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International Political Economy, Business Ecosystems, Entrepreneurship, and Sustainability: A Synthesis on the Case of the Energy Sector

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Abstract: This paper explores the intricate relationships among the evolution of the international political economy, the dynamics of business ecosystems, and the transformations in entrepreneurship within the European energy sector, with a specific emphasis on Greece, particularly the less developed region of Eastern Macedonia and Thrace. The aim is to understand how geopolitical, economic, and technological dynamics interact across macro-, meso-, and microlevels, especially within the context of the ongoing global energy transition. A multi-method approach is employed, including interviews with 16 experts, a survey of 89 energy firms, and eight in-depth interviews with microfirm owners. A key finding is that an integrated and evolutionary macro–meso–micro framework is essential for understanding and addressing the complex dynamics across various sectors, especially in the energy sector. The study highlights the need for targeted support for smaller firms through a restructured energy policy to foster local entrepreneurship and innovation. It further emphasizes that understanding the evolution of the global energy system and its components is crucial for addressing sustainability in environmental and socioeconomic terms, as the emerging model of energy production and consumption is directly tied to the reshaping of socioeconomic development models in the new globalization.

Keywords: international political economy; business ecosystems; entrepreneurship; energy sector; innovation; energy transition; energy policy; European Union; Greece; Region of Eastern Macedonia–Thrace (ReMTh)

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1. Introduction

The global energy sector, particularly its current restructuring, can only be fully understood, and its prospects effectively assessed, within an integrated framework that includes International Political Economy (IPE), business ecosystems, and entrepreneurship. It is the synergy of these dimensions that will ultimately ensure the sustainability and viability of the global system.

Some key approaches in International Political Economy incorporate elements of organic-evolutionary development and institutional frameworks [1] as well as technological advancements [2,3]. However, there is a notable gap in studies that integrate political, economic, and technological structures to analyze various "capitalisms"—capitalist socioeconomic formations [4–6].

Furthermore, business ecosystems at the "mesolevel" (In economics, the mesolevel refers to the intermediate level of analysis between the micro —individuals and firms— and macro —entire economies— levels. It focuses on groups, institutions, and networks, such as industries, regions, sectors, or local innovation systems, exploring how their dynamics influence economic outcomes [7–9]. The terms macro–meso–micro and variations such as

macro–meso, macro–micro, meso–micro, macro, meso, micro, or microlevel, and others will be used without quotation marks from this point forward.) are deeply influenced—though not solely—by organizational strategy at the microlevel of individual organizations [10,11]. The "physiological" synthesis of strategy, technology, and management [12–14] suggests that technological and managerial priorities also play a crucial role in shaping innovative efforts across various types of organizations. Business ecosystems at the mesolevel appear to widely adopt ecological metaphors and examine the institutionally complex, evolutionary environment at the macrolevel, and the innovation of individual actors at the microlevel in a holistic manner [15]. These three dimensions—macro, meso, and micro—are interconnected and evolve together dynamically.

In the context of entrepreneurship, influential studies such as the World Competitiveness Ranking [16] push the discussion on competitiveness beyond the traditional macro–meso dimension [17,18]. These studies explore composite macro–micro dimensions, focusing on the interaction between institutional environments and entrepreneurship, which drives socioeconomic development. This ongoing conceptual enrichment of business ecosystems with aspects of innovation systems [19,20] and business clusters [18,21] is therefore warranted.

Despite this, the existing literature does not provide a comprehensive and effective synthesis of the research fields of IPE, business ecosystems, and entrepreneurship. When defining and selecting the research focus for the empirical study of this synthesis, it becomes evident that the energy sector is increasingly relevant [22]. The urgent need for energy transition is being progressively examined, showing that it extends and evolves codependently at the macro-, meso-, and microlevels [23,24]. This paper aims to investigate this dialectical coevolution (Socioeconomic formations develop over time within a dialectical framework for understanding phenomena [25]. The revival of Heraclitean dialectics after the Enlightenment is mainly credited to Hegel [26]. He proposed the theoretical model of "thesis–antithesis–synthesis", which suggests that all processes begin with a thesis, representing a temporary balance. Over time, an antithesis arises, creating instability. When the existing system can no longer absorb the growing accumulation of quantities and qualities, the resulting tension may lead to a synthesis. Hegelian dialectics influenced thinkers like Marx [27] in his analysis of the base-superstructure dynamic, and later Schumpeter [28] with his idea of creative destruction fueled by innovations in capitalism. This study aims to apply a dialectical approach to examining IPE at the macrolevel, business ecosystems at the mesolevel, and entrepreneurship at the microlevel. This synthesizing shift is becoming increasingly relevant as the holistic macro–meso–micro perspective demonstrates that these levels of understanding are interconnected and coevolving, rather than isolated.) across these levels [7–9], with a particular emphasis on the energy sector.

The key questions addressed in this study are as follows:

I. How does the acceleration of the global energy transition, particularly in response to recent geopolitical crises, influence the restructuring of the IPE and the energy sector?
II. How do local energy ecosystems, especially in less developed regions, contribute to the development of national and international energy sectors, particularly in terms of innovation and sectoral transformation?
III. What are the major challenges smaller energy firms in these regions face in integrating strategy, technology, and management to support the energy transition?
IV. What types of policy interventions can most effectively support smaller firms in the energy sector, enabling them to play an active role in the global energy transition?
V. How will the ongoing reconfiguration of global socioeconomic development models, driven by changes in energy production and consumption, impact sustainability, and long-term energy security on a global scale?

To this end, it is important to highlight that while the study is primarily a national-level investigation centered on Greece, the energy transition is examined within the wider context of EU energy policy and global energy dynamics. Consequently, the interplay between

national and international energy politics is crucial for comprehending how Greece's energy sector integrates into broader regional and global frameworks.

Section 2 provides a review of the relevant literature, followed by Section 3, which outlines the research hypotheses and methods. In Section 3, a mixed-methods approach is detailed, combining thematic-cluster analysis from expert interviews for grounded-theory development with mixed firm-level surveys using statistical and qualitative analysis tools. Section 4 presents the findings, and Section 5 discusses the results in relation to the hypotheses, proposing policy dimensions. The concluding Section 6 summarizes the findings, examines limitations, and suggests directions for further research.

2. Theoretical Background

Recent literature has identified the autonomous scientific field of IPE as evolving through three distinct streams [29,30]: the pre-1970s–1980s period (first stream and theoretical foundation), the post-1980s period (second stream, focusing on globalization studies up to 2008), and the post-2008 period (third stream and exploration of new globalization aspects). Traditional approaches that primarily focus on macroeconomic characteristics have been increasingly questioned, with an emphasis on the critical interaction between political, economic, and technological structures [6]. It has been argued that studying IPE is incomplete without a combined and evolutionarily integrated examination of these interrelated dimensions [31–36]. Analyzing various global geoeconomic events regarding their influence on the new energy IPE suggests that the world is entering a period of moderate overall performance (According to Vlados and Chatzinikolaou [29], there are four likely scenarios for the performance of the global system in the new era of globalization. These range from the "low-performance zone" marked by protectionism and populism to the "high-performance zone" characterized by global cooperation, sustainable growth, and innovation.), with the energy transition progressing more slowly than expected due to reinforced nation-centric retrenchments and lower levels of innovation [37–40].

In the context of business ecosystems, concepts nurtured and distinguished by evolutionary economics—heavily employing biological analogies—have increasingly been adopted to shed light on the complexities of contemporary socioeconomic systems and organizations [41–43]. The macro–meso–micro framework provides a comprehensive theoretical perspective that enhances the methodological foundations of evolutionary economics. It also broadens our understanding of these phenomena by bridging the domains of IPE and the dynamics of entrepreneurship [7–9]. This dialectical synthesis, rooted in evolutionary and institutional economic theories, challenged the traditional separation between macroeconomics and microeconomics [44]. Moore [11] is considered one of the pioneers in the theoretical enrichment of the ecosystem metaphor, arguing that using biological examples is an effective method for understanding complex socioeconomic systems. Iansiti and Levien [10] also observed that certain firms within these ecosystems adopt roles analogous to keystone species in nature, promoting diversity and stability while actively pursuing individualized goals.

