

Article

Financial Sustainability of Energy Business Development: The Unregulated Activity Phenomenon

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Abstract: The article presents study results showing the increasing role of unregulated activity as a boost for innovative processes in energy companies and their investment appeal. A summary of academic literature, reports by leading consulting companies, and international energy agencies make it possible to outline the landscape of the most economically viable areas of business activity in the energy industry, the most promising of which are energy efficiency, design and deployment of EV charging networks, smart grids, and telecom services. Analysis of financial performance statements of over 30 energy companies from different countries demonstrates the contribution of unregulated activities to their financial stability, which shows in growing profits, capitalization, and stock prices. It is revealed that despite the active promotion of unregulated activities by the state that primarily seeks to achieve the goals of the low-carbon transition, there is a stronger government presence in the capital structure of energy companies, which in the future will slow down investment activity in the industry. In this regard, the discussion considers the barriers to organizing unregulated business in the electricity sector and methods to eliminate them. In particular, a set of necessary conditions is defined, under which entrepreneurship in the industry contributes to improving the efficiency of the main business processes—production and transportation of energy.

Keywords: unregulated activities; electric power industry; financial sustainability; investment attractiveness; energy transition; diversification



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1. Introduction

The electric power industry is an infrastructure industry that supplies all sectors of the economy with electricity, a commodity that is the material basis of any production. Due to the extreme social importance of electricity and the social responsibility of energy business in all countries of the world, the electric power industry is under close control of the state. This is manifested through the establishment of ceiling tariffs for certain categories of consumers [1,2], limited competition in some areas of production (for example, in the transmission and distribution of electricity [3,4]), strict control over the implementation of environmental standards [5], labor safety [6], and, above all, reliability and uninterrupted power supply to the serviced area.

In recent years, the development of the electric power industry has been mainly determined by the expansion of a large number of cutting-edge technologies emerging in the context of ongoing digital transformation [7], an unprecedented progress in the field of artificial intelligence and big data analysis systems [8], as well as the deployment of energy transition programs—the transformation of the energy sector from production

and energy consumption mainly based on fossil fuels, to energy systems using renewable energy sources and clean decentralized energy solutions [9,10]. It is important to note that these advanced technologies are being actively implemented not only by the energy sector, but also in manufacturing, transportation, and telecommunications, leading to the so-called technological convergence which is usually accompanied by shifts in the structure of energy production and an overall increase in energy consumption [11,12]. New market segments are taking shape, united by the concept of “knowledge-intensive service” [13]: digitalization; technical maintenance of energy assets based on risk-oriented strategies, predictive analytics, and robotic technologies; integrated engineering and life cycle management of energy facilities; electrification; demand-side management; and forward-looking personnel training.

Given the conditions, market opportunities are opening up for energy businesses to sell their products as part of their so-called unregulated activities. In countries such as the USA [14,15], France [16,17], and Great Britain [18], energy companies have been engaged in unregulated activities for quite a long time, enjoying government support in the form of special economic and legal instruments. In developing countries, most of which only recently liberalized their electric power sectors, the development of such types of competitive business often faces a number of challenges [19].

During the current energy crisis, which manifested itself through high volatility of energy prices, the limited supply of energy resources, and aggressive competition in global fuel and energy markets, active entrepreneurship in the electric power industry is one of the solutions to the investment problem as an additional income coming from business segments focused on the implementation of non-core services makes it possible to finance modernization projects or to expand power production and increase the sustainability of the core (regulated) activities of power companies. Within this study, our hypothesis is based on the above assumption.

The study objectives are as follows:

- the systematization of the promising areas of unregulated activity in the electric power industry;
- the assessment of economic effects from their implementation;
- the identification of business challenges faced by energy companies and the development of organizational recommendations for their elimination.

Unregulated activity in this paper is defined as the implementation of a wide range of additional services provided by energy companies that are in demand in competitive markets. The formation of the prices of these services is guided by free market relations and is not burdened by the restrictions of regulatory authorities in terms of a maximum ceiling tariff rate and the level of sales profitability, as is the case in the core activities: generation, transmission, transport, and sale of electric and thermal power. Therefore, in addition to the term “unregulated activity”, the terms “non-core activity” and “supplementary activity” are also used in the paper.

It should be emphasized that there are practically no publications available in the scientific literature that would reveal the phenomenon of unregulated activities in the energy sector in a comprehensive manner and contain aggregated information on the types, volumes, and efficiency of non-core services provided by energy companies. There is also no definite stance on the conditions and state measures to support a non-core business, or tools that, on the contrary, would limit entrepreneurial activity in the industry due to the unconditional priority of reliability and continuity of electricity supply over commercial results, hence the main theoretical and practical contribution of this study. The theoretical significance of this article is that it defines promising fields of entrepreneurship in the electric power industry and identifies organizational and economic effects in the

development of unregulated activities by energy companies. The article has strong practical applicability as it contains recommendations for industry players and regional authorities that would set the framework of entrepreneurship in the electric power industry and prompt its orientation towards areas that are useful to society. The authors' conclusions are based both on the study of available information on the practices of energy companies and on the results of expert surveys, which facilitates an understanding of the factors contributing to the successful implementation of unregulated activities.

