICA INTERCONNECTOR. (2023). *EuroAfrica project schedule.* https://www.euroafrica-interconnector.com/at-glance/project-timeline/

EUROPEAN COMMISSION. (2023). *Questions and Answers on the new list of EU energy Projects of Common and Mutual Interest.* https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_6048

EUROSTAT. (2024a). *Complete energy balances.* https://ec.europa.eu/eurostat/databrowser/view/nrg_bal_c/default/table?lang=en

EUROSTAT. (2024b). *Electricity prices for household consumers.* https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_204__custom_10180477/default/table?lang=en

FRANCE24. (2023). Egypt's Economic Turmoil Squeezes Struggling Middle Class. *France24*. https://www.france24.com/en/live-news/20230117-egypt-s-economic-turmoil-squeezes-struggling-middle-class

HELAL, H. (2023). President Al-Sisi: Power Cuts Save 300 billion Dollars Monthly. *Shorouk News.* https://www.shorouknews.com/news/view.aspx?cdate =30092023&id= 281db9fd-88dd-4bbd-aa23-bd10351d5aea

INTERNATIONAL ENERGY AGENCY. (2022). *Egypt-Saudi electricity interconnection project.* https://www.iea.org/policies/14291-egypt-saudi-electricity-interconnection-project

INTERNATIONAL ENERGY AGENCY. (2023). *Electricity Market Report 2023.*

INTERNATIONAL MONETARY FUND. (2022). IMF *Executive Board Approves 46-month US$3 billion Extended Arrangement for Egypt.* https://www.imf.org/en/News/Articles/ 2022/12/16/pr22441-egypt-imf-executive-board-approves-46-month-usd3b-extended-arrangement

INTERNATIONAL MONETARY FUND. (2023). *IMF Country Report* No. 23/2.

KANDIL, A. (2023). Egypt denies gas production decline at Zohr field. *Ahram Online*. https://english.ahram.org.eg/NewsContentP/3/505363/Business/Egypt-denies-gas-production-decline-at-Zohr-field.aspx

KHALID, M. (2023). Egypt lowers gas supply to fertilizer companies amid severe shortage. *Ahram Online.* https://english.ahram.org.eg/NewsContent/3/12/511318/Business/Economy/Egypt-lowers-gas-supply-to-fertilizer-companies-am.aspx

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY. (2018). *Inauguration of Projects of the Ministry of Electricity and Renewable Energy.*

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY. (2024). *Technical Statistics: Maximum Load.* http://www.moee.gov.eg/test_new/ST_load.aspx

MINISTRY OF FINANCE. (2018). *Financial Statement of State's General Budget for the Financial Year 2017/2018.*

MOHAMMED, A. (2023). *Madbouly: Power Cuts Would Have Lasted for 21 Hours Without Megaprojects. Al-Masry Al-Youm*. https://www.almasryalyoum.com/news/details/2943651

MOODY's. (2023). Government of Egypt Credit Rating. https://www.moodys.com/credit-ratings/Egypt-Government-of-credit-rating-258330?lang=en&cy=can

NEW AND RENEWABLE ENERGY AUTHORITY. (2022). *Energy Strategy.* http://www.nrea.gov.eg/About/Strategy

OPEC. (2024). *Oil Trade Database.* https://asb.opec.org/data/ASB_Data.php

REUTERS. (2023). Egypt says IMF agrees to merge first two reviews of reform program. https://www.reuters.com/world/africa/egypt-says-imf-agrees-merge-first-two-reviews-reform-program-2023-09-23/

SALAH, F. (2023). Egypt hires HSBC to negotiate with German lenders for Siemens station sale. *Daily News Egypt.* https://www.dailynewsegypt.com/2023/08/29/egypt-hires-hsbc-to-negotiate-with-german-lenders-for-siemens-station-sale/

SALEM, A. (2020). Ministry of Electricity Decides to Cancel Coal Generation Projects. *Al-Mal News.* https://almalnews.com/%d8%aa%d8%a3%d9%83%d9%8a%d8%af%d9%8b%d8%a7-%d9%84%d9%84%d9%85%d8%a7%d9%84-%d8%a7% d9%84%d9%83%d9%87%d8%b1%d8%a8%d8%a7%d8%a1-%d8%aa%d9% 82%d8%b1%d8%b1-%d8%a5%d9%84%d8%ba%d8%a7%d8%a1-%d9%85/

SALEH, A. (2021). Minister of Electricity: Terminating Use of Coal in the Energy Strategy. *Al-Masry Al-Youm.* https://www.almasryalyoum.com/news/details/2487286

SGUAZZIN, A. (2023). IMF Boss Says Egypt to 'Bleed' Reserves Unless It Devalues. *Bloomberg.* https://www.bloomberg.com/news/articles/2023-10-05/imf-s-georgieva-says-egyptian-pound-must-be-devalued?embedded-checkout=true

SIEMENS. (2018). *Completion of world's largest combined cycle power plants in record time.* https://press.siemens.com/global/en/feature/completion-worlds-largest-combined-cycle-power-plants-record-time

SIEMENS. (2022a). *Prospects for using hydrogen in gas power plants are becoming tangible.* https://www.siemens-energy.com/global/en/home/press-releases/prospects-using-hydrogen-gas-power-plants-are-becoming-tangible.html

SIEMENS. (2022b). *Siemens Mobility finalizes contract for 2,000 km high-speed rail system in Egypt.* https://press.siemens.com/global/en/pressrelease/siemens-mobility-finalizes-contract-2000-km-high-speed-rail-system-egypt

STATE INFORMATION SERVICE. (2022a). *Energy.* https://sis.gov.eg/Story/173487/Energy?lang=en-us

STATE INFORMATION SERVICE. (2022b). *Government: Mega Projects Caused A Record Drop in Unemployment Rate in 30 Years*. https://www.sis.gov.eg/Story/171495/Government-Mega-projects-caused-a-record-drop-in-unemployment-rate-in-30-years?lang=en-us

STATE INFORMATION SERVICE. (2022c). *The New Republic is an Axis for Electric Interconnection between Continents.* https://www.sis.gov.eg/Story/228909/%D8%A7% D9%84%D8%AC%D9%85%D9%87%D9%88%D8% B1%D9%8A%D8%A9-%D8%A7%D9%84%D8%AC%D8%AF%D9%8A%D8% AF%D8%A9-%D9%85%D8%AD%D9%88%D8%B1-%D9%84%D9%84%D8%B1%D8%A8%D8%B7-%D8%A7%D9%84%D9%83%D9%87%D8%B1%D8%A8%D8%A7%D8%A6%D9%8A-%D8%A8%D9%8A%D9%86-%D8%A7%D9%84%D9%82%D8%A7%D8%B1%D8%A7%D8%AA?lang=ar

STATE INFORMATION SERVICE. (2022d). *Zohr Natural Gas Field Project.* https://www.sis.gov.eg/Story/173276/Zohr-Natural-Gas-Field-Project?lang=en-us

STATE INFORMATION SERVICE. (2023a). *Egypt enjoys competitive edge in producing green hydrogen.* https://www.sis.gov.eg/Story/185004/Egypt-enjoys-competitive-edge-in-producing-green-hydrogen?lang=en-us

STATE INFORMATION SERVICE. (2023b). *El Dabaa Nuclear Energy Plant Project.* https://www.sis.gov.eg/Story/176389/El-Dabaa-Nuclear-Energy-Plant-Project?lang=en-us

STATE INFORMATION SERVICE. (2023c). *Prime Minister: Power Cuts Are Caused by Severe Heat Wave.* https://www.sis.gov.eg/Story/260632/%D8%B1%D8%A6%D9%8A%D8%B3-%D8%A7%D9%84%D9%88%D8%B2%D8%B1%D8%A7%D8%A1-%D8%AA%D8%AE%D9%81%D9%8A%D9%81-

%D8%A3%D8%AD%D9%85%D8%A7%D9%84-%D8%A7%D9%84%D9%83%D9%87%D8%B1%D8%A8%D8%A7%D8%A1-%D8%A8%D8%B3%D8%A8%D8%A8-%D8%A7%D9%84%D9%85%D9%88%D8%AC%D8%A9-%D8%A7%D9%84%D8%AD%D8%A7%D8%B1%D8%A9-%D8%A7%D9%84%D8%B4%D8%AF%D9%8A%D8%AF%D8%A9?lang=ar

SULEIMAN, H. (2022). *Rural Vulnerability, Employment and Social Safety Programmes in Egypt: How Far Could State Initiatives Go?* EuroMeSCo Paper N. 59, European Institute of the Mediterranean.

SUEZ CANAL ZONE. (2023a). *Indian ReNew power to establish Green Hydrogen plant with $ 8Bn in SCZONE-Egypt.* https://sczone.eg/indian-renew-power-to-establish-green-hydrogen-plant-with-8bn-in-sczone-egypt/

SUEZ CANAL ZONE. (2023b). *SCZONE converts $7 billion MOU with Energy China into a framework agreement soon.* https://sczone.eg/sczone-converts-7-billion-mou-with-energy-china-into-a-framework-agreement-soon/

TANCHUM, M. (2022). *Egypt's Synergy Between Natural Gas and Green Transition: Cairo's Positioning as an Energy Hub for Europe.* Middle East Institute.

UNITED NATIONS. (2018). *Case Study on Policy Reforms to Promote Renewable Energy in Morocco.* E/ESCWA/SDPD/2017/CP.6.

Grid and Bear It: Tunisia's Trans-Mediterranean Electrical Interconnection Megaprojects

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Introduction

Tunisia has authorised the construction of electricity interconnection megaprojects from Tunisia to Europe to enable integration with the European super grid (or MedGrid). Predominant debates around electricity interconnections with Europe, and the overall energy transition partnerships between North African nations and Europe, are often dichotomous. While some view these connections as an opportunity to stimulate both Tunisia's economy and transition to greener, low-carbon energy production (World Bank, 2023), others have pointed to their potential to be exploitative, green-grabbing, extractivist endeavours that perpetuate post-colonial, unequal North-South power dynamics (Ben Ammar, 2022; Hamouchene & Sandwell, 2023; Schuetze, 2023).This chapter analyses both the socioeconomic benefits and the limitations or disadvantages to Tunisian communities, seeking to understand the extent of their potential as mutually beneficial infrastructure megaprojects.

To navigate this conundrum, the chapter examines two governance aspects related to two electricity interconnection megaprojects, ElMed and TuNur: (1) promoting national and subnational development; and (2) accountability mechanisms. The chapter examines whether the interconnections created through these projects will stimulate the expansion of Tunisia's power generation capacity from renewable sources and how these projects will benefit, or harm, Tunisian citizens. Further, to ensure that the potential benefits align with Tunisia's overall energy transition needs and priorities, this chapter examines the country's energy context and the current legislative framework and strategies for energy transition and the development of renewable energy.

The electricity transmission megaprojects: case selection

Requiring the construction of overland and submarine High Voltage Direct Current (HVDC) cables that cover distances of 200 km (ElMed) and 1,320 km (TuNur), the chapter regards these trans-Mediterranean interconnection infrastructure projects as megaprojects. (ElMed Project, n.d.) is a joint venture between Tunisia and Italy's electricity transmission systems operators, Société Tunisienne de l'Electricité et du Gaz (STEG) and Terna. It aims to construct a 600 megawatts (MW) direct current undersea electricity link to connect the Tunisian and Italian power systems. The project's expected cost is €1.014 billion, half of which, i.e. €582 million to be provided by STEG through loans. The project will receive more than €307 million of European Union (EU) funds from the Connecting Europe Facility (CEF) programme (CEF Energy, 2023) and €248 million in funding from the World Bank Group (World Bank, 2023). Project funding is also provided by the government of Italy, the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the German Development Bank KfW. In addition, €23 million of concessional financing was also provided by the Green Climate Fund through the initiative. Construction is due to start in 2024 with an estimated completion in 2028.

TuNur is a private export project funded by Zammit Group (Malta), Nur Energy (UK-based), and Armonia LLC (United States). It is designed to connect Tunisian solar energy to the Euro grid. It consists of the development of a large-scale 4.5 gigawatts (GW) (4,500 MG) hybrid - the combination of Photovoltaic (PV) and Concentrated Solar Power (CSP) production since CSP features the capacity to store energy in

molten salt, thermal storage, as a means to address the intermittency of solar energy (Tunur, n.d.-c) - renewable energy plants in southern Tunisia (Rjim-Maatoug) and an HVDC transmission line to transport electricity to Italy. This will ensure the sale of electricity across the European market, and, according to TuNur's website, "provide the EU with an alternative source of basic renewable energy and save more than 5 million tons of CO2." (Tunur, n.d.-b). TuNur aims to begin construction in 2027 to be operational by 2032.

As both projects will export renewable energy produced in Tunisia to foreign markets, detractors highlight that they are diverting much-needed renewables away from the Tunisian energy mix and are instead exploiting Tunisia's wind and abundant solar potential for the sake of Europe's energy transition. Therefore, the export-oriented nature of these projects supports the arguments advanced by critics highlighting the neo-colonial and extractivist character of energy interconnection endeavours. By contrast, these projects emphasise the mutual benefits of their interconnection for both the European market and Tunisia. For instance, TuNur claims its interconnection will supply renewable energy to European markets while providing an array of benefits to Tunisian communities – including boosting subnational development in the producing region, creating multi-skilled employment, and boosting trade between Tunisia and the EU (Tunur, n.d.-b). Similarly, the ElMed project is advertised as "positioning [Tunisia] as a regional hub for renewable energy," as it "boosts energy security, integrates renewable energy sources, and reduces carbon emissions while making the power sector more financially viable and attracting investments in Tunisia" (World Bank, 2023). In addition, thanks to its attendant "increased power system flexibility delivered by the balancing of electricity supply and demand over a broader geographic area," (Benbarka, 2023) the ElMed project is advertised as enabling a two-way flow of electricity, rather than an exclusively export-oriented project. This chapter assesses the extent to which benefits to the Tunisian economy and communities are indeed possible from these projects, beyond the use of the unexported portion of electricity produced from renewables in the country's domestic power market.

Tunisia's energy transition: a comprehensive legal framework

Until 2000, Tunisia's oil and gas reserves and energy production facilities were able to cover the domestic energy demand. In addition, the country exported its surplus oil and gas production, making the oil sector the most important source of foreign currency during the 1970s and 1980s. However, since 2001, the country has suffered an energy deficit, which continues to increase due to the decline in national reserves of oil and gas and the continuing increase in energy demand. Tunisia's energy budget deficit — the gap between what is being imported versus what is being produced and used internally — has reached record levels in recent years, exceeding 50% compared to 10% before 2010. According to the current rate of development of conventional energy reserves and projections for oil and gas production, as well as the forecasts for increased domestic consumption during the coming years, the energy deficit is expected to exceed 80% by 2035. Importantly, Tunisia's electricity mix is heavily reliant on natural gas; according to the most recent data published by the Ministry of Industry, Energy and Mines, natural gas made up 97.8% of the electricity mix as of the end of 2023, compared to 2.2% for renewables (Direction Générale

Export-oriented nature of these projects supports the arguments advanced by critics highlighting the neo-colonial and extractivist character of energy interconnection endeavours

des Stratégies et de Veille, 2023). These figures do not, however, include electricity generated through self-production from solar panels on the roofs of private homes or businesses. This is especially problematic due to Tunisia's reliance on imported gas from Algeria, which supplies 60% of Tunisia's gas needs. Diversification of the electric and energy mixes is paramount to avoid dependence on one energy source and a sole supplier. This can be mitigated if important new oil and gas discoveries are made and alternative sources such as renewable energies are developed.

Energy subsudies are the costliest component of Tunisia's subsidy system

As a result of the current energy situation, there is pressure on the state budget as energy prices are subsidised, the cost of which has been "between 4 and 6% of GDP, or about 13% of the total expenditures for the period from 2006 to 2016. This makes energy subsidies the costliest component of Tunisia's subsidy system"(Eibl, 2017, p. 7). As energy consumption and the national population grow annually, energy import demand reciprocates and government spending continues. A gradual transition away from fossil fuels would reduce the country's energy deficit, reliance on imported hydrocarbons, and government spending on fuel subsidies through the increased reliance on cheaper renewable energy. It is important to note that a transition away from fossil fuels is a slow, non-linear process and while Tunisia — like all countries — is still run on a hydrocarbon-based energy system, money saved from using Tunisian oil and gas could be used to fund further renewable energy development. Overall, an energy transition can provide an opportunity for Tunisia to reduce CO2 emissions and increase revenue from exporting electricity, or green molecule fuels, to Europe, thanks in part to its excellent solar potential. On average, southern Tunisia receives 3,200 sunshine hours per year and solar irradiation levels of 2,600 kWh per m² per year (National Agency for Energy Conservation, 2023). Although the viability of a solar project depends on several factors, selecting locations that receive high Direct Normal Irradiation (DNI) (Cleveland & Morris, 2013) levels is crucial, and Tunisia boasts figures higher than anywhere in Europe (Karellas et al., 2015). Energy exportation also has the potential to diversify the Tunisian economy if the revenues from exporting energy to Europe are invested in productive sectors that would generate other revenues and broaden the economy. However, there is an important caveat to Tunisia's exportation plan. If Tunisia's power market becomes integrated with the EU power market, Tunisia would have to pay EU prices. Considering the cost-of-living differences, electricity might have to be subsidised in Tunisia.

It is within this context that Tunisia has been putting in place measures to transform its energy system. To mitigate the natural decline in oil and gas reserves, Tunisia established the National Agency for Energy Management (ANME) in 1985. In addition, the Tunisian legislature enacted the following legal texts related to energy efficiency and renewable energy:

- 1985: Law No. 48 of 1985 relating to encouraging research on, production and marketing of renewable energies: Providing several tax concessions.
- 1990: Law No. 62 of 1990 relating to energy efficiency: Providing tax and financial concessions (grants and loans at differential rates).
- 1993: Code of Investment Stimulation: Providing financial grants and tax exemptions.
- 2004: Issuance of the Energy Efficiency Law.
- 2009: Revising the 2004 Energy Efficiency Law to encourage self-production projects to produce electricity from renewable energies.