Building on these theoretical foundations, it can be argued that the energy sector consists of various "biologically" interconnected entities that play a vital role in the ecosystem's balance and efficiency—an energy ecosystem [45–47]. These entities are categorized as suppliers, producers, distributors, and consumers. Suppliers provide raw energy materials, such as essential fuels and tools for constructing renewable energy production methods [39,40,48,49]. Producers generate the primary resources, and distributors act as intermediaries, ensuring that energy reaches end-users effectively and efficiently [50–52]. Consumers use this energy at the end of the chain, influencing the demand for different types of energy produced [53,54]. (Suppliers of energy raw materials hold a key position in the energy ecosystem, as they can exert significant influence on production, often showing monopolistic tendencies. Additionally, the move by producers toward renewable energy sources may require distributors to adjust their logistical infrastructures. Likewise, in-

creasing consumer demand for sustainable energy can prompt producers to innovate and diversify the energy sources they offer.)

In the field of entrepreneurship, evolutionary economics has been used to shed light on its complex dynamics, studying firms as "organisms" that react proactively and adapt to their external environment [55–57]. The Stra.Tech.Man framework (strategy–technology–management synthesis), introduced by Vlados [12], likens firms to "living organisms", each classified into a particular "physiological" category. This analogy emphasizes the adaptability of firms, much like biological entities evolving to survive and thrive.

In a related concept, "technocenosis" describes the interaction and coexistence of various technologies within a shared ecosystem, mirroring how firms operate and adapt within their organizational environments [58]. As technologies evolve to respond to environmental pressures, firms too must innovate continuously or risk becoming obsolete. The technocenosis framework further stratifies these technologies into hierarchical "castes" based on their energy usage and influence within the system [59].

Organizational physiology, however, presents a more holistic model. It not only encompasses technological factors but also incorporates strategic and managerial components that guide a firm's adaptation and growth. This comprehensive perspective has been a focal point in the current research due to its broader applicability. For instance, studies employing this approach have categorized Greek firms into three main types: "monad-centered", "massive", and "flexible" [12,13,60]. Monad-centered firms are characterized by instinctive strategies, sporadic technological decisions, and management practices driven by day-to-day operations. In contrast, flexible firms utilize open, networked technologies and embrace participative management, while massive firms are typified by linear strategies, heavy investment in research and development (R&D), and structured hierarchical management [61].

This framework suggests therefore that every firm has a unique physiological architecture, analogous to DNA in biological organisms, which dictates its evolutionary path [60,61]. It has been demonstrated that business ecosystems—particularly in less developed regions—depend critically on the internal innovative integration of the Stra.Tech.Man elements by the participating organizations for their development [14].

However, despite the close relation among these three theoretical fields—IPE, business ecosystems, and entrepreneurship—they have often not been effectively co-examined in international literature, leading to a lack of clear and synthetically convergent interdisciplinary findings. This paper aims to address this gap, using the energy sector as a case study within a specific focused spatial context.

3. Methods and Hypotheses

The study of the energy sector across macro-, meso-, and microlevels—specifically within the contexts of IPE, business ecosystems, and entrepreneurship—appears to be both feasible and interesting at the EU level and, more precisely, within Greece (Today, the EU faces energy tensions with Russia and internal differences among member states regarding economic productivity and fiscal policies. Greece emerges as a critical case due to the severe structural crisis it underwent in the 2010–2020 decade [62]. The handling of the Greek crisis highlighted the need for stronger economic governance and fiscal discipline within the EU, while also demonstrating its ability to stabilize economies under pressure through mechanisms like the European Stability Mechanism [63]), focusing particularly on the Region of Eastern Macedonia–Thrace (ReMTh). This region was selected due to its relatively underdeveloped status, not only within the EU but also within Greece, to examine the potential developmental impacts of major shifts in the global energy landscape on such areas.

To enable this exploration, we leverage a wealth of secondary data, organized into specific indicators, and enhance it with primary data collected from field research (Figure 1). A foundational aspect of our study is the clear definition and rationale for using "indicators". While typically associated with quantitative measurements in statistical analysis, we expand

the term to include key qualitative concepts crucial for grasping the dynamics within the energy sector [64,65]. Our methodological framework, therefore, adopts a mixed-methods approach, which is essential to capture both tangible and intangible factors—spanning geopolitical, economic, and technological dimensions—that influence the IPE, business ecosystems, and entrepreneurship in the context of the ongoing global energy transition.

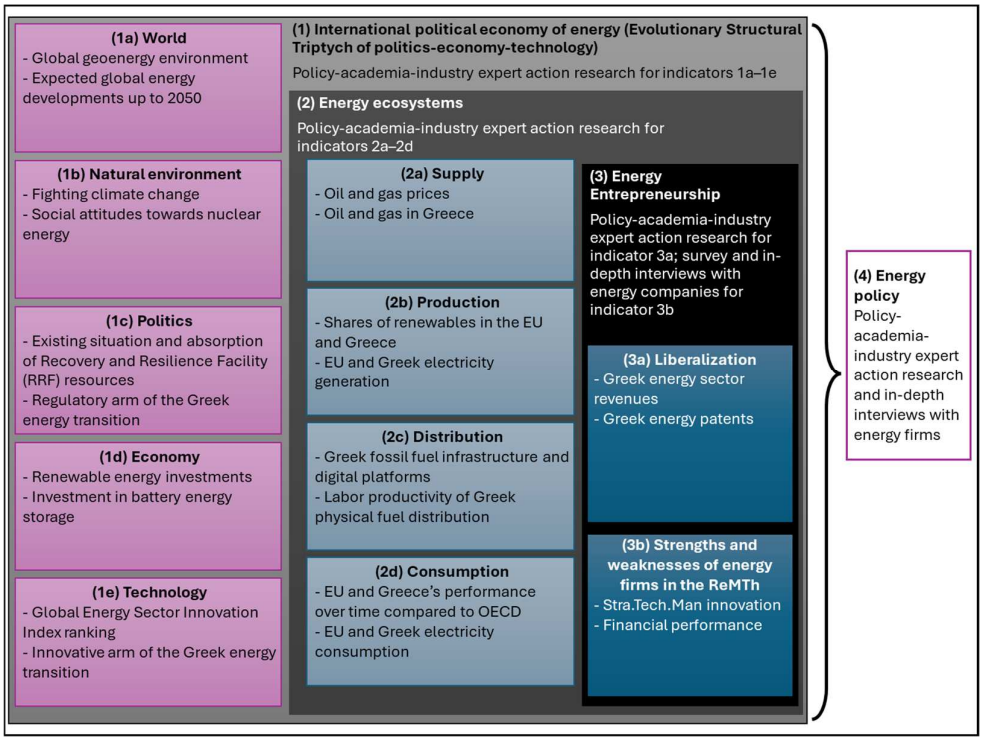

Figure 1. The overall methodological framework.

In our study, indicators go beyond mere quantitative metrics; they are pivotal conceptual and operational tools that guide the thematic analysis of qualitative data. These data are collected through extensive fieldwork, including expert interviews, energy firm surveys, and in-depth case studies, which are instrumental in developing a new understanding of the sector's evolution.

The methodological approach of our study is deeply rooted in critical social theory and interpretivism. It aligns with critical social theory's perspective that views social phenomena as constructed through human actions and underlying structures [66]. The interpretive component of our approach focuses on an in-depth exploration of human experiences and meaning-making, rather than the pursuit of objective truths [64,67–69]. We employ grounded theory through action research, aiming to generate fresh theoretical insights by analyzing new data without the constraints of pre-existing frameworks [65]. This is achieved by coding and organizing extensive qualitative data into thematic categories to facilitate theory development [65]. To ensure the reliability of our findings, we use triangulation and integrate both qualitative and quantitative techniques, providing a comprehensive understanding of the intricate issues at hand [70].

