Bridging Continents: Integrated Planning of Cross-Border Energy Infrastructure

APPROACHES AND BEST PRACTICES TOWARDS INTEGRATED ENERGY INFRASTRUCTURE PLANNING BETWEEN EUROPE AND THE MENA REGION

Guidehouse

IMPRINT

PREPARED FOR

German Federal Ministry for Economic Affairs and Energy (BMWE)

SUBMITTED BY

Guidehouse Germany GmbH
Bellevuestr. 3, Building E2, 5th Floor
10785 Berlin
Germany
www.guidehouse.com

DESIGN

Leah Di Meglio, Renée Baran-Hickman, Delbbie Dela Paz

AUTHORS

Larissa Oppermann, Katharina Meyer-Landrut, John Niedergesäss,
Matthias Schimmel, Dr. Karoline Steinbacher (Guidehouse)

PICTURE CREDITS

Unless otherwise noted, the copyright and/or the authorisation to use the images is owned by Guidehouse. Images are properly licensed through Adobe Stock.

PUBLISHER

Guidehouse, First edition: December 2025

TABLE OF CONTENTS

ABBREVIATIONS

CEF-E	Connecting Europe Facility for Energy
COMELEC	Comité Maghrébin de l'Électricité
CSO	Civil Society Organisation
DSO	Distribution System Operator
EBRD	European Bank for Reconstruction and Development
ECOWAS	Economic Community of West African States
EIB	European Investment Bank
EIJLLPST	Eight Country Interconnection Project
ENTSO-E	European Network of Transmission System Operators for Electricity
ENTSOG	European Network of Transmission System Operators for Gas
EU	European Union
EUR	Euro
FID	Final Investment Decision
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
GW	Gigawatt
HVAC	High voltage alternating current
HVDC	High voltage direct current
IEA	International Energy Agency
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
LAS	League of Arab States
MASEN	Moroccan Agency for Sustainable Energy
MATTCC	Mediterranean Think Tank Alliance on Climate Change
MEDCEN	Mediterranean Clean Energy Regulators Network
MEDENER	Mediterranean Association of National Agencies for Energy Management
MED-GEM	Mediterranean Green Electrons and Molecules Initiative
MEDREG	Association of Mediterranean Energy Regulators
MEFED	MENA-Europe Future Energy Dialogue
MER	Central American Electricity Marke
MoU	Memorandum of Understanding
Med-TSO	Association of Mediterranean Transmission System Operators
MENA	Middle East and North Africa
MW	Megawatt
MWh	Megawatt per hour
NIP	Neighbourhood Investment Platform (NIP)
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
PAEM	Pan-Arab Electricity Market
PPA	Power-Purchase Agreement
PV	Photovoltaic
SET	Sustainable Electricity Trade
QDF	Qatar Fund for Development
TeraMED	Towards 1TW Renewables in the Mediterranean by 2030 Initiative
TSOs	Transmission System Operators
TYNDP	Ten-Year Network Development Plans
UAE	United Arab Emirates
USD	US Dollar
WAPP	West African Power Pool Organisation

FOREWORD

The MEFED Advisory Group (AG) was established in the context of the MENA Europe Future Energy Dialogue (MEFED) conferences, which was first held in Jordan in 2022. The AG convenes regional and international organisations committed to the goal of increased cooperation between Europe and the MENA region with the aim of enhancing energy cooperation between both regions. The Advisory Group supports and consults the initiative, helps identify emerging and relevant topics, and regularly convenes to discuss key developments.

During the MENA-Europe Future Energy Dialogue (MEFED) 2024, high-level representatives from participating countries and members of the AG endorsed the Thessaloniki Declaration, calling for an accelerated development of joint energy infrastructure for hydrogen and electricity. This study aims to address this persistent gap, provides an overview of the current approach of integrated planning of cross-border energy infrastructure and give insights into best practices. The analysis was carried out by Guidehouse. The study has immensely benefitted from the thoughtful review and input of the Advisory Group, whose insights helped refine and strengthen the final outcome. Many thanks to Gayathri Nair (IRENA), Naglaa Khattab; Anas El Hraiech and Angelo Ferrante (Med-TSO), Hasan Ozkoc, Bardhi Hoxha and Lamine Zitouni (MEDREG), Emanuela Menichetti, Matteo Urbani and Houda Ben Jannet (OMEC), Maged Mahmoud (RCREEE), Dr. Jauad El Kharraz (TERAMED Initiative), Radia Sedaoui and Sean Ratka (UN ESCWA), Marie Claire Boillot and Mohamed Alaa (Union for the Mediterranean) for their engagement and collaboration throughout the process.

EXECUTIVE SUMMARY

Creating a secure, sustainable, and cost-effective energy system across Europe and the MENA region that enables the uptake of renewables, requires stronger cross-border infrastructure and market integration. Integrated infrastructure planning is a key prerequisite. Despite political momentum and several bilateral projects, integrated infrastructure planning remains fragmented. While the EU benefits from fully integrated energy markets and mature institutions like the European Network of Transmission System Operators for Electricity (ENTSO-E) and European Union Agency for the Cooperation of Energy Regulators (ACER), a coordinated planning approach within the MENA region as well as for Europe-MENA cooperation is missing. The Association of Mediterranean Transmission System Operators' (Med-TSO) Ten-Year Mediterranean Network Development Plan (TYMNDP) and the Association of Mediterranean Energy Regulators' (MEDREG) work on regulatory harmonisation offer promising building blocks but lack binding authority and consistent national commitment. Existing platforms and initiatives such as the Pan-Arab Electricity Market and the MENA-Europe Future Energy Dialogue (MEFED) provide important high-level coordination but have not yet translated into a shared vision or concrete interregional planning mechanisms.

To address these challenges, this study calls for a structured, institutionalised framework for integrated EU-MENA infrastructure planning. Such a framework should enable coordination across borders, energy carriers, and flexibility solutions, aligning long-term investment decisions with shared climate and energy goals. Achieving this requires a set of complementary actions:

» Strengthening regional authorities and associations like MEDREG, Med-TSO, MEDENER, OMEC to align more closely with EU counterparts;

» Fostering systematic cooperation between ENTSO-E and Med-TSO in their respective TYNDP processes; and

» Accelerating regulatory convergence through initiatives like MEDREG's development of a Mediterranean Grid Code and support for fully independent national regulators.

In addition, a balanced approach is needed that combines a top-down strategic vision with bottom-up modular implementation. Bilateral and sub-regional projects can serve as trust-building pilot initiatives that evolve into larger integrated systems. Finally, structured knowledge exchange between EU and MENA actors is essential to harmonise planning methodologies, regulatory practices, and investment frameworks. Unlocking the full potential of EU-MENA energy integration will require sustained political will, stronger institutions, and targeted cooperation – but strategic benefits for energy security, climate resilience, and economic development are substantial and well within reach.

01

Driving Regional Integration through Energy Infrastructure

The Middle East and North Africa (MENA) region is poised to become a clean energy hub. Leveraging its vast solar and wind potential, favourable land conditions, and declining technology costs, the MENA countries are taking significant steps towards renewable energy development. The region aims to increase its installed renewable capacity from under 50 GW in 2022 to 200 GW by 2030, a 4.5-fold expansion and the highest growth rate globally.[1] Renewable energy is becoming increasingly cost-competitive in the MENA region, reaching record-breaking tender prices. Since 2015, utility-scale solar PV prices have fallen by 75%, from USD 56/MWh in Jordan to just USD 14/MWh in a recent Abu Dhabi tender.[2] Enhanced regional cooperation will be critical to integrating the growing share of renewables and unlocking the region's full renewable energy potential.