Tunisia developed its energy strategy in the context of the globally declining levelised cost of electricity (LCOE) for prices of solar and wind energy (Catsaros, 2023), the worsening energy deficit, and the rise in oil and gas prices in global markets. In 2013 the Tunisian government held a comprehensive national dialogue with the participation of all local and regional stakeholders. This aimed to develop a new energy approach in line with the challenges presented at the national level and the profound changes that have occurred in global energy markets. This national dialogue led to the formulation of the 2014 "National Energy Transition Strategy", updated in 2019, and more recently in 2023. This strategy is focused on developing the country's hydrocarbon resources; improving the country's capacity to produce, store, and transport hydrocarbons; improving electricity production and electrification; and improving energy management, including energy efficiency and development of renewable energy.

The totality of these measures is aimed at producing the following targets:

- Between 2014 and 2030, reducing the use of fossil fuels by 77 Mtep, with 75% of this reduction emanating from energy efficiency measures and 25% emanating from increased renewables share in the energy mix.
- Between 2014 and 2020, energy spending is cut down by 22.5 million TND and subsidy spending is reduced by 9 million TND.
- By 2030, the energy sector creates 12000 new jobs, mainly in renewable energy production.
- By 2030, reducing CO2 emissions by 22 MtCO2, a 45% reduction.

This strategy led to the creation of the Tunisian Solar Plan (Agence Nationale pour la Maîtrise de l'Énergie, 2015), announced in 2015. It aimed to increase the share of renewable energies in the electric generation capacity to 30% (later revised to 35%) while reducing energy demand by 30% by 2030. To implement this strategy, the Ministry of Energy and Mines established the Energy Transition Fund in 2014 and issued Law No. 12 of 2015 (11 May 2015) on the production of electricity from renewable energies. This law was amended in 2019 by Law No. 2019-47 (29 May 2019) on improving the investment climate. Law No. 12 of 2015 stipulated three (3) systems for producing electricity from renewable energies: self-consumption, independent power generation to meet the needs of national consumption, and power production for exports. This law covered smaller projects such as low-voltage self-production through solar power on residential rooftops and medium- to high-voltage production dedicated to commercial and industrial production capacities of minimum power; less than 10 MW for photovoltaic energy and less than 30 megawatts for wind energy. It also created a concession system for the development of megaprojects (greater than minimum power) intended for total sale to the STEG and for export.

The Ministry also prepared the applicable texts represented in:

- Order No. 1123 of 2016 (24 August 2016) relating to setting the conditions and procedures for implementing projects for the production and sale of electricity from renewable energies.
- Decree issued on 9 February 2017 related to the approval of the specifications for connecting to the network and contracts for purchasing the electrical energy produced.

Upon the 2017 completion of the legislative framework specifying regulations for production, network connection, and sales, the Ministry published the plan for electricity

production from renewable energies for 2017-2020, which – as revised in 2018 – sought to raise the country's total renewable capacity from 200 MW to 1,000 MW.

Improved laws but insufficient funds

The Tunisian Government's problem is how to finance the massive infrastructure overhaul required to generate and distribute green energy

The Tunisian Government has effectively restructured the legal framework to facilitate the country's energy transition: a potentially economically astute policy. However, funding remains a key stumbling block. Its problem is how to finance the massive infrastructure overhaul required to generate and distribute green energy. Although the Tunisian electricity utility has an installed generation capacity of 5,476 MW which provides 99% of the population with access to electricity (World Bank, 2021), Tunisia is a fossil fuel-poor country and has a minimal daily production of oil that is lower than the daily oil consumption. Thus, unlike Middle East and North Africa (MENA) states with hydrocarbon surpluses, Tunisia does not possess enough oil or natural gas export revenues that it can direct into investments in solar and wind power infrastructure nor into upgrading and expanding the national transmission grid. Despite efforts to stimulate investment in renewables through legislation such as the abovementioned 1993 code for investment stimulation and Law No. 12 of 2015 (11 May 2015) on the production of electricity from renewable energies, national private investment in renewable energy production remains scarce. Therefore, Tunisia must seek to finance its energy transition through other means. Publicly-funded schemes, such as the Energy Transition Fund (Agence Nationale pour la Maîtrise de l'Énergie, n.d.), an AMNE-managed mechanism to pool capital for investment in energy management programs to support the reduction of fossil fuel subsidies and support companies seeking to reduce energy consumption, are promising developments. However, this alone will not provide sufficient capital to build solar and wind energy generation plants and high voltage (HV) distribution infrastructure to meet Tunisia's growing energy demands and renewable energy targets. Herein lies the problem; an energy transition would be beneficial for Tunisia's energy sovereignty and CO2 reduction goals, plus potentially beneficial for Tunisia's economic diversification. However, it would be challenging for the North African state to undergo such a transition without foreign financial support or, as Ben Ammar proposes (2022, pp. 25–27), a comprehensive reorganisation and decentralisation of electricity production. Approximately 3% of Tunisian electricity is presently produced from renewable energy sources (International Trade Administration, 2024) and the prospect of the state meeting the 35% by 2030 target, by itself, looks increasingly untenable. Thus, establishing partnerships with other countries could support the energy transition. Europe is the most obvious partner with the potential to establish a mutually beneficial energy collaboration; Europe needs to diversify its electricity supply after it sanctioned the importation of Russian gas (European Council, 2024) and set more ambitious renewable energy targets in the REpowerEU plan (European Commission, 2022), while taking temporary counter-CO2 reduction policies such as increasing coal use to meet demand (Seker, 2023). In addition, the proximity between North Africa and Southern Europe makes the prospects of electricity interconnection and green hydrogen exports feasible and economically viable. As highlighted by the Tunisian Minister of Economy and Planning Feryel Ouerghi, during a parliament plenary session to approve an IBRD loan to STEG as part of the ElMed project, "electricity interconnection between Tunisia and Italy will contribute to Tunisia importing electricity in summer (during peak demand) and exporting our excess to Europe in winter, which

will enable STEG to make a profit" (L'Economiste Maghrébin, 2024). This win-win arrangement is leading the EU and European multilateral development banks to invest in green energy solutions in Tunisia.

Previous interconnection projects were nonstarters when faced with an array of practical obstacles. Famously, the Desertec Industrial Initiative was abandoned in 2013 due to political, financial and technological obstacles making it highly unrealistic (Calderbank, 2013).

Since then, advancements in electricity transmission technology have meant that Euro-North Africa interconnection is even more feasible. From a purely technical viewpoint, North African-produced solar and wind power is a viable supply source for the European electricity market. However, technical viability and benefits to electricity markets should not override a critical examination of the potential socioeconomic and development impacts of these interconnection endeavours.

Assessing the socio-economic impact of the TuNur and ElMed projects on Tunisian communities

Promoting national and subnational development

This chapter finds that the megaprojects have some moderate benefits for Tunisia's development, yet these benefits are constrained, especially since most of the financing is in the form of loans. For a megaproject to have a transformative economic impact, it must create, either directly or indirectly, meaningful employment, economic diversification opportunities, and sustainable development benefits, including improved infrastructure and the transfer of skills and knowledge. In line with the dichotomous discourses animating the energy transition debate in Tunisia, interview data and desk research revealed a lack of agreement and conflicting narratives about whether megaprojects meant for export promote development at the national and subnational levels. Tunisian government and donor narratives have highlighted the benefits of these projects for Tunisia's development and energy transition. For instance, the World Bank touted the benefits of ElMed for Tunisia, including positioning the country as a "regional hub for renewable energy" and "making the power sector more financially viable and attracting investments in Tunisia" (World Bank, 2023). Similarly, in a public webinar live-streamed on Facebook, Deputy Director of Renewable Energy within the Ministry of Industry, Mining, and Energy Khaled Draouil stated that while the government's priority is to gear renewable projects for domestic use, interconnectivity projects with Europe are beneficial for Tunisia in several areas at the national and local level, stating that "we know that projects lead to opening branches of foreign companies, which leads to technological transfers and employment," a phenomenon, which he believes is more likely given firms' Environmental, Social, and Governance (ESG) requirements. Additionally, Draouil pointed to the role of carbon footprint taxes, such as Europe's Carbon Border Adjustment Mechanism, positing that "if products are produced in factories that are powered by renewable energy, this will increase their chances of being exported and also attract investment for other industries to be installed in these regions" (Natural Resource Governance Institute, 2023).

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By contrast, others view foreign funding of renewable megaprojects in strictly extractivist terms. For instance, investigative journalist Aïda Delpuech described it as a green-

washing attempt to feign investment in the Tunisian energy sector. Similarly, Saber Ammar, Project Manager at the Humanist Institute for Development Cooperation (Hivos), pointed out that, rather than promoting development, these megaprojects exploit already degraded infrastructure, arguing that the TuNur project will use the national electricity grid to transmit renewable energy from Rjim Maatoug to the north coast, and that "they're going to use the national grid, without making STEG benefit from it. They [TuNur] are going to give a little bit of money, basically nothing" (S. Ammar, personal communication, October 28, 2023).

Megaprojects could have a positive indirect impact through spurring more funding and investments in Tunisia's economy generally and its renewables sector specifically

This research has found evidence in favour of these megaprojects and their provision of moderate positive impacts on national and subnational development in Tunisia. First, this research finds evidence supporting the argument that megaprojects have a positive indirect impact through spurring more funding and investments in Tunisia's economy generally and its renewables sector specifically. For instance, in 2020, TuNur won a bid for a 10 MW solar project as part of Tunisia's third round of the authorisation regime launched in 2019 (Bouafii, n.d.). This project, called Taqet Gabes 10 MW, is scheduled to "deliver all power to STEG, to help supply over 4,000 Tunisian homes and save over 8,500 tons of CO2 per year" (Tunur, n.d.-a). In addition, due to its positioning in the central coastal governorate of Gabes, long affected by the negative environmental impacts of oil refining, a renewable project will have a positive impact on the region's environment and local economy. This move could be interpreted as TuNur supporting Tunisia in its effort to meet its electricity needs rather than only operating as an exporting company.

Second, these megaprojects will have positive impacts on Tunisia's infrastructure, including through improving the country's fraying electricity grid. As Draouil stated in the public webinar referring to the ElMed project, "for the interconnection with Italy for instance, to transport the electricity from the south to the Tunisian coast, the donor invested in the grid, which benefits us in the long run as there will have been improvements to our national grid" (Natural Resource Governance Institute, 2023). This was confirmed by the World Bank, which states that the project will fund the construction of "(a) a new 400/225 kV substation in Grombalia, (b) a new 400 kV double-circuit overhead transmission lines (OHTL) of 65 km length from the new HVDC converter station to the 400 kV Grombalia 2 substation, and (c) a new 400 kV single-circuit OHTL of 51 km from Grombalia 2 substation to the existing Mornaguia substation." (Benbarka, 2023, p. 10). Similarly, according to the TuNur website, the company claims that its Italy transmission line will start with the connection point to the power plant in Southern Tunisia via +/- 525 kV AC and DC overhead lines spanning 660 km to the landfall point in Northern Tunisia (Tunur, n.d.-c).

Third, these megaprojects and the partnerships between Tunisia on the one hand and European states and donors on the other can help Tunisia position itself as a regional renewable energy hub and a green corridor between Africa and Europe, which in turn will help ensure continued investments and technical transfers to the country. For instance, as the ElMed project works directly with STEG, knowledge transfer to STEG staff and management to support project implementation is included as part of donor requirements for "capacity building to STEG staff and Project Implementation Unit (PIU)." (Benbarka, 2023, p. 11). In addition, the World Bank, one of the project's funders, claims that "technical assistance by the World Bank Group will include

helping to establish a renewable energy Center of Excellence to position Tunisia as a training hub for renewable energy projects in the North Africa region" (World Bank, 2023).

This World Bank initiative, with additional funding through a Green Climate Fund grant, will include the recruitment of trainers/teachers and associated educational institution staff. However, no estimated numbers of teachers and staff have been provided (Benbarka, 2023, p. 11). In addition, this centre of excellence will include "(b) capacity development which will feature two pilot training courses at vocational level (e.g., RE construction, maintenance and electrician skills) and a course at undergraduate level (e.g., engineering, planning and management), and (c) engagement with domestic firms about how to engage in RE projects" (Benbarka, 2023, p. 12).

While this chapter found evidence of national and subnational development benefits emanating from these megaprojects, these benefits are limited and largely overstated by their proponents. For instance, a training and excellence centre is important and conducive to knowledge transfer and the creation of medium- to high-skilled labourers. However, the low number of workers required in renewable projects does not guarantee job prospects for future graduates. Indeed, the Project Information Document (PID) and the Environmental and Social Impact Assessment (ESIA) confirm that ElMed's job creation prospects are modest, estimated at approximately 300 workers (Benbarka, 2023, p. 16). These 300 workers will make up the semi-skilled to unskilled construction workforce during the construction phase of the project, while only an estimated 25 to 30 workers will be needed during the longer term "operation phase, which will primarily entail the O&M [operations and management] and security services of the converter station" (EBRD, 2023b, p. 115).

As per World Bank requirements, and in order to "provide temporary or more long-term employment opportunities to some of the affected communities, the borrower will require contractors to recruit construction workers from the country, with preference given to recruitment of workers from Project-affected communities" (Benbarka, 2023, p. 16). However, due to the medium or high skills required for the operation phase workforce, these longer-term 20-25 jobs will "likely be hired at a regional or national level more than local. Moreover, the number of workers employed in this phase will be low" (EBRD, 2023b, p. 120).

Despite the low number of long-term workers to be recruited from the affected communities, the ESIA classifies the positive economic impact of temporary employment as "moderate (positive)" (EBRD, 2023b, p. 116). This assessment is potentially made based on the assumption of indirect employment opportunities that would be created through the project's supply chain, including through "the procurement of goods and services from local companies, which will further increase jobs in the domestic market," as well as the income, taxes, and expenditure effects resulting from wages and increased income related to the project (EBRD, 2023b, p. 116).

While ElMed provided realistic estimates depicting the low number of short- and long-term workers to be hired during the project period, TuNur depicts a grossly exaggerated picture of the job creation opportunities of its project, claiming that the project will "create more than 20,000 direct and indirect jobs, in a region where the number of candidates leaving for Europe continues to grow" (Delpuech & Poletti, 2022). How TuNur arrived at these projections is unclear, as is the distinction between

Overstated promises are fuelling further distrust in the potential positive impacts of megaprojects on sustainable development in Tunisia

short-term unskilled construction jobs and longer-term, highly skilled operation jobs. As Delpuech wondered, "How long would the [jobs] last? Are they for a two-year period of the construction phase or the whole project?"(A. Delpuech, personal communication, October 28, 2023). In addition, since the Rjim Maatoug site is under military management (Delpuech & Poletti, 2022), the project's indirect job creation prospects are also overstated. As Delpuech explained, "these plants are closed. In Morocco, we were only allowed 2 km away from the (Noor) plant (Heidelberg Materials, n.d.). It's guarded by the military and they become like a parallel world in the region" (A. Delpuech, personal communication, October 28, 2023). This would be due to security concerns for such infrastructure, leading to the facility's isolation. This hinders local economic integration.

Previous attempted megaprojects in the North African region have also advanced untrue and exaggerated promises about their projects' job creation potential. For instance, planners of the Desertec Industrial Initiative claimed it would create job opportunities in the EU and MENA countries. However, on the MENA side, these would have mostly consisted of temporary work in the plant construction phase, while "only a relatively small part of the employment opportunities will be created during the operation and maintenance phase" (Klawitter & Schinke, 2011, p. 36). In 2011, Daniel Ayuk Mbi Egbe of the African Network for Solar Energy (ANSOLE, 2024) raised concerns about Desertec's job creation and technology transfer plans, claiming Europeans rather than Africans would find work (Hamouchene, 2015). In Tunisia, the private sector seems to be favouring foreign companies and staff at the expense of nationals, as "of the 22 renewable energy projects, only half have Tunisian project leaders and only four are exclusively led by Tunisian firms" (El Amine, 2023).

These overstated promises are fuelling further distrust in the potential positive impacts of megaprojects on sustainable development in Tunisia. Indeed, Ammar doubted the validity of TuNur's job creation claims and thought these promises were misleading and were meant to convince the Tunisian people to support such projects. He claims to have witnessed local government officials telling people to allocate or sell their lands, and accuses TuNur of lying about providing employment and investing in Tunisia.(S. Ammar, personal communication, October 28, 2023).

Notably, off-the-record conversations with Tunisian government officials have revealed that neither TuNur (UK) Ltd nor its Tunisia branch have signed a concession with the Tunisian government for their interconnection project. Further, as TuNur has been registered as a private limited company in the United Kingdom (UK) since 2011, it is required to publish financial information on the UK government's centralised register of companies (Companies House, 2024). According to its latest financial reports, the company does not generate any revenue and has accumulated losses, as of 31 December 2022, of 6,372,591 euros (Companies House, 2024). It is therefore clear that this company does not currently possess the funding to support its claims about its megaproject or any of the infrastructure and job creation benefits touted on its website. This explains the lack of transparency of TuNur and the unavailability of any representatives for interviews. As Delpuech confirmed from her investigative work, she found it challenging to collect information about TuNur's work, stating that "we were lucky to have spoken to a representative from TuNur, and then some of the things he said were off the record, but he was the only one answering. They seem to be secretive" (A. Delpuech, personal communication, October 28, 2023). This is highly problematic as it compounds

citizens' mistrust in private investment in renewables, which risks creating further disengagement and lack of societal acceptance, potentially hindering Tunisia's energy transition. The information vacuum allows the perpetuation of the narrative around foreign funding as an exploitative, neo-colonialist venture that will provide energy for Europe whilst neglecting Tunisian needs (Hamouchene, 2017).

Government funding and investment present another key limitation to the positive socioeconomic potential of interconnection megaprojects. First, while a critique of the gaps and shortcomings of climate mitigation and adaptation financing is beyond the scope of this chapter, the nature of the funding attached to megaprojects carries implications for sustainable development in recipient countries such as Tunisia. For instance, funding for the ElMed project is almost exclusively in the form of loans and concessional loans. While this can ensure that Tunisia has the financial capacity necessary to ensure the implementation of this megaproject, it risks putting Tunisia even further in debt, in turn putting pressure on limited foreign currency reserves. In addition, the infrastructure improvements promised within the ElMed project, including the aforementioned electricity grid improvements, will also be carried out through loans, rather than grants. Indeed, the World Bank project information document states that the Tunisia grid reinforcement will cost an estimated €110 million, consisting of a €91.2 million International Bank for Reconstructions and Development (IBRD) loan and €18.8 million Green Climate Fund loan.

