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Spatial Dimensions of Contemporary Energy Policies in Expanding Metropolitan Areas

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Abstract

The issue of energy occupies a significant position in contemporary policies aimed at achieving sustainable development goals. In order to achieve a sustainable future through the integration of social, economic, and environmental goals, energy policies seek to reduce carbon dioxide emissions, increase access to clean energy at affordable prices, and increase energy efficiency. It is therefore emphasised that energy policies are of critical importance even in determining how land will be used in expanding urban areas. In this context, energy policies in expanding cities and even metropolises have the potential to support sustainable development goals. Contemporary energy policies significantly affect the sustainability and energy efficiency of urban settlements. Factors that directly affect energy demand and use are included in land use decisions. Energy-efficient planning and policies recommend actions that take into account factors that influence energy demand in order to promote sustainable energy use in urban environments. This study examines the spatial characteristics of settlements on the Mediterranean coast at different scales and their inclusion in contemporary energy strategies. A classification is made using literature research, local policy and strategy reports of countries and cities at different scales, and research covering the energy-related studies of organisations. Although there are dominant settlement areas in countries bordering the Mediterranean, these cities can be characterised by factors such as energy needs and urbanisation since they are under common climatic conditions.

The necessity for the adoption of regulatory energy efficiency legislation and national energy efficiency programmes in Mediterranean countries has been a prominent theme in recent scientific research and local policies. Increasing energy efficiency and reducing energy consumption and emissions are frequently highlighted as key priorities in this region. Research conducted at the meso-micro level of energy policy emphasises the importance of user participation in evaluating optimisation results and suggests adaptable methodologies in various contexts. Ultimately, it can be concluded that energy policies in countries bordering the Mediterranean must include urban planning, the efficient use of renewable energy resources, environmental protection and social participation. The success of these policies should be shaped and implemented taking into account regional characteristics and local needs.

Keywords: Energy, Energy policy, sustainable development, Mediterranean

Introduction

The attainment of sustainable development goals in contemporary times is intricately tied to the efficacy of energy policies. Pursuing a sustainable future entails the seamless integration of social, economic, and environmental objectives. Positioned at the nucleus of a nation's overarching economic, environmental, and political framework, energy policy assumes paramount significance. Its intricate nature perennially situates it at the forefront of national agendas, influenced by an array of factors including the scope of fossil fuel reserves, geographical positioning, accessibility

of vital resources, and the labyrinthine web of geopolitical interactions among nations engaged in energy exportation and importation (Alola et al., 2019; Jablonski et al., 2012; Jebali et al., 2017). Environmental energy policies aim to reduce carbon dioxide emissions, increase access to clean energy at affordable prices, and enhance energy efficiency. A comprehensive approach encompassing various dimensions is essential in defining energy policies for local governments. It is equally crucial to establish energy-efficient buildings and infrastructure that contribute to socially just and comfortable living environments, ensure equitable access to energy, and promote energy-saving practices. From an economic perspective, factors such as energy costs, efficiency, contributions to the economy, and pursuit of energy independence take precedence. Additionally, the environmental dimension necessitates focusing on reducing greenhouse gas emissions, improving air and water quality, conserving natural resources, and ensuring the sustainability of green spaces (Longo et al., 2020; Natanian & Wortmann, 2021; Pacheco et al., 2012; Song et al., 2017). This holds particularly true for rapidly growing metropolitan areas experiencing significant expansion and transformation, where energy policies are pivotal in land use planning. Research indicates that energy policy serves as a primary determinant of land use in expanding metropolitan areas. Thus, it is understood that energy policies in metropolitan areas hold substantial potential in supporting sustainable development goals. The sustainability of urban settlements and energy efficiency are significantly influenced by energy policies, with land use decisions encompassing factors directly impacting energy demand and usage. Energy-efficient planning and policies recommend actions that consider factors influencing energy demand to promote sustainable energy use in urban environments (MAEP, 2020; Roma, 2023; Urban Learning, 2023).

The sustainability and energy efficiency of urban settlements underscore the necessity for a holistic approach within contemporary spatial planning paradigms. Land-use decisions directly impact energy demand and consumption. Energy-efficient planning and policies advocate actions that consider factors influencing energy demand to promote sustainable energy use in urban environments. In this context, this study examines how the spatial characteristics of metropolitan areas are integrated into modern energy strategies. Drawing examples from worldwide contexts and coastal regions of the Mediterranean, this research presents illustrations to demonstrate the practical analysis of the physical and geographical dimensions of energy efficiency. The Mediterranean coastline hosts numerous metropolitan areas characterized by factors such as climate conditions, energy needs, and urbanization trends. Through examples and experiences, the study explores how energy policies in various domains are shaped by spatial considerations. This analysis contributes to understanding the geographical ramifications of energy policies in burgeoning metropolitan areas and informs future planning endeavors.