Europe has embarked on an ambitious journey with its Green Deal objective to achieve carbon neutrality by 2050. The Green Deal has already delivered a deep transformation, with the share of renewables increasing from 34% in 2019 to 47% in 2024, while the fossil fuel share has decreased from 39% to a historic low of 29%.[3] With almost EUR 110 billion spent in renewable energy generation in 2023, Europe now invests ten times more in clean energy than in fossil fuels.[4] While initial successes have been achieved, a large share of European energy demand currently is and will increasingly be met through imports. To support this shift and to achieve its energy and climate goals, Europe must double its current electricity interconnection capacity within the next 10 to 15 years. This requires not only infrastructure deployment but also accelerated permitting processes and enhanced social acceptance to avoid bottlenecks. This challenge calls for a coordinated, pan-European approach to electricity system planning that integrates borders, sectors, regions and technologies.[5, 6]

Establishing energy interconnections between Europe and the MENA region is essential for creating a secure, sustainable, and cost-effective energy system for both regions. An interconnected energy system can facilitate large-scale integration of renewable energy sources and reduce the need for additional generation capacity, thereby lowering overall societal costs associated with the energy transition. Efficient operation of existing electricity and gas interconnectors, along with the development of new infrastructure linking countries and regions, can support economic integration, resource sharing and cost and risk reduction. For Europe, diversification of energy supply enhances energy security; for MENA countries, cross-regional integration can provide future-proof jobs, generate economic value and provide alternative income sources as fossil fuel demand declines. Numerous recent interconnection projects underline the potential for stronger regional cooperation and a more interconnected and resilient energy network between Europe and the MENA region. Planned infrastructure projects such as the Elmed Interconnector between Tunisia and Italy and the GreatSea Interconnector connecting Israel, Cyprus, and Greece highlight the growing interest from project developers and investors. The business case for these projects lies in their ability to create an integrated, sustainable energy grid that leverages energy trade opportunities, reduces system costs, improves reliability, and enables efficient distribution of renewable energy across regions.

Despite these ambitious efforts, there is still no shared vision for integrated energy infrastructure planning between Europe and the MENA region. Multi-country initiatives such as the SET-Roadmap, which aims to connect Morocco to the European Union (EU)[7], and organisations like MEDREG and Med-TSO are working to promote a more coordinated, cross-regional approach. Another example is the Pan-Arab Electricity Market initiative, which seeks to facilitate energy trade and cooperation among Arab countries and underscores the need for comprehensive infrastructure development and integrated planning to create a resilient, efficient energy network.[8] To unlock the full potential of Euro-Mediterranean energy cooperation, a common framework for long-term, integrated infrastructure planning is urgently needed.

Integrated planning of cross-regional infrastructure between the MENA region and Europe would make the planning process more effective and efficient, while facilitating energy cooperation between the regions. Integrated energy infrastructure planning refers to a process that considers the broader system environment during development. This may include planning for large-scale transmission networks but can also apply to local distribution systems. Ideally, integrated planning also incorporates all energy carriers such as electricity, gas, blended hydrogen, CO2, heating, cooling, district energy, liquid fuels within a shared framework that also covers the transportation sector. It addresses longer planning horizons and wider geographical coverage, enabling better alignment of infrastructure investments with future energy needs.[9] To capitalise on the strategic benefits of cross-border interconnections, it is essential to identify an appropriate approach to integrated planning.[10] Typically, three different possible types of integrated energy infrastructure planning can be identified[i]:

01

Cross-border integration of energy infrastructure: Enhanced cross-border integration can improve the balance and security of energy supply, particularly through electricity interconnections. It also enables more efficient use of renewable energy sources by leveraging different demand patterns and generation profiles across connected regions. This approach allows countries with abundant renewable energy resources to support those with limited availability, both systematically and during short-term periods of low production.[11]

02

Integration between different types of energy infrastructure: Connecting electricity and gas networks offers a cost-effective way to absorb large volumes of variable renewable energy. This will increasingly occur through electrolysers and hydrogen power plants, creating a deeply interdependent energy system. Historically, these infrastructures have been operated separately. Integrating planning processes of infrastructure of different energy carriers would streamline energy demand and infrastructure investments and ensuring grid stability.[12] While alignment of energy carriers is gaining traction in some regions – such as in the TYNDPs of ENTSO-E and the European Network of Transmission System Operators for Gas (ENTSOG) for the EU – other regions, including MENA, still lack this form of integrated planning.[13]

03

Integration between energy infrastructure and flexibility technologies: Flexibility technologies – such as demand-side management, energy storages, sector coupling applications and digital solutions – can improve the efficiency of energy infrastructure use, sometimes deferring or even reducing the need for new investments while maintaining stability and security of supply. Inadequate integration of these technologies could result in inefficient levels of infrastructure build-out.[14]

This study contributes to the ongoing discussion on integrated energy infrastructure planning by exploring cross-border approaches and showcasing best practices from Europe, the MENA region, and beyond. It focuses on integrated planning for electricity infrastructure from a cross-regional perspective. The paper highlights current EU-MENA, reviews institutional and technical developments, and provides targeted recommendations to support more coordinated planning aligned with long-term climate and energy goals.

i Integrated planning of the energy system as a whole, including supply and demand, can also be considered a form of integrated planning. However, this is out of scope of the research since the focus is on infrastructure.

02

Current Approach for EU-MENA Energy Infrastructure Planning

Increasing interconnections with neighbouring regions is key to unlocking the full renewable potential of the MENA region. The MENA region has taken steps towards developing electricity interconnection capacity within the region. However, most existing interconnections are primarily used for electricity exchanges in emergency situations, either covering unexpected outages or scheduled maintenance. As a result, electricity trade typically occurs due to capacity shortages rather than for economic and commercial reasons. Consequently, exchange prices do not reflect real-time market conditions or true generation costs, leading to inefficiencies and limited trade volumes.[15] Interconnection investment in the MENA region is largely driven by security-of-supply concerns rather than potential market savings.[16] This is evident in the extremely low utilisation rates of existing infrastructure, especially compared to European levels. Higher utilisation of the existing infrastructure could deliver significant cost savings by leveraging economies of scale, avoiding renewable curtailment, and improving returns on investments. Existing cross-border projects represent valuable first steps and provide a foundation for further development through integrated planning.

The Gulf Cooperation Council (GCC)[ii] power grid stands out as the most advanced and structured regional electricity interconnection within the MENA region. The established Gulf Cooperation Council Interconnection Authority (GCCIA) is the only subregional entity in MENA to have implemented a formal transmission pricing framework. It operates a unified 400 kV transmission system, supporting both scheduled and unscheduled electricity exchanges among its six member states. Scheduled exchanges occur through direct bilateral agreements between member countries. The GCCIA allows countries to procure transmission rights under defined legal terms for commercial trade. As such, the GCCIA provides a framework for interconnection use and cost allocation that is still lacking in other parts of the MENA region.[17] Unscheduled exchanges take place when the GCCIA grid supplies electricity to member states facing shortages.[18] In such cases, power is temporarily provided by a neighbouring country and later returned in kind, based on annual pricing set by the GCC Advisory and Regulatory Committee in coordination with the GCCIA.[19] Despite considerable interconnection capacity, the actual utilisation of the GCC interconnections remains low – at around 10% compared to Europe's 76% in 2023.[20]

The Eight Country Interconnection Project (EIJLLPST interconnection)[iii], spanning from Iraq to Egypt, is strategically positioned to serve as a central electricity trading hub, bridging the two major regional energy systems of Egypt and Turkey. This potential hub could eventually expand its 400 kV and 500 kV transmission lines to facilitate electricity trade with both Europe and the Gulf region.[21] Launched in 1998, the project links Egypt, Iraq, Jordan, Syria, and Turkey, with subsequent extensions to Libya, Lebanon, and Palestine. Its objective was to share reserves in emergencies and exchange surplus electricity between countries, capitalising on differences in daily and seasonal consumption profiles. However, commercial trade among these countries has remained marginal due to limited renewable generation capacity (except in Jordan) and relatively low interconnection capacity.[22] A notable development for regional electricity trade in the region is the interconnection between Egypt and Saudi Arabia, which will enable both countries to exchange up to 3 GW of power.[23] This will be the first large high-voltage direct current (HVDC) interconnection between North Africa and the Middle East, covering around 1,350 km. The interconnector is expected to be operational by the end of 2025.[24]

ii Six member states: Kuwait, Saudi Arabia, Bahrain, Qatar, the United Arab Emirates (UAE), and Oman.