Second, the interconnection project will support Tunisia's aim of managing the peak domestic electricity demand through enabling it to export excess electricity production in winter while importing electricity from Europe to meet the summer peak in electricity demand. While the export revenues may contribute to replenishing Tunisia's foreign reserves, the country will also have to purchase electricity at European prices using foreign currency, therefore diminishing and potentially cancelling out any net profits from this arrangement. As the government and proponents of this project are estimating that ElMed will help reduce the cost of electricity for households (Bahoury, 2024), continued government spending on subsidies may be to enable that.

This section demonstrates that the interconnection megaprojects have the potential for limited positive impacts on national and subnational development in Tunisia. However, as revealed through this research, the TuNur project remains theoretical, as the company does not currently hold the funding nor the government approval to carry out its advertised megaproject. While the ElMed megaproject is in a more advanced state and its funding is already secured, its stated benefits will remain to be seen during the construction and operations phases. Oversight and accountability mechanisms are therefore essential to ensure that these megaprojects deliver on their development promises.

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Accountability and oversight mechanisms

Transparency is a key prerequisite for accountability and oversight. This research finds positive transparent practices associated with the ElMed project. First, donors and the Tunisian government have effectively communicated the details of the ElMed megaproject and its financing to the public. This is evidenced by the World Bank's official announcement of the project's funding and publication of key project documents, as well as the plethora of Arabic and French language media pieces available across Tunisian print media and radio, for

which parliamentarians and officials from the Ministry of Industry and Energy have provided official statements (Bahoury, 2024; Ben Mohammed, 2024; Khdimallah, 2023; Mosaïque FM, 2024). These articles and official statements detail the project's funding, scope, and role in achieving Tunisia's strategic energy transition goals (Al Zaghlami, 2023; Mosaïque FM, 2022; Tuniscope, 2022). Such efforts in publicising the project and its scope and benefits for Tunisia are positive and important to ensure societal acceptance of this megaproject and public buy-in for the country's overall energy transition efforts.

Second, as part of the ElMed project, the Tunisian government is obligated to abide by project donors' requirements, including through the preparation and publication of project feasibility studies, stakeholder engagement plans, environmental and social impact assessment and management, and sustainability. Funding for the ElMed project was secured from the Connecting Europe Facility (CEF) and the World Bank's Country Partnership Framework (CPF) (Nova, 2024). Both funding agreements entail transparency provisions. For instance, a condition of the CEF funding is the presence of "transparent, accountable and adequate monitoring and reporting measures, including measurable indicators" (EUR-Lex, n.d.) and therefore recipients of funds are subject to reporting requirements. Similarly, the World Bank CPF emphasises transparency and accountability in the use of resources. This involves mechanisms for public participation, disclosure of project information, and independent oversight to prevent corruption and ensure that funds are used effectively. Importantly, it includes safeguards to ensure that projects are implemented in an environmentally and socially sustainable manner. Thanks to these donor requirements, key documents related to the ElMed project, such as the feasibility studies, Stakeholder Engagement Plan (SEP), Environmental and Social Impact Assessment (ESIA), and Resettlement Action Plan (RAP) are published online (Bahri et al., 2023).

Environmental and social impact assessments (ESIA) and mitigation plans with a grain of salt

The public availability of key project documents is an essential step towards ensuring that the public, civil society and oversight actors have access to the necessary information to assess the project's delivery of its stated benefits and the mitigation of its harms. For instance, the project's ESIA seeks to assess the negative environmental and social impacts the project could have and provides appropriate mitigation plans. It is therefore a crucial tool for citizens to hold the government accountable for the mitigation plans it put in place to offset any negative impacts on the environment and the local communities.

However, while transparency is an important step towards ensuring oversight and accountability, it is important to note that the mere publication of these documents does not guarantee effective accountability and oversight. First, an independent evaluation of the comprehensiveness and accuracy of the existing ESIA is necessary as the ESIA pointed to some potential environmental risks associated with the construction phase of the ElMed project. For instance, it points to how constructing the overhead line (OHL) between Mornaguia and Mlâabi provides a high risk of collision for both migratory and wetland/forest resident bird species (EBRD, 2023b, p. 98). It therefore recommends that construction is 1 to 7 km away from Lebna wetland and Important Bird Area sites and the OHL is fitted with anti-collision devices (EBRD, 2023b, p. 100). The ESIA deems that the risks and potential impacts associated with the underwater component of the project, namely the installation of the submarine cables,

are likely to have a low impact on marine habitats and biodiversity on the condition that suitable digging techniques (ploughing and/or jetting) are used (EBRD, 2023c).

Despite recognising other potential risks, such as seabed contamination, change in the energy of the physical environment, disturbance and/or harm to marine fauna, and underwater noise, the ESIA states that "the project's overall impact has been evaluated to be negligible and therefore mitigation measures that will lead to net gain are most likely not required but will be confirmed during detailed design" (EBRD, 2023c, p. 19). The ESIA also finds "no impacts on cultural heritage" associated with the project, and it found "the magnitude of the impact on local economic activities" was considered "moderate" (EBRD, 2023c, p. 112).

These findings are in stark contrast to the World Bank's categorisation of the ElMed project as "Category A", suggesting that it will have "significant adverse environmental impacts that are sensitive, diverse, or unprecedented" (Elmed Studies, 2018, p. 8). This gap is also highlighted by the EBRB, which assessed the current ESIA and "identified insufficient assessment of risks and impacts on marine and terrestrial biodiversity, impacts on livelihoods, restrictions of access, insufficient stakeholder identification and engagement, and the need to conduct a Critical Habitat Assessment, a navigational risk assessment and additional socioeconomic impact assessment" (EBRD, 2023a). Therefore, specialised environmental civil society actors in Tunisia need to examine and evaluate publicly available project documents such as the ESIA and raise any concerns about gaps or inaccuracies.

As the next subsection illustrates, even with a comprehensive and accurate ESIA and mitigation plan in place, accountability and oversight are not guaranteed without meaningful citizen engagement.

The need to implement public consultation plans

Institutional reform is necessary to ensure the implementation of accountability and oversight mechanisms for megaprojects in Tunisia. As stated above, government officials and donors have endeavoured to publicise the benefits of the ElMed project for Tunisia's economy and energy transition. While this is a positive transparency step, it risks amounting to propaganda if not balanced with honest communication on the potential risks and the establishment of effective mechanisms to gather and address citizen concerns. When policy-making includes collecting the public's perspectives through public consultation mechanisms, it can increase oversight as policy-makers must justify how public perspectives are included. Also, it makes holding decision-makers accountable for their actions and decisions easier.

Even with a comprehensive and accurate ESIA and mitigation plan in place, accountability and oversight are not guaranteed without meaningful citizen engagement

Public consultations are required by Tunisian law under Decree 328-2018 of 29 March 2018, which stipulates in Article 3 the need for local and central institutions to engage in "an interactive process enabling concerned parties to present their suggestions and observations about a public policy during its development by a public entity" (Official Journal of the Tunisian Republic, 2018). Further, public consultation is a funding condition of the ElMed project. For instance, the CEF requires funding recipients to "ensure public consultation in compliance with applicable Union and national law" (EUR-Lex, n.d.). Similarly, the EBRD stipulates that "community safety and security, and employment expectations will also need to be thoroughly addressed through enhanced stakeholder engagement and management plans" (EBRD, 2023a). This research found evidence of thorough

public consultation plans embedded throughout the ElMed project cycle. These plans are detailed in the project's Stakeholder Engagement Plan (SEP), which was produced in 2018 and made publicly available. The SEP sets out various methods of citizen consultation and information during the project preparation phase, including through public consultations, small group meetings, pamphlets, a Facebook page, and radio. These mechanisms are aimed at achieving the following specific outcomes:

- Awareness about project objectives raised among stakeholders;
- Project affected persons (PAPs) informed about project adverse impacts, mitigation measures and their entitlements;
- Contact information shared with stakeholders;
- Awareness about project impacts raised among stakeholders, and consensus reached, about project benefits;
- Public awareness raised, and project benefits understood;
- Shareholders informed, and endorsing the project;
- Safeguards instruments (Environmental and social impact assessment [ESIA] and resettlement Action Plan [RAP] prepared timely, in consensus with PAPs and other stakeholders;
- Grievance redress mechanism prepared in consensus, and timely [manner] (Elmed Studies, 2018, p. 18).

In addition, the SEP sets out plans to hold three "Open house" meetings for discussions and compilation of complaints from people affected by the project (Elmed Studies, 2018, p. 18).

Desk research reveals evidence of Terna conducting public consultations in Italy during the project preparation phase between September 2020 and July 2021 (NS Energy, 2023). Indeed, the ElMed project website provides details about the public consultation undertaken on the Italian side, detailing that "Terna met with residents from the municipalities of Campobello di Mazara, Castelvetrano and Partanna in Sicily to present the project" (Terna & STEG, n.d.). By contrast, this research found no evidence online of any public consultations undertaken by STEG in the affected regions of Tunisia. In the absence of government communication on this issue, it is therefore unclear whether any public consultations have taken place in Tunisia as part of the ElMed project's preparation phase. In addition, the Tunisian government's portal for online public consultations shows no ongoing consultations and does not display any previous consultations regarding the ElMed project (Presidency of the Government - Electronic Administration Unit, n.d.). As construction works are planned to start in 2024, any unachieved public consultations planned for the preparation phase risk not being accomplished. This means that the ESIA and resettlement action plan were not prepared in consensus with project-affected persons, nor was a grievance redress mechanism developed in line with the project's stakeholder engagement plan. This suggests that, while the existence of legal dispositions and donor conditionality are conducive to accountability and oversight of megaprojects, an implementation gap exists. Therefore, institutional reform is required to contribute to filling this implementation gap.

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The limits of donor-imposed accountability and oversight mechanisms: the need for institutional reform

This section has so far revealed positive signs of donor-imposed accountability and oversight mechanisms related to the ElMed project. While this bodes well for ElMed, it

is important for Tunisia's overall energy transition that accountability be derived from government regulation and sound public sector governance, rather than rely on donor requirements. For instance, while the development of environmental impact assessments is required under Tunisian law thanks to Decree N°2005-1991 regarding EIA processes, there is no obligation in the Tunisian legal framework for publishing ESIA reports. This means that ESIAs for future projects may not be made publicly available if donors do not require them.

Similarly, despite the advances in the legislative framework governing renewable energy production in Tunisia, the institutional framework continues to lag, leading to overlap in responsibilities and conflicts of interest. One key institutional conflict of interest resides with STEG's highly centralised control of the energy sector (El Amine, 2023). For instance, STEG continues to be solely responsible for setting electricity prices, including those emanating from renewable energy. This is problematic in the current context considering that STEG also produces renewable energy while the current legal framework obligates foreign companies operating in Tunisia to sell their produced renewable energy to STEG. Therefore, accountability during negotiations between the Tunisian government and foreign companies can only be ensured with the creation of an independent regulatory body responsible for overcoming conflicts of interest. In turn, the added layer of oversight and accountability a national regulatory body will provide is beneficial for Tunisia's successful energy transition. In addition to protecting consumers from price fluctuations. A regulatory commission guarantees transparency and price stability, which consequently encourages investment in the energy industry and the creation of market regulations (Mokrani, 2022, p. 12).

Before the CPF could be agreed upon, a Systematic Country Diagnostic (SCD) was undertaken to identify how the funding could "most effectively and sustainably achieve the poverty reduction and shared prosperity goals" (World Bank, 2022). An SCD aims to identify the quality of governance by assessing factors such as transparency and accountability (World Bank Group, 2017). The Tunisia SCD identifies the high need to improve service delivery SOEs, such as STEG and SONEDE, pointing to poor governance regarding "transparency, internal governance, the strategic management of SOE portfolios (ownership functions, and monitoring of performance and compliance), and recruitment and retention of staff with the requisite skills" (World Bank, 2022). Furthermore, the SDC suggests transparency and anti-corruption reforms may face resistance from key SOEs (and their unions) (World Bank, 2022). Indeed, STEG does not have an excellent track record regarding public consultation and accountability before constructing renewable energy projects. The residents of Borj Essalhi, in the Cap Bon peninsula of northeast Tunisia, were not suitably informed or consulted before the turbines of the Sidi Daoud wind farm were constructed near their homes (Delpuech & Poletti, 2021). Residents argued they were misled or forced into leasing their land. At the same time, the wind farm has impacted farmers' livelihood, caused noise pollution, damaged the land, and interfered with migratory birds' flight paths(Delpuech & Poletti, 2021). The lack of STEG accountability for these harms inflicted on the communities of Borj Essalhi suggests significant pressure would need to be applied to ensure any accountability or oversight mechanisms are established in Tunisia's energy transition.

Residents argued they were misled or forced into leasing their land

Who benefits?

Tunisia has embarked on an energy transition to address its growing energy deficit and diversify its energy and electricity mixes, which are heavily dependent on gas imports from Algeria. Attracting investment to ramp up renewable energy production is an important pillar in Tunisia's energy transition, with the understanding that foreign investment in large renewables and interconnection electricity projects will boost clean energy production and yield important benefits for Tunisia's fledgling economy.

The overall benefits for Tunisia from megaprojects are moderate and largely exaggerated by donors and the implementing government alike

This chapter examined the socioeconomic impacts of the ElMed and TuNur electricity interconnection megaprojects on Tunisia. This research revealed that TuNur's interconnectivity megaproject only exists on the company's website, as the company has not secured any funding or a government concession to undertake a project of the claimed scale in Tunisia.

This research finds that the ElMed project has some positive impacts on national and subnational development in Tunisia and towards increasing the country's energy independence. This project offers a relative rebuttal to the critique of megaprojects as solely exploitative of Tunisia's resources within a one-way relationship in which Europe benefits from North Africa's sun and wind for its own energy transition. Rather, electricity interconnection with Europe can offer a two-way flow of electricity, enabling Tunisia to better manage the peaks and troughs in its energy demand. However, the caveat to this is the fact that Tunisia will be obligated to purchase this electricity at European prices with its already dwindling foreign reserves. For a country facing a compounded economic crisis, a more financially and environmentally sustainable solution would be to focus its resources and capacities on energy efficiency measures geared towards reducing domestic electricity demand.

In a similar vein, this research reveals that the overall benefits for Tunisia from megaprojects are moderate and largely exaggerated by donors and the implementing government alike. This is consistent with literature revealing the limited positive impact of renewable energy megaprojects on macroeconomic development and the livelihoods of local communities. As some critical voices highlighted, "mega-projects are united by their extreme complexity (both in technical and human terms) and by a long record of poor delivery" (Brookes, 2015, p. 241). For instance, the employment potential of the ElMed project is moderate, with an estimated 300 short-term construction jobs created and 25-30 longer-term positions during the operational phase. This is not surprising given the poor track record of renewable projects in directly stimulating employment. For example, the Noor Solar plant in Ouarzazate, Morocco, one of the largest concentrated solar power plants in the world, created 1,000 construction phase jobs and only 60 permanent operations and maintenance jobs (HeliosCSP, 2023). Furthermore, detractors have highlighted how the Noor plant has been a drain rather than a boon for the Moroccan economy, citing examples such as the "contractual arrangements between the Moroccan Agency for Sustainable Energy (MASEN), the Office Nationale de l'Electricité et de l'Eau (ONEE), and Saudi ACWA, which operates and maintains the Noor plant together with MASEN, have—for instance—led to major losses by publicly owned MASEN. In 2020, these amounted to €75 million" (Schuetze, 2023, p. 13).

This merits a critical examination of Tunisia's and North African nations' emphasis on north-south partnerships and the development of megaprojects as a central element in their energy transition strategies.

Otherwise, a focus on megaprojects at the expense of investment in decentralised, community-focused electricity generation solutions risks leading to a situation in which "the most marginal people are the ones who are going to pay the cost of the energy transition. And that's not fair" (S. Ammar, personal communication, October 28, 2023).

Indeed, while megaprojects such as ElMed bring in funding to improve infrastructure and increase energy supply, this funding is largely through loans, further indebting the country. While ElMed's funding has already been negotiated and secured in the form of loans, future projects should be negotiated through alternative climate funding means which do not risk further indebting already cash-strapped developing countries. For instance, Tunisia can seek to secure grants or engage in "debt-for-nature swaps" — whereby parts of its existing debts are cancelled in exchange for investments in environmental conservation measures (Assab & Al Hamawi, 2023).

This chapter found transparency measures implemented by the ElMed project, suggesting a positive move towards accountability and oversight. However, it is important to note that transparency alone does not guarantee effective accountability and oversight. Oversight actors must seek to independently evaluate the merits and accuracy of published documents, such as the ESIA, while advocating to hold the government accountable for their stated promises and mitigation plans. Notably, this research identified a gap between legal and donor requirements on the one hand and implementation on the other. For instance, despite public consultations being stipulated in Tunisian law and as a donor requirement for the ElMed project, no evidence was found to indicate that required public consultations took place during the preparation phase of ElMed. This suggests that, while donor-imposed accountability and oversight measures are welcome, they should not jettison the need for institutional reform within the Tunisian energy sector to ensure a well-governed energy transition.

While state-owned enterprise (SOE) governance reform is a current priority for Tunisia, emphasised by International Monetary Fund (IMF) loan conditionality, reforming STEG is urgently required to support a just and successful energy transition in Tunisia. Overall, improvements in the governance of energy sector SOEs are required for Tunisia to ensure a successful energy transition. The country's key energy SOEs continue to be entangled in a vicious cycle of poor financial management which hinders the state's ability to overcome debt and ensure revenue flows from its energy sector. For instance, the government's delayed payment of its electricity and gas bills to STEG has in part led to the accumulation of STEG debts towards its gas providers, namely Tunisia's state-owned oil and gas operator Entreprise Tunisienne d'Activités Pétrolières (ETAP) and the Algerian Sonatrach. ETAP has subsequently suffered its worst financial deficit since its creation in 1974, leading the government in 2020 to seize its bank accounts due to its failure to pay its oil tax (Business News, 2020). In addition, as STEG defaulted on paying its debt to Sonatrach for imported gas, the government had to intervene and pay 80% of STEG's $400 million debt to the Algerian SOE (Mosaïque FM, 2020). This unsustainable trend amongst public energy institutions and SOEs calls for a restructuring of these enterprises and their financial management and relationship with the state (Khdimallah, 2023).