- Indicator 1a covers global trends such as worldwide infrastructure and the general directions of the global energy system (In this research, we employ the "Evolutionary Structural Triptych" (EST) framework, which analyzes the interdependent and coevolving economic, political, and technological dimensions of globalization, emphasizing their impact on the evolving global order since the landmark year of 2009 [29]. To address the International Political Economy of energy, we have expanded the triptych to include two broader aspects: global geoenergy developments and changes in the natural environment worldwide.) [71]. Indicator 1b relates to macrolevel socio-

environmental dimensions [72] and the increasing acceptance of nuclear energy [73]. Indicator 1c examines changes in the regulatory framework, such as the absorption of resources from the Recovery and Resilience Facility (RRF) [74]. Related information is also provided in the regulatory dimension of the Energy Transition Index (ETI) [75]. Indicator 1d includes economic dimensions, including the gradual diffusion of renewable energy investments [71] and the market development of energy storage [76,77]. Indicator 1e spans technology factors based on studies like the Global Energy Innovation Index (GEII) [78] and the innovation arm of the ETI [75,79].

- Indicator 2a concerns supply dimensions, with significant insights on price transitions for conventional fuels and dependence on specific energy markets [80,81]. Indicator 2b is about production phenomena, with available data highlighting changes in renewable energy capacity and production, and overall electricity generation [82]. Indicator 2c amalgamates factors on energy distribution, related to the sufficiency of Greek infrastructure for electricity, natural gas, and oil distribution [81] and the presence of digital platforms across EU regions [83]. Indicator 2d addresses changing energy consumption conditions, such as energy security performance and comparisons of different energy forms [84].
- Indicator 3a addresses broader energy market trends, focusing on current issues of oligopolistic structure and liberalization, such as the profitability and market shares of established utility firms [85–87] and the development of Greek patents in energy technologies [81]. Indicator 3b is concerned with the innovation dynamics of energy firms, selecting the ReMTh as the field of study. A survey was conducted between 15–20 March 2024, on the registered firms in the broader energy sector in the ReMTh within the Greek Business Registry, identifying around 1000 active firms. (Firms with at least one registered energy-related activity code from the Greek Business Registry (ΓΕΜΗ) were included, encompassing all aspects of energy supply, production, and distribution, utilizing Bradford's [22] recent comprehensive manual. Firms under registration suspension or inactive were excluded. The initial results yielded 2237 firms. The sample was then "cleaned" by meticulously removing firms without any online presence outside of the Registry database, resulting in a final sample of 1025 firms. An email was then sent to all, requesting them to complete the questionnaire.) A survey sample size of 5 to 10% was targeted, resulting in a final sample of 89 firms. In-depth interviews were then conducted with select microfirms from the sample until theoretical saturation was achieved [88]. These interviews were an extensive form of the survey. (The findings were also triangulated with recent related research conducted in the ReMTh on microfirms in the services sector [60].) The findings for indicator 3b were also examined through a lens of thick description [89,90]. The following section will focus primarily on presenting the thick description results, highlighting insights from the survey and interviews with selected entrepreneurs in the ReMTh.

The data sources for this mixed-methods (quantitative and qualitative) research were fourfold [91]. First, secondary data were qualitatively analyzed for indicators 1a–1e, 2a–2d, and 3a, covering macrolevel, mesolevel, and microlevel data, respectively.

Second, a qualitative action research approach was implemented [64,92–95], gathering primary interview data from 16 experts in key policy, academic, and business positions [96–98] using the snowball sampling method [70]. These experts' opinions were sought to assess the findings from the secondary data analysis, and their responses were categorized using an empirically grounded theory approach, reaching theoretical saturation once no new categories emerged (Table S1).

Third, mixed primary data from a Likert-scale [99] survey of energy firms in the ReMTh were analyzed (Table S2). For statistical analysis, IBM SPSS Statistics 29.0.0.0 was used to conduct descriptive and frequency analyses [100]. The Pearson correlation coefficient, which measures the strength and direction of a linear relationship between two continuous variables, was also calculated, ranging from −1 to 1, where −1 indicates a perfect negative linear relationship, 0 indicates no linear relationship, and 1 indicates a

perfect positive linear relationship [101]. As in the survey research, the in-depth interviews were quantitatively analyzed using descriptive statistics and then qualitatively analyzed using thick descriptions, which also considered the frequency of occurrence of specific related words. Word frequency can be a tool of grounded theory, particularly in mixed-method research conditions [64,69,102].

Fourth, mixed primary data from in-depth semi-structured interviews with energy microfirms in the ReMTh were analyzed. The interviews combined Likert scales and open-ended questions (Table S3).

Based on the above, several broad hypotheses were formulated. Specifically, the three groups of hypotheses that were approached based on the presented methodology were as follows:

Hypothesis 1. *Global Shifts in Energy and Renewable Energy Sources (RES)—Renewable energy is projected to grow worldwide, though at different rates across countries. This growth is driven by a heightened geopolitical understanding of the climate crisis's urgency, continuous advancements in technology that significantly reduce production costs, and accelerating developments triggered by current global geopolitical conflicts and realignments (including the Russia–Ukraine war, the US–China trade conflict, ongoing conflicts in the Middle East, and the emergence of a new phase of globalization). Rapid increases in renewable energy production and storage will be key elements in this broader global geo-economic restructuring.*

- (1a) If global energy systems keep evolving quickly alongside new strategic players entering renewable sectors like solar and wind energy, substantial changes in energy are likely by 2050 due to intensified investment in renewables, expected rapid technological advancements, and changing geopolitical arrangements.
- (1b) In a scenario where efforts to curb climate change remain uneven but intensify, especially within the EU and Greece, renewables will continue to expand, with nuclear energy becoming increasingly accepted as environmental concerns grow.
- (1c) The EU's Recovery and Resilience Mechanism could play a crucial role if used strategically, fostering a more balanced green energy transition that aligns and reconciles, at least partially, the different regulatory goals of EU countries.
- (1d) If investments in renewable energy grow swiftly, yet disparities in energy storage investments persist and expand between developed and developing nations, global energy systems will likely face widening imbalances from these economic and technological gaps.
- (1e) Greece may continue to rank moderately on global energy innovation indexes if it lags in energy innovation compared to the European average, held back by structural challenges and a relatively fragmented regulatory framework.

Hypothesis 2. *Energy Security and Price Volatility of Conventional Fuels—Global energy stability seems increasingly vulnerable, creating complex energy security challenges for numerous countries. This instability stems from an ongoing reliance on fossil fuel imports and the still-limited global development of renewable energy capacity and existing energy technologies.*

- (2a) If oil and natural gas prices remain volatile due to uncertain and shifting geopolitical conditions, energy supply chain stability in regions like the EU and Greece will likely be significantly impacted in the medium term, given their reliance on fossil fuel imports.
- (2b) A rapid expansion of renewable energy production within the EU and Greece could better align the electricity production, distribution, and consumption profiles across the EU over time, enhancing integration within the European grid.
- (2c) Improvements in energy infrastructure, especially in distribution and storage, would greatly enhance the operational and financial efficiency of electricity systems in the EU and Greece if pursued as a priority.

- (2d) If energy security differs across developed regions due to geopolitical, economic, and technological influences, Greece's and the EU's energy consumption patterns may increasingly converge, although this will not eliminate numerous regional specificities and rigidities.