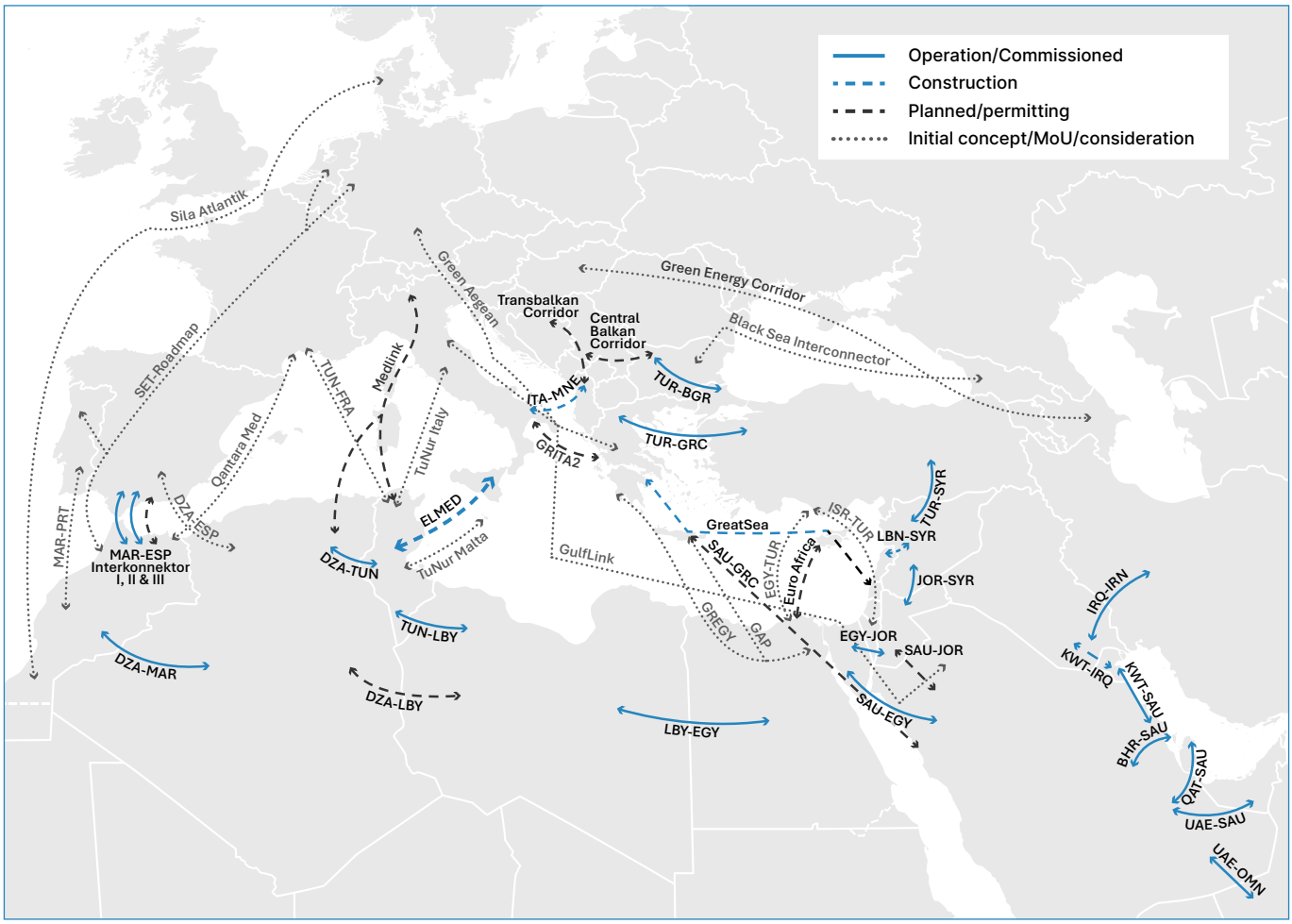
iii Egypt, Iraq, Jordan, Lebanon, Libya, the Palestinian territories, Syria, and Turkey (all part of the Mashriq region, extending from the western border of Egypt to the eastern border of Iraq)

Despite strong physical interconnections, the Maghreb region remains under-integrated due to its political fragmentation, delays in infrastructure development and renewable energy projects, and regulatory misalignment.[25] Morocco, Algeria and Tunisia established a robust regional interconnection framework, initially launched in the 1950s and formalised under the Comité Maghrébin de l'Électricité (COMELEC) in 1974. Since 1997, Morocco has been connected to Spain, enabling the synchronisation of Algeria, Morocco, and Tunisia with the European grid via ENTSO-E. COMELEC holds the mandate to coordinate regional planning for generation and transmission, and the three countries jointly manage reserve margins to stabilise the Maghreb power system. However, its activity has declined, with no major initiatives or public updates since 2021.[26]

The Morocco-Spain link remains the only interconnector between North Africa and Europe. Two 400 kV HVAC lines currently connect Morocco and Spain with a combined capacity of 1,400 MW, reaching a utilisation rate of 38% in 2021.[27] A third 400 kV HVAC interconnection with 700 MW capacity is planned for commissioning in 2026, with an estimated investment of EUR 150 million, split equally between Morocco and Spain.[28] At present, the West Mediterranean Corridor is the only active link between Europe and North Africa. An overview of existing and planned interconnections in the MENA region is shown in Figure 1. In addition, two additional lines are under study, one with Portugal and one with Mauritania.

New Europe-MENA interconnection projects are emerging, but progress remains slow. Several electricity interconnections between Europe and the MENA region are planned, demonstrating political will to enhance integration. However, only a few have reached a final investment decision (FID). In the East-Mediterranean region, the GreatSea Interconnector – connecting Greece via Cyprus to Israel –is currently under construction. This two-way HVDC multiterminal link will have a capacity of up to 2 GW, connecting mainland Greece, Crete, Cyprus, and Israel. Construction of the undersea cables between Greece and Crete began in 2022 and is expected to finish by 2027. The Central Mediterranean Corridor connects Italy and France with Algeria and Tunisia, with several projects currently underway. The most advanced is the ELMED interconnector, expected to be completed by 2028. It will link Italy and Tunisia via a 600 MW HVDC submarine cable spanning approximately 200 km.[29] In the Eastern Mediterranean Corridor, new interconnections are planned between Greece and Egypt and between Egypt and Jordan, with ongoing discussions about a Cyprus-Egypt link. Additionally, eight further electricity interconnection projects between the EU and MENA are under consideration in the latest TYNDP published by ENTSO-E in March 2024.[30]

Figure 1. *Selected existing and planned electricity interconnections projects in the EU-MENA region*



Disclaimer: *This overview of major EU-MENA interconnections is provided for illustrative purposes only. It is non-exhaustive and does not claim to be comprehensive or fully representative.*

The absence of coherent and consistent regulation and pricing schemes in MENA countries remains a barrier for intra-regional electricity trade. Some countries in the region, such as Morocco, Oman and Egypt, are gradually shifting towards market-based pricing systems.[31, 32, 33] In many other countries, domestic electricity subsidies keep prices artificially low, distorting market signals and undermining the economic viability of regional power trading. This creates a mismatch between countries: those with subsidised electricity have little incentive to export power at market rates, particularly to prevent unintended wealth transfers. At the same time, countries that rely on market-based pricing may be reluctant to import subsidised electricity, as it can lead to market distortions and create an uneven playing field. Even where interconnectors exist, the lack of compatible pricing structures and interoperability on issues related to grid codes and operational rules – including maintenance, emergency response plans, data exchange and others – can make cross-border power trade economically unviable.[34] In addition, the lack of transparent data-sharing platforms across national operators exacerbates planning inefficiencies and reduces investor confidence.

03

Integrated Planning of Cross-Border Energy Infrastructure

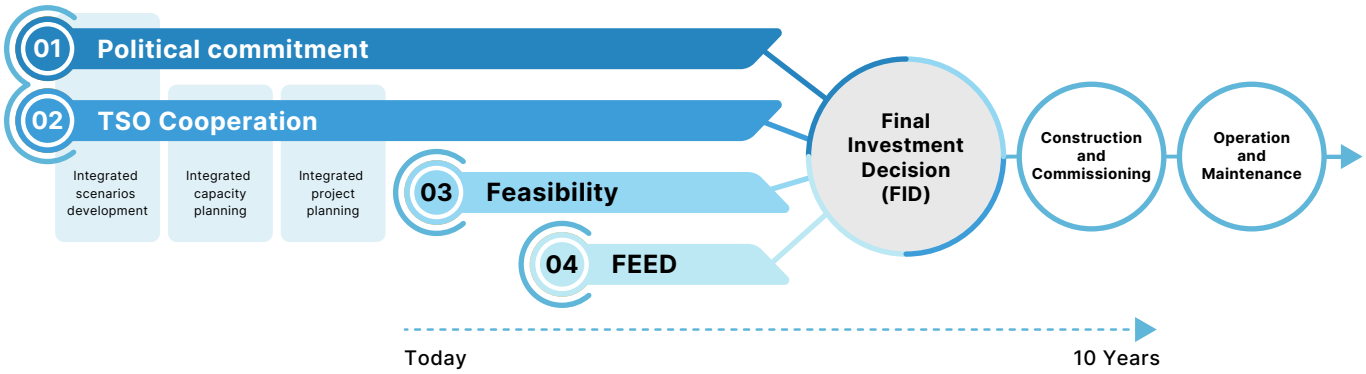
An integrated planning approach enables TSOs and project developers to streamline project planning and implementation. By eliminating duplicative efforts, leveraging shared resources, and improving credit ratings, this approach can reduce timelines and costs while making projects more attractive to institutional investors. It also diversifies risk profiles, opening access to a broader range of financing options.[35] Integrated energy infrastructure planning promotes a holistic view of regional needs, ensuring projects are designed to meet the long-term demand. Incorporating the perspectives and requirements of multiple countries from the outset allows planners to identify synergies, optimise infrastructure deployment, and uncover opportunities for cross-border collaboration. This needs-based approach to project development and prioritisation minimises economic risks – one of the strongest arguments for integrated energy infrastructure planning.