Tunisia can draw lessons from Turkey's successful electricity market liberalisation process. This successfully restructured the Turkish Electricity Authority, a vertically

structured state-owned enterprise which dominated electricity generation, transmission and distribution (Bağhe & Taymaz, 2008, p. 1604) through a controlled "unbundling" to create separate generation and transmission companies as well as an energy exchange that operates day-ahead trading, intra-day trading, and electricity futures markets. Overseen by Turkey's separate Energy Regulatory Market Authority, the ongoing liberalisation process has enabled the robust participation of private companies as well as closer cooperation and coordination with the EU electricity market.

Recommendations

- In addition to trans-Mediterranean electrical interconnection megaprojects, Tunisia must pursue community-focused electricity generation solutions as part of its energy transition strategy.
- Transparency and oversight mechanisms need to be maintained through the construction and operation of the ElMed project to ensure environmental risks are minimised.
- Tunisia should seek to fund its energy transition through grants and engage in debt-for-nature swaps, rather than securing loans that risk putting the country deeper in debt.
- The government must engage in governance and financial management reform and restructuring of STEG to end unsustainable practices and resourcefully support Tunisian's energy transition. This could include the creation of an independent energy regulatory body.

References

AGENCE NATIONALE POUR LA MAITRISE DE L'ÉNERGIE. (n.d.). *Fonds de Transition Energétique: Réalisations, défis et opportunités | ANME.* Agence Nationale pour la Maîtrise de l'Énergie. https://www.anme.tn/fr/content/fonds-de-transition-energetique-realisations-defis-et-opportunites

AGENCE NATIONALE POUR LA MAITRISE DE L'ÉNERGIE. (2015). *Du Plan Solaire Tunisien* (p. 25). https://www.energiemines.gov.tn/fileadmin/user_upload/energies_renouvelables/PST_2015.pdf

AL ZAGHLAMI, M. (2023). *Electrical line project between Tunisia and Italy: Launching the request for technical proposals in June 2023.* Il Borsa Arabi. http://tinyurl.com/yxz6n489

AMMAR, S. (2023, October 28). [Zoom].

ANSOLE. (2024). ANSOLE – *African Network for Solar Energy.* https://ansole.org/

ASSAB, A., & AL HAMAWI, H. (2023). *The Road to COP28: Fueling a Green Revolution in the Middle East and North Africa by Bridging the Climate Finance Gap.* Natural Resource Governance Institute. http://resourcegovernance.org/articles/road-cop28-fueling-green-revolution-middle-east-and-north-africa-bridging-climate-finance

BAÇHE, S., & TAYMAZ, E. (2008). The impact of electricity market liberalization in Turkey: "Free consumer" and distributional monopoly cases. *Energy Economics*, 30(4), 1603–1624. https://doi.org/10.1016/j.eneco.2007.03.003

BAHOURY, T. (2024, February 1). Mohamed Ali Fenira: Les retombées du projet ELMED en Tunisie. *Leconomiste Maghrebin.* https://www.leconomistemaghrebin.com/2024/ 02/01/mohamed-ali-fenira-evoque-les-retombees-du-projet-elmed-pour-la-tunisie/

BAHRI, A. A., BEN JEMIA, S., PECORA, M., & ANDRIGHETTO, R. (2023). *Tunisia-Italy Power Interconnector Project Resettlement Framework* (p. 106). ElMed Studies. https://documents1.worldbank.org/curated/en/099041223190576450/pdf/P179240095 6b7f0c20844808816c2ff7be6.pdf

BEN AMMAR, I. (2022). *Towards a just energy transition in Tunisia.* Transnational Institute. https://www.tni.org/en/publication/towards-a-just-energy-transition-in-tunisia

BEN MOHAMMED, W. (2024). The Electric Interconnection between Tunisia and Italy. *Al-Sabah News.* https://shorturl.at/sxV27

BENBARKA, A. (2023). *Project Information Document–Tunisia-Italy Electricity Integration* (P179240; p. 19). World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099041823142027387/P1792400ce0383030ab5e094f80e97f1f8

BOUAFII, A. B. (n.d.). *TuNur, en consortium avec son partenaire Shanghai Electric, sécurise un projet solaire photovoltaïque de 10 MW à Gabès, en Tunisie, dans le cadre du 3e Round du régime d'autorisation.* https://www.tunur.tn/fr/tunur-en-consortium-avec-son-partenaire-shanghai-electric-securise-un-projet-solaire-photovoltaique-de-10-mw-a-gabes-en-tunisie-dans-le-cadre-du-3e-round-du-regime-dautorisation/

BROOKES, N. J. (2015). Mankind and Mega-projects. *Frontiers of Engineering Management, 1*(3), Article 3. https://doi.org/10.15302/J-FEM-2014033

BUSINESS NEWS. (2020). Les retards de paiement de la Stir et la Steg à l'origine de la saisie sur les comptes de l'Etap. https://www.businessnews.com.tn/la-stir-et-la-steg-a-lorigine-de-la-saisie-operee-sur-les-comptes-de-letap,520,102249,3

CALDERBANK, S. (2013). Desertec abandons Sahara solar power export dream. *Euractiv.* https://www.euractiv.com/section/trade-society/news/desertec-abandons-sahara-solar-power-export-dream/

CATSAROS, O. (2023). Cost of Clean Energy Technologies Drop as Expensive Debt Offset by Cooling Commodity Prices. *Bloomberg*. https://about.bnef.com/blog/cost-of-clean-energy-technologies-drop-as-expensive-debt-offset-by-cooling-commodity-prices/

CEF ENERGY. (2023). *CEF Energy: ELMED celebrates its grant agreement at the PCI Energy Days - European Commission.* European Commission. https://cinea.ec.europa.eu/news-events/news/cef-energy-elmed-celebrates-its-grant-agreement-pci-energy-days-2023-12-05_en

CLEVELAND, C. J., & MORRIS, C. (Eds.). (2013). Section 10—Solar. *In Handbook of Energy* (pp. 405–450). Elsevier. https://doi.org/10.1016/B978-0-08-046405-3.00010-3

COMPANIES HOUSE. (2024). *TUNUR (UK) LTD filing history—Find and update company information—GOV.UK* [UK Government]. https://find-and-update.company-information.service.gov.uk/company/07848390/filing-history?page=1

DELPUECH, A. (2023, October 28). [Zoom].

DELPUECH, A., & Poletti, A. (2021). *Borj Essalhi: The High Costs of Wind Turbines. Inkyfada.* https://inkyfada.com/en/2021/04/20/wind-turbines-cap-bon-tunisia/

DELPUECH, A., & POLETTI, A. (2022). *TuNur: Les zones d'ombre derrière l'export du soleil tunisien vers l'Europe.* Inkyfada. https://inkyfada.com/fr/2022/11/11/enquete-tunur-exportation-energie-solaire-tunisie-europe/

DIRECTION GENERALE DES STRATEGIES ET DE VEILLE. (2023). *Conjoncture Energétique* (p. 39). Ministère de l'Industrie, des Mines, et de l'Energie.

EBRD. (2023a). *STEG - ELMED power interconnector—Submarine cable.* European

Bank for Reconstruction and Development. https://www.ebrd.com/work-with-us/projects/psd/54389.html

EBRD. (2023b). *Tunisia-Italy Power Interconnector Environmental and Social Impact Assessment (ESIA) Section 8 Risks and potential impacts assessment – Terrestrial domain. ELMED Interconnector – Submarine cable (54389).* https://www.ebrd.com/work-with-us/projects/esia/elmed-interconnector-submarine-cable.html

EBRD. (2023c). *Tunisia-Italy Power Interconnector Environmental and Social Impact Assessment (ESIA) Section Section 9 Risks and potential impacts assessment – Marine domain. ELMED Interconnector – Submarine cable (54389).* https://www.ebrd.com/work-with-us/projects/esia/elmed-interconnector-submarine-cable.html

EIBL, F. (2017). *The political economy of energy subsidies in Egypt and Tunisia: The untold story* (p. 31). The Oxford Institute for Energy Studies. https://www.oxfordenergy.org/publications/political-economy-energy-subsidies-egypt-tunisia-untold-story/

EL AMINE, Y. (2023). T*unisia's Energy Sector: A Just Transition Analysis. Arab Reform Initiative.* https://www.arab-reform.net/publication/tunisias-energy-sector-a-just-transition-analysis/

ELMED PROJECT. (n.d.). *Elmed | Italy Tunisia submarine power line*. https://elmed-project.com/

ELMED STUDIES. (2018). *Feasibility Studies of the Tunisia-Italy power interconnection Stakeholder Engagement Plan.* https://ewsdata.rightsindevelopment.org/files/documents/25/WB-P164625.pdf

EUR-LEX. (n.d.). *Regulation (EU) 2021/1153 of the European Parliament and of the Council of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014 (Text with EEA relevance).* EUR-Lex: Access to European Union Law. https://eur-lex.europa.eu/eli/reg/2021/1153

EUROPEAN COMMISSION. (2022, May 18). *REPowerEU*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en

EUROPEAN COUNCIL. (2024). *EU sanctions against Russia explained.* https://www.consilium.europa.eu/en/policies/sanctions-against-russia/sanctions-against-russia-explained/

HAMOUCHENE, H. (2015, March 1). *Desertec: The renewable energy grab?* New Internationalist. https://newint.org/features/2015/03/01/desertec-long

HAMOUCHENE, H. (2017). Another case of energy colonialism: Tunisia's Tunur solar project. openDemocracy. https://www.opendemocracy.net/en/north-africa-west-asia/another-case-of-energy-colonialism-tunisia-s-tunur-solar-pro/

HAMOUCHENE, H., & SANDWELL, K. (2023). *Dismantling Green Colonialism.* Pluto Press. https://www.plutobooks.com/9780745349213/dismantling-green-colonialism

HEIDELBERG MATERIALS. (n.d.). *Noor Solar Power Plant* (Morocco). https://www.heidelbergmaterials.com/en/noor

HELIOSCSP. (2023). Noor Ouarzazate Solar Complex in Morocco, World's Largest Concentrated Solar Power Plant. *HeliosCSP - Portal de noticias de energía termosolar.* https://helioscsp.com/noor-ouarzazate-solar-complex-in-morocco-worlds-largest-concentrated-solar-power-plant/

INTERNATIONAL TRADE ADMINISTRATION. (2024). *Tunisia–Electrical Power Systems and Renewable Energy.* U.S. Department of Commerce. https://www.trade.gov/country-commercial-guides/tunisia-electrical-power-systems-and-renewable-energy

KARELLAS, S., KALOGIROU, S., LAPPAS, A., PAPADOPOULOS, A., & KAKARAS, E. (2015). *Energetic and exergetic evaluation of the hybridization of Solar Combined Cycle Power Plants. 2*1.

KHDIMALLAH, M. (2023). Projet «Elmed »: Un jalon stratégique pour l'Europe et l'Afrique du Nord. *La Presse de Tunisie.* https://lapresse.tn/2023/10/27/projet-elmed-un-jalon-strategique-pour-leurope-et-lafrique-du-nord/

KLAWITTER, J., & SCHINKE, B. (2011). *Desertec and Human Development at the Local Level in the MENA-Region: A human rights-based and sustainable livelihoods analysis.* Germanwatch & Brot fur die Welt. https://www.brot-fuer-die-welt.de/fileadmin/mediapool/2_Downloads/Fachinformationen/Analyse/analyse_28_englisch_Desertec_and_Human_Development.pdf

L'ECONOMISTE MAGHREBIN. (2024, January 30). ElMED: Adoption, en plénière du projet de loi relatif au prêt accordé à la STEG. *Leconomiste Maghrebin.* https://www.leconomistemaghrebin.com/2024/01/30/elmed-adoption-en-pleniere-du-projet-de-loi-relatif-au-pret-accorde-a-la-steg/

MOKRANI, M. A. (2022). *La transition énergétique en Algérie, au Maroc et en Tunisie.* Natural Resource Governance Institute. https://resourcegovernance.org/sites/default/files/documents/ la_transition_energetique_en_algerie_au_maroc_en_tunisie.pdf.pdf

MOSAÏQUE FM. (2020). *La STEG rembourse plus de 80% de sa dette auprès de la Sonatrach.* https://www.mosaiquefm.net/fr/actualite-national-tunisie/788141/la-steg-rembourse-plus-de-80-de-sa-dette-aupres-de-la-sonatrach

MOSAÏQUE FM. (2022). *The electrical interconnection project between Tunisia and Italy will be completed in 5 or 6 years* [Facebook Live]. https://www.facebook.com/mosaiquefm/videos/1173373286888380/

MOSAÏQUE FM. (2024). *Belhassen Chiboub: The ElMed project will enable Tunisia to meet its energy needs*. https://shorturl.at/giMOR

NATIONAL AGENCY FOR ENERGY CONSERVATION. (2023). *Solar Photovoltaic.* ANME. https://www.anme.tn/en/content/solar-photovoltaic

NATURAL RESOURCE GOVERNANCE INSTITUTE. (2023). *Just energy transition at the national level* [Facebook Live]. https://www.facebook.com/watch/live/?ref=watch_permalink&v=367473048937031

NOVA, R. A. (2024, February 2). Tunisia, Arrobbio (World Bank) at Nova: Elmed confirms its commitment to sustainable energy. *Agenzia Nova.* https://www.agenzianova.com/en/news/tunisia-arrobbio-world-bank-in-nova-elmed-confirms-commitment-to-sustainable-energy/

NS ENERGY. (2023). *Tunisia-Italy Interconnector (ELMED)* Project. https://www.nsenergybusiness.com/projects/tunisia-italy-elmed-interconnector-project/

OFFICIAL JOURNAL OF THE TUNISIAN REPUBLIC. (2018). *Decree Law 328-2018.* https://www.pist.tn/jort/2018/2018A/Ja0282018.pdf

PRESIDENCY OF THE GOVERNMENT - ELECTRONIC ADMINISTRATION UNIT. (n.d.). *Public Participation Portal. Republic of Tunisia.* http://tinyurl.com/2s4dwrk4

SCHUETZE, B. (2023). Follow the Grid, Follow the Violence: The Project for a Trans-regional Mediterranean Electricity Ring. *Middle East Critique,* 0(0), 1–19. https://doi.org/10.1080/19436149.2023.2242108

SEKER, A. U. (2023). *EU coal exit postponed in face of energy crisis.* Anadolu Agency. https://www.aa.com.tr/en/economy/eu-coal-exit-postponed-in-face-of-energy-crisis/2786108

TERNA, & STEG. (n.d.). *The Strategy: The Stakeholder Engagement*. ElMed Project. https://elmedproject.com/

TUNISCOPE. (2022). *Details of the electrical interconnection project between Tunisia and Italy.* https://www.tuniscope.com/ar/article/345568/arabe/iktisad/gaz-165421

TUNUR. (n.d.-a). Taqet Gabes 10 MW. https://www.tunur.tn/portfolio/taqet-gabes-10-mw/

TUNUR. (n.d.-b). *Tunur–Exportation Project.* https://www.tunur.tn/project/projets-dexportation/

TUNUR. (n.d.-c). *Tunur–Italy Transmission line.* https://www.tunur.tn/project/tunur-italy-transmission-line-2/

WORLD BANK. (2021). *Access to electricity (% of population)–Tunisia.* World Bank Open Data. https://data.worldbank.org

WORLD BANK. (2022). Tunisia Systematic Country Diagnostic: Rebuilding Trust and Meeting Aspirations for More Prosperity and Inclusion.. https://www.worldbank.org/en/country/tunisia/publication/tunisia-systematic-country-diagnostic-rebuilding-trust-and-meeting-aspirations-for-more-prosperity-and-inclusion

WORLD BANK. (2023). World Bank Approves $268 Million Project Linking Tunisia's Energy Grids with Europe. https://www.worldbank.org/en/news/press-release/2023/06/22/world-bank-approves-268-million-project-linking-tunisia-s-energy-grids-with-europe

WORLD BANK GROUP. (2017). An Early-Stage Assessment of the Systematic Country Diagnostic and Country Partnership Framework Process and Implementation: An Independent Evaluation (p. 186). https://ieg.worldbankgroup.org/sites/default/files/Data/Evaluation/files/scd-cpf.pdf

The Impacts of Energy Megaprojects in North African Countries: Opportunities and Challenges

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Introduction

The demand for energy is increasing at an unprecedented rate around the globe. As a result, many countries are exploring ways to meet their energy needs while addressing climate change concerns. In North African (NA) countries such as Morocco, Algeria, Tunisia and Egypt, energy megaprojects have been implemented to meet the growing demand. However, the EU (EU) recognises that these projects present strategic considerations, and it is essential to understand the EU's role in supporting these projects. Megaprojects are large-scale and complex infrastructure projects involving the collaboration of several public and private entities in a multiple-year timeframe. These projects are usually characterised by high risk and complexity, as well as significant capital investment. Furthermore, megaprojects seek to achieve significant economic, social, and/or ecological impacts. While these projects typically cost at least $1 billion, a high-risk, complex project costing less than $1 billion may be considered a megaproject, depending on the magnitude of the transformational effects on the country in which they are developed.

This chapter aims to elucidate the strategic considerations for the EU on energy megaprojects in NA countries, specifically Morocco, Algeria, Tunisia, and Egypt. This chapter examines the EU in these countries through a multiple-case study approach based on secondary data and country profile strategies. This chapter provides recommendations for the EU to support energy megaprojects in North Africa, which include strengthening its partnership with the studied countries. It is crucial to develop a long-term partnership with evolving objectives. By doing so, the EU can support short-term objectives such as economic development, reliable energy systems, generating employment opportunities, and maintaining energy security. Furthermore, the EU can increase exports of services and goods, improve relationships and soft power, and strengthen long-term collaboration. This chapter also considers the potential of renewable energy sources in NA countries and the EU's role in supporting their development.