Hypothesis 3. *Energy Market Liberalization and Innovation—Globally, the energy market is undergoing swift restructuring and, in many cases, liberalization, yet less developed regions face challenges in participating equally in this global transformation due to competitive weaknesses in their specific energy business ecosystems.*

- (3a) As Greece's energy market gradually opens and becomes more competitive, large producers could see increased revenue; however, oligopolistic pressures may still slow down innovation and hinder consumer relief.
- (3b) Energy businesses in the ReMTh, especially smaller firms, may continue to struggle with limited strategic, technological, and managerial capabilities. This may lead to persistent issues in innovation and financial performance, reinforcing the developmental lag in less competitive areas.

Regarding energy policy dimensions, the implementation of an integrated macro–meso–micro framework could significantly enhance policy interventions by focusing on the "cellular" elements of ecosystems—namely, the various firms [24,103]. In the discussion section following the results, a corresponding new energy policy horizon will be proposed.

4. Results

In June 2024, 16 interviews were conducted with key experts from Greece's energy sector, including senior business executives, professors specializing in energy issues, and politicians responsible for energy matters within their parties (Table S4).

(1a) The hypothesis is validated as experts confirm that renewable energy sources, particularly solar and wind, are gaining importance due to their local availability and ability to reduce dependency on fossil fuels. However, they highlight the need for substantial investments in energy storage to manage the intermittent nature of renewables, a point not fully covered in the hypothesis but crucial to achieving the projected transformations by 2050. Thus, while the rise of renewable energy powers is acknowledged, its full potential hinges on overcoming storage challenges.

(1b) The hypothesis is validated, as experts agree that despite varying performances in climate change mitigation, renewables will continue to gain traction, with nuclear energy playing an increasingly accepted role in Europe. They particularly note the long-term role of natural gas in providing flexibility for renewable systems, emphasizing that nuclear energy can address energy stability issues. The experts highlight that nuclear energy, though essential, presents challenges regarding safety and waste management, which may slow its adoption despite its benefits.

(1c) The strategic deployment of the EU's RRF is validated as crucial for facilitating the green transition, in line with the hypothesis. However, the interviewees expressed concerns about the fragmented regulatory landscape across the EU, which creates inefficiencies and delays in investments in green technologies. This validates the hypothesis while adding the caveat that better regulatory cohesion is needed to maximize the RRF's impact across member states.

(1d) This hypothesis is validated, as experts acknowledge the steady rise in renewable energy investments but also emphasize significant regional disparities, particularly between developed and developing regions, in energy storage investments. They point out that these disparities could limit the global energy system's ability to fully transition to renewables, underlining the need for targeted investment in energy storage infrastructure to ensure the reliability of renewable energy sources.

(1e) The hypothesis is validated, as the experts predict that Greece's innovation rankings will remain moderate in global indices. They attribute this to systemic issues, such as the lack of a strong innovation culture, weak connections between universities and industry, and a fragmented regulatory environment that hampers the effective implementation of energy policies and innovations. These factors are expected to limit Greece's ability to compete with other countries in energy innovation.

(2a) This hypothesis is validated, as experts affirm that global oil and gas prices will continue to fluctuate, significantly impacting regions like the EU and Greece, which are heavily dependent on conventional fuel imports. The experts emphasize that geopolitical events, such as wars and sanctions, further exacerbate price volatility and market instability, particularly affecting supply chains and energy security in these regions.

(2b) The hypothesis is largely validated by expert opinions, which affirm the continued expansion of renewable energy generation in both the EU and Greece. The experts highlight the alignment of Greece's energy transformation with broader European trends, as evidenced by the convergence of Greece's electricity generation profile with that of the EU (Figure 2).

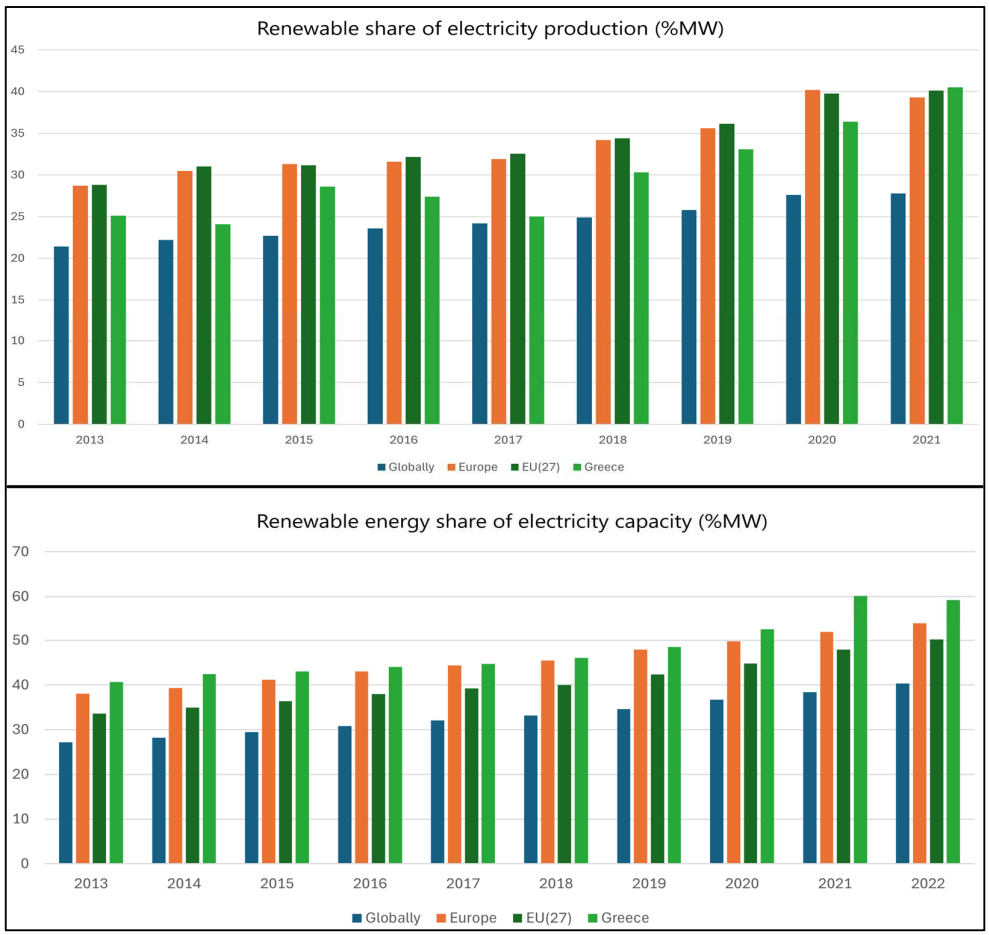

Figure 2. Shares of renewable generation and capacity based on data from the International Renewable Energy Agency [82].

Significant advancements in Greece's renewable energy landscape have been observed from 2013 to 2021, with renewable energy production increasing from 14 TWh to 22 TWh. During this period, the share of renewables in total electricity generation rose from 25% to over 40%, surpassing both global and EU averages. Renewable capacity in Greece also doubled, from 8 GW to 14 GW, making renewables account for 60% of the total electricity generation capacity by 2021 [82]. These achievements reflect Greece's strategic goals to

reduce fossil fuel dependency, particularly lignite, and to achieve net-zero emissions by 2050. The share of lignite in electricity generation has dramatically declined, from 60% in 2005 to 10% in 2021, with wind, solar, and natural gas increasingly bridging the gap. Looking forward, Greece aims to meet 61% of its electricity needs with renewables by 2030, backed by significant investments in offshore wind projects and electricity interconnections designed to bolster renewable energy exports.

Despite the substantial progress, experts caution that infrastructure and energy storage limitations continue to hinder Greece's full convergence with EU energy security standards. Although natural gas remains a crucial element of the energy mix, its future is uncertain due to rising costs and concerns surrounding energy security. Thus, while Greece's commitment to clean energy and proactive measures have positioned it favorably within global and EU trends, persistent challenges in infrastructure and storage capacity must be addressed to secure a fully renewable and resilient energy system [81].