In the future energy system, the interdependence between different types of energy infrastructure and between countries will become significantly more pronounced. Planning for infrastructure such as electricity, gas, and hydrogen typically involves three essential components, outlined on the next page and illustrated in Figure 2:[iv] (1) developing joint scenarios, (2) identifying needs to determine where additional transport capacity is required, (3) selecting project, which includes assessing how these capacity needs can best be met, taking into account project costs and benefits.[36]

1. **Integrated scenarios development:** Scenario development is typically the first step in planning processes. System operators, in coordination with policymakers and regulators, analyse and assess the evolution of consumption and supply of electricity and other energy carriers, considering factors such as population growth, societal changes, economic development, and technological advancements. Regional profiles – shaped by resources and geography – must be understood. Grid capacity requirements and project benefit estimates depend heavily on the chosen scenario; therefore, energy system integration parameters should be incorporated from the outset. Multiple system operators across countries can adopt an integrated approach, working collaboratively to develop a shared vision for a future energy grid.[37, 38]
2. **Integrated capacity planning:** Based on current grid capacities and the envisaged scenario, additional capacity needs are identified to support renewable energy integration, alleviate bottlenecks, congestions and curtailments, and improve overall reliability and resilience. While this can be done nationally, an integrated approach involves TSOs jointly modelling capacity needs, demand-side patterns, and renewable energy generation across connected regions to enhance cross-border electricity flows.
3. **Integrated project planning:** Project promoters – typically TSOs or DSOs – jointly develop solutions to address identified grid needs. These may include constructing new transmission or distribution lines, upgrading existing infrastructure, adding reserve capacity, or implementing other non-wire alternatives. Integrated planning considers projects holistically, accounting for benefits at both national and cross-regional levels rather than planning each segment within one country's border. It also aligns with energy policies and expansion targets, supports cost-sharing mechanisms among participating countries, and facilitates the foreign investment, particularly from climate-aligned funds and blended finance mechanisms that reduce capital costs.[39]

iv To ensure efficient and optimal use of infrastructure, elements related to trading rules and interoperability also need to be considered and gradually harmonised, which could be considered as a fourth step.

Figure 2. *Idealised integrated planning approach*



Integrated infrastructure planning for electricity and gas must consider two strategic pathways: repurposing or upgrading existing assets and developing new infrastructure where necessary. For gaseous energy carriers, this may involve repurposing pipelines, while for electricity, it means upgrading current infrastructure to be smarter, more digital, efficient, and flexible. Striking the right balance between these options is essential to avoid overexpansion, which could lead to sunk costs, stranded assets, inefficient use of land and sea space, and greater impacts on biodiversity.[40]

3.1 APPROACHES TO INTEGRATED PLANNING

There is no one-size-fits-all model for integrated infrastructure planning, but the benefits can be substantial across a range of approaches. Integrated planning benefits can be achieved in various setups and cooperation schemes. Cross-border power system integration efforts can be categorised by their degree of integration, varying from simple and limited integration degrees to more complex forms of integrated planning. The greater the degree of integration, the greater the potential economic benefits, but also the greater the complexity of organisation.[41] The International Energy Agency (IEA) has delineated three types of cross-border integrated planning structures from this hierarchy of integration: bilateral, multilateral, and unified. Under bilateral integration, trades occur between only two administrative territories. In some cases, this energy trade may be unidirectional or bidirectional, while at other times it involves intermediary transit (or wheeling) jurisdictions.[v] Multilateral modes of integration involve three or more jurisdictions trading among themselves. Finally, under unified models of integration, regional institutions can take on some or all the of the responsibilities for managing the power system across multiple jurisdictions, including market organisation or system operations.[42] Each form of integration may come with its own challenges, but integrated planning efforts without fully harmonised markets or formalised institutions can be beneficial for participating jurisdictions.

Effective cross-border integration requires coordination across multiple time horizons, from long-term planning to real-time operations. These models can range from planning for a long-term system integration, e.g., through power purchase agreements (PPAs), to short-term ancillary services, real-time dispatch, and emergency measures. In between those two extremes are areas such as the sharing of short-term forecasts or information on day-ahead scheduling. While this can be seen as a hierarchy from long-term to short-term integration, it does not imply a natural development. In practice, many cross-border integration initiatives commence with enhanced collaboration in long-term system planning, potentially leading to cooperation in the development of regional day-ahead markets. However, there are also instances where integration begins with a focus on short-term markets.

v Jurisdictions that transfer power flows without participating in the transaction.

3.2 BEST PRACTICES OF INTEGRATED PLANNING

Integrated infrastructure planning is achievable across diverse market structures and stakeholders. Whether in fully liberalised and harmonised energy markets or in less integrated ones, cooperation on scenario development, capacity planning, and project implementation can succeed. While harmonised, liberalised markets facilitate collaboration, integrated planning can also be driven by public entities, private actors, or a combination of both.

The EU Internal Energy Market is a well-known example for institutionalised integrated energy planning. Within the EU, the cooperation between TSOs and DSOs across the different member states is highly advanced. Through institutions like ENTSO-E and ENTSOG, Europe has shifted from isolated national grid plans to cohesive regional and continental strategies that include electricity, gas, and hydrogen infrastructure. ENTSO-E and ENTSOG (eventually also European Network of Network Operators for Hydrogen, ENNOH) are cooperating to deliver EU-level integrated network planning, with increasingly aligned scenarios between the electricity, hydrogen, and gas sectors. TYNDPs play a crucial role in this process by providing a comprehensive roadmap for the development of the European electricity grid, which increasingly also integrates gas and hydrogen infrastructure planning. By fostering collaboration among different stakeholders and leveraging advanced planning methodologies, these plans aim to enhance cross-border cooperation and ensure that the infrastructure can support the integration of renewable energy sources.

Successful regional integration depends on underlying economic and institutional conditions, as seen beyond Europe. While the EU's regional grid system might be the best known, it relied heavily on the region's economic integration. Other regions provide more immediate and replicable examples for different economies. Two notable cases from Central America and Western Africa demonstrate that integration initiatives can succeed with external financial backing, market structures that balance autonomy with interdependence, and purpose-built institutions.

In Central America, the Mercado Eléctrico Regional (MER) offers a distinct model of regional electricity market integration. Instead of creating a supranational market with integrated governance structures, MER complements national energy planning with regional frameworks, guided by institutions like the Ente Operador Regional (EOR) and the Consejo de Electrificación de América Central (CEAC).[43] MER develops indicative regional expansion plans that guide national decisions, particularly for large-scale interconnection projects.[44] The backbone of this integration is the SIEPAC transmission line, a jointly planned and owned 1,800 km high-voltage corridor linking the six national grids, as shown in Figure 3. Its development was coordinated under the 1996 Marco Treaty and executed through Empresa Propietaria de la Red (EPR); a public-private entity co-owned by the national utilities.[45] SIEPAC is not only a shared asset but also jointly operated: EOR manages dispatch and maintenance scheduling in coordination with national operators, ensuring reliability and minimising disruptions. MER's governance structure – anchored by Comisión Regional de Interconexión Eléctrica (CRIE, the regional regulator), EOR (the system operator), and CDMER (the policy council) – ensures that regional coordination respects national sovereignty. Each country retains control over its internal market, while MER facilitates cross-border trade under common rules.[46] Although MER does not yet integrate other energy carriers or enforce unified investment decisions, it remains a leading example of how regional planning and shared infrastructure can enhance energy cooperation without compromising national autonomy.