The Mediterranean coast holds strategic importance concerning urbanization and energy management. Sustainable growth of metropolitan areas and energy efficiency necessitate the adoption of contemporary energy policies. In this context, the integration of spatial planning issues with optimal utilization of limited resources is imperative. The Mediterranean coast exhibits a potential to effectively harness climate advantages. Scientific research will play a fundamental role in developing spatial and non-spatial policies in the region, contributing significantly to supporting environmental sustainability and fostering economic development. Metropolitan areas with high energy demand stand out as priority areas for policy formulation and implementation in achieving sustainable growth and efficient energy management.

This research relies on an extensive sample encompassing Mediterranean countries, including Gibraltar, Spain, France, Monaco, Italy, Slovenia, Croatia, Montenegro, Albania, Greece, Türkiye, Cyprus, Syria, Palestine, Israel, Lebanon, Egypt, Libya, Malta, Tunisia, Algeria, Morocco, and Bosnia and Herzegovina. These samples are subject to various growth rates in urbanization processes due to increasing population values, spatial growth trends, and the influence of economic, social,

and political dynamics. In this context, addressing the challenges arising from increased energy demands through sustainable energy policies has become a fundamental priority in contemporary planning policies. This study aims to compile these complex and multidimensional aspects. Its objective is to determine whether settlements in the shared climatic zone are benefiting from energy resources in a sustainable manner or to identify differences in country policies.

Methodology

This section discusses the methodology concerning the location, physical geography, population changes, and compiled literature information of coastal cities around the Mediterranean and their surrounding countries.

2.1. Mediterranean Countries

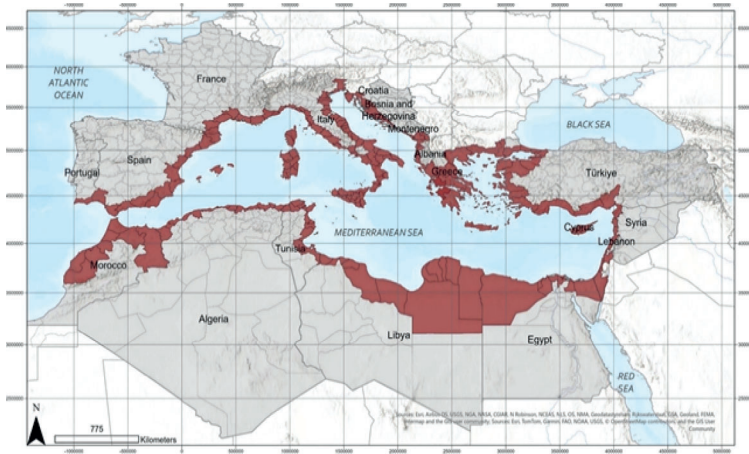
The Mediterranean region encompasses nations situated in Southern Europe, the Middle East, and North Africa, all of which have immediate borders with the Mediterranean. Despite their diverse nationalities, these Mediterranean countries share a common climate and geography. The region exhibits similar vegetation and cultural features. The climatic attributes, varied landscapes, historical significance, and economic stakes of the region derive from intricate interconnections and historical integration among Mediterranean civilizations. The unique essence of the Mediterranean has been a melting pot for numerous cultures, resulting in a blend that has profoundly shaped social, cultural, economic, and even environmental aspects through their interactions. Figure 1 delineates the countries surrounding the Mediterranean Sea and the administrative units with a coastline along the Mediterranean Sea.

Mediterranean countries comprise Gibraltar, Spain, France, Monaco, Italy, Slovenia, Croatia, Montenegro, Albania, Greece, Türkiye, Cyprus, Syria, Palestine, Israel, Lebanon, Egypt, Libya, Malta, Tunisia, Algeria, Morocco, and Bosnia and Herzegovina. Examining population changes in these Mediterranean countries reveals notable trends. From the 1990s to the 2000s, countries such as Albania, Bosnia and Herzegovina, and Jordan continued to experience declining population growth rates. Albania and Bosnia and Herzegovina even witnessed negative population growth rates in certain years. Conversely, Türkiye's population growth rate appears to have increased and then stabilized. After 2010, there was an uptick in population growth rates in Balkan countries like Bosnia and Herzegovina and Albania, as well as in Middle Eastern countries such as Jordan and Israel. Meanwhile, both Türkiye and Egypt experienced declines in their population growth rates during this period. By 2020, it is evident that many countries are facing a decline in their population growth rates. In general, an analysis of population data reveals periodic fluctuations in population growth rates in Balkan countries and the Middle East, as per data from the World Bank (2023).