(2c) The experts confirm that infrastructure adequacy and economic gains from fuel trading are indeed critical factors for the efficiency and financial performance of electricity systems, particularly in Greece. They emphasize that Greece's outdated energy infrastructure, including its grid capacity, poses significant challenges to optimizing the financial and operational efficiency of its electricity systems, thus validating the hypothesis.

(2d) The hypothesis is partially validated. Experts agree that energy security will continue to vary across developed countries due to differing geopolitical, economic, and technological factors. However, they note that energy consumption patterns between the EU and Greece are converging, especially as Greece reduces its reliance on lignite and increases renewable energy production. Despite these advancements, challenges related to energy storage and infrastructure remain persistent issues that could affect long-term energy security.

(3a) The hypothesis is validated by experts, who note that Greece's energy sector has experienced a shift toward a more liberalized and competitive market, as reflected in increased revenue despite the PPC's reduced market share. However, they highlight concerns about declining innovation, specifically the reduction in patents within the energy sector, which could hinder future technological progress. This suggests that while market liberalization is underway, challenges in fostering innovation could limit Greece's long-term competitiveness in the energy market.

(3b) Regarding the survey of 89 firms and the in-depth interviews with eight microfirms from this sample in the ReMTh, it is important to provide some context about the area. The ReMTh is one of the 13 NUTS2 regions in Greece, a country experiencing relative developmental lag and low competitiveness [104]. Between 2010 and 2019, the ReMTh's per capita gross domestic product shrank by 22%, compared to a 12% decrease for Greece as a whole [105]. This substantial decline is largely attributed to the region's heavy dependence on low-value-added agricultural activities. In contrast, the manufacturing and construction sectors are neither attractive nor competitive and contribute minimally to the region's gross value-added [106].

Local business practices in the ReMTh tend to favor traditional methods over systematic approaches. These firms are typically centered around individual owners (monad-centered) and rely on short-term, instinctive strategies. Their use of technology is often sporadic and unsystematic, and management practices are predominantly based on family-oriented entrepreneurship. This reliance on traditional methods limits the adoption of modern managerial practices, positioning these firms within a model of necessity entrepreneurship rather than a systematic and strategic one [13,107–109].

Between April and June 2024, responses were collected from 89 energy firm owners in the ReMTh through a survey consisting of 15 Likert-scale questions and one open-ended question regarding the region's development prospects (Tables S6 and S7). In general, respondents tend to overstate their answers, possibly out of fear of criticism or an overconfidence in their abilities. These entrepreneurs expressed positive views on matters related to their operations but showed clear dissatisfaction when asked about external

factors—such as the sector's oligopolistic consolidation or government policy. A deeper analysis, considering the historical context and ethnographic characteristics of the sample, suggests that these entrepreneurs—most of whom operate small and not particularly dynamic firms with low annual turnovers—generally lack extensive expertise in business theory and contemporary business practices (Table S5).

These entrepreneurs reported generally high perceived performance in internal business dimensions but showed significant dissatisfaction with aspects they felt were beyond their control. One paradoxical finding from the survey's statistical analysis, requiring further exploration, is the perceived disconnection between the energy transition in their firms and the broader energy policies (Table S8). A possible explanation is that these entrepreneurs view national and local energy system transformations as an external force beyond their influence, leading to frustration and somewhat irrational thinking, since this connection should be self-evident. Several strong positive correlations also need further clarification, such as between adaptability and sustainability, sustainability and resilience, financial performance and resilience, resilience and adaptability, and Stra.Tech.Man dimensions and adaptability (Table S8). These correlations indicate that while entrepreneurs may not formally implement initiatives around these dimensions, they perceive them as relevant. However, there were also weak correlations, such as between crises and policy, renewable energy communities and inclusivity, sector oligopolization and resilience, and between crises and the promotion of smart grids.

Smart grids—defined as energy networks that combine digital communication technology with energy transmission systems to optimize energy distribution, reduce transmission losses, and ensure efficient energy automation—are critical for enhancing system resilience [22]. However, the survey revealed weak correlations between smart grids and crisis mitigation, indicating that although entrepreneurs recognize the importance of these technologies, they have performed little to incorporate them into their operational strategies.

In this context, distributed energy generation (DEG), which refers to producing energy closer to the point of consumption, is pivotal for reducing transmission losses and strengthening local energy security [24,46,77,110]. The integration of DEG is especially relevant in the ReMTh, where smart grid infrastructure is still underdeveloped. The survey highlighted that despite the potential of DEG and smart grid technologies to lower energy costs and improve system resilience, many firms have not strategically adopted these advancements, suggesting a broader hesitation to embrace innovation in energy management.

Focusing on the in-depth interviews, a representative sample of microentrepreneurs provided insights that differed somewhat from the broader survey results, with particular interest deliberately placed on small firms, as they dominate the entrepreneurial landscape in the less developed region under study (Tables S9 and S10). These entrepreneurs appeared to have a limited grasp of effective leadership within a business context, a concept they seemed to fear and identified as a comparative weakness. This issue also correlates with their relative lack of innovative flexibility. Speaking candidly, they demonstrated a need for improvement in specific—or all—examined dimensions, even if they did not explicitly state this. Notably, they frequently used terms in open-ended responses that were not strongly supported by the quantitative data (Table S11).

These microentrepreneurs frequently used the word "improvement", indicating that they generally perceive progress. However, the phrase "has not changed" followed closely, which is somewhat contradictory. When asked about strategy, "competition" was often mentioned, while "innovation" was rarely cited. In technology-related questions, "machinery" was commonly referenced, but "innovation" was again mentioned infrequently. In management—an area where terminology seemed more accessible compared to other questions (as evidenced by slightly lower satisfaction scores)—the phrase "has not changed" dominated, suggesting that while these entrepreneurs understand management terms better, they do not fully implement them and could respond more directly. In the Stra.Tech.Man innovation dimension, the word "innovation" appeared more frequently, suggesting that these in-depth interviews may have helped somewhat in educating these entrepreneurs.

In the energy dimension, problematic situations were often emphasized more than in other categories, but the concept of innovation was rarely mentioned. Regarding financial performance, stability was the main focus, while other contributing factors were rarely acknowledged, which contrasts with previous statements reflected in the frequency of words in other categories just discussed.

The open-ended questions in both the survey and the in-depth interviews revealed other interesting findings. The educational level of these entrepreneurs appeared somewhat limited, particularly among microentrepreneurs interviewed in-depth, who did not explore energy development in the ReMTh as deeply as some of the survey respondents. However, most discussions centered around the need for investments in the ReMTh, often highlighting—without explicitly recognizing it—a "Keynesian approach" to boosting demand without a corresponding focus on business-side supply [111,112]. In the survey, respondents had a higher level of education, likely due to the inclusion of some larger, more dynamic firms in the sample (Table S5).

Overall, it became clear that most of the examined entrepreneurs face challenges in adopting a modern management mindset—a fact reflected primarily in their responses to management-related questions. This seems to be largely due to the fact that many of these firms are family-owned, resulting in limited investments in management skills and modern leadership styles. It is also evident from the fact that these entrepreneurs, in the overwhelming majority, were unable to provide detailed financial information or consider fundamental financial indicators. Considering earlier complementary research conducted in the ReMTh in the services sector, it is apparent that similar problems persist, and there are no significant differences in the energy sector's microfirms. The services sector sample showed similar weaknesses as the energy sector sample [60].

The interaction with these entrepreneurs highlighted that the larger the firm, the more outward-looking and open they were to examine various factors. Based on relevant findings from a recent study [13], it can be argued that the ambitions of these entrepreneurs differ greatly from Schumpeter's [113], "private kingdom" concept, viewing improvement as an exercise in curbing business profits and personal needs (Most energy producers in the sample initially launched photovoltaic projects as small firms centered on renewable energy, particularly photovoltaics. Why did they choose this path? At that time, government subsidies were guaranteed, and many entrepreneurs saw this as a form of "entrepreneurship" that would provide a stable income. However, this was more a form of necessity entrepreneurship, enabling small investors to secure a steady return. The current challenge is how these small-scale producers can transition to energy storage and similar solutions, which are innovation-intensive and require significantly more strategy, technology, and management expertise than their current projects. This shift is essential, especially since the guaranteed state prices for photovoltaic energy in Greece are no longer in place). Therefore, the findings appear to confirm previous conclusions [12,61,114] that most microfirms in Greece are structured around monad-centered physiological traits, a fact that creates significant competitiveness challenges for the Greek economy and its regions.