Figure 3. *SIEPAC line*

West Africa's interconnection between Côte d'Ivoire, Liberia, Sierra Leone, and Guinea (CLSG) highlights the power of joint infrastructure development through regional cooperation. The project was jointly developed by Côte d'Ivoire, Liberia, Sierra Leone, and Guinea based on an intergovernmental agreement, which established TRANSCO CLSG – a multinational special purpose vehicle (SPV) co-owned by the national utilities of the four countries. This SPV was empowered to coordinate all aspects of the project: planning, financing, construction, and operation, ensuring that the interconnection was developed as a single, unified system rather than fragmented national segments. The CLSG project is a priority initiative under the WAPP Master Plan, designed to form part of the regional transmission backbone and enable power trade across the Mano River Union countries.[47] Through this institutional setup, the countries achieved synchronised development of each segment of the 1,300+ km, 225 kV transmission line.[48] The financing of the CLSG Interconnector further illustrates the power of blended, multilateral funding.[49] The project's estimated USD 500 million cost was covered through a combination of concessional loans and grants from the World Bank, African Development Bank, EIB, KfW, and the EU-Africa Infrastructure Trust Fund. Each institution financed specific country segments, coordinated through TRANSCO CLSG. National governments also contributed counterpart funds and guarantees.[50]

Effective regional integration relies on regulatory frameworks that balance national and supranational oversight. Regulatory authorities play a crucial role in cost sharing, market regulation, and participant monitoring. Where formal regional bodies are absent, private sector collaborations – often driven by the utilities – can accelerate integrated planning. For example, the Total Grid Orchestration (TGO) Alliance in North America, along with global initiatives such as Next Grid Alliance and the Utilities for Net Zero Alliance (UNEZA), fosters cooperation among utilities, solution providers, and prosumers to share resources, innovate, and advance grid development.[51]

04

Visions and Ongoing Initiatives for Further Integration for Europe-MENA Energy Infrastructure

The vision of a fully integrated Europe-MENA power system has long been on the agenda. Recent years have seen renewed focus on strengthening electricity links between Europe and North Africa to facilitate renewable energy trade and market integration. The Sustainable Electricity Trade (SET) Roadmap, led by the Moroccan Agency for Sustainable Energy (MASEN), aims to establish the technical, market, and regulatory conditions necessary for the seamless trade of renewable electricity between Morocco and four European nations, namely France, Germany, Portugal, and Spain. Preparatory studies validated the potential advantages of integrating the electricity markets of these five countries. In 2022 a Memorandum of Understanding (MoU) between involved countries was signed to undertake all necessary actions to facilitate renewable electricity trade.[52, 53] Earlier efforts, such as the Mediterranean Solar Plan (MSP) launched by the Union for the Mediterranean (UfM) in 2008, sought to add 20 GW of renewable capacity by 2020, align national energy policies, and create a supportive regulatory environment for grid connections in the region. Despite political support at its inception, the plan lost momentum after 2014, lacking endorsement from UfM Energy Ministers, and was ultimately discontinued before tangible projects materialised.[54]

The Pan-Arab region is taking concrete steps toward creating a unified electricity market to unlock large-scale power trade and system cost savings. In 2016, the World Bank and partners launched the Pan-Arab Regional Energy Trading Platform (PA-RETP) Initiative to develop a common vision for regional electricity integration across the Arab region. The aim is to establish a completely integrated Pan-Arab grid by 2038 and build regional institutions necessary to enhance electricity and gas trade within the region and eventually with neighbouring markets.[55] The initiative was formalised in 2017 when LAS members signed a MoU to advance the concept of a Pan-Arab Electricity Market (PAEM). The PAEM Grid Code was issued in May 2020. In December 2024, LAS members signed the market agreements, setting the stage for Pan-Arab countries to expand electricity trade and enable more effective cooperation within and beyond the region. Following the ratification of the PAEM governance agreements, market committees – such as the Advisory Regulatory committee and TSOs which will be responsible for planning process – will be activated. The aim is to facilitate market operations and trade by aligning technical and regulatory frameworks, improving economic efficiency, and encouraging greater private sector participation.[56] By 2035, the electricity trade in the MENA region is expected to increase from the current 2% to between 37% and 41%, with an electricity generation capacity exceeding 600 GW.[57] The World Bank estimates that strategically coordinating expansion plans could reduce system costs in the region by between USD 107 billion and USD 196 billion by 2035.[58]

Political commitment is the foundation for cross-border energy infrastructure planning. Developing cross-border interconnections typically requires close cooperation between the relevant TSOs and national authorities. This cooperation can take various forms of integrated planning, ranging from informal bilateral negotiations between TSOs to formal, multi-stakeholder planning processes. Typically, cross-border projects begin with high-level political commitment formalised in a bilateral MoU or intergovernmental agreement. Such agreements mandate TSOs to initiate technical discussions and feasibility studies. In the GCC, this process is institutionalised and coordinated by the GCCIA, which acts as a regional platform for system planning, operations, and grid code harmonisation.[59] In the Southern Mediterranean, including Egypt, Jordan, Morocco and Algeria, coordination has historically been bilateral. These agreements typically define the maximum exchange capacity, applicable conditions (seasonal or emergency use), and the compensation method.[60]

Once the technical feasibility is confirmed, the TSOs collaborate to harmonise operational procedures. This includes defining interoperability standards, dispatch coordination protocols, and procedures for emergency support or unscheduled exchanges. Within the GCCIA framework, this can result in a joint grid code or bilateral operational agreement. For example, the construction of the new Oman-UAE interconnector – a 400kV AC double-circuit interconnector – is driven by the GCCIA. The respective TSOs also collaborate on financial and cost-sharing arrangements, covering not only CAPEX for infrastructure investments but also decisions on shared assets such as substations or compensation equipment. In addition, development banks and financial institutions – including the World Bank, the Arab Fund for Economic and Social Development, and the Qatar Fund for Development (QDF) – provide concessional financing or grants to support interconnection projects. For instance, QDF contributed a USD 100 million loan for the Oman-UAE project, while the remaining costs were covered by national utilities and the GCCIA.[61]

Finally, the respective TSOs are involved in the permitting and implementation stages, including environmental impact assessments, land acquisition, and construction supervision. They also cooperate on the commissioning and testing phases to ensure technical compatibility and operational reliability of the new interconnection. Countries typically negotiate annually on the specific amount of electricity to be traded. Intra-regional interconnections remain underutilised and largely driven by national security-of-supply concerns rather than a shared commitment to developing a competitive regional electricity market. Consequently, countries tend to prioritise investments in domestic power generation over regional cooperation, further hindering the integration and economic optimisation of the regional electricity network.[62]

Med-TSO and MEDREG are emerging as key facilitators of regional electricity planning in the Mediterranean.[63] Med-TSO, the Association of the Mediterranean Transmission System Operators (TSOs) for electricity, operates the transmission networks of 20 Mediterranean countries. Established in 2012 in Rome, it now serves as a technical platform that leverages multilateral cooperation as a strategy of regional development, áiming to enhance the integration of the Mediterranean power systems.[64] One of its flagship initiatives is the Ten-Year Mediterranean Network Development Plan (TYMNDP), also known as the Mediterranean Master Plan (MMP). The first edition was published in 2022 and is regularly updated. The MMP outlines 15 strategic clusters of cross-border interconnection projects targeted for implementation by 2030, based on a harmonised planning methodology developed collaboratively by member TSOs. This approach mirrors the Ten-Year Network Development Plan process used by ENTSO-E in Europe. Med-TSO conducts detailed network studies to assess the operational reliability of the interconnected Mediterranean grid under various future scenarios. These studies analyse how different interconnection clusters influence electricity flows and system stability, including exchanges with the ENTSO-E network. Further, a standardised cost-benefit analysis (CBA) framework ensures transparent and comparable project evaluation. Med-TSO has developed a region-specific CBA methodology adapted from ENTSO-E's proposal to ACER in 2016, fully aligned with EU Regulation 347/2013 on trans-European energy infrastructure. This methodology provides a harmonised basis for evaluating the economic, environmental, and technical benefits and costs of proposed interconnection projects. It is essential for prioritising investments and guiding decisions on regional electricity infrastructure development.