2.2. Data Collection

The methodology of this study is based on a comprehensive literature review focusing on energy policies, energy efficiency, and spatial factors in countries neighboring the Mediterranean. The review spans the last two decades. Inputs from regional and national authorities, along with references to various databases, scientific publications, national policy documents, and local policies, were compiled to gather relevant studies.

This compilation includes research investigating the evolution of energy policies, underlying principles, contextual factors, and the impact of spatial elements on energy strategies in countries bordering the Mediterranean. An analytical approach was employed throughout the review process to fully comprehend the current state of knowledge regarding energy management. At this stage,



data obtained at both regional and national levels underwent rigorous evaluation to illuminate the fundamental understanding of energy policy development and the underlying principles supporting these policies. Local energy policies were classified into a common framework at macro, meso, and micro scales.

Literature Review

The examination of energy policies in Mediterranean Countries spans from the macro to the micro scale in the literature review.

3.1. Exploring energy policy approaches in Mediterranean Countries at a macro scale

The focus of this study encompasses the countries and metropolitan areas surrounding the Mediterranean basin. From this point, the Mediterranean basin is encircled by the continents of Europe, Asia, and Africa, where the Mediterranean climate prevails due to the convergence of these three nations. This climatic type exerts a significant influence on sectors such as agriculture, tourism, and maritime trade in the region. Regarding energy supply and distribution, the Mediterranean climate poses both challenges and opportunities. The region's sunny climate offers considerable potential for solar energy production, while wind energy also emerges as a promising energy source. The solar and wind potential of the Mediterranean region supports the integration of renewable energy sources into the energy policies of these areas (Fathi Nassar & Yassin Alsadi, 2019; Kaldellis & Apostolou, 2017).

Although the Mediterranean climate provides favorable conditions for solar energy production, wind energy proves particularly effective in coastal areas (Ben Amar et al., 2008). Nonetheless, challenges persist in terms of energy supply and distribution, as economic and political disparities among countries in the region can impact energy trade and cooperation.

Achieving sustainable utilization of coastal areas necessitates striking a balance between tourism and energy generation. Ongoing research is delving into the potential efficacy of offshore wind farms for energy generation and their ecological ramifications (Lacal-Arántegui et al., 2020). Simi-

larly, the development of solar energy installations in coastal regions mandates careful consideration of environmental impacts and land usage concerns.

The effectiveness of energy policies in Mediterranean countries should encompass economic, social, and environmental dimensions. Community engagement and collaboration with local stakeholders play pivotal roles in fostering acceptance and success of energy initiatives (Longo et al., 2020). Furthermore, energy efficiency measures ought to be seamlessly integrated into land-use planning. For instance, urban revitalization endeavors should strive to augment the prevalence of energy-efficient structures, while enhancing public transportation systems is paramount (Okeil, 2010; Pacheco et al., 2012; Song et al., 2017).

The Euro-Mediterranean Partnership comprises the 15 Member States of the European Union and, since 1995, an additional 12 countries spanning North Africa and the Eastern Mediterranean. These 12 countries include Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia, and Türkiye. The Euro-Mediterranean Energy Partnership has delineated three primary energy policy objectives: ensuring security of supply, enhancing the competitiveness of the energy sector, and preserving environmental integrity. Among the notable challenges confronting this partnership, the substantial political dimension warrants particular attention. The Mediterranean region encompasses a heterogeneous group of 12 countries, each characterized by distinct economic profiles, energy market configurations, and individual national energy priorities and policy objectives (Kagiannas et al., 2003). It is evident that both national and regional policies are evaluating the opportunities and benefits presented by the Mediterranean climate in terms of energy (Jablonski et al., 2012).

Alola et al. (2019) examine the dynamics of renewable energy consumption in Mediterranean countries (Spain, France, Slovenia, Greece, Türkiye, Lebanon, and Israel), accounting for geographical and ecological factors, carbon emissions, and housing policies. Employing various methodologies, the study scrutinizes the enduring positive relationship between housing, real income, tourism, carbon emissions, and the expansion of renewable energy. However, short-term deviations tend to revert to long-term equilibrium, except in Israel, where housing policy has not propelled renewable energy development. According to Jebali et al. (2017), from a policy perspective, two principal findings emerged concerning energy efficiency and its determinants in Mediterranean countries. Firstly, a sustained decline in energy efficiency was observed in the Mediterranean region during the period 2009-2012. Secondly, factors conducive to enhancing energy efficiency were identified. While France, Italy, and Malta attained the highest energy efficiency scores among Mediterranean countries, it was underscored that Eastern and Southern Mediterranean countries should adopt robust regulatory frameworks for energy efficiency and national agendas to enhance their energy efficiency.