Thus, in the less competitive region of the ReMTh, energy firms—particularly microfirms—do not appear to be highly developed in terms of strategy–technology–management integration, innovation in the energy sector, or financial performance. These firms exhibit various weaknesses that reflect the challenges faced by energy firms in these areas. Moving forward, we will discuss how enhancing Stra.Tech.Man physiology (a more effective synthesis of strategy, technology, and management) through supportive public policies could offer solutions to these inherent weaknesses.

The hypothesis is validated, as the evidence from the survey and in-depth interviews confirms that energy firms in the ReMTh, especially microfirms, struggle with strategy–technology–management effective innovative integration, energy innovation, and financial performance, reflecting the expected challenges in such less competitive regions.

5. Discussion

By critically examining the findings in relation to existing literature, several valuable conclusions can be drawn. Comparing these results with established theories and prior empirical studies provides a solid foundation for discussing the future of the energy sector, based on the macro-, meso-, and micro-developments identified in the research (Figure 3).

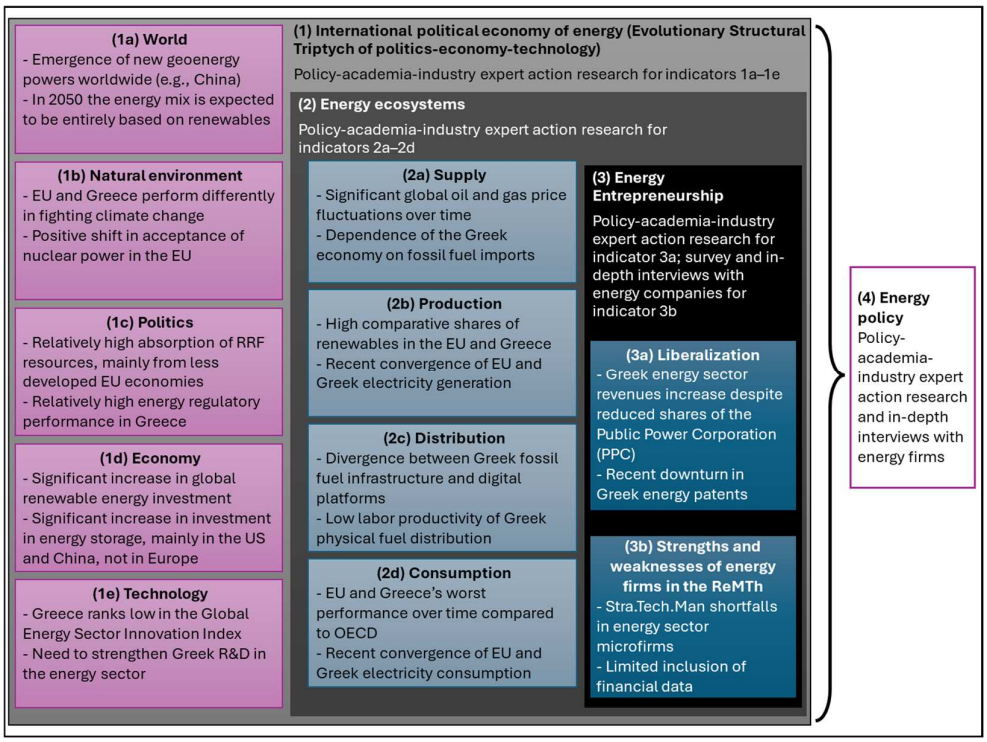

Figure 3. Addressing the hypotheses.

1. The validated Hypothesis 1 aligns with past research on the global energy transition driven by renewable energy sources such as solar and wind [82]. The research reflects findings from experts who emphasize the increasing importance of renewable energy in shaping the global energy mix due to technological advancements and political initiatives aimed at reducing fossil fuel dependency [22]. This supports the work of scholars like Kuzemko [115–117] and Newell [38,118], who have discussed the interplay of policy, economic factors, and technological progress in driving energy market transitions. The experts agree on the crucial role of renewable energy investments, though they also highlight challenges not fully addressed in the hypothesis, such as energy storage limitations, which are critical to ensuring reliable electricity supply from intermittent energy sources [76,77]. Furthermore, the research validates the growing acceptance of nuclear energy in Europe, a trend predicted by various geopolitical developments, despite lingering concerns about safety and waste management, which may slow its widespread adoption [73].

The hypothesis also echoes findings on regional disparities in investment and innovation, particularly between developed and developing nations [83]. This divergence is noted in the research, which indicates that while renewable energy investments are steadily increasing, the gap in energy storage infrastructure may impede the global energy transition [50–52]. Similar challenges are observed in Greece, where systemic issues such as a weak innovation culture and regulatory fragmentation hamper its ability to compete in energy innovation on a global scale [12,104]. These insights are consistent with past theoretical perspectives, such as those advanced by Katzenstein [119] and Keohane and Nye [120], who highlighted the need for a more holistic approach to understanding interdependencies in the global political economy—though not specifically in the energy sector. The broader

emphasis on international cooperation and regulatory reform, as recommended by various researchers, is crucial for addressing the uneven distribution of energy technology advancements and ensuring a more inclusive and sustainable global energy future [39,84].

2. The validated Hypothesis 2 largely aligns with past research on energy ecosystems in the EU and Greece, particularly regarding the impact of global oil and gas price fluctuations [48,49]. Scholars have highlighted how regions like the EU and Greece, heavily reliant on conventional fuel imports, remain vulnerable to price volatility driven by geopolitical events such as wars and sanctions [117]. This mirrors findings from the primary and secondary data in this study, which emphasize the destabilizing effects of supply chain disruptions caused by events like the Ukraine war [121]. While the hypothesis acknowledges the importance of renewable energy generation, the research also highlights that infrastructure and storage capacity constraints, particularly in Greece, limit full energy convergence with the broader EU, a challenge echoed in past studies focused on energy transition [23,24,54].

The research also supports the hypothesis regarding the critical role of infrastructure adequacy and economic gains from fuel trading in electricity system performance, specifically in Greece, where outdated infrastructure hampers efficiency [87,110]. This aligns with past work on the need for coordinated energy strategies and infrastructure upgrades [8]. Similarly, the study validates the convergence of energy consumption patterns between Greece and the EU, particularly as Greece reduces its reliance on lignite and increases renewable energy production [122]. However, as past research on energy ecosystems has noted, persistent challenges in energy storage and infrastructure continue to affect long-term energy security [45–47]. The study draws on evolutionary economic and ecosystem theory, echoing works by Moore [11] and Iansiti and Levien [10], which stress the importance of innovation and interconnected roles within ecosystems—although only Iansity and Levien's approach has primarily used examples from the energy sector. This framework aligns with the broader trends in global energy systems, emphasizing the importance of coordinated policies to address specific regional challenges within the context of emerging global interdependencies and digital transformations [83].

3. The validated Hypothesis 3 concerning the Greek energy sector highlights both convergence and divergence with past research. Hypothesis 3a aligns with previous findings that market liberalization has increased revenue, despite the reduced market share of the PPC [87]. This shift, however, is not accompanied by a rise in innovation, as evidenced by the decrease in patent activity, which aligns with the findings that market competition alone does not necessarily drive technological advancements [71]. This observation is consistent with earlier research that underscores the challenges in fostering a culture of innovation within established sectors dominated by traditional players like PPC [10,19,20]. The decline in innovation amidst revenue growth has been noted as a critical issue, indicating that economic performance does not always correlate with technological progress [22].