The chapter is structured as follows: section 4.1 presents the EUs strategic objectives and challenges in NA countries, and the relevance of such NA countries to meet those objectives. Section 4.2 presents the country profile case studies, namely Algeria, Egypt, Morocco, and Tunisia. Section 4.3 presents the main EU initiatives directed towards NA countries, and the main instruments usually employed by the EU and its member states, distinguishing between financial instruments, policy mechanisms, and industrial cooperations. Section 4.4 includes the proposed strategies and lateral considerations concerning the allocation of risk in energy megaprojects, distinguishing the relevance of such projects' risk for alternative technologies. Finally, section 4.5. presents the concluding remarks and recommendations for the EU and its members.

EU strategic objectives and challenges in NA countries

The EU and its member states have promoted over the years multiple projects and policies to favour international cooperation and improve the sustainability of energy systems. Supporting Africa is, in general, a shared priority between Europe and Africa. Wide access to

energy is a key component for the development of social infrastructure and services, such as healthcare and education, which can ultimately boost economic development and industrialisation (Africa-EU Energy Partnership, n.d.).

Due to its proximity with Europe, NA countries are of strategic importance to the EU, in which investment for a just energy transition is fair and equitable, and supports the implementation of Nationally Determined Contributions (NDC) and National Adaptation Plans (NAPs) of African countries under the Paris Agreement to enhance mitigation and adaptation (AU-EU, 2022). African countries, and NA countries specifically, aim for security, peace and sustainable and sustained economic development and prosperity.

NA countries have significant solar and wind energy resources, estimated to be among the best worldwide. For instance, between 2010 and 2015, Morocco, increased its installed wind capacity from 253 megawatts (MW) to 934 MW, and its installed solar capacity from 34 MW to 200 MW (IRENA, 2023).

The EU (and its member states) pursue the following general objectives regarding the initiatives taking place in NA countries:

1. Energy security: The EU and its member states actively seek to enhance their energy security. One of the ways they are doing this is by exploring opportunities for increased cooperation with NA countries. This is crucial for the EU's objective of diversifying its gas supply, especially considering the recent conflict between Ukraine and Russia.

2. Decarbonisation: The increased cooperation with the NA countries can provide opportunities to accelerate the decarbonisation of EU energy systems. Given the global nature of greenhouse emissions, decarbonising NA countries' energy systems has also to be considered a relevant objective for the EU.

3. Commercial exports: Energy megaprojects present a commercial opportunity for EU industry, particularly for manufacturers, engineering companies, utilities, energy network operators, and financial institutions. These entities can export goods and services to the emerging economies in NA countries.

4. Technology and knowledge generation: Energy megaprojects can drive technological innovation, particularly in renewables and hydrogen generation, for the benefit of the EU.

5. Economic and technological aid: The EU has several programmes to provide economic and technical support to countries in North Africa. These initiatives indirectly benefit the EU, including stabilising the region, improving diplomatic relations, and providing social and humanitarian assistance to the people of NA countries. Additionally, the aid could increase the EU's soft power, potentially improving access to NA countries, promoting democratic values such as human rights, and increasing the accountability of energy megaprojects.

To achieve their shared objectives, both the EU and NA countries have adopted different strategies for energy sustainability. Spain and Morocco have a long-standing relationship, and their coordination appears more organic and coherent on many issues, which has recently resulted in the signing of 19

Efforts need to be made to stabilise the geopolitical and diplomatic situation in the region, which would incentivise further collaborations between NA countries, particularly Morocco, Tunisia, and Algeria

agreements to consolidate new eras of trust (Diplomatique, 2023). This follows a tense diplomatic relationship due to Spanish interference when the Western Sahara's pro-independence movement leader was treated for COVID-19 at a hospital in Madrid (Euronews & EFE, 2021). Regarding the electricity sector, they have recently signed an agreement for the construction of a power interconnector under the Strait of Gibraltar (Energy Reporters, 2019). Other examples of fruitful collaborations include the long-standing tradition of collaboration that Germany and Egypt have, which is undoubtedly beneficial. Not under the scope of this chapter, but also worth mentioning, is the strong cooperation that Russia has with Egypt regarding the construction of nuclear reactors, which will significantly increase their energy mix.

Efforts need to be made to stabilise the geopolitical and diplomatic situation in the region, which would incentivise further collaborations between NA countries, particularly Morocco, Tunisia, and Algeria, enabling energy exchange and promoting stability in their respective energy systems. For instance, Morocco's border with Algeria remains closed since 1994 (Department for Business & Trade, 2023), and, since the breakdown of diplomatic relations between both countries, Algeria decided not to renew the 25-year Maghreb-Europe Gas Pipeline (MGE) operation contract, which expired on 31 October 2021 (Rosenthal, 2023). This had a significant and immediate impact on Morocco's energy mix, as Algerian gas represented 10% of Morocco's electricity supply. Morocco is increasingly securing gas supplies from others, including domestic sources. Since 2022, Tunisia underwent a new electoral system in December 2022, showing positive signs of political evolution. This has led the government to working on a series of reform plans to engage with International Financial Institutions for structural support. The market has become increasingly concentrated, creating entry barriers with a high cost of doing business and stringent rules on investment, trade and licences, and limited access to finance (World Bank Group). Since 2017, Egypt has been working to establish itself as a leading destination for foreign direct investment (FDI) through the promulgation of a new investment law in 2017. While this has received great interest and success, there are multiple concerns perceived lack of democratic practices in politics and suppression of political dissent (Taim, 2023).

Furthermore, some of the challenges associated with the strategies come from the short-term implementation and lack of a long-term sustained strategy, resulting in a reactive and contingent approach, often benefiting other geopolitical competitors such as China, Russia and Turkey, which have been more proactive and benefit from this advantage. For instance, the Ukrainian-Russian conflict triggered a race to increase Algerian gas imports. Initiatives come from countries like Italy, which has a strategy named "Piano Mattei" (Reuters, 2024b), which has the aim to make Italy an energy hub to transport natural gas supplies from Africa to the rest of Europe, with Eni playing a key role in the initiative. Still, due to a negligible budget, it is unlikely to significantly impact NA countries unless either Italy or the EU funds it. The lessons learned from Kreditanstalt für Wiederaufbau (KfW) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) can be used to suggest parameters and guidelines for "Piano Mattei". Furthermore, Tunisia's and Italy's cooperation has

also recently accelerated for political and immigration reasons.

There is a significant limitation in the current approach, which revolves around the credibility and reputation of both the EU member states and industrial operators. The EU and NA countries have different standards regarding anti-corruption and environmental concerns. These standards can be indirectly measured by looking at proxies such as the corruption perception index, the reliability of the regulatory and enforcing system, and the implementation of environmental policies. The increased stake of EU contractors in energy megaprojects exposes them to reputational risks. Hence, it is crucial to avoid scandals to foster stable and long-term relationships between the EU and the considered countries.

These strategies face significant challenges, and their implementation requires strong will and direction from the parties involved, particularly the EU. The lack of a clear long-term and coherent energy strategy between the two regions creates ambiguity and uncertainty in long-term scenarios, which is where the EU can take the lead in filling this gap and paving the way for a coherent set of actions towards a clear roadmap for the future.

This reflection sheds light on the main challenges and limitations of cooperation programmes between the EU and NA countries. The EU has a loose approach towards these programmes, with individual EU member states promoting their plans with limited coordination. This inevitably results in suboptimal and sometimes adversarial strategies. On the one hand, competition between EU member states and their industries can benefit NA countries. On the other hand, the lack of a coherent and detailed EU strategy and coordination can lead to a fragmented and sometimes contradictory geopolitical and energy plan for the EU. However, the elephant in the room is Libya, which is particularly relevant for energy, geopolitical, and stability reasons.

Country profile cases

In examining the case studies, we considered the country's context. Each country is considered to have unique demographic, economic, and political conditions that influence the effectiveness of the EU's efforts.

The electric cables connecting NA countries with EU member states, particularly Spain and Italy, have been some of the initial steps for connecting energy infrastructure in NA countries, especially Morocco and Tunisia. The Spain-Morocco Interconnection Projects I and II have been instrumental in stabilising energy systems in Spain, which justifies the decision to implement a third interconnector between the two countries. Similarly, the Morocco-Portugal Power Link is part of Portugal's and Morocco's objective to become an energy-electricity bridge. However, controversies have arisen because of Morocco's ambitious plans to build regasification plants, storage tanks, and pipelines (Faouzi, 2024), proceeding mainly from fossil fuel-fired plants, following the reversal of the Maghreb-Europe pipeline.

Morocco has steadily positioned as a leader in the development of energy megaprojects, and due to the consistent high solar intensity and onshore wind resources, it continues to be attractive for significant transforming investments.

A significant example of this is the ambitious XLinks, connecting Morocco and the United Kingdom (UK). XLinks will be a new electricity generation facility entirely powered by solar and wind energy combined with a battery storage facility, connected exclusively to Great Britain via 4,000km high voltage direct current (HVDC) sub-sea cables (Xlinks, n.d.). It is expected to generate 11.5 gigawatts (GW) of zero carbon electricity from the sun and wind to deliver 3.6 GW of reliable energy, which shows the potential to increase investment in solar and wind energy projects.

The EU has made efforts in Algeria, mainly through Government agreements with Spain, Italy, and Germany, for gas and decarbonisation projects. Multiple Combined Cycle Gas Turbine plants (CCGTs) have been developed in Algeria under European cooperation, such as the Hassi R'Mel integrated solar combined cycle power station –in which ABENER ENERGÍA and COFIDES are shareholders (Cofides, 2011)–, the Terga CCGT –in which Alstom Power Centrale from France and Orascom Construction from Egypt (Orascom Construction, 2012) were the contractors–, and the Algeria Kais CCGT project –in which Global Cargo Care from the Netherlands delivered generators at the project site (NS Energy, 2021b)–. Tunisia has followed a similar example, including the Rades CCGT –in which GAMA Power System from Turkey was hired as a subcontractor (NS Energy, 2018)–, the Ghannouch CCGT –Turnkey contract awarded to ALSTOM (Alstom, 2008)–, and the Tahaddart CCGT –Turnkey contract awarded to Siemens Energy (Modern Power Systems, 2005)– in Morocco, or the ambitious development and presence of Siemens in Egypt, including the El Burullus Power Plant, Beni Suef CCGT, and the New Capital Power Plant (Siemens, 2018).

With additional efforts towards their sustainable development strategies, countries like Egypt have pledged to develop green or blue hydrogen projects. Egypt announced an outline of a low carbon hydrogen strategy, with backing from Egypt's Sovereign Fund and the European Bank for Reconstruction and Development (EBRD) (Zgheib, 2022), as they aim to become a hub for hydrogen production by 2040 (Lewis, 2022). Hydrogen can be produced from different sources. Green hydrogen proceeds from renewable energy sources, while blue hydrogen proceeds from fossil fuels, particularly from natural gas. Pledges to produce green or blue hydrogen must be tested against future market conditions. In the absence of a sufficient carbon tax regime, it is more likely that countries like Algeria and Egypt will resort to producing grey hydrogen using established processes like methane reformation without carbon capture and storage, resulting in significant greenhouse gas emissions.

The following sub-sections briefly introduce the countries considered, namely: Algeria, Egypt, Morocco, and Tunisia, and include some of the relevant megaprojects considered in the chapter.

Algeria

Algeria is a country located in North Africa with a current energy mix that is heavily reliant on producing and exporting natural and liquefied gas. This over-dependence on fossil fuels led to severe economic instability during the COVID-19 pandemic, as there was a significant decrease in demand for these products. Table 1 presents some of the most relevant energy megaprojects in Algeria.

Table 1. Sample of Energy Megaprojects

Infrastructure Type	Project	Project Cost (€) Millions	Capacity	Notes
Electric interconnection	Algeria - Italy Interconnection Project	850	1,000 MW	Project in planning stages. Expected completion date in 2028.
Gas	Algeria Kais CCGT	4 billion	1,266 MW	Construction began in February 2017.
Gas	Terga CCGT	2.4 billion	1,200 MW	Became operational in 2012.
Gas pipeline	Algeria Sardinia Italy Gas Pipeline	2 billion	3 BCM per year	The project is still under planning.
Solar	El Kheneg Solar Farm	40	60 MW	Became operational in 2014.
Solar	Hassi R'Mel Integrated Solar Combined Cycle Power Station	350	150 MW	Became operational in July 2011.
Wind	Adrar Wind Power Project	23	10 MW	Became operational in July 2014.

Elaborated by author, sourced from Joint Italian Arab Chamber of Commerce (2023), NS Energy (2021b), Orascom Construction (2012), Euronews (2022), NREL (2021) & Windpower (2013).

In 2011, Algeria set a goal to achieve 40% of electricity generation via renewable sources by 2030. This led to the establishment of new laws on renewable energy promotion and the development of renewable energy policies, such as the National Strategy for the Environment (SNE), the National Action Plan for Environment and Sustainable Development 2035 (PNAE-DD), and programmes for energy transition and the development of renewable energies. The Algerian Sustainable Consumption and Production National Action Plan (SCP-NAP) was also developed under the Ministry of Environment and Renewable Energy coordination under the EU-funded SwitchMed programme, with advisory services and technical support from the United Nations (UN) Environment Programme.

The state-owned oil company, Sonatrach has established strategic partnerships with European firms such as Eni from Italy, Cepsa from Spain, Wintershell Dea from Germany, and OMV from Austria to accelerate the development of gas projects and decarbonisation via green hydrogen. Despite the effort, it is unlikely that green hydrogen will contribute to a relevant portion; most likely, it will be blue hydrogen, which will represent the bulk of hydrogen production in the country (Collins, 2023) . This is mainly related to the fact that the local electricity grid in Algeria would have to be strengthened to reduce the cost of re-

Local electricity grid in Algeria would have to be strengthened to reduce the cost of renewable energy, which could increase the production of green hydrogen

newable energy, which could increase the production of green hydrogen. On the contrary, because Algeria possesses large natural gas reserves, it is more likely that they have the capacity to produce blue hydrogen at lower costs with the existing infrastructure. This collaboration aims to diversify Algeria's economy, reduce dependence on oil and gas, and improve the business climate. While this is still a challenging situation, there are renewed expectations that the business environment can improve by further focusing on the development of renewable energy, which has the potential of attracting international investment worldwide, and particularly from the EU, as part of their strategic interests.

Algeria has faced an unstable political environment for several years, mainly related to the long-standing government in power

Despite these efforts, Algeria has faced an unstable political environment for several years, mainly related to the long-standing government in power. Multiple social problems have resulted from social movements and public demonstrations, creating a sense of uncertainty for investors, and leading to an unstable environment for international markets. However, with the change of government, there has been more willingness and openness towards international markets (Rouaba, 2020). Following the 2020 referendum, changes in the maximum number of terms for presidents and MPs has been established, as well as the intention of implementing a new constitution that fosters the improvement of international relationships. Examples such as the National Investment Development Strategy aim to transform the economy by implementing structural governance reforms, improving human capital, improving quality of life, and reshaping industry sectors through industrial diversification to attract foreign investment.

Furthermore, the Algerian Law on Renewable Energy Promotion (Law 04-90) establishes a general structure for deploying a Renewable Energy Policy and sets production targets. The law aims to promote sustainable development in Algeria, protect the environment, and contribute to the international effort to curb climate change impacts. The legislation provides tools to promote the development and use of renewable energy sources.

The Renewable Energy and Energy Efficiency Development Plan set a target of 37% from solar power and 3% from wind power, with 23,000 MW of renewable capacity by 2030. 10,000 MW would be allocated for export to the European energy market.

Lastly, the EU-Algeria Association Council supports Algeria in diversifying its economy by improving its business climate through the development of renewable energy sources (to reduce dependence on oil and gas) and the modernisation of public finances. These measures support Algeria's economic reform programme. Algeria is the first country in North Africa to adopt Partnership Priorities with the EU to focus future cooperation on jointly identified areas of mutual interest.

Egypt

Egypt has a diverse energy mix, with natural gas as the primary source. Table 2 presents some of the most relevant energy megaprojects in Egypt.

Table 2. Sample of Energy Megaprojects

Infrastructure Type	Project	Project Cost (€) Millions	Capacity	Notes
Electric interconnection	Euro-Africa Interconnector	2.5 billion	2,000 MW	In planning stages. Cyprus - Egypt commissioning in expected for December 2028-2029.
Gas (CCPP)	El Burullus Power Plant	2 billion	4.8 GW	Became operational in May 2018.
Gas (CCPP)	Beni Suef CCGT	2.2 billion	4.8 GW	Became operational in July 2018.
Gas (CCPP)	New Capital Power Plant	2.2 billion	4.8 GW	Became operational in July 2018.
Nuclear	Dabaa Nuclear Power Plant	30 billion	4.8 GW	Construction began in July 2022.
Solar	Benban Solar Park	4 billion	1650 MW	Became operational in August 2019.
Wind	Gulf of Suez Wind II - Red Sea Wind Energy Wind Farm	660	500 MW	Construction began in November 2022.

Elaborated by author, sourced from EuroAfrica Interconnector (2020), NS Energy (2021a), Orascom (2018), Siemens (2018), Energy Industry Review (2018), World Nuclear News (2022), Conecon (2019).

The Egyptian government has established a long-term strategic plan, known as Egypt's Vision 2030, to achieve sustainable development in all fields, including energy, the environment, economic development, social justice, and others. This strategic plan aims to ensure that energy is produced and consumed sustainably, and that the country reduces its carbon footprint.

To achieve its goals, the Egyptian government has invested in a range of strategic projects, including renewable energy projects, such as the Benban solar park, a 1.8 GW solar power plant, and approved a bill regarding incentives for projects involving green hydrogen and its derivatives (Egypt Oil & Gas, 2023). During COP27, the Egyptian government announced the national low-carbon strategic framework (UNIDO, n.d.), with the ambitious objective of becoming a hub for low-carbon hydrogen. Until 2024, the Egyptian Government has signed memorandums of understanding (MoUs) for seven green hydrogen projects, which could lead to total investments worth up to $40 billion over 10 years (Reuters, 2024b). The Suez Canal Economic Zone is another strategic project that aims to promote energy-intensive industries and increase regional energy production.