Elevating the proportion of renewable energy in total energy consumption in Mediterranean countries was identified as a significant impediment to enhancing energy efficiency in this region. It was also observed that economic growth contributes to improving energy efficiency, implying that as economic growth accelerates in this region, energy efficiency will correspondingly rise. This contention suggests that such economic growth will engender enhanced energy efficiency through an augmentation in the share of less energy-intensive sectors, such as financial services, rather than an expansion in the industrial share of energy. The affirmative impact of population density on energy efficiency has also been discerned, with countries exhibiting high population density, such as Malta and Italy, demonstrating higher energy efficiency (Jebali et al., 2017).

3.2. Energy policies in metropolises surrounding the Mediterranean at a meso-micro scale

Examining energy policies implemented at the meso-micro scale within national frameworks re-

veals the presence of approximately 23 metropolitan areas spread across the 13 Mediterranean countries. This observation underscores the substantial potential of energy policies in rapidly expanding metropolitan regions to contribute to sustainable development objectives. Ozarisoy and Altan's study (2021) addresses the imperative for energy-efficient retrofitting of outdated social housing in South-Eastern Europe, probing into the intricate interplay among socio-demographic factors, building attributes, and energy consumption. Employing a socio-technical systems approach, the study scrutinizes energy usage in post-war Mediterranean housing, elucidating correlations between variables such as income, age, and thermal comfort, thereby offering insights for enhancing energy policies in Cyprus and Europe.

Natanian and Wortmann (2021) advocate for a methodology aimed at integrating optimization techniques into energy-oriented urban and architectural design investigations in warm climates. Taking Tel Aviv as a case study, their four-step approach comprehensively assesses energy supply and demand parameters, links predictive metrics with energy performance, conducts solar and geometric optimization within a multi-objective optimization framework, and evaluates optimal outcomes through energy simulations. Notably, the research delves into the impact of morphological factors on energy supply and demand, revealing the intricate interaction between urban form, solar potential, and energy efficiency.

Analyzing the energy action plans of the metropolises within the study's scope, Spain emerges as noteworthy. In Barcelona, the city is strategically progressing towards energy self-reliance by prioritizing energy transition. The city aspires to achieve carbon neutrality through 100% utilization of renewable energy, democratization of energy access, and reclamation of energy management as a public service. Initiatives to reduce energy consumption include enhancing energy efficiency, promoting local energy production, and advocating for clean energy usage (The City Council, 2023). Valencia has surpassed the European Climate Pact's 2020 targets within nearly 12 years through energy and urban transformation efforts. The city has slashed greenhouse gas emissions by 31% and curbed energy consumption by 18%. It aims to further reduce emissions by 40%, enhance energy efficiency, and increase renewable energy utilization to 27% by 2030. Additionally, it champions sustainable transportation modes and supports eco-friendly tourism (The València Climate and Sustainable Energy Action Plan, 2023). Málaga has pledged its commitment to the European Covenant of Mayors, striving to achieve a 20% reduction in CO₂ emissions by 2020. Moreover, the city has participated in the Green Digital City Card program, actively engaging in energy management, lighting initiatives, and electricity generation (Málaga City Council, 2014; Malaga Smart, 2023).

In Italy, Rome's Smart City Plan encompasses several policy initiatives aimed at promoting energy efficiency and the adoption of clean energy, which are being integrated with technological innovations (Nastasi & Di Matteo, 2016; Roma, 2023). Meanwhile, Milan is recognizing its potential role in addressing climate change and is formulating sustainable energy strategies. The city is implementing various measures to encourage energy conservation, the utilization of clean energy, and the adoption of green technologies throughout its urban landscape (Comune di Milano, 2009; Nastasi & Di Matteo, 2016). Naples has garnered attention by establishing the first renewable energy community, creating a community-driven energy initiative through the installation of solar panels in an underserved area of the city (Nastasi & Di Matteo, 2016; Zanchini, 2023).

In France, Marseille has developed an ecological and intelligent energy network known as the "Massileo" project, leveraging the temperature differential between seawater and freshwater to provide heating and cooling for a neighborhood. Supported by funding from the European Cohesion Policy, this initiative has attracted interest from other nations due to its feasibility (The

European Commission, 2018). Similarly, the city of Nice has initiated projects focusing on sustainability and renewable energy. By prioritizing energy efficiency, electric mobility, and green technologies, it actively promotes sustainable energy objectives (IRIS, 2023). Toulon, a major port city, plays a crucial role in industry, maritime activities, and tourism. It has implemented significant measures in energy and sustainability, particularly aiming to reduce the environmental impact of the port and maritime sectors through enhanced energy efficiency. The city aims to reduce carbon dioxide emissions by enabling ships in the harbor to operate on electricity, achieved through the installation of electrical connection points in the harbor and other measures (MAEP, 2020).