Unlike ENTSO-E's planning process, Med-TSO's approach remains voluntary and non-binding. While ENTSO-E's TYNDP directly informs the EU's selection of Projects of Common Interest (PCIs) and regulatory coordination through ACER and the European Commission, Med-TSO's plan does exert the same influence on national investment decisions or funding allocation. Its outputs are not formally embedded in regulatory or financing mechanisms within the MENA region, and participation is at the discretion of national TSOs. Europe benefits from a mature institutional framework for grid planning, whereas MENA countries still largely plan in isolation and with a focus on self-sufficiency. The Med-TSO Master Plan represents a significant step toward aligning national development strategies across Mediterranean countries and fostering cross-regional market integration.[65] At the same time, regional energy initiatives aimed at enhancing a cooperation are already underway. For example, Med-TSO and the LAS signed a MoU in December 2024 to strengthen collaboration on PAEM, with the goal of facilitating knowledge sharing and promoting electricity market integration across MENA countries.

A range of additional technical platforms for stakeholder coordination have played a central role in recent discussion. Since its establishment in 2007, MEDREG has significantly advanced to regulatory harmonisation across the Mediterranean, supporting transparent and stable frameworks for energy investments. As an association of 28 energy regulators from 23 EU and MENA countries, MEDREG provides capacity-building programmes and technical guidelines aimed at strengthening national regulatory authorities. It offers a unique platform for developing and consolidating consistent energy regulatory frameworks in the region. A key initiative includes the work on the Guidelines for the Mediterranean Grid Codes.[66] The Union for the Mediterranean (UfM), an intergovernmental organisation comprising

43 member states, serves as a pioneering platform that brings together countries from both shores of the Mediterranean. Beyond policy coordination, the UfM has played a pivotal role in fostering regional energy cooperation, particularly through its Energy Platforms (currently called working groups mandated to implement the UfM Ministerial Action Plan). These platforms act as dialogue and coordination mechanisms between EU and MENA stakeholders. Another notable example is the Organisation Méditerranéenne de l'Energie et du Climat (OMEC, formerly OME). This think tank conducts regional studies on energy topics and is pioneer in convening stakeholders for high-level conferences, workshops and training sessions on the issues related to the energy sector and infrastructure in Mediterranean countries.

MEDENER, the Association of National Agencies for Energy Management in the Mediterranean, focuses on promoting energy efficiency and renewable energy deployment. Through joint studies and regional dialogues, MEDENER supports the implementation of sustainable energy policies and fosters knowledge exchange among its members. RCREEE is a regional organisation dedicated to advancing renewable energy and energy efficiency in the Arab region. It provides technical assistance, capacity building, and policy support to member countries to strengthen their energy strategies and frameworks. RCREEE also serves as the technical arm of the League of Arab States' energy department. MED9, an informal group of nine EU Mediterranean countries, has emerged as a political platform advocating stronger regional energy integration and infrastructure financing. It promotes a shared vision for EU-MENA energy connectivity and accelerates the deployment of cross-border projects. In addition, various international organisations contribute to advancing energy infrastructure and cooperation in the MENA region. For example, the International Renewable Energy Agency (IRENA) models renewable energy capacity developments in the MENA region, assessing export potential and infrastructure requirements.[67, 68] The International Energy Agency (IEA) works with governments and industry to shape a secure and sustainable energy future. In MENA, the IEA collaborates with governments to facilitate workforce transitions from oil and gas to clean energy industries and provides green hydrogen supply chain analysis, including costs-benefits assessments for sector development, for instance in Oman.

In addition, networks, associations and think tanks are driving initiatives to connect the energy systems of both regions. The Mediterranean Think Tank Alliance on Climate Change (MATTCC) is a network that seeks to unite think tanks from or focused on the Mediterranean regions to address climate challenges. It fosters research, policy development, and advocacy effort to tackle pressing environmental issues. The Mediterranean Clean Energy Network (MEDCEN) brings together Mediterranean civil society organisations (CSOs) and think tanks to accelerate the transition to clean, affordable, and sustainable. MEDCEN supports renewable capacity deployment, promotes grid integration, facilitates policy and investment, and fosters a just and an inclusive energy transition, underpinned by R&D and innovation. It aims to align countries with the Paris Agreement and COP28 pledge to triple renewables and double energy efficiency, with TERAMED as a flagship initiative. MED-GEM is a strategic initiative designed to accelerate the Mediterranean's transition to carbon-neutral energy by integrating renewable electricity with clean hydrogen and derived molecules, such as ammonia or synthetic fuels.

The MENA-Europe Future Energy Dialogue (MEFED) has emerged as a high-level platform for advancing cross-border energy cooperation, focusing on cross-regional infrastructure financing and integrated planning. Launched in 2022 at the Dead Sea in Jordan, MEFED brings together policymakers, regulators, financiers, and infrastructure developers from both regions. The second MEFED iteration, MEFED24, held in Thessaloniki, Greece, culminated in the signing of the Thessaloniki Declaration, which endorsed a shared political vision for deepening EU-MENA energy cooperation. The declaration emphasised accelerating cross-border infrastructure, scaling renewable hydrogen, and aligning regulatory and financing frameworks to support integrated energy markets. Beyond the conference, MEFED is anchored by an Advisory Group that convenes regularly to track progress on strategic projects and facilitate knowledge exchanges. The group comprises key regional organisations, ensuring institutional alignment and continuity across technical, regulatory, and policy dimensions of EU-MENA energy cooperation.

05

Key Recommendations to Accelerate Integrated Infrastructure Planning

Despite growing momentum, there is still no coherent, shared vision for an integrated EU-MENA energy network. Regulatory fragmentation among MENA countries remains significant, and national priorities often take precedence over regional cooperation. While many proposed projects demonstrate progress and political will for cross-regional energy infrastructure development, a coordinated approach for integrated infrastructure planning is lacking.

Key recommendations:

1. Strengthen existing regional institutions and authorities. Effective regional integration depends on strong regional institutions.

The establishment of the new Directorate-General for the Middle East, North Africa, and the Gulf (DG MENA) at the European Commission signals a strong commitment to the region. Its flagship project, the T-Med Initiative, has the potential to accelerate the creation of a common vision for the cross-regional integration and enable private sector investment in infrastructure projects. For a successful implementation, buy-in from partner countries and cross-regional stakeholders will be instrumental. Alongside political initiatives, technical exchange platforms such as MED-TSO, MEDREG and OMEC form the foundation of energy cooperation in the MENA region. Empowering these institutions with a stronger mandate would enhance their capacity to shape cross-regional infrastructure priorities, aligning investment decisions with long-term policy objectives and regional integration goals. At the same time, institutionalised regional platforms would enable strategic dialogue and promote synergies between technical planning, investment promotion, and high-level policy alignment.

2. Closer cooperation between ENTSO-E and Med-TSO in their respective TYNDPs.

Med-TSO's TYMNDP provides a valuable foundation and represents an important step towards regional planning in the Mediterranean, making it crucial for integrating EU and MENA electricity systems. The cooperation agreement between Med-TSO and ENTSO-E supports the regular exchange of models and assumptions; however, full alignment of processes remains challenging. The cooperation is still less institutionalised and lacks binding commitments compared to ENTSO-E's TYNDP. Med-TSO's plan does not (yet) exert the same influence on national investment decisions or funding allocation as ENTSO-E's plans. Strengthening this cooperation – such as by formally requiring ENTSO-E to consider Med-TSO's in budget decisions or by creating a new EU-MENA governance framework – would be essential to advance cross-regional integrated planning.

3. Build a coherent vision for grid regulation.

Regulatory alignment is essential to enable cross-border electricity trade and infrastructure development. MEDREG has been working toward a common Mediterranean Grid Code, which – although non-binding – lays the foundation for harmonised procedures and technical standards across the region. However, regulatory maturity emains uneven; for instance, Lebanon and Tunisia currently lack fully independent regulatory authorities. MEDREG plays a key role in supporting the establishment of National Regulatory Authorities (NRAs) and developing robust regulatory frameworks, which are prerequisites for integrated planning and investment coordination.

4. Commercialise cross-border trade to unlock market benefits.

To realise the benefits of connected markets and create compelling business cases for interconnection projects, it is essential to commercialise cross-border electricity trade between countries and regions. This requires regulatory frameworks that enable commercialisation and increase the utilisation of existing interconnectors.

There are initial approaches that leverage existing infrastructure between neighbouring countries. For example, Med-TSO has proposed a practical stepwise approach to promote pilot projects. These projects build upon current bilateral agreements, regulations, and operational protocols as follows.

PHASE 01

Improve existing bilateral agreements by incorporating pre-defined prices.

PHASE 02

Expand the predefined price concept to include daily auctions to optimise cross-border trade.