Egypt has also fostered strategic partnerships with the EU, which is committed to supporting Egypt's energy transition and sustainable development. The partnerships include the EU-Egypt Association Agreement, the EU Global Gateway, the EU

The Egyptian Government has signed memorandums of understanding for green hydrogen projects, which could lead to total investments worth up to $40 billion over 10 years

Agenda for the Mediterranean, the RE-PowerEU initiative and its Economic and Investment Plan, and the EU-Egypt Partnership Priorities. These partnerships provide a framework for cooperation on renewable energy, energy efficiency, and other areas related to sustainable development.

To incentivise green investment, Egypt has issued green bonds to finance environmentally friendly renewable energy and energy efficiency projects. The government has also implemented debt swaps to reduce foreign debt, with the obligation to invest in projects that contribute to sustainable development. For instance, the German embassy in Cairo has signed a debt swap agreement with the Ministry of International Cooperation, the Ministry of Electricity and Renewable Energy, and the Central Bank of Egypt, where Germany will forgo €54 million in Egyptian debt, provided Egypt uses the equivalent sum in local currency to finance the project to link two 500 MW wind farms to the electrical grid.

Finally, at COP27, held in Sharm El-Sheikh, the EU and Egypt established a strategic partnership to boost their long-term cooperation on the clean energy transition, fostering sustainable development, combatting climate change and environmental degradation, and ensuring energy security. This partnership focuses on collaboration along the EU-Egypt Association Agreement, the EU Global Gateway, the EU Agenda for the Mediterranean and its Economic and Investment Plan, and the EU-Egypt Partnership Priorities. Through these partnerships and initiatives, Egypt is well-positioned to take advantage of the opportunities presented by the transition to a low-carbon economy and sustainable development.

Morocco

Morocco has recently undergone significant developments in the energy sector. As the European Commission evaluates the effectiveness of energy megaprojects in NA countries, it is essential to understand the country's energy mix and its efforts towards sustainable development.

Table 3 presents some of the most relevant energy megaprojects in Morocco.

Table 3. Sample of Energy Megaprojects

Infrastructure Type	Project	Project Cost (€) Millions	Capacity	Notes
Electric interconnection	Spain - Morocco Interconnection I	120	400 kV	Began operations in August 1997.
Electric interconnection	Spain - Morocco Interconnection II	115	400 kV	Began operations in June 2006.
Electric interconnection	Spain - Morocco Interconnection III	150	400 kV	Announcement of third interconnector made in February 2019.
Electric interconnection	Xlinks Morocco – UK Power Project	22 billion	10.5 GW	Project planned to become operational in 2030. Project Guidance updated in April 2024.

Electric interconnection	Portugal - Morocco Power Link	700	1,000 MW	Morocco and Portugal signed joint declaration to boost cooperation on the project in December 2023.
Gas (CCPP)	Tahaddart Combined Cycle Power Plant	337.8	400 MW	Began operations in January 2005.
Hydropower	Abdelmoumen pumped storage hydroelectric plant	350 million	350 MW	Expected to become operational in 2024.
Solar	Ouarzazate Solar Power Station	500	580 MW	Began operations in February 2016.
Wind	Boujdour II Wind Farm	402	300 MW	Began operations in July 2023.

Elaborated by author, sourced from REE (2007 & 2019), Morocco World News (2023), Power Technology (2022), Vinci Construction (2024), ESFC (2022) & WSRW (2023).

Fossil fuels, including oil and coal, dominate Morocco's energy mix. However, hydroelectric power also provides a relevant portion of baseload power. In recent years, the country has been making efforts towards sustainable development by establishing a National Sustainable Development Strategy. The strategy aims to operationalise sustainable growth by focusing on governance, transitioning towards a green economy, managing and developing natural resources and biodiversity conservation, accelerating the national climate change policy, promoting human development, and reducing social and territorial inequalities.

Recent changes in the Moroccan government are showing signs of willingness to maintain the country open to international collaborations. An example of this includes their involvement with the Open Government Partnership (OGP), in which they commit to upholding the principles of open and transparent government by endorsing the Open Government Declaration (OGP, n.d.). Morocco has made great achievements in this context, as one of the few countries in the world that is actively working to achieve the principles of open governance on three levels: an OGP action plan, an Open Parliament action plan, and a local action plan. The National Investment Development Strategy aims to transform the economy by implementing structural governance reforms, improving human capital, improving quality of life, and reshaping industry sectors through industrial diversification to attract foreign investment.

The Industrial Acceleration Plan 2014-2020 was an initiative developed by the government to establish strategic sectors such as automotive, aeronautics, and renewable energy. The plan aims to improve Morocco's institutional, political, and macroeconomic stability to enhance the reception capacity of investors to develop more and better infrastructure.

Morocco has also implemented legal and fiscal reforms to promote sustainable development in the energy sector since 2014. These include Law 48-15 on electricity market regulation, a carbon-

Recent changes in the Moroccan government are showing signs of willingness to maintain the country open to international collaborations

neutral trajectory, phasing out fossil fuel assets, the establishment of the Mohammed VI Fund for Investment (M6FI) in sustainable projects, and the EU-Morocco Green Partnership to consolidate cooperation in protecting the environment, conserving biodiversity, and fighting climate change.

Morocco has established strategic partnerships with the EU and other international partners to achieve energy independence and sustainable development. The country has received support from organisations such as the EBRD and the Ministry of Energy Transition and Sustainable Development (METSD). Funding agencies or funds that are actively involved in sustainable projects include the Clean Technology Fund (CTF), Kreditanstalt für Wiederaufbau (KfW) from Germany, the World Bank (WB), the African Development Bank (AfDB), the AFD (Agence Française de Développement), the European Investment Bank (EIB), and the NEOM Investment Fund (NIF).

Morocco has also undertaken significant projects to achieve energy independence and sustainable development. The recently installed Noor Ouarzazate solar complex, with a capacity of 580 MW, is an example of this. Morocco has one of the most important solar potentials in the world, with a solar radiation intensity of 2,635 kWh/m2. The project was funded by several sources, including the Clean Technology Fund (CTF), the German state bank KfW, the WB, the AfDB, AFD, EIB, and NIF.

Moreover, Morocco is actively working towards decarbonising its electricity sector. The EBRD and the Ministry of Energy Transition and Sustainable Development (METSD) signed an MoU to strengthen cooperation in moving the energy transition forward. This includes implementing Law 48-15 on electricity market regulation, a carbon-neutral trajectory, and phasing out fossil fuel assets.

Tunisia

Tunisia has been making significant strides in energy transition in recent years. The country's current energy mix relies heavily on fossil fuels, with around 97% of the electricity generated from non-renewable sources. However, the Tunisian government has established a national energy transition strategy focusing on renewable energy development. Table 4 presents some of the most relevant energy megaprojects in Tunisia.

Table 4. Sample of Energy Megaprojects

Infrastructure Type	Project	Project Cost (€) Millions	Capacity	Notes
Electric interconnection	TuNur Italy Transmission Line	Not available	2,000 MW	Construction is expected to begin in 2027.
Electric interconnection	ElMed Project	850	600 MW	EU grant signed in August 2023 for €307 million.
Gas (CCPP)	Rades C Combined Cycle Power Plant	345	450 MW	Began operations in September 2022.

Gas (CCPP)	Ghannouch Combined Cycle Power Plant	335	400 MW	Began operations in July 2011.
Solar	The Kairouan Solar Project	85	120 MW	Launch documents signed in September 2023 between AfDB, SEFA, and AMEA power.
Wind	Sidi Daoud Wind Farm Project	54	54 MW	Began operations in January 2000.

Elaborated by author, sourced from Tunur, Elmed Project, Mitsubishi Power (2022), NS Energy (2018), Alstom (2008), ADB (2022), ESI Africa (2023), RES4MED (2016).

The 30/30 strategy, which includes the efficient use of energy and energy mix diversification policies, has set an ambitious goal of achieving a 30% reduction in primary energy consumption by 2030. The Tunisian Solar Plan (PST) was implemented to achieve this goal, which sets targets for investment in wind energy, solar photovoltaic, and concentrated solar power.

The government has also introduced changes in regulatory frameworks to promote investment in self-generation projects and independent electricity production from renewable sources. Law 2015-12 is a regulatory and institutional framework that establishes a legal framework governing the implementation of electricity production projects from renewable energies through three regulatory regimes: self-consumption, permit regime via calls for projects, and concession regime via calls for tenders.

Tunisia has also established an Energy Transition Fund to implement the energy transition agenda, including the Tunisia Solar Plan. The fund aims to support renewable energy development and reduce dependence on fossil fuels. The government has also partnered strategically with European member states such as Germany, Italy, and France to invest in sustainable projects. The projects are being funded by financial institutions such as the EIB, the AFD, and the KfW.

The Tunisian-German Partnership, established in 2012, focuses on energy cooperation primarily centred on renewable energies, reduction of energy consumption, sustainable development, and climate protection. The GIZ-GmbH supports promoting renewable energy and improving energy efficiency, focusing on developing the solar market in rural areas.

Tunisia has also initiated efforts to build a 400 MW pumped hydro energy storage plant. The project's studies are being funded by the AFD, EIB, and KfW, and they aim to provide energy storage solutions for renewable energy sources.

Tunisia has introduced changes in regulatory frameworks to promote investment in its self-generation projects and independent electricity production from renewable sources

EU initiatives and instruments

The EU has launched several programmes and promoted the uses of various instruments to foster development and investment in NA countries, including Egypt, Algeria, Tunisia, and Morocco. This section briefly summarises, firstly, the initiatives developed and, secondly, the instruments employed to meet their overarching objectives concerning EU interventions in NA countries.

EU initiatives

The different initiatives launched by the EU have the objective of creating adequate framework conditions to support capacity-building, access to finance, and creating or opening opportunities for their citizens, businesses, and other stakeholders for the economy to thrive. These programmes include the EU's Global Gateway Initiative, the Comprehensive EU Strategy for Africa, the European Green Deal, the European Neighbourhood Policy (ENP), and the European External Investment Plan. While these initiatives may not be entirely coordinated, they contribute towards the general EU strategy in NA countries.

European Union's Global Gateway Initiative

The EU's Global Gateway Initiative aims to invest €300 billion between 2021-2027 in sustainable infrastructure development, connectivity and trade (European Commission, 2024). This initiative focuses on ensuring lasting benefits for local communities and improving transport, digital, and energy infrastructure to enhance connectivity between the EU and NA countries, thereby facilitating trade. The sustainable investment component promotes investments in critical sectors like energy, transport, and digital infrastructure through public-private partnerships and financing mechanisms. The Global Gateway Initiative is committed to promoting economic cooperation and creating opportunities for businesses in areas like renewable energy, digital economy, and sustainable infrastructure.

Comprehensive EU Strategy for Africa

The Comprehensive EU Strategy for Africa (European Parliament, 2020a) covers many topics related to the EU's partnership with Africa. It acknowledges the changing nature of development policies and practices in Africa and the need for a more comprehensive and integrated approach to development that addresses the interrelated nature of governance, security, humanitarian aid, climate change, and trade and investment. The EU's commitment to providing humanitarian assistance and support to African countries affected by conflict, natural disasters, and other crises is highlighted. The document stresses the need to build resilience and capacity in these countries to prevent and respond to future crises. The EU's efforts to address climate change and promote sustainable development in Africa are mentioned, including providing financial and technical assistance and support for renewable energy and energy efficiency.

European Green Deal

The European Green Deal (EGD) (El-Katir, 2023; European Commission, 2024b) is a long-term policy initiative from the EU towards a green economy by 2050. The EGD specifies policies, regulations, and measures that will impact the EU's trading agreements and relationships with developing countries, including Africa. In the case of Africa, particularly North Africa, it fosters Africa-EU collaborations by concentrating efforts on the renewable energy transition by accessing clean energy sources and collaborating on climate change mitigation, supporting sustainable development, and implementing environmental protection measures to address grand challenges.

European Neighbourhood Policy

The European Neighbourhood Policy (ENP) (EEAS, 2021) is designed to strengthen relations and cooperation between the EU and its neighbouring coun-

tries. The policy aims to promote prosperity, stability, and security in the region. It aligns with these countries' development agendas and enhances trade relations to promote economic integration. The ENP is strengthened by the European Neighbourhood Instrument (ENI), which serves as its financial arm and supports sectors such as economic development, governance, and infrastructure.

European External Investment Plan

The European External Investment Plan (EIP) combines EU grants with private investment to promote sustainable development, job creation, and economic growth in Africa and the EU. The plan supports sectors such as economic development and governance. The Euro-Mediterranean Partnership (EuroMed) is an agreement between the EU and 16 South Mediterranean countries that aims to enhance economic integration and promote democratic reforms in North Africa and the Middle East. The EU's primary objectives for evaluating energy megaprojects in NA countries include boosting energy security, accelerating decarbonisation, creating commercial opportunities, driving technological innovation, and providing economic and technical aid.

Instruments available for the EU

The variety of international instruments have the objective of supporting the EU and member states in enhancing good governance and their own rule-making processes into how they will support NA countries. To realise its objectives, the EU (and its member states) can leverage a combination of various approaches, herein summarised into three main categories of instruments, namely: (1) financial instruments, (2) policy mechanisms, and (3) industrial cooperation. The financial instruments refer to the packages of capital to provide efficient flow and transfer of economic resources and are mainly directed towards economic aid for energy megaprojects and implementing countries, namely debt swaps and direct loans. Green bonds are also included in this category; however, they are an exception from traditional financial instruments, as they are explicitly aimed at incentivising decarbonisation. The policy mechanisms are created and implemented to ensure that the EU and their member states operate in a way that is consistent with their values and goals. The EU policies focus mainly on trade relations, economic prosperity, agricultural production, environmental protection, employment, security, and foreign policy. The focus of the policies explored in this section is primarily on decarbonisation and can indirectly facilitate commercial exports from the EU and the generation of technology and knowledge in the long run. The last instrument to be considered is industrial cooperation, referring to the implementation of various agreements with specific modes of coordination. Its aim is to directly contribute to technology transfer and generation, and provide economic and technological aid.

The cases considered in this chapter combine financial and policy instruments, as well as industrial forms of cooperation. Although the results cannot be generalised as the same instrument can be used to support different objectives, general conclusions can be drawn from the megaprojects considered as part of this chapter. The instruments' design is crucial, and this is where the details matter the most. Table 5 distinguishes between the D-Direct contribution and the I-indirect contribution of the instruments towards the EU objectives regarding the NA countries interventions.

Table 5. Instruments available to the EU and association with EU objectives

		Energy Security	Decarbonisation	Commercial Exports	Technology and Knowledge Generation	Economic and technological Aid
Financial **Instruments**	Green bonds		D			I
	Debt swaps	I		I	I	D
	Direct loan	I		I	I	D
Policy Mechanism	Carbon Border Adjustment Mechanisms (CBAM)		D	I	I	
	EU Assistance for Regulatory and Market Reform	I	D	I		
	EU Development Aid Frameworks and the Development Bank Interventions	I	D	I	I	I
Industrial cooperation	Direct Industrial support			I	D	D
	Capacity-building			I	D	D

Financial instruments

The high cost of financing in NA countries often poses a significant challenge for developing, energy projects in general. While this is not exclusive to megaprojects, considering the monetary threshold in our definition, this problem is exacerbated. EU countries, development banks, and export EU credit agencies are completely positioned with the United States of America (USA) and China to provide attractive financial packages for energy megaprojects in NA countries. This includes the €300 billion fund to challenge the influence of China by delivering a value-driven approach to meet grand challenges (Rankin, 2021). The EU and member states are increasing the support to their states because of the desire to speed green transition away from fossil fuels and invest in new low-carbon technologies (Financial Times, 2023). This approach supports EU industrial operators working in NA countries and provides essential financial assistance to domestic countries. Moreover, these financial packages can play a vital role in guiding the infrastructure development needed to align with the EU strategy on matters such as the decarbonisation of energy systems and energy security. Unlike general financial aid, the financial packages tied with specific

energy megaprojects can focus more on EU objectives (e.g., diversification of gas and country exports) and are more easily controllable as EU industrial operators channel them. This aspect is particularly relevant due to the region's instability and the perceived risk of corruption.

Some of the most common financial instruments include (1) green bonds, (2) debt swaps, and (3) direct loans to governments.

Green bonds

Green bonds are an innovative financial tool to raise funds for projects promoting sustainability and combat climate change. These bonds are designed to finance environmentally-friendly projects such as renewable energy, energy efficiency, clean transportation, and sustainable water management. When investors purchase green bonds, the proceeds are used to finance projects that positively impact the environment and contribute to the fight against climate change.

In the context of EU aid for decarbonising NA countries, green bonds are an effective tool to finance sustainable development projects in the region. With the EU aiming to support the transition to a low-carbon economy in Africa, green bonds could provide a reliable source of financing for sustainable energy projects such as solar and wind power plants. Such projects could help reduce carbon emissions in the region and promote sustainable economic growth.

Overall, green bonds have the potential to play a significant role in financing sustainable development projects and promoting climate action. As the world continues to face the challenges of climate change, innovative financial tools such as green bonds will become increasingly important in the global effort to build a more sustainable and resilient future.

Debt swaps

Debt swaps are a financial arrangement in which a country or organisation can exchange its debt with another country's or organisation's debt. This can be done to reduce the amount of debt owed by a country or organisation to another country or organisation. Debt swaps can also be used to provide financial support to countries or organisations that are struggling financially. In the context of EU aid for decarbonising NA countries, debt swaps can be crucial in providing financial assistance to countries in the region to achieve their climate goals.

The EU's approach to decarbonising NA countries includes providing financial support and assistance to countries in the region to help them transition to low-carbon economies. Debt swaps can be used as a tool to provide this financial assistance. For example, the EU could offer to exchange a portion of a country's debt with a commitment to invest in low-carbon projects in that country. This would provide the country with much-needed financial support while supporting the EU's climate goals. By reducing a country's debt burden, debt swaps can free up resources for investments in climate-friendly sectors, such as renewable energy and energy efficiency.