In Croatia, Zagreb is integrating energy policy into urban planning, supporting sustainable energy objectives through activities such as energy efficiency measures, the utilization of renewable energy sources, and the adoption of environmentally friendly fuels and green technologies (Urban Learning, 2023). In Gaza, the Palestinian government is promoting sustainable energy sources over traditional ones, recognizing the vital role of energy sector enhancement for economic progress and development in Gaza. Significant upgrades and expansions of the electricity grid are urgently required to meet current demand (ITA, 2023). In Türkiye, Istanbul has implemented energy and sustainability action plans at the local community level, such as in Kadıköy and Şişli. Antalya is implementing measures to reduce energy consumption and greenhouse gas emissions as part of its Sustainable Energy and Climate Action Plan. The city has devised a comprehensive strategy that includes measures to decrease energy consumption in buildings, transportation, and other sectors (Antalya Metropolitan Municipality, 2022). Izmir is undertaking projects aimed at environmental preservation and sustainable urban development, striving to reduce CO₂ emissions, adapt to climate change, and ensure sustainable and accessible energy (Izmir Metropolitan Municipality, 2016).

In Greece, Athens, Thessaloniki, and Patras; in Portugal, Lisbon and Porto; in Egypt, Cairo and Alexandria; in Tunisia, Tunis; and in Algeria, Algiers, nationwide energy action plans are in place. These cities are actively engaged in initiatives aimed at enhancing energy efficiency, utilizing clean energy sources, and pursuing sustainability objectives.

Results of the Research

This study investigates the energy policies of nations and metropolitan regions surrounding the Mediterranean basin. The Mediterranean climate significantly impacts various sectors such as agriculture, tourism, and maritime trade, presenting both challenges and opportunities for energy supply and distribution. While economic and political disparities among countries affect energy trade and cooperation, achieving sustainable development in coastal areas requires balancing tourism and energy production. Research on offshore wind energy and solar energy in coastal regions continues.

Since 1995, the Euro-Mediterranean Energy Partnership, comprising 15 EU Member States and 12 additional countries, aims to ensure energy security, enhance competitiveness, and preserve environmental integrity. However, economic disparities among the 12 Mediterranean countries with distinct energy priorities and policy objectives pose challenges. Recognizing the energy potential of the Mediterranean climate, national and regional policies emphasize the need for regulatory frameworks to improve energy efficiency.

Research examines dynamics of renewable energy consumption and determinants of energy efficiency in Mediterranean countries. Despite a positive correlation between renewable energy consumption and factors like housing, real income, and tour

Country/City	Scale	Key Objectives and Initiatives of Energy Policy Focus	Challenges and Considerations
Euro-Mediterranean Partnership	Macro	Ensuring security of supply, improving competitiveness, safeguarding environmental integrity	Political dimension, diverse economic profiles, energy market configurations, and individual national energy priorities
Mediterranean Countries (Spain, France, Slovenia, Greece, Türkiye, Lebanon, Israel)	Macro	Exploration of renewable energy consumption dynamics, consideration of geographical and ecological factors, carbon emissions, and housing policies	Economic and political differences affecting energy trade and collaboration; challenges in sustainable use of coastal areas; national and regional policies assessing opportunities
Metropolises in the Mediterranean	Meso-Micro	Implementation of energy policies within metropolitan areas; focus on sustainable development goals	Economic, social, and environmental dimensions; community involvement and cooperation with local stakeholders; integration of energy efficiency measures into land-use planning
Metropolitan areas/Cities	Meso-Micro	Various initiatives for energy efficiency, clean energy adoption, and sustainable development	Varied goals, measures, and strategies; success stories in energy transition, reduction of emissions, and adoption of green technologies

Table 1. The energy policies in Mediterranean countries into different categories based on their focus, objectives, and approaches (prepared by the author)

ism, energy efficiency decreased in the region from 2009-2012. Enhancing energy efficiency requires strong regulatory frameworks alongside economic growth contributions. Additionally, countries with high population density exhibit higher energy efficiency.

Analysis of energy policies at the meso-micro scale reveals approximately 23 metropolitan areas across 13 Mediterranean countries (see Table 1). These areas hold significant potential for contributing to sustainable development goals. Studies focus on energy-efficient retrofitting of social housing, integration of optimization techniques into urban design, and implementation of ecological and smart energy networks. Metropolitan cities like Barcelona, Valencia, and Málaga in Spain, and Rome, Milan, and Naples in Italy, demonstrate proactive measures toward energy efficiency and sustainability. Other cities across Mediterranean countries are also implementing nationwide energy action plans to enhance energy efficiency and promote the use of clean energy sources, as depicted in Table 1's classification of energy policies at different scales.