Hypothesis 3b finds support in earlier studies of less competitive regions like the ReMTh, where microfirms exhibit limited development in integrating strategy, technology, and management [13,14,60]. Past research has documented that in less developed areas, businesses often rely on traditional, intuition-based practices rather than systematic approaches, which hampers their capacity for innovation and competitiveness [109]. This aligns with findings from studies on similar business environments, which emphasize the slow adaptation of small firms to modern managerial practices and their struggle to adopt strategic and technological advancements [12]. Furthermore, the lack of resources and strategic vision among these firms reiterates conclusions from broader literature on the structural challenges faced by small and microenterprises in lagging regions [103,104,107,108,114].

For microenterprises in ReMTh, achieving the integration of strategy, technology, and management involves overcoming significant obstacles, including limited access to

capital, inadequate infrastructure, and a lack of specialized personnel. Similar issues are observed in other less-developed EU regions, such as Southern Italy and parts of Eastern Europe, where infrastructure gaps, regulatory inconsistencies, and limited support for microfirms present persistent challenges. Lessons from these regions—especially regarding their approaches to fostering regional energy ecosystems—provide valuable insights for extending the findings of this study and understanding how the proposed framework could be applied across the EU [123–125].

In light of the identified deficiencies in energy firms, a new comprehensive energy policy is proposed (Figure 4) to enhance the potential of these firms and their underlying business ecosystems [126]. It is important to clarify that the analysis that follows outlines a conceptual framework for policy implementation rather than a patentable invention. The primary objective is to establish a structured approach that enhances business ecosystems through mechanisms such as public support and innovation hubs, thereby facilitating energy transitions at both local and regional levels.

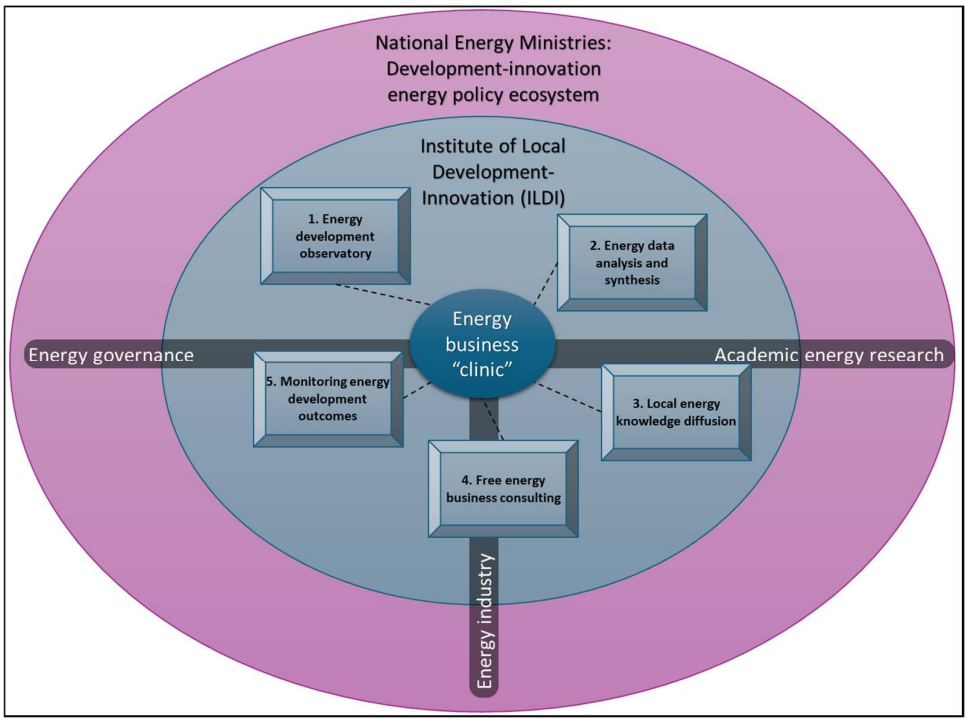

Figure 4. The proposed policy ecosystem, the role of the Institutes of Local Development and Innovation (ILDIs), and the free consulting model.

At the macrolevel, the emphasis should be on formulating inclusive national strategies and promoting public support mechanisms to encourage energy business innovation and growth. This would require collaborative efforts between national ministries and agencies covering both the macrolevel and the mesolevel, creating a cooperative environment that fosters business development.

The mesolevel revolves around intermediary organizations, such as incubators, accelerators, technology parks, chambers of commerce, banks, and venture capital firms. These entities play a critical role in connecting institutions, providing resources, and cultivating energy entrepreneurship. Strengthened coordination between these entities is recommended to ensure the effective allocation of financial resources and the creation of innovation hubs.

The proposed Institutes of Local Development and Innovation (ILDIs) are positioned as key actors in this energy ecosystem, serving as catalysts for knowledge dissemination and resource allocation. Their proposed functions include the following:

1. Energy development observatory: Conducting continuous industry and local-level research.
2. Energy data analysis and synthesis: Facilitating partnerships, decision-making, and evaluating investment opportunities.
3. Local energy knowledge diffusion: Organizing business forums and managing digital platforms for knowledge sharing.
4. Energy business consulting: Providing "free" targeted support to promote "Stra.Tech.Man innovation" in local firms (entrepreneurial clinic).
5. Monitoring energy development outcomes: Regularly publishing progress reports, such as quarterly assessments.

A critical aspect of this approach could be the focus on providing business consulting, particularly in the proposed "entrepreneurial clinic" model with "free at the point of sale" (publicly provided with no direct cost) consulting services. This model could be adaptable, offering direct and practical support to socioeconomic organizations, especially those facing challenges, ensuring their inclusion in development initiatives and helping them create or improve their business plans. This approach compares firms to patients needing care, suggesting that just as hospitals treat the sick, ILDIs can provide essential support to firms with chronic issues. Policies promoting entrepreneurship must view the environment as a macro–meso–micro composite, spreading modern entrepreneurship methods across firms, along with financial support.

The specifics of how ILDIs operate can be tailored to the needs of the development-innovation policy ecosystem. For example, within a European framework, they could establish offices across all NUTS2 regions—such as the ReMTh, which was thoroughly examined in this paper. The consulting process itself could vary based on these customized needs, potentially involving private consultants funded by taxes to assist less competitive firms in developing business plans. Essentially, ILDIs could function as a "developmental one-stop shop", connecting intermediary actors like an umbrella organization and providing public consulting services to less competitive firms.

The policy recommendations propose targeted, actionable steps, such as public–private partnerships and financial incentives for small firms adopting renewable technologies. By introducing consulting services for capacity-building and innovation, particularly in energy storage and smart grid adoption, the policy framework is tailored to meet the needs of smaller firms. This approach ensures that microfirms in less competitive regions like ReMTh can overcome structural limitations and engage actively in energy transition efforts [127–129].

In summary, the diverse findings of this multi-method study have been synthesized into actionable policy recommendations, highlighting the need for a comprehensive macro–meso–micro framework. This approach ensures alignment between international and national energy strategies (macrolevel) and local business ecosystems (mesolevel), while providing smaller firms (microlevel) with tailored support to enhance their strategic, technological, and managerial practices for innovation. The proposed ILDIs are positioned as key mechanisms for translating these findings into practical actions, offering free consulting services, and fostering innovation at the firm level. By linking policy interventions across all levels of the energy ecosystem, this framework addresses both systemic challenges and firm-specific needs effectively.

6. Conclusions

To sum up, this paper highlighted that geopolitical, economic, and technological shifts interact structurally at the macrolevel, supported by ecosystemic dynamics at the mesolevel and entrepreneurship mutations at the microlevel. The energy sector served as a characteristic example of how these levels coevolve, where microlevel strategies can influence mesolevel ecosystems and vice versa, ultimately affecting stability and policy directions at the macrolevel.