Direct loan

Direct loans can be a valuable tool for the EU to support NA countries' transition towards a more sustainable energy production system. A direct loan is granted directly by a lender without the involvement of intermediaries such as banks. This can make access to funding more accessible and faster for entities needing financing, such as energy companies in NA countries.

By providing direct loans, the EU can support the development of renewable energy projects, such as wind and solar power

Direct loans can help mobilise private investment and leverage additional funding from other sources, such as development banks

plants, to help reduce the region's dependence on fossil fuels and contribute to a more sustainable energy production system. Additionally, direct loans can help finance the necessary infrastructure, such as transmission lines and substations, to bring renewable energy to the grid.

Direct loans can also have favourable terms and conditions, such as lower interest rates and longer repayment periods, which can make them a more attractive financing option for energy companies in NA countries. This can help mobilise private investment and leverage additional funding from other sources, such as development banks.

The EU may consider offering direct loans to countries, such as those in North Africa, as it provides more flexibility and can have specific conditions attached. For instance, green bonds can only be used for green energy projects, whereas direct loans can be used for any type of energy megaproject. Compared to debt swaps, direct loans can indirectly pressure countries, especially since NA countries already have significant public debt that affects their credit metrics. Therefore, direct loans should not only be considered as a form of financing, but also as a tool that enables the EU to exert pressure on NA countries if certain conditions are not met. Examples of such conditions could be reaching a certain level of renewable energy use in order to receive discounted interest rates or deferred payments. NA countries may be interested in such deals as they would benefit from a lower cost of debt for strategic infrastructure, particularly if they meet the pre-defined loan requirements.

Overall, direct loans can be an effective tool for the EU to support the transition of NA countries towards a more sustainable electricity production system. By providing financing to energy companies and supporting the development of renewable energy projects, the EU can contribute to a more sustainable future for the region and help mitigate the impacts of climate change.

Policy mechanisms

This section presents three main policy mechanisms commonly considered by the EU in promoting sustainable energy development and addressing climate change. These policy tools include (1) Carbon Border Adjustment Mechanisms, (2) EU Assistance for Regulatory and Market Reform, and (3) EU Development Aid Frameworks and Development Bank Interventions.

Carbon Border Adjustment Mechanisms (CBAM)

The CBAM is a policy tool designed to prevent carbon leakage and ensure that imported goods are subject to the same carbon pricing mechanisms as domestically produced goods. The CBAM seeks to prevent carbon-intensive industries from relocating to countries with less stringent climate regulations while protecting domestic industries' competitiveness and incentivising global emission reductions.

Under a CBAM, importers shall pay a carbon tax or purchase carbon allowances equivalent to the carbon emissions embedded in the production of imported goods. The carbon price is determined based on the carbon intensity of the production process in the exporting country, ensuring that imported products face a comparable carbon cost to domestically produced goods subject to carbon pricing.

The CBAM is often proposed as part of climate policies to complement domestic emission reduction efforts, such as carbon pricing schemes or emissions trading systems. It aims to level the playing field for

domestic industries while encouraging trading partners to adopt more ambitious climate policies.

However, implementing a CBAM presents various challenges, including concerns about trade compatibility, administrative complexity, and potential impacts on international trade relations. Despite these challenges, proponents argue that it can effectively align trade and climate objectives, incentivise emission reductions globally, and drive the transition to a low-carbon economy.

By requiring importers to pay a carbon price equivalent to the carbon emissions embedded in the production of imported goods, the CBAM ensures a level playing field for EU industries. However, while the EU has not yet proposed a CBAM for Africa, discussions about extending such mechanisms to other regions may arise in the future as part of broader efforts to address climate change and promote global decarbonisation.

If implemented correctly, CBAM can be crucial in promoting the transition to a greener economy and reducing carbon emissions in NA countries. The EU has already provided financial and technical support to NA countries to develop their renewable energy sector and reduce their dependence on fossil fuels. CBAM can complement these efforts by ensuring that imported goods from countries with lower environmental standards do not undermine the progress made in the region towards a greener economy.

However, developing and implementing a CBAM for imports from Africa would require extensive consultation and negotiation with African countries. This is because of their specific circumstances and interests, including economic development needs, capacity to comply with carbon pricing requirements, and potential impacts on trade relations. Therefore, discussions about extending the CBAM to other regions, including Africa, may evolve. Still, it is essential to ensure that CBAM does not harm the economies of NA countries.

To achieve this, the policy should be implemented in a way that promotes fair competition and does not discriminate against developing countries. The revenue generated from CBAM should support the transition to a greener economy in both the EU and the NA countries. A joint fund could support renewable energy projects and promote sustainable regional development.

EU Assistance for Regulatory and Market Reform

The EU supports NA countries' transition towards green energy and market liberalisation. With the world's energy needs continuously increasing, it is essential to have a sustainable, efficient, and reliable energy system that can meet society's demands without compromising the environment. This is why the EU assists NA countries in electricity market liberation, which is a crucial step towards achieving a sustainable and efficient energy system.

CBAM can be crucial in promoting the transition to a greener economy and reducing carbon emissions in NA countries

One of the challenges in implementing regulatory and market reforms in NA countries is ensuring accountability and transparency in the process. The WB has been a significant player in this area, providing funds and technical assistance to support regulatory and market reform in NA countries. However, the WB's impact on accountability and regulatory reform is often compared to that of the EBRD, the EIB, and other strictly European EU institutions.

The WB is also trying to pressure Tunisia, a country in NA, to undergo necessary

reform, with the National Utility (Société Tunisienne de l'Electricité et du Gaz - STEG) being the primary target. Tunisia is considered a good baseline case for regulatory and market reforms, and other NA countries could also be included.

Despite the efforts of the WB and other institutions, it is still essential to determine whether the EU is contributing effectively to the energy transition and market liberalisation in NA countries. The EU has significant skills and experience in this field, and it can be argued that these should be leveraged to support NA countries' regulatory and market reforms. The EU can provide technical assistance, training, and financial support to help NA countries implement sustainable and efficient energy systems.

The EU's assistance for regulatory and market reform in NA countries is crucial to achieving a sustainable and efficient energy system. Market liberalisation is essential for creating a competitive and efficient energy market that provides consumers with affordable and reliable energy. While the WB and other institutions have been providing support for regulatory and market reform in NA countries, the EU's skills and experience in this area should also be leveraged to ensure that the energy transition in NA countries is successful.

EU Development Aid Frameworks and the Development Bank Interventions

KfW and GIZ play a crucial role in promoting cooperation with NA countries, especially in endeavours aimed at decarbonising electricity production

The EU Development Aid Frameworks is an important document that lays out the EU's aid support to NA countries, focusing on promoting the transition to green energy. EU government development banks have the potential to mobilise resources and facilitate knowledge transfer for sustainable development goals. By investing in renewable energy projects and promoting energy efficiency measures, these banks help mitigate climate change and foster economic growth in NA countries. They also promote partnerships between EU member states and NA countries, fostering regional cooperation and stability.

EU development banks such as the EIB and the EBRD significantly promote sustainable development in the region. For example, the EIB provides financing for renewable energy projects and supports initiatives to enhance energy security and resilience. Similarly, the EBRD invests in renewable energy infrastructure and promotes private sector participation in the energy sector.

KfW and GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) are institutions that play a crucial role in promoting cooperation with NA countries, especially in endeavours aimed at decarbonising electricity production. They provide financial support and technical assistance for sustainable development projects. KfW has a long-standing partnership with NA countries, offering funding for renewable energy infrastructure and energy efficiency initiatives. GIZ complements these efforts by providing expertise and capacity-building support to local stakeholders.

It is important to note that there are vast differences in the level of development and economic conditions in each NA country. For instance, Morocco and Egypt have relatively developed infrastructure, while Tunisia and Algeria have a more challenging economic environment.

KfW/GIZ has been one of the most significant contributors to Morocco's renewable energy sector, supporting several projects, including the Noor Ouarzazate Solar Power Station, one of the largest solar power plants globally. KfW/GIZ has also provided technical assistance and capacity-building to the Moroccan government, helping de-

velop a robust regulatory framework for the renewable energy sector.

In Algeria, France's AFD has been involved in several projects, including developing the country's renewable energy sector. In Tunisia, AFD has supported several projects, such as the modernisation of the country's railway infrastructure and contributions to the energy sectors.

While development aid frameworks allow for a coordinated and strategic approach to development aid, ensuring that resources are utilised efficiently, they can also lead to a lack of diversity in aid providers, with only a few institutions dominating the aid landscape.

The EU Development Aid Frameworks document outlines the EU's support for the green energy transition in NA countries. KfW/GIZ is a significant player in this space, and its role varies across different countries. Comparing KfW/GIZ to other European institutions highlights the pros and cons of development aid framework approaches, ultimately informing future aid strategies. For instance, among the pros that GIZ has is that it contributes to the implementation of the EU's political objectives and international obligations through its advisor activities, including developing and implementing national adaptation plans (NAPs), promoting the expansion of renewable energy sources and green hydrogen production, as well as climate-friendly, resource-efficient technology to avoid greenhouse gas emissions (GIZ, 2023). One of the major cons is the aid structure and business model from KfW/GIZ, as they make a clear distinction between technical cooperation, led by GIZ, and financial cooperation, led by KfW. Both GIZ and KfW manage their own procurement processes and issue their own tenders (Troilo, 2011), which is an issue for most NA countries, which need technical assistance and financial support for the megaprojects they are developing.

Industrial cooperation

Direct Industrial support

The EU's industrial operators have a significant role in promoting the deployment of energy megaprojects in NA countries. These projects require massive investments in infrastructure, technology, and skilled labour, and the EU's industrial operators have the expertise and resources needed to make them a reality.

Direct industrial support from the EU can take many forms: technical assistance, technology transfer, and project management. EU operators offer technical expertise in areas such as renewable energy, energy storage, and energy efficiency. An example is Siemens in Egypt for developing and operating Combined Cycle Gas Turbine (CCGT) stations.

Capacity-building

The EU's assistance in building capacity and developing skills among the workforce in NA countries is a significant step towards creating a sustainable energy ecosystem in the region. It involves various activities like training programmes, knowledge sharing, and technology transfer, which aim to increase the reliability of energy supply and dispatch and create job opportunities in NA countries.

Technical training, particularly for operating and maintaining energy systems, is essential for creating a sustainable energy ecosystem. It not only enhances the local workforce's skills but also benefits EU exports. By providing technical training as an additional service to NA countries, the EU can demonstrate a long-term commitment to the partnership, ultimately stabilising energy systems in the region.

Siemens' programme in Egypt for developing and operating CCGT stations is a great example of such training. The technical training programme by Siemens enhances the skills of the local workforce, contributes to job creation, and benefits EU exports. However, the Siemens example is just one of the many examples of capacity-building activities in which the EU is involved as part of its assistance in developing energy megaprojects in NA countries.

Risk allocation in energy megaprojects

When considering individual energy megaprojects, one of the most crucial aspects to address during the negotiation and ratification of contracts is the allocation of risk. This is crucial, particularly in NA countries where sovereign, compliance, regulatory, and reputational risks are significant factors. To ensure the best international practice, the following allocation of risk is suggested in line with conventional risk allocation approaches (Gatti, 2018; Vinter, Price, & Lee, 2013). Please refer to Table 6 for the type of energy infrastructure whose risks are considered relevant.

Table 6. Relevance of their risks and their allocation for different types of energy infrastructure

Main Risk Considered	Type of Energy Infrastructure
Completion risk **Financial risk** **Sovereign, legal, and regulatory risk**	Relevant for all energy infrastructure considered, including pipelines, electricity interconnections, wind farms, solar power plants, nuclear, hydroelectric, and hydrogen production facilities.
Demand risk	This is particularly relevant for oil and gas pipelines and potentially hydrogen production and conveyance. [5]
Supply risk	This is especially relevant for fossil fuel power stations, in particular gas and oil.

Completion risk is a critical factor that should be allocated more efficiently to experienced EU main contractors who can deliver energy megaprojects efficiently. To ensure this, it is recommended to have a single point of responsibility by using integrated contracts such as design and build, lump sum turnkey. It is advisable to limit the number of nominated subcontractors by the client, such as NA countries utilities and governments, wherever possible. Guaranteeing a general portion of local content and employment can enable EU contractors to have better control over project delivery. The financial and training package mentioned above can strengthen EU contractors' bargaining power to acquire better conditions in terms of project control and prices.

The NA countries' governments should allocate sovereign, legal, and regulatory risks better.

These risks can be measured with proxies' indicators associated with the NA countries, including:

[5] This will depend on the evolution of the hydrogen market.

- Credit Ratings: Agencies like Moody's (Moody's, n.d.), Standard & Poor's (Cullian, 2019), and Fitch (Fitch, 2024) provide credit ratings for countries, indicating their creditworthiness and the likelihood of default on debt obligations.
- Sovereign Credit Default Swap (CDS) spreads: CDS spreads measure the cost of insurance against default on a country's sovereign debt. Higher spreads indicate higher perceived risk.
- Global Competitiveness Index (GCI): The GCI, developed by the World Economic Forum, assesses the competitiveness of countries based on factors like infrastructure, macroeconomic stability, health, education, and market size (World Economic Forum, 2020).
- Ease of Doing Business Index: The WB's Ease of Doing Business Index ranks countries based on the regulatory environment for starting and operating a business, which can indirectly reflect sovereign risk (World Bank, 2024a).
- Corruption Perceptions Index (CPI): Transparency International's CPI ranks countries based on perceived levels of public sector corruption, which can affect governance and sovereign risk (Transparency International, 2023).
- Legal System and Rule of Law Index: These indices assess the quality and effectiveness of a country's legal system and the rule of law. Examples include the World Justice Project Rule of Law Index and the Lex Mundi Rule of Law Index (World Justice Project, 2023).
- Property Rights Protection Index: This index measures the extent to which a country's legal system protects property rights. The International Property Rights Index (IPRI) is one such measure (Property Rights Alliance, 2023).
- Contract Enforcement Index: This index evaluates the ease and efficiency of contract enforcement in a country's legal system. The WB's Doing Business report includes a measure of contract enforcement (World Bank, 2024b).
- Regulatory Quality Index: This index assesses the quality of regulations and their implementation in a country. It considers factors such as transparency, predictability, and efficiency of regulatory processes. The World Bank's Worldwide Governance Indicators (WGI) include a measure of regulatory quality (World Bank, 2024c).
- Investor Protection Index: This index measures the extent to which a country's legal framework protects the rights of investors. The Global Investor Protection Index (GIPI) is one such measure.

All these indicators emphasise a relevant perceived sovereign risk by foreign investors in NA countries. Such risks can only be partially transferred via contracting instruments, such as equilibrium clauses. Series contracts aiming at multiple energy projects in sequence can provide a basis for longer-term partnerships, reducing the risk of retaliation by EU contractors due to altered government conditions or legal and regulatory amendments. This approach can also help the EU influence the energy strategy of NA countries. As previously described, it would be extremely attractive in the presence of financial packages.

Demand risk is a significant concern, especially for pipelines. EU member states can secure revenue streams by establishing long-term agreements such as offtake or take-or-pay contracts. This

EU member states can secure revenue streams by establishing long-term agreements such as offtake or take-or-pay contracts

strategy particularly benefits EU countries looking to diversify their gas supply in response to the ongoing Ukrainian-Russian conflict. Some member states, like Italy, are pursuing this approach with Algeria, which facilitates the financing and rapid implementation of new pipelines. Despite these efforts, there have been concerns about the ability of Algeria to meet their future supply commitments. Therefore, it is appropriate for EU contractors and member states to address this potential risk and establish reliable compensation mechanisms in their long-term contracts.

NA countries are far from becoming a net exporter of electricity as they are currently coping with internal challenges such as meeting growing demand, rebalancing the energy mix, replacing old power stations, and making the energy infrastructure more resilient to climate change

Supply risk is a significant concern for NA countries, particularly net importers of fossil fuels such as Tunisia and Morocco. To ensure the availability of fuel supplies and reduce price fluctuations, these countries should establish long-term contracts with fuel suppliers.

Reflections on the possible strategies for EU and NA countries

The increased electricity interdependency between NA countries and the EU can become a platform for future models in which either the EU or NA countries become the predominant exporter of electricity. The following two potential strategies for improving EU-NA countries cooperation on energy megaprojects further discuss this.

Potential long-term strategy 1: One possible long-term strategy for NA countries is to become a net electricity exporter to the EU. However, since fossil fuels still dominate the NA's countries energy mix, this could be controversial as it may appear that the EU is greenwashing their energy production by relying on NA's countries quota of fossil fuels. The reputational risk of this strategy is too significant to ignore, so the author hypothesises a scenario in which NA countries significantly expand their renewable energy production and export the excess electricity to southern European countries via existing interconnections, which could be further expanded in the long run.

This strategy has several challenges, mainly because the current penetration of renewable energy is limited in the countries considered. NA countries are far from becoming a net exporter of electricity as they are currently coping with internal challenges such as meeting growing demand, rebalancing the energy mix, replacing old power stations, and making the energy infrastructure more resilient to climate change. Even if NA countries considerably expand their renewable power generation, the EU cannot afford to rely heavily on this strategy due to the instability of the region, which would impact energy security. While this strategy is potentially possible, it is considered more theoretical than practical to date.

Furthermore, the stabilisation of the electricity grid and increased reliability of energy systems is crucial for NA countries, and it is highly beneficial to southern European member states. This section recommends implementing energy stabilisation through grid substations and international connectors. The latter provides excellent opportunities for further interdependence and creates the basis for a long-term partnership. Global interdependencies can facilitate liberalising energy markets in NA and promote more synergistic energy planning in the long run, which would benefit the European decarbonisation strategy. A clear vision for extended energy systems has yet to be fully developed. In the short run, electricity interconnections will facilitate the

stability of the national systems of both NA countries and southern EU member states, but energy exports will be limited between the two sides.

Potential long-term strategy 2: The EU is prioritising the long-term goal of producing electricity using a mix of energy sources that meet decarbonisation targets, including extensive use of renewable energy. However, achieving this goal could be difficult without nuclear power, considering the current state of renewable energy technologies and resources in Europe. The European Network of Transmission System Operators for Electricity (ENTSO-E) and the EU are concerned about this issue, as some countries, such as the Netherlands, Poland, and Finland, are moving forward with nuclear energy.