Discussion

In Mediterranean coastal cities and the surrounding countries, the determination of energy-efficient policies takes place under a common framework due to the shared geographical and climatic conditions. This research observes a comprehensive perspective of energy policies at various scales in Mediterranean countries. The study addresses two scales: firstly, at the macro level and across the Mediterranean region concerning approaches to energy policies; and secondly, at the meso-micro level, specifically focusing on the implementation of energy policies and city examples within major metropolitan areas. At the macro level, a perspective has been presented emphasizing the importance of regional cooperation and strategies in energy policies. Goals at this level include ensuring energy supply securi-

ty, enhancing the competitiveness of the energy industry, and preserving environmental integrity. However, factors such as the diverse economic profiles, energy market configurations, and national energy priorities in the region pose challenges to policy implementation. The energy demands of Mediterranean countries are classified into two groups, with different forecast scenarios related to renewable energy sources. According to Bastida-Molina et al. (2022)'s research, energy supply has been emphasized as a fundamental element for the social, environmental, and economic development of a society, along with the need for sustainability in the energy scenario. It is noted that countries located in the Northern part of the Mediterranean exhibit an adequate level of energy consumption but face excessive CO₂ emissions and high external dependence for energy supply. Conversely, countries in the Southern part, including those in the MENA region comprising the Middle East and North Africa, experience deficits in energy supply without issues concerning CO₂ emissions and external energy contribution. It is indicated that countries in the Southern Mediterranean need to significantly increase their energy demand, with renewable sources expected to make a substantial contribution to meeting this demand. The research conducted by Kagiannas et al. (2003) also lends support to the Mediterranean Southern countries aiming to reduce CO₂ emissions.

According to analyses highlighted by Ferrante (2016), the energy policies of Mediterranean countries have focused on factors such as dynamics of renewable energy consumption, geographical and ecological elements, carbon emissions, and housing policies. However, it has been noted that economic and political differences may influence energy trade and cooperation, there are challenges regarding sustainable usage in coastal areas, and national and regional policies evaluate opportunities in the energy sector. Many researchers emphasize the promotion of renewable energy sources, particularly solar and wind energy, underscoring their significant contribution to environmental protection (Ahmed Shata & Hanitsch, 2006; Lira-Loarca et al., 2021; Soukissian et al., 2021). It has been indicated that the development of renewable energy sources (Poza-Vazquez et al., 2011) and diversification of energy resources could also contribute to reducing dependency on external energy supply (Kagiannas et al., 2003).

Observations indicate a focus on the implementation phase of energy policies in metropolitan areas along the Mediterranean coast. According to research conducted by Ferrante (2016), the relationship between population density and energy studies in metropolitan areas is deemed significant. Energy policies aim to contribute to sustainable development goals by shaping the interaction between metropolitan areas and built environments. Various measures are taken to support energy efficiency, clean energy usage, and sustainable development goals through city examples. At this stage, emphasis is placed on the importance of collaboration with local stakeholders and community participation, considering economic, social, and environmental dimensions. From a comprehensive perspective, energy policies in the Mediterranean region exhibit multidimensionality, focusing on sustainable development goals and being open to regional cooperation. However, various challenges are encountered, and it is observed that each country, and even each city, shapes its energy policies according to its own specific conditions and objectives.

Conclusions

The need for adopting regulatory energy efficiency legislation and national energy efficiency programs in Mediterranean countries has been emphasized in recent scientific research and local policies. Additionally, there is an understanding of the necessity to adopt consumption reduction policies for industries with higher energy consumption. Furthermore, increasing awareness of energy savings by encouraging individuals to change their energy-saving habits and raising public awareness is imperative. Given the differences in energy policies among Mediterranean countries, energy efficiency measures