PHASE 03

Open the auction market to additional participants.

This phased approach ensures gradual implementation and continuous progress. Med-TSO developed this framework to establish the essential prerequisites and principles of cooperation needed for a potential market model for cross-border power trading among Morocco, Algeria, and Tunisia, while maintaining existing interconnections between Morocco and the European Union, as well as the link with Libya.

However, systemic progress depends on political will and mutual trust among stakeholders. Without a commitment to deepen collaboration beyond current trade levels, commercialisation of cross-border infrastructure will remain unattainable. Achieving this will require a multi-step approach: 1) Build political momentum for interconnector commercialisation, 2) Facilitate cross-regional data sharing among grid operators and stakeholders, ensuring transparency on capacity allocation, 3) Ensure grid interoperability 4) Secure skilled personnel and organise their upskilling and 5) Establish dispute resolution mechanisms.

5. Balancing top-down vs bottom-up approaches to planning.

Effective infrastructure planning requires a balance between top-down strategies and bottom-up initiatives. While regional master plans and high-level political declarations are important, practical progress often stems from bilateral or sub-regional projects that build trust and operational experience. Initiatives like TERAMED illustrate how bottom-up mobilisation by civil society and think tanks can accelerate renewable energy infrastructure development. Aligning TERAMED's grassroots-driven 1 TW renewable energy target with regional interconnection planning can help address both technical and political barriers simultaneously. TERAMED's model of local pilot projects and community engagement offers a replicable template for building the social licence and economic rationale needed to scale up cross-border infrastructure projects. Encouraging a modular planning approach – where pilot interconnections or bilateral frameworks evolve into larger regional architectures – can align political will with technical and financial feasibility while allowing flexibility for national priorities.

6. Establish a coordinated policy and regulatory framework.

A harmonised policy and regulatory framework can facilitate and promote investment rather than act as an obstacle. It creates greater transparency and predictability, along with longer tariff stability. In addition, regulation can accelerate permit granting, enable longer regulatory periods, and ensure appropriate investment incentives. Regulators also play a key role in providing incentives for projects that carry comparatively higher risks during development, construction, operation, or maintenance.

7. Continue learning across regions.

Cross-border electricity trade and infrastructure cooperation call for increased knowledge exchange and mutual learning between different regions. Structured exchanges at both regional and bilateral levels can help align technical standards, planning practices, and regulatory approaches. Lessons learned from the EU's experience with regional electricity market integration, as well as successful bilateral energy partnerships with countries like UAE, Morocco, Egypt, and Jordan, offer valuable insights for advancing market coupling, infrastructure financing, and governance structures. Cross-regional platforms such as the MEFED and technical cooperation through Med-TSO and MEDREG can serve as vehicles for this exchange, which could be further supported through organisations and experts such as OMEC and MEDENER.

ENDNOTES

1 **International Energy Agency (IEA) (2024).** COP28 Tripling Renewable capacity Pledge. Online available at: https://iea.blob.core.windows.net/assets/ecb74736-41aa-4a55-aacc-d76bdfd7c70e/COP28TriplingRenewableCapacityPledge.pdf

2 **International Energy Agency (IEA) (2024).** COP28 Tripling Renewable capacity Pledge. Online available at: https://iea.blob.core.windows.net/assets/ecb74736-41aa-4a55-aacc-d76bdfd7c70e/COP28TriplingRenewableCapacityPledge.pdf

3 **EMBER (2025).** European Electricity Review 2025. Online available at: https://ember-energy.org/latest-insights/european-electricity-review-2025/

4 **EIB (2024).** The only way forward. Online available at: https://www.eib.org/en/essays/europe-energy-transition-renewable

5 **ENTSOE (2025).** TYNDP 2024: Europe's electricity infrastructure plan. Online available at: https://www.entsoe.eu/outlooks/tyndp/2024/

6 **EMBER (2023).** Breaking borders: The future of Europe's electricity is in interconnectors. Online available at: https://ember-energy.org/latest-insights/breaking-borders-europe-electricity-interconnectors/

7 **GIZ (2023).** SET Roadmap. Online available at: https://energypartnership.ma/news/set-roadmap/

8 **Noumba Um & Alsuraih (2021).** How the Pan-Arab electricity market can promote regional cooperation and economic recovery. Online available at: https://www.brookings.edu/articles/how-the-pan-arab-electricity-market-can-promote-regional-cooperation-and-economic-recovery/

9 **ACER (2025).** Infrastructures for Energy System Integration.
Online available at: https://www.acer.europa.eu/green-deal/energy-system-integration/infrastructures

10 **Economic, Social and Environmental Council (2024).** Cross-border energy infrastructure planning. Online available at: https://www.eesc.europa.eu/en/news-media/press-summaries/cross-border-energy-infrastructure-planning

11 **CE Delft (2023).** Case Study Integrated Infrastructure Planning. 4i-TRACTION Deliverable 4.2. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

12 **CE Delft (2023).** Case Study Integrated Infrastructure Planning. 4i-TRACTION Deliverable 4.2. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

13 **ENTSOE (2025).** TYNDP 2024: Europe's electricity infrastructure plan. Online available at: https://www.entsoe.eu/outlooks/tyndp/2024/

14 **CE Delft (2023).** Case Study Integrated Infrastructure Planning. 4i-TRACTION Deliverable 4.2. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

15 **IRENA (2023).** Planning and prospects for renewable power: North Africa. Online available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/Jan/IRENA_Planning_Prospects_NAfrica_2023.pdf

16 **Poudineh et al. (2016).** Business model for cross-border interconnections in the Mediterranean basin. Online available at: https://www.jstor.org/stable/resrep30968.8?seq=2

17 **World Bank Group (2024).** Transmission Pricing Methodologies for use in the Pan-Arab Electricity Market. Online available at: https://documents1.worldbank.org/curated/en/099072124082035121/pdf/P1745041896f3b0261ba5c134ea628f9140.pdf

18 **Bahrain Center for Strategic International and Energy Studies (2018).** Trading in Electricity Between GCC States.
Online available at: https://derasat.org.bh/wp-content/uploads/2019/01/Energy-Report-1-EN.pdf

19 **World Bank Group (2024).** Transmission Pricing Methodologies for use in the Pan-Arab Electricity Market. Online available at: https://documents1.worldbank.org/curated/en/099072124082035121/pdf/P1745041896f3b0261ba5c134ea628f9140.pdf

20 **ENTSOE (2024).** ENTSO-E HVDC Utilisation and Unavailability Statistics 2023. Online available at: https://eepublicdownloads.entsoe.eu/clean-documents/SOC%20documents/Nordic/2024/HVDC_Utilisation_and_Unavailability_Statistics_2023.pdf

21 **Med-TSO (2023).** Executing short-term demonstration project in the Eastern Region. Online available at: https://med-tso.org/wp-content/uploads/2023/05/Executing-short-term-demonstration-project-in-the-Eastern-Region.pdf?utm_source=chatgpt.com

22 **Med-TSO (2023).** Executing short-term demonstration project in the Eastern Region. Online available at: https://med-tso.org/wp-content/uploads/2023/05/Executing-short-term-demonstration-project-in-the-Eastern-Region.pdf?utm_source=chatgpt.com

23 **International Energy Agency (2022).** Egypt-Saudi electricity interconnection project. Online available at: https://www.iea.org/policies/14291-egypt-saudi-electricity-interconnection-project

24 **Power Technology (2024).** Saudi Arabia-Egypt Electricity Interconnection Project. Online available at: https://www.power-technology.com/projects/saudi-arabia-egypt-electricity-interconnection/?cf-view

25 **IRENA (2023).** Planning and prospects for renewable power: North Africa. Online available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/Jan/IRENA_Planning_Prospects_NAfrica_2023.pdf

26 **IRENA (2023).** Planning and prospects for renewable power: North Africa. Online available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2023/Jan/IRENA_Planning_Prospects_NAfrica_2023.pdf

27 **Red Electrica (2022):** Exchange capacity. Online available at: https://www.sistemaelectrico-ree.es/en/2021/spanish-electricity-system/exchanges/exchange-capacity

28 **MED-TSO (2022).** ES-MA Project Sheet. Online available at: https://med-tso.org/wp-content/uploads/2022/02/ES-MA_project_sheet.pdf

29 **EBRD (2024).** EBRD finances Tunisia-Italy 600 MW ELMED electricity interconnector. Online available at: https://www.ebrd.com/home/news-and-events/news/2024/ebrd-finances-tunisiaitaly-600-mw-elmed-electricity-interconnector.html