The EU aims to balance its energy market across the region by using interconnection systems to stabilise the power grid and export any excess energy generated from renewable sources. However, if NA countries integrate their electricity systems too closely with the EU market, it could significantly drive up the price of electricity in NA countries. This could undermine some of the EU's goals, and the Euro-NA interconnection could backfire. Therefore, the interconnection with NA should not be based on a single market of electricity, and the pricing mechanisms in NA countries should be separated from those in Europe.

This approach requires the active involvement of EU member states, especially in southern Europe, particularly Italy, Spain and Portugal. However, since these countries lack a solid nuclear programme, generating carbon-free (during the operation), baseload power is more challenging, making them net energy importers instead of exporters. This situation presents a significant challenge to achieving their goals of decarbonising the energy system. Despite France's aging nuclear fleet, which needs expansion, it remains the only country in a solid position to maintain the role of energy exporter (IAEA, 2022).

Conclusion and recommendations

This chapter highlighted the strategic relevance, impacts, opportunities, and challenges of the investment in energy megaprojects for the EU and NA countries. Strengthening partnerships with NA countries remains on top of the EU's priorities to maintain sustainable investments to attract EU investors and partners to boost regional sustainable growth. Furthermore, the EU is looking to strengthen its energy reliance from NA countries, implementing multiple initiatives executed through various instruments that shift from a donor-recipient model to a relationship model based on cooperation.

If NA countries integrate their electricity systems too closely with the EU market, it could significantly drive up the price of electricity in NA countries

The main recommendations are:

1. Improve industry planning to promote a more systemic approach and encourage synergies such as cogeneration opportunities. For example, hydrogen production should be planned correctly in conjunction with domestic chemical and agriculture industries and potentially with the EU industrial strategy.
2. Promotion of green hydrogen: If the EU wants to promote the production of green hydrogen in NA countries, it should influence the existing carbon tax regime in the relevant countries or identify alternative incentives that minimise the generation of greenhouse gases.
3. The EU shall provide financial aid for energy megaprojects in NA countries. In doing so, the EU shall consider

appropriate financial instruments that either directly support more sustainable energy mixes (e.g., green swaps) or provide forms of financial support that would provide it a degree of leverage and bargaining power even after the granting of the financing, e.g., direct loans with contingent terms that provide favourable borrowing conditions only if the pre-defined targets have been satisfied by NA countries.

4. The EU shall provide a general platform to facilitate homogeneous and collaborative interventions for energy collaboration between EU member states. The member states are taking a more proactive and semi-independent role in shaping their support and partnerships with NA countries.

The EU shall consider gradually expanding the energy market to NA countries. In doing so, the higher electricity prices in the EU and the lower willingness to pay for renewable projects in NA countries should be considered. In the long term, it's important to work towards better collaboration in the energy sector to promote a more sustainable global energy system and address the challenge of reducing greenhouse gas emissions. This collaboration should extend beyond the EU and involve global efforts to transition towards cleaner energy sources. To realise such ambitious recommendations, a gradual approach is necessary, and sophisticated financial instruments and EU subsidies are required to take into consideration the relevant differences with NA countries' energy systems.

References

ADB. (2022). *Steg - Centrale De Ghannouch – Tunisia.* https://www.afdb.org/sites/default/files/documents/projects-and-operations/tunisia_-_kairouan_solar_pv_project_-_project_summary_note.pdf

AFRICA-EU ENERGY PARTNERSHIP. (n.d.). *Africa-EU Energy Partnership.* https://africa-eu-energy-partnership.org/gei/

ALSTOM. (2008). *Alstom to build first GT26-based combined-cycle power plant in Tunisia.* https://www.alstom.com/sites/alstom.com/files/2018/07/08/Global/Group/Resources/Documents/Investors%20document/Regulated%20Information/PR_Ghannouch_010708.pdf

AU-EU. (2022). *6th European Union – African Union Summit: A Joint Vision for 2030.* European Council. https://www.consilium.europa.eu/media/54412/final_declaration-en.pdf

COFIDES. (2011). *The Hassi R´Mel Solar-Gas Hybrid Power Plant Oficially Inaugurated In Algeria.* https://www.cofides.es/en/noticias/notas-de-prensa/hassi-rmel-solar-gas-hybrid-power-plant-oficially-inaugurated-algeria#:~:text=The%20Spanish%20Minister%20for%20Industry%2C%20Tourism%20and%20Trade%2C,Spanish%20firm%20ABENER%20ENERG%C3%8DA%20and%20COFIDES%20are%20shareholders

COLLINS, L. (2023). *Algeria aims to supply Europe with 10% of its clean hydrogen needs by 2040 in new national H2 roadmap*. Hydrogen Insight. https://www.hydrogeninsight.com/policy/algeria-aims-to-supply-europe-with-10-of-its-clean-hydrogen-needs-by-2040-in-new-national-h2-roadmap/2-1-1426265

CONECON. (2019). *Benban, Egypt – Commissioning of the World's Largest Solar Power Plant.* https://www.conecon.com/en/news/benban-aegypten

CULLIAN, T. (2019). *Sovereign Ratings List. S&P Global.* https://www.spglobal.com/ratings/en/research/articles/190807-sovereign-ratings-list-11099434

DEPARTMENT FOR BUSINESS & TRADE. (2023). *Overseas business risk: Morocco.* Government of the United Kingdom. https://www.gov.uk/government/publications/overseas-business-risk-morocco/overseas-business-risk-morocco

DIPLOMATIQUE. (2023). Spain, Morocco sign 19 agreements, 'consolidate new era of mutual trust'. https://diplomatique.ma/en/2023/02/02/spain-morocco-sign-19-agreements-consolidate-new-era-of-mutual-trust/

EEAS. (2021). *European Neighourhood Policy.* https://www.eeas.europa.eu/eeas/european-neighbourhood-policy_en#:~:text=The%20European%20 Neighbourhood%20Policy%20(ENP,their%20mutual%20benefit%20and%20interest

EGYPT OIL & GAS. (2023). *Egypt Incentivizing Green Hydrogen Projects Through a New Law to Be Ratified Soon.* https://egyptoil-gas.com/features/egypt-incentivizing-green-hydrogen-projects-through-a-new-law-to-be-ratified-soon/

EIB. (2006). *Steg - Centrale De Ghannouch.* https://www.eib.org/en/projects/all/20050635

EL-KATIRI, L. (2023). *Sunny Side Up: Maximising The European Green Deal's Potentialfor North Africa And Europe.* ECFR. https://ecfr.eu/wp-content/uploads/2023/01/Sunny-side-up_Maximising-the-European-Green-Deals-potential-for-North-Africa-and-Europe.pdf

ELMED PROJECT. (n.d.). *The Connection With The Future Energy.* https://elmed-project.com/

ENERGY INDUSTRY REVIEW. (2018). *World's largest combined cycle power plants completed in record time.* https://energyindustryreview.com/power/worlds-largest-combined-cycle-power-plants-completed-in-record-time/

ENERGY REPORTERS. (2019). Spain and Morocco sign interconnector deal. https://www.energy-reporters.com/transmission/spain-and-morocco-sign-interconnector-deal/

ENGIE. (2024). *500-MW Gulf of Suez 2 (Egypt) wind farm project breaks ground.* https://engiemiddleeast.com/press-releases/500-mw-gulf-of-suez-2-egypt-wind-farm-project-breaks-ground/

ESFC. (2022). *Noor Ouarzazate: the world's largest concentrated solar power plant built in Morocco.* https://esfccompany.com/en/articles/solar-energy/noor-ouarzazate-the-world-s-largest-concentrated-solar-power-plant-csp-built-in-morocco/

EUROAFRICA INTERCONNECTOR. (2020). *EuroAfrica at a glane.* https://www.euroafrica-interconnector.com/

EURONEWS & ANEP. (2022). Algeria's renewable energy potential: Solar power is the way to go. *Euronews.* https://www.euronews.com/2022/10/03/algerias-renewable-energy-potential-solar-power-is-the-way-to-go

EURONEWS & EFE. (2021). Ex-foreign minister quizzed over letting Polisario chief into Spain. *Euronews.* https://www.euronews.com/2021/10/05/ex-foreign-minister-quizzed-over-letting-polisario-chief-into-spain

EUROPEAN COMMISSION. (2024a). *Gobal Gateway.* https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/stronger-europe-world/global-gateway_en

EUROPEAN COMMISSION. (2024b). *The European Green Deal.* https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

EUROPEAN PARLIAMENT. (2020). *A Comprehensive EU Strategy for Africa.* https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/603506/EXPO_BRI(2020)603506_EN.pdf

FAOUZI, A. (2024). Morocco to Cut Energy Ties with Spain, Build Regasification and Pipelines. *Morocco World News.* https://www.moroccoworldnews.com/2024/04/361948/morocco-to-cut-energy-ties-with-spain-build-regasification-and-pipelines

FINANCIAL TIMES. (2023). The EU's plan to regain its competitive edge. https://www.ft.com/content/124b4cdb-deb9-49a0-b28d-d97838606661

FITCH RATINGS. (2024). *Sovereigns.* https://www.fitchratings.com/sovereigns

GATTI, S. (2018). *Project Finance in Theory and Practice: Designing, Structuring, and Financing Private and Public Projects, 3* edition. ed. Academic Press, S.l.

GIZ. (2023). *Climate change, just transition and renewable energies.* https://www.giz.de/en/ourservices/99580.html

HAKO, N. (2023). *Tunisia launches its first privately financed solar project.* ESI Africa. https://www.esi-africa.com/renewable-energy/tunisia-launches-its-first-privately-financed-solar-project/

IAEA. (2022). *Country Nuclear Power Profiles.* https://www.iaea.org/publications/15285/country-nuclear-power-profiles

IRENA. (2023). *North Africa: Policies and finance for renewable energy deployment.* https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2023/Dec/IRENA_North_Africa_policies_finance_RE_2023.pdf?rev=e3c4c1eb15124941a64faa70e6deb24a

JOINT ITALIAN ARAB CHAMBER OF COMMERCE. (2023). *Algeria-Italy: Electricity Interconnection Project.* https://jiac.it/blog/2023/09/20/algeria-italy-electricity-interconnection-project/

LEWIS, A. (2022). Egypt signs framework deals in bid to launch hydrogen industry. *Reuters*. https://www.reuters.com/world/middle-east/egypt-signs-framework-deals-bid-launch-hydrogen-industry-2022-11-15/#:~:text=Egypt%20signed%20eight%20framework%20agreements%20on%20Tuesday%20to,win%205%25%20of%20the%20global%20market%20by%202040

MITSUBISHI POWER. (2022). *Mitsubishi Power-led Consortium Announces the Completion of STEG's Rades C Power Plant, Generating 10% of Tunisia Electricity Production Capacity.* https://power.mhi.com/regions/mena/news/mitsubishi-power-led

MODERN POWER SYSTEMS. (2005). Siemens launches in Morocco. https://www.modernpowersystems.com/news/siemens-launches-in-morocco/

MOODY'S. (n.d.). *Country/Jurisdiction*. https://www.moodys.com/researchandratings/country/home

MOROCCO WORLD NEWS.(2023). Morocco, Portugal Sign Joint Declaration on Electrical Interconnection Project. https://www.moroccoworldnews.com/2023/12/359296/morocco-portugal-sign-joint-declaration-on-electrical-interconnection-project

NREL. (2021). *ISCC Hassi R'mel CSP Project.* https://solarpaces.nrel.gov/project/iscc-hassi-rmel

NS ENERGY. (2018). *Projects – Rades C Combined-Cycle Power Plant.* https://www.nsenergybusiness.com/projects/rades-c-combined-cycle-power-plant/

NS ENERGY. (2021a). *EuroAfrica Interconnector Project.* https://www.nsenergybusiness.com/projects/euroafrica-interconnector-project/

NS ENERGY. (2021b). *Projects – Kais Combined-Cycle Power Plant.* https://www.nsenergybusiness.com/projects/kais-combined-cycle-power-plant/

OGP. (n.d.). Joining OGP. https://www.opengovpartnership.org/process/joining-ogp/

ORASCOM CONSTRUCTION. (2012). *Project Details – Terga Combined Cycle Plant.* https://orascom.com/projects/terga-combined-cycle-plant/

ORASCOM. (2018). *Project Details – Burullus Power Plant.* https://orascom.com/projects/burullus-power-plant/

POWER TECHNOLOGY. (2022). *Tahaddart Combined Cycle Power Plant, Morocco.* https://www.power-technology.com/marketdata/tahaddart-combined-cycle-power-plant-morocco/

PROPERTY RIGHTS ALLIANCE. (2023). *International Property Rights Index 2023.* https://www.internationalpropertyrightsindex.org/

RANKIN, J. (2021). Global gateway infrastructure strategy aims to counter belt and road initiative impact in Asia, Africa and Europe. *The Guardian*. https://www.theguardian.com/business/2021/dec/01/eu-infrastructure-fund-challenge-china-global-influence-asia-africa-eastern-europe-gateway

REE. (2007). *2ª Interconexión Eléctrica España-Marrecos – Proyecto Remo.* https://www.ree.es/sites/default/files/downloadable/remo.pdf

REE. (2019). *Spain and Morocco agree on the development of a third interconnection between both countries.* https://www.ree.es/en/press-office/news/press-releases/2019/02/spain-and-morocco-agree-development-third-interconnection-between-both-countries

RES4MED. (2016). *Country Profiles – Tunisia.* https://www.res4med.org/wp-content/uploads/2017/11/Country-Profile-Tunisia-Report_05.12.2016.pdf

REUTERS. (2024a). Egypt signs 7 green hydrogen MoUs worth a potential $40 billion. https://www.reuters.com/world/middle-east/egypt-signs-7-green-hydrogen-mous-worth-potential-40-billion-2024-02-28/

REUTERS. (2024b). What we know about the Italian development plan for Africa. https://www.reuters.com/world/what-we-know-about-italian-development-plan-africa-2024-01-29/

ROSENTHAL, J. (2023). *In Reverse: Natural Gas and Politics in the Maghreb and Europe.* Foreign Policy Research Institute. https://www.fpri.org/article/2023/06/in-reverse-natural-gas-and-politics-in-the-maghreb-and-europe/

ROUABA, A. (2020). Algeria referendum: A vote 'to end years of deviousness'. *BBC News.* https://www.bbc.com/news/world-africa-54748146

SIEMENS. (2018). *Completion of world's largest combined cycle power plants in record time*. https://press.siemens.com/global/en/feature/completion-worlds-largest-combined-cycle-power-plants-record-time

TAIM, A. (2023). Shadows of Doubt: Decoding Egypt's Political Climate and Global Concerns Ahead of the 2024 Election. *Modern Diplomacy.* https://moderndiplomacy.eu/2023/12/08/shadows-of-doubt-decoding-egypts-political-climate-and-global-concerns-ahead-of-the-2024-election/

TRANSPARENCY INTERNATIONAL. (2023). *Corruption Perceptions Index.* https://www.transparency.org/en/cpi/2023

TROILO, P. (2011). *Alleviating the confusion: Germany's new aid structure and business model.* Devex. https://www.devex.com/news/alleviating-the-confusion-germany-s-new-aid-structure-and-business-model-76022

TUNUR. (n.d). *TuNur Italy Transmission Line.* https://www.tunur.tn/portfolio/tunur-italy-transmission-line/#:~:text=TuNur%20Italy%20is%20a%202%2C000MW%20transmission%20line%20purposefully,the%20heart%20of%20the%20European%20network%20from%202032.

UNIDO. (n.d.). *Egypt.* https://hydrogen.unido.org/egypt#:~:text=Egypt%20will%20be%20competitive%20to%20become%20a%20hub,actions%20towards%20developing%20low-carbon%20hydrogen%20initiatives%20and%20projects.

VINCI CONSTRUCTION. (2024). *Abdelmoumen Pumped Storage Hydroelectric Plant.* https://www.vinci-construction-projets.com/en/realisations/abdelmoumen-pumped-storage-hydroelectric-plant/

VINTER, G.D., PRICE, G., LEE, D. (2013). *Project Finance, 4th Revised edition edition.* ed. Sweet & Maxwell.

WINDPOWER. (2013). *Algeria's first wind farm completed.* https://www.windpowermonthly.com/article/1221141/algerias-first-wind-farm-completed

WORLD BANK GROUP. (2023). *The World Bank in Tunisia.* https://www.worldbank.org/en/country/tunisia/overview

WORLD BANK. (2024a). *Ease of Doing Business rankings.* https://archive.doingbusiness.org/en/rankings

WORLD BANK. (2024b). *Enforcing Contracts.* https://archive.doingbusiness.org/en/data/exploretopics/enforcing-contracts

WORLD BANK. (2024c). *Regulatory Quality: Percentile Rank*. https://data.worldbank.org/indicator/RQ.PER.RNK?skipRedirection=true&view=map

WORLD ECONOMIC FORUM. (2020). *Global Competitiveness Report Special Edition 2020: How Countries are Performing on the Road to Recovery*. https://www.weforum.org/publications/the-global-competitiveness-report-2020/

WORLD JUSTICE PROJECT. (2023). *WJP Rule of Law Index.* https://worldjusticeproject.org/rule-of-law-index/country/2023

WORLD NUCLEAR NEWS. (2022). *Construction of Egypt's first nuclear power plant under way.* https://www.world-nuclear-news.org/Articles/Construction-of-Egypts-first-nuclear-power-plant-u

WSRW. (2023). *Giant Siemens-Enel wind farm now operational.* https://wsrw.org/en/news/giant-siemens-enel-wind-farm-now-operational

XLINKS. (2024). *Xlinks First updates guidance on construction costs and strike price for the Morocco-UK Power Project.* https://xlinks.co/xlinks-first-updates-guidance-on-construction-costs-and-strike-price-for-the-morocco-uk-power-project/

XLINKS. (n.d.). *The Morocco - UK Power Project.* https://xlinks.co/morocco-uk-power-project/

ZGHEIB, N. (2022). *EBRD supports first green hydrogen facility in Egypt.* EBRD. https://www.ebrd.com/news/2022/ebrd-supports-first-green-hydrogen-facility-in-egypt-.html.

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