should be a priority for certain countries. Research findings suggest significant potential for improvement through the dissemination of knowledge and transfer of energy efficiency practices among these countries. In terms of policy outcomes, policies aimed at enhancing energy efficiency in the Mediterranean region should focus on large-scale approaches and dissemination of renewable energy technologies. Moreover, countries utilizing fossil fuel subsidies, which could hinder the development and transfer of renewable energy technologies, are encouraged to gradually phase out these subsidies. Increasing energy efficiency and reducing energy consumption and emissions are often highlighted priorities. Research conducted at the meso-micro level of energy policy emphasizes the importance of user participation in evaluating optimization outcomes and proposes adaptable and replicable methodologies in various contexts. Studies involving measurable metrics indicate that they can effectively guide designers to consider energy aspects in early design stages and strengthen sustainable design practices, particularly when combined with optimization techniques. Some findings underscore the importance of aligning policy design with sustainable development goals and future trends in energy efficiency. In conclusion, energy policies in Mediterranean coastal countries should encompass urban planning, efficient utilization of renewable energy sources, environmental protection, and community engagement. The success of these policies should be tailored and implemented considering regional characteristics and local needs. Furthermore, there is a need for improvement in energy storage and transmission infrastructure. Additionally, ongoing energy transition efforts in the region present significant opportunities for sustainable energy production and environmental protection. While energy policies operate at the national level, there is a need for action at the city level where policies are localized, developed, and disseminated.

References

- Ahmed Shata, A. S., & Hanitsch, R. (2006). Evaluation of wind energy potential and electricity generation on the coast of Mediterranean Sea in Egypt. *Renewable Energy*, 31(8), 1183–1202. <https://doi.org/10.1016/j.renene.2005.06.015>
- Alola, A. A., Alola, U. V., & Akadiri, S. Saint. (2019). Renewable energy consumption in Coastline Mediterranean Countries: impact of environmental degradation and housing policy. *Environmental Science and Pollution Research*, 26, 25789–25801. <https://doi.org/10.1007/s11356-019-05502-6>
- Antalya Metropolitan Municipality. (2022). Sustainable Energy and Climate Action Plan. https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/31/n3hU0YXW2UfxnTBVa4ukUvve_z2ugWOB.pdf
- Bastida-Molina, P., Hurtado-Pérez, E., Moros Gómez, M. C., Cárcel-Carrasco, J., & Pérez-Navarro, Á. (2022). Energy sustainability evolution in the Mediterranean countries and synergies from a global energy scenario for the area. *Energy*, 252, 124067. <https://doi.org/10.1016/j.ENERGY.2022.124067>
- Ben Amar, F., Elamouri, M., & Dhifaoui, R. (2008). Energy assessment of the first wind farm section of Daoud, Tunisia. *Renewable Energy*, 33(10), 2311–2321. <https://doi.org/10.1016/j.renene.2007.12.019>
- Comune di Milano. (2009). Sustainable Energy and Climate Action Plan. https://mycovenant.eumayors.eu/docs/seap/261_534_1304094182.pdf
- Fathi Nassar, Y., & Yassin Alsadi, S. (2019). Assessment of solar energy potential in Gaza Strip-Palestine. *Sustainable Energy Technologies and Assessments*, 31, 318–328. <https://doi.org/10.1016/j.seta.2018.12.010>
- Ferrante, A. (2016). Towards Nearly Zero Energy: Urban Settings in the Mediterranean Climate. In *Towards Nearly Zero Energy: Urban Settings in the Mediterranean Climate*. <https://doi.org/10.1016/B978-0-08-100735-8.00006-4>
- IRIS. (2023). Smart Cities. <https://irissmartcities.eu/nice-france/>
- ITA. (2023). Energy. <https://www.trade.gov/country-commercial-guides/west-bank-and-gaza-energy#:~:text=The Palestinian government encourages the,10%25 from renewable energy sources.>
- İzmir Metropolitan Municipality. (2016). İzmir Sürdürülebilir Enerji Eylem Planı. https://mycovenant.eumayors.eu/docs/seap/21351_1502449751.pdf
- Jablonski, S., Tarhini, M., Touati, M., Gonzalez Garcia, D., & Alario, J. (2012). The Mediterranean Solar Plan: Project proposals for renewable energy in the Mediterranean Partner Countries region. *Energy Policy*, 44,