2. Materials and Methods

The study was conducted in three stages.

Stage one: Analytical reports (IRENA, McKinsey&Company, Deloitte) and academic papers devoted to the problem of business diversification, the organization of entrepreneurial activity in the electric power industry, and the specifics of regulating electric power markets were analyzed. More than 80 papers were reviewed; the search for papers was mainly carried out in the MDPI and ScienceDirect databases. The systematization of the analyzed sources is shown in Table 1. This stage aims to define the conditions and landscape of the most relevant types of unregulated activities for energy companies around the world.

Table 1. Reference list of analyzed literary sources.

Type of the Source	Database	Journal Title	Number of Sources
Articles	Science Direct	<i>Energy Policy</i>	6
		<i>Renewable and Sustainable Energy Reviews</i>	2
		<i>Energy Research & Social Science</i>	3
		<i>Energy</i>	1
		<i>Energy Strategy Reviews</i>	1
		<i>Energy Economics</i>	1
		<i>Engineering Science and Technology</i>	1
		<i>Research Policy</i>	1
		<i>Procedia CIRP</i>	1
	MDPI	<i>Energies</i>	18
		<i>Sustainability</i>	14
		<i>Applied Sciences</i>	4
		<i>Algorithms</i>	1
		<i>Recycling</i>	1
		<i>Land</i>	1
		<i>Laws</i>	1
Other		4	
Analytical reports		7	
Internet sources		16	
Companies financial reports (Appendix A)		32	
TOTAL		116	

Stage two: The financial (annual) reports of major energy companies in the world were reviewed to verify the identified areas of non-core business (see Appendix A). The sample includes enterprises from Italy, Japan, the USA, Israel, Germany, Sweden, Russia, China, France, Belgium, Canada, and England, primarily engaged in traditional activities (production and distribution of electric power) and, at the same time, actively promoting supplementary services for customers in various market segments. This stage aims to clarify the areas of non-core business that are promising for energy companies, and to

establish links between the degree of its development and the dynamics of financial results, as well as the growth of investment attractiveness, which determines the possibility of business growth and additional financing for companies' core businesses.

The main criterion for selecting energy companies for the study was the availability of open-source quantitative data on their activities presented in annual reports, financial documents, or on official websites. The analysis focused on key indicators reflecting financial stability and economic efficiency, such as revenue, profit, profitability, capitalization, and other relevant metrics. Unfortunately, a significant number of companies of interest do not publish data in the public domain, and some of them do not release their reports in English. Moreover, separate data on indicators characterizing regulated and unregulated activities are often unavailable. This circumstance limited the sample to mainly public energy companies that ensure transparency of their reporting.

Stage three identifies the challenges that potentially impact business activities in the electric power industry. In particular, a survey was conducted of more than 40 experts—managers and professionals working for major Russian energy companies in different fields of business (generation, electricity transmission and distribution, energy sales, and municipal energy), such as PJSC T Plus (Ekaterinburg, Russia), PJSC Rosseti (Ekaterinburg, Russia), LLC Bashkirenergo (Ufa, Russia), JSC Chelyaboblkommunenergo (Chelyabinsk, Russia), as well as representatives of state energy regulatory authorities. Three key questions were discussed during structured interviews with the respondents:

- What restrictions prevent the development of additional business areas in energy companies?
- What measures should be envisaged by the state to eliminate risks from the energy company's involvement in entrepreneurial activities to the detriment of its core production and possible reduction in the reliability of energy supply?
- What unregulated activities have the greatest commercial potential?

Expert assessments made it possible to identify the most common factors that reduce the readiness of energy enterprises to diversify. These factors are relevant for many developing countries that relatively recently liberalized their electric power industries. Based on the comparison of the survey results with expert opinions presented in scientific publications and analytical materials, a list of universal conditions that stimulate the development of unregulated activities in energy companies was compiled.

3. Results

3.1. Unregulated Activities Development Conditions

Some of the catalysts for the development of unregulated activities in the electric power industry at the present stage are the goals of decarbonization and energy transition, better energy efficiency, and the implementation of the principles of a circular economy. Industries that are difficult to decarbonize are already in need of a number of new solutions to achieve this goal: the use of green hydrogen, bioenergy, and electrification [20,21]. For example, in the transport sector, direct electrification shall become the dominant technology in road and railway transport, while “green” ammonia and methanol shall play a key role in shipping [22].