30 **ENTSO-E (2024).** TYNDP 2024: Europe's electricity infrastructure plan. Online available at: https://www.entsoe.eu/outlooks/tyndp/2024/

31 **World Bank Group (2018).** Morocco Energy Policy MRV. Online available at: https://documents1.worldbank.org/curated/en/964331541085444404/pdf/Morocco-Energy-Policy-MRV.pdf

32 **NAMA (2025).** Oman Electricity Market. Online available at: https://omanpwp.om/oman-electricty-market

33 **UN Economic Commission for Africa (2023).** Regulatory Review of the Electricity Market in Egypt. Online available at: https://res4africa.org/wp-content/uploads/2023/07/Summary-Regulatory-Review-of-Electricity-Market-in-Egypt-1.pdf

34 **KAPSARC (2018).** Electricity Market Integration in the GCC and MENA: Imperatives and Challenges. Online available at: https://www.kapsarc.org/research/publications/electricity-market-integration-in-the-gcc-and-mena-imperatives-and-challenges/

35 **IRENA (2019).** Regional Markets: Innovation Landscape Brief. Online available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Regional_markets_Innovation_2019.pdf?la=en&hash=CEC23437E195C1400A2ABB896F814C807B03BD05

36 **CE Delft (2023).** Case study: Integrated Infrastructure Planning. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

37 **CE Delft (2023).** Case study: Integrated Infrastructure Planning. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

38 **IRENA (2019).** Regional Markets: Innovation Landscape Brief. Online available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Regional_markets_Innovation_2019.pdf?la=en&hash=CEC23437E195C1400A2ABB896F814C807B03BD05

39 **CE Delft (2023).** Case study: Integrated Infrastructure Planning. Online available at: https://ce.nl/wp-content/uploads/2023/07/CE_Delft_200129_D2-4_CaseStudy_Integrated-Infrastructure-Planning_FINAL.pdf

40 **CAN Europe (2023).** Powering Europe's Tomorrow – A blueprint for 100% renewable and resilient infrastructure. Online available at: https://caneurope.org/content/uploads/2023/11/24.11.23-Powering-Europes-Tomorrow-A-blueprint-for-100-renewable-and-resilient-infrastructure.docx.pdf

41 **IEA (2019):** Integrating Power Systems across Borders. Online available at: https://iea.blob.core.windows.net/assets/d9381c64-bbe8-4855-812c-e5e3d3f50dbf/Integrating_Power_Systems_across_Borders.pdf

42 **IEA (2019):** Integrating Power Systems across Borders. Online available at: https://iea.blob.core.windows.net/assets/d9381c64-bbe8-4855-812c-e5e3d3f50dbf/Integrating_Power_Systems_across_Borders.pdf

43 **Energy for Growth Hub (2024).** Central America as a Blueprint for Regional Power Integration. Online available at: https://energyforgrowth.org/article/central-america-as-a-blueprint-for-regional-power-integration/

44 **ESMAP (2010).** Central American Electric Interconnection System (SIEPAC) | Transmission & Trading Case Study. Online available at: https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_Central American Electric Interconnection System-Transmisison & Trading.pdf

45 **Inter-American Development Bank (2017).** Central American Electricity Integration. Online available at: https://publications.iadb.org/en/publications/english/viewer/central-american-electricity-integration.pdf

46 **ESMAP (2010).** Central American Electric Interconnection System (SIEPAC) | Transmission & Trading Case Study. Online available at: https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_Central American Electric Interconnection System-Transmisison & Trading.pdf

47 **African Development Bank (NN).** CLSG Electricity Networks Interconnection Project. Online available at: https://mapafrica.afdb.org/en/projects/46002-P-Z1-F00-058

48 **African Development Bank (NN).** CLSG Electricity Networks Interconnection Project. Online available at: https://mapafrica.afdb.org/en/projects/46002-P-Z1-F00-058

49 **ECOWAPP (2025).** Creation of the WAPP | ECOWAPP. Online available at: https://www.ecowapp.org/en/content/creation-wapp

50 **African Development Bank (NN).** CLSG Electricity Networks Interconnection Project. Online available at: https://mapafrica.afdb.org/en/projects/46002-P-Z1-F00-058

51 **National Grid Partners (2024).** Welcome to the NextGrid Alliance. Online available at: https://www.ngpartners.com/alliance

52 **ECCO (2024).** Setting the Scene for an Interconnected, Renewable Mediterranean Energy System. Research Paper. Online available at: https://eccoclimate.org/wp-content/uploads/2024/10/The-basis-for-an-interconnected-mediterranean-energy-system_Research-paper_ECCO.pdf

53 **GIZ (2023).** SET Roadmap. Online available at: https://energypartnership.ma/news/set-roadmap/

54 **UfM (2024).** Mediterranean Solar Plan Project Preparation Initiative. Online available at:https://ufmsecretariat.org/mediterranean-solar-plan-project-preparation-initiative/

55 **PPIAF (2020).** Pan-Arab Regional Energy Trading Platform (PARETP) Phase 2.1. Online available at: https://www.ppiaf.org/activity/middle-east-and-north-africa-pan-arab-regional-energy-trading-platform-paretp-phase-21-0

56 **Worldbank (2024).** Bridging Borders with Energy: MENA's Path to Regional Energy Integration. Online available at: https://www.worldbank.org/en/news/opinion/2024/12/10/bridging-borders-with-energy-mena-s-path-to-regional-energy-integration

57 **Med-TSO (2023).** Executing short-term demonstration project in the Eastern Region. Online available at: Integrating the power markets in the south-west Mediterranean

58 **Worldbank (2024).** Bridging Borders with Energy: MENA's Path to Regional Energy Integration. Online available at: https://www.worldbank.org/en/news/opinion/2024/12/10/bridging-borders-with-energy-mena-s-path-to-regional-energy-integration

59 **KAPSARC (2018).** Electricity Market Integration in the GCC and MENA: Imperatives and Challenges. Online available at: https://www.kapsarc.org/our-offerings/publications/electricity-market-integration-in-the-gcc-and-mena-imperatives-and-challenges

60 **World Bank (2020).** Guidebook for Economic and Financial Analysis of Regional Electricity Projects. Online available at: https://documents1.worldbank.org/curated/en/391831593529562018/pdf/Guidebook-For-Economic-and-Financial-Analysis-of-Regional-Electricity-Projects-A-Report-of-the-Pan-Arab-Regional-Energy-Trade-Initiative.pdf

61 **Times of Oman (2025).** GCCIA, QDF ink financing agreement for Oman direct interconnection project. Online available at: https://m.timesofoman.com/article/155067-gccia-qdf-ink-financing-agreement-for-oman-direct-interconnection-project?utm_source=chatgpt.com

62 **MEDREG (2020).** Regional Integration: Sub-Regional Regulatory Convergence. Online available at: https://www.medreg-regulators.org/Portals/_default/Skede/Allegati/Skeda4506-518-2021.3.10/Regional_Integration_ENG.pdf?IDUNI=c3qgp0qbj1ugwu4rvv1iuhuz4849

63 **MED-TSO (2022).** Masterplan of Mediterranean Interconnections. Online available at: https://masterplan.med-tso.org/MPreport_split.aspx?chapter=3

64 **Med-TSO (2025).** About us. Online available at: https://med-tso.org/en/about-med-tso/

65 **Med-TSO (2022).** Mediterranean Network Development Plan at 2020. Online available at: https://med-tso.org/wp-content/uploads/2022/02/Deliverable_1.1_Mediterranean_Master_plan_2020.pdf

66 **MEDREG (2022).** Med-TSO and MEDREG work together to enable electricity exchanges and trading in the Mediterranean. Online available at: https://www.medreg-regulators.org/PG/Eventdetail.aspx?IDUNI=cfpskkr1bu5kxr3u5xtp30dh8016&MDId=7494&Skeda=MODIF4505-526-2022.1.11

67 **IRENA (2025).** Middle East and North Africa. Online available at: https://www.irena.org/How-we-work/Middle-East-and-North-Africa

68 **IRENA (2025).** Energy Transitions across the Mediterranean: Enabling Infrastructure for a Sustainable Future. Online available at: https://www.irena.org/-/media/Files/IRENA/Remember/Assembly/Fifteenth%20session%20of%20the%20Assembly/A_15_Side%20Event_Energy%20Transitions%20across%20the%20Mediterranean

Guidehouse