The scientific novelty of this study lies in its integrated macro–meso–micro analytical framework, which has not been extensively applied to the energy sector in existing literature. This approach offers a more holistic understanding of the sector's evolution, particularly in less developed regions like the ReMTh. In terms of practical implications, the proposed ILDIs can be implemented to provide targeted consulting services to small energy firms in regions like the ReMTh, helping them integrate strategy, technology, and management more effectively. Restructuring energy policies should prioritize offering microfirms access to resources that promote innovation and sustainable practices. Additionally, investments in energy storage infrastructure and renewable energy sources will empower local ecosystems to actively participate in the global energy transition, enhancing both regional competitiveness and contributing to global sustainability goals.

Furthermore, the energy transition in regions like the ReMTh, though progressing at a relatively slow pace, plays a crucial role in supporting global sustainability goals by contributing to decentralized and resilient energy systems. In this context, ambitious plans have been proposed for one of Greece's largest ports, located in the ReMTh region, which has the potential to become a significant hub for the Mediterranean and Southeastern Europe, facilitating the transfer of liquefied natural gas (LNG) across the region and into Europe [130]. However, the ReMTh must prioritize advancing local renewable energy production and storage infrastructure to strengthen its energy security and align with broader international decarbonization targets—a challenge highlighted by this research, as competitiveness deficiencies have been recognized. Therefore, as part of the EU's energy transition agenda, the ReMTh illustrates how less developed regions can actively participate in the global shift toward sustainable energy, contributing to both environmental sustainability and socioeconomic resilience.

The main findings of this study are summarized as follows:

I. In the context of IPE—and through comprehensive macrolevel analysis—it is evident that recent developments in the energy transition, driven and accelerated by the Russia–Ukraine war (which seemingly acted as a catalyst and political accelerator for the shift to renewable energy) and the current crisis in the Middle East, are gaining critical importance. In the near future, these developments are expected to significantly reshape the global landscape and create new geopolitical balances. In this regard, the energy transition has become a central focus of interest for broader IPE discussions.

II. From an ecosystemic perspective—and in the context of integrated mesolevel analysis—it is clear that the local dynamics of energy sector development are of particular interest, as they define the specific ecosystemic forces that influence the innovative development of the energy sector at both national and international levels. This is especially true in sectors undergoing rapid transformation and transition, such as the energy sector today, where the unique dynamism emerging within local and regional ecosystems appears to be of immense significance.

III. At the microlevel of individual firm dynamics, it is evident that less developed business entities, characterized by a lack of deep and strategic vision, limited capacity to acquire, assimilate, and generate new technology internally, and insufficient advanced management methodologies across all levels, from planning to organization and control, face significant challenges in functioning effectively as mechanisms supporting the energy transition.

IV. In this context, it is crucial to develop policies that systematically support microfirms that are part of local and regional energy ecosystems. Equipping them with new knowledge and entrepreneurial skills would enable them to play a more active role in the ongoing global energy transition.

V. In conclusion, the study of the evolution of the global energy system and its various subsystems is becoming central to the discourse on sustainability, both in environmental and socioeconomic terms, on a global scale. In practice, the emerging model of energy production and consumption is directly linked to the current reconfiguration

of individual socioeconomic development models in the new phase of globalization we are entering [2,29,37,38]. The outcomes in both of these areas—overall energy transformation and the adaptation of individual socioeconomic systems to the new reality—will determine the global society's ability to respond to the energy crisis. Consequently, this will shape the possibility of creating a sufficiently sustainable and viable future for humanity.

Particular attention should also be given to the role of smaller firms in driving energy innovation, especially in less developed regions like the ReMTh. While often limited by scarce resources, these microfirms have the potential to contribute meaningfully to the global energy transition. To successfully implement the proposed organizational and physiological improvements, these firms can pursue several key approaches.

First, such microfirms can utilize collaborative networks, like energy cooperatives or local partnerships, to pool resources and share knowledge. For example, firms in regions like the ReMTh could join renewable energy communities, where shared investments in solar or wind infrastructure help mitigate the financial strain of adopting new technologies. Such partnerships grant smaller firms access to advanced technologies that would otherwise be unattainable [23].

Second, such microfirms can adopt flexible and lean management strategies. Digital tools, including cloud-based energy monitoring platforms or decentralized management systems, can help streamline operations and improve efficiency without necessitating large-scale organizational overhauls [83]. These tools provide real-time data on energy use and performance, enabling firms to optimize operations and reduce costs through more informed decision-making.

Third, collaboration with local intermediary organizations, such as the proposed ILDIs, can provide essential support. If these institutes are established—though this remains of course uncertain—collaboration with other similar institutions can be a viable alternative. Microfirms can also seek synergies with public organizations that can coordinate stakeholders to help improve their strategic outlook, adopt new energy technologies, and enhance management practices. Tailored to each firm's specific business context, this guidance can strengthen their competitiveness and support the necessary physiological hybridism to enhance their potential in the three Stra.Tech.Man dimensions [60].

Despite the comprehensive methodological approach, certain limitations must be acknowledged. First, the hypotheses were based on a selected set of indicators (1a–1e, 2a–2d, 3a–3b), which may not cover the full spectrum of factors affecting the energy sector. Second, the survey targeted respondents proficient in online media and email, potentially biasing the sample toward more technologically adept firms, which may not fully represent the broader business landscape of the ReMTh. Third, the integrative and critical approach to literature and data selection was designed to address broader questions, which may overlook specialized or emerging trends not captured by this general approach. Fourth, the research focused exclusively on the EU and Greece, particularly the ReMTh, limiting the findings' applicability primarily to regions with similar socioeconomic and cultural characteristics, thus constraining the potential for broader generalization.

Based on these limitations, future research could first utilize a broader set of indicators to generate and test similar hypotheses, such as energy storage capacity, grid infrastructure efficiency, and regional renewable energy adoption rates, to develop and test similar hypotheses in other regions. This would enable cross-country comparisons and the creation of tailored policy interventions. Second, the same sample could be targeted with reduced bias by using telephone and in-person contacts to achieve better representativeness overall. Third, expanding the research to include other regions within and beyond the EU could allow for comparisons across different socioeconomic and cultural contexts, identifying challenges and opportunities specific to those areas and repositioning the findings based on their unique characteristics. Fourth, future research could broaden the integrative and critical approach to literature and data analysis by incorporating additional data to identify evolving trends and emerging issues in other regions with similar competitiveness

deficiencies, while also developing a methodology for calculating an energy sustainability index based on empirical data [131,132], providing a universal tool for assessing energy sustainability and guiding policy decisions at the country level.

Although the study primarily focused on the European context, particularly Greece, a broader comparison with other global regions—such as the Americas, Asia, and Africa—would have provided valuable additional insights. For example, in the Americas, countries like the United States are increasingly prioritizing renewable energy and decentralization, driven largely by market-led innovation, in contrast to Europe's more "regulatory-focused" approach [22]. Meanwhile, Asian economies, especially China and India, are investing heavily in renewables but face the challenge of balancing rapid industrial growth with environmental sustainability [50,51]. In Africa, the energy transition presents a unique set of challenges, as energy access remains a key issue, with off-grid and decentralized solutions gaining traction due to limited infrastructure [22]. These regional differences could highlight the necessity of further tailoring energy transition strategies to local socioeconomic and infrastructural conditions for more effective outcomes.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/su162210092/s1, Table S1: Action research; Table S2: Survey; Table S3: In-depth interviews; Table S4: Coding of the expert interview responses; Table S5: Survey identity (frequencies); Table S6: Percentage frequencies of Likert scales in the survey; Table S7: Descriptive statistics of the survey; Table S8: Pearson correlation matrix of the survey; Table S9: Descriptive statistics of in-depth interviews (averages); Table S10: Some variables that show outliers in the descriptive statistics of in-depth interviews; Table S11: Frequency of occurrence of related words in interviews.

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