However, it is not only the global agenda that serves as a driver for the development of non-core activities in the electric power industry; there are objective economic, financial, and strategic reasons for this:

- Electric power companies have extensive physical infrastructures which are economically profitable to use and monetize, for example, by leasing electric power line

supports to mobile operators and internet service providers for fiber-optic communications [23].

- Turnkey solutions (design and construction of facilities, energy efficiency services, demand-side management, and carbon footprint reduction) are becoming increasingly attractive to customers. Energy companies can provide them in combination with grid connections or an energy supply contract [24].
- Electric power companies that boast the necessary competencies and consumers' trust are increasingly involved in large-scale projects to create smart cities and related smart infrastructure [25]. Non-core activities, such as the development of smart grids, smart metering, 5 G, and charging stations for electric vehicles, help enterprises to remain competitive by penetrating new markets and increasing their preparedness for the future in which digital technologies and smart solutions will be key.
- Energy companies have strong relationships with governments, equipment manufacturers, and component suppliers, which helps them overcome potential regulatory obstacles faster, receive subsidies for "green" initiatives, often implemented as entrepreneurial projects [26], and offer non-core services with fairly low marginal costs compared to many other market participants, making their business more sustainable.

Regulation in the energy sector is aimed at balancing the interests of multiple stakeholders, including government, private companies, and the public. This mainly concerns:

- The establishment of tariffs for electricity, gas, and other energy services to maintain fair prices for monopolists, protect consumers from excessive costs, and ensure sustainable economic development of energy companies;
- determining the market structure and the development of requirements to be met by organizations that are engaged in the production and energy marketing;
- implementation of environmental goals, including the establishment of standards for harmful emissions;
- mechanisms for the provision of subsidies, preferential tariffs, and tax benefits [27].

The unregulated activities (entrepreneurship) of energy companies vary significantly depending on the local legislation and market structure. European countries such as Germany, France, and the United Kingdom have complex regulatory systems focused more on global sustainable development goals and curbing tariff growth. For example, the German regulatory framework is designed in such a way as to support the Energiewende strategy, using preferential tariffs and long-term contracts to accelerate the introduction of renewable energy sources [28,29]. France, with its centralized and nuclear-oriented policy, relies heavily on state control through the state-owned EDF company [30]. This ensures more stable electricity prices, but creates problems for the transition to environmentally friendly energy. The UK, by contrast, uses a market model run by the Office of Gas and Electricity Markets (Ofgem), which focuses on promoting competition and achieving carbon neutrality through a combination of policy incentives and price controls.

The regulatory framework in the United States and Canada is formed on the basis of decentralized structures delegating authority to specialized energy agencies of states and provinces. In the United States, the Federal Energy Regulatory Commission (FERC) controls interstate markets, while states set their own policies. This leads to a variety of regulatory frameworks [31]. For example, California's stringent requirements for renewable energy sources are in stark contrast to Texas's deregulated, fossil-fuel-oriented approach. In the state of Texas, electricity distribution activities are partially unregulated, and electric grid companies set tariffs independently [32,33].

Canada demonstrates diversity in the regulatory policy [34]. The electricity market there is largely decentralized: there is no national market in the country, and provinces

and territories manage their own power systems, while there are some interprovincial and international ties, especially with the United States [35].

China's energy legal system has a structure of "four verticals and seven horizontals". Vertically, it includes laws, administrative regulations, departmental rules, and local regulations [36,37]. Horizontally, the legislative framework covers the electric power industry, coal, oil and gas, nuclear energy and renewable energy, energy conservation, and regulatory policy for these energy sectors.

Since the end of 2021, there has been a leap in the reform of the electricity market in China: all coal-fired power plants entered the sales market, the regulated retail tariff for commercial and industrial electricity consumers has been abolished, pilot trading of contracts for "green" electricity has begun, and supplementary services have been liberalized [38]. By 2030, China aims to create a single national electricity market [39].

Special attention is being paid in China today in terms of the regulation of projects for the construction and operation of installations using renewable energy sources.

The Indian energy market, especially in the electricity sector, has undergone significant liberalization efforts, primarily due to the Electricity Act of 2003 [40]. This act was aimed at increasing the participation of the private sector and developing competition by unbundling state-owned vertically integrated utilities into separate companies engaged in the production, transmission, and distribution of electricity. The law introduced the concept of open access, allowing large consumers to directly buy electricity from producers instead of relying on local distribution companies. However, this concept has not been fully implemented, which leads to an aggravation of the problem of cross-subsidization in a number of states [41].

There has been significant privatization in the generation segment, private companies made significant contributions to India's installed generating capacity, especially in the field of renewable energy, but transmission and distribution of electricity remain largely under state control [42].