291–300. <https://doi.org/10.1016/j.enpol.2012.01.052>

- Jebali, E., Essid, H., & Khraief, N. (2017). The analysis of energy efficiency of the Mediterranean countries: A two-stage double bootstrap DEA approach. *Energy*, 134, 991–1000. <https://doi.org/10.1016/j.energy.2017.06.063>
- Kagiannas, A. G., Askounis, D. T., Anagnostopoulos, K., & Psarras, J. (2003). Energy policy assessment of the Euro-Mediterranean cooperation. *Energy Conversion and Management*, 44, 2665–2686. [https://doi.org/10.1016/S0196-8904\(03\)00012-8](https://doi.org/10.1016/S0196-8904(03)00012-8)
- Kaldellis, J. K., & Apostolou, D. (2017). Life cycle energy and carbon footprint of offshore wind energy. Comparison with onshore counterpart. *Renewable Energy*, 108, 72–84. <https://doi.org/10.1016/j.renene.2017.02.039>
- Lacal-Arántegui, R., Uihlein, A., & Yusta, J. M. (2020). Technology effects in repowering wind turbines. *Wind Energy*, 23(3), 660–675. <https://doi.org/10.1002/we.2450>
- Lira-Loarca, A., Ferrari, F., Mazzino, A., & Besio, G. (2021). Future wind and wave energy resources and exploitability in the Mediterranean Sea by 2100. *Applied Energy*, 302, 117492. <https://doi.org/10.1016/J.AP-ENERGY.2021.117492>
- Longo, S., Beccali, M., Cellura, M., & Guarino, F. (2020). Energy and environmental life-cycle impacts of solar-assisted systems: The application of the tool “ELISA.” *Renewable Energy*, 145, 29–40. <https://doi.org/10.1016/j.renene.2019.06.021>
- MAEP. (2020). French Strategy for Energy and Climate. https://www.consultations-publiques.developpement-durable.gouv.fr/IMG/pdf/ppe_-english_full_document_for_public_consultation.pdf
- Málaga City Council. (2014). Update Sustainable Energy Action Plan. https://mycovenant.eumayors.eu/docs/seap/14856_1420703301.pdf
- Malaga Smart. (2023). Energy. <https://malagasmart.malaga.eu/en/sustainable-and-safe-habitat/energy/>
- Nastasi, B., & Di Matteo, U. (2016). Solar energy technologies in Sustainable Energy Action Plans of Italian big cities. *Energy Procedia*, 101, 1064–1071. <https://doi.org/10.1016/j.egypro.2016.11.136>
- Natanian, J., & Wortmann, T. (2021). Simplified evaluation metrics for generative energy-driven urban design: A morphological study of residential blocks in Tel Aviv. *Energy and Buildings*, 240, 110916. <https://doi.org/10.1016/j.enbuild.2021.110916>
- Okeil, A. (2010). A holistic approach to energy efficient building forms. *Energy and Buildings*, 42(9), 1437–1444. <https://doi.org/10.1016/j.enbuild.2010.03.013>
- Ozariso, B., & Altan, H. (2021). Developing an evidence-based energy-policy framework to assess robust energy-performance evaluation and certification schemes in the South-eastern Mediterranean countries. *Energy for Sustainable Development*, 64, 65–102. <https://doi.org/10.1016/j.esd.2021.08.001>
- Pacheco, R., Ordóñez, J., & Martínez, G. (2012). Energy efficient design of building: A review. *Renewable and Sustainable Energy Reviews*, 16(6), 3559–3573. <https://doi.org/10.1016/j.rser.2012.03.045>
- Pozo-Vazquez, D., Santos-Alamillos, F. J., Lara-Fanego, V., Ruiz-Arias, J. A., & Tovar-Pescador, J. (2011). The Impact of the NAO on the Solar and Wind Energy Resources in the Mediterranean Area. In *Advances in Global Change Research* (Vol. 46). https://doi.org/10.1007/978-94-007-1372-7_15
- Roma. (2023). Roma Smart City. https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/33/bifEtvo554_StDZRzoot9ibb_MLNVYyY.pdf
- Song, Q., Li, J., Duan, H., Yu, D., & Wang, Z. (2017). Towards to sustainable energy-efficient city: A case study of Macau. *Renewable and Sustainable Energy Reviews*, 75, 504–514. <https://doi.org/10.1016/j.rser.2016.11.018>
- Soukissian, T. H., Karathanasi, F. E., & Zaragkas, D. K. (2021). Exploiting offshore wind and solar resources in the Mediterranean using ERA5 reanalysis data. *Energy Conversion and Management*, 237, 114092. <https://doi.org/10.1016/J.ENCONMAN.2021.114092>
- The City Council. (2023). Strategy for energy transition. <https://ajuntament.barcelona.cat/ecologiaurbana/en/what-we-do-and-why/energy-and-climate-change/strategy-energy-transition>
- The European Commission. (2018). The Mediterranean helps boost the energy needs of Marseille. <https://www.euronews.com/my-europe/2018/04/11/the-mediterranean-helps-boost-the-energy-needs-of-marseille>
- The València Climate and Sustainable Energy Action Plan. (2023). <https://energy-cities.eu/members/city-of-valencia/#:~:text=By 2030%2C Valencia aims to,Climate and Energy Action Plan.>
- Urban Learning. (2023). Zagreb. <http://www.urbanlearning.eu/cities-on-board/zagreb/#:~:text=The energy policy of the,new ICT and green technologies%2C%0A>
- Zanchini, E. (2023). Combatting energy poverty with community energy (Italy). <https://caneurope.org/achievements/comuni-rinnovabili/>