The United Arab Emirates (UAE) and Saudi Arabia use a hybrid model of energy market regulation, combining state control with international partnerships to diversify the energy sector [43,44]. The UAE is actively implementing projects in the field of renewable energy, based on a clear regulatory framework that attracts foreign investment. This contrasts with the more conservative approach of Saudi Arabia, where regulation is being developed to support the Vision 2030 goal of reducing dependence on oil.

These regulatory models reflect the unique priorities and specific features of each country's energy organization. Understanding these different approaches is essential for navigating the national characteristics and complexities of energy markets and developing policies that meet both the local needs and global sustainable development goals [31].

In general, we can state that in tightly regulated and centralized markets such as France and China, energy enterprises primarily focus on meeting government targets for the implementation of core activities, rather than on exploring opportunities from the sale of new services. At the same time, there are more opportunities for diversification in decentralized markets [45]. At the same time, the lack of strong regulation can lead to underinvestment in infrastructure and lack of quality assurance, which makes it difficult to implement and maintain non-core services. In both cases, it is necessary to maintain a balance: regulated markets should leave space for entrepreneurial activity, while poorly regulated markets shall ensure that the required conditions for their development are met [46].

3.2. The Non-Core Activities' Impact on the Energy Transition

The present stage of the energy transition is characterized by the transition from carbon-based energy sources, primarily coal and oil, to low-carbon ones, such as gas, wind, solar, and hydropower [47]. Non-tariff measures play a key role in the global energy transition. These activities include projects to improve energy efficiency, integrate smart grids, digitalize and introduce innovative renewable technologies, and optimize energy storage [48].

At the same time, different countries set their own priorities regarding the means to achieve energy consumption goals [49]. For example, Germany's energy companies have been focusing on diversifying their energy mix through investments in renewable energy sources and upgrading existing infrastructure using technologies such as carbon capture and storage (CCS) [50]. Such initiatives are crucial for achieving the long-term goals of decarbonization and ensuring the electric grid stability amid the growing share of renewable energy sources. In regions such as Hong Kong, where more than two thirds of carbon emissions come from electricity generation, companies are actively working to reduce their dependence on coal, increasing the share of natural gas to almost 48% compared to 25% in 2015 [51]. Small-scale renewable energy projects such as the Lamma wind farm, along with waste-to-energy initiatives such as T-PARK, contribute to the sustainability of the energy supply of the respective provinces and reduce environmental impacts.

The key features of the modern energy transition are as follows:

1. Decarbonization (reduction in CO₂ emissions), which shall be achieved through both demand and supply-related technologies (energy production). Decarbonization technologies can be divided into demand-related technologies and supply-related technologies. The first group includes energy efficiency and demand-side management technologies. The second group includes renewable energy technologies (RES), low-carbon fossil fuels (primarily the transition from coal to gas in electricity production, which halves CO₂ emissions), water technologies (although hydrogen is not an energy source, it, similar to electricity, is an energy carrier), and nuclear energy [52,53].
2. Electrification is the use of electricity to produce various types of final energy (mechanical, thermal, electromagnetic, etc.). It is expressed in an increase in demand for electricity both among the population and households, including due to an increase in the share of electric vehicles, the use of electricity for heating purposes, and in industrial production. In some industries (for example, the chemical industry), the use of electricity makes it possible to not only reduce CO₂ emissions, but also to reduce energy consumption in general [54].
3. Digitalization is the process of introducing digital technologies into the energy sector. These include such technologies as smart grids, demand-side management technologies, digital twin technologies, AI failure prediction, smart metering devices, and p2p electricity markets [55].

In recent years, energy companies have been investing heavily in smart technologies. For example, Enel's investments in digital infrastructure amounted to EUR 53 billion. The company aims to deploy smart meters and electric grid automation systems that provide real-time monitoring and efficient resource management [56]. These investments not only increase operational efficiency, but also support new services such as demand response and energy management for consumers, creating new sources of revenue for utilities.

The total amount of investments in solutions that meet the goals of energy transition is estimated by experts [10,22,57] at USD 0.4 to 2.6 trillion (Table 2).

Table 2. Global investment needs in technology solutions to achieve energy transition goals.

Sector	Technology	Average Annual Investments, USD Million (in 2021 Prices)		
		The Period up to 2023	Basic Energy Scenario (2023–2050)	A Scenario Involving the Fulfillment of Decarbonization Goals (2023–2050)
Electricity generation				
Electric grids	Assets modernization	300	315	630
	Increased electric grid flexibility, including through energy storage and storage systems	9	66	170
Power generation	Bioenergy	300	315	630
	Solar concentrators	9	66	170
	Geothermal energy	24	52	93
	Hydropower	1	9	89
	Tidal energy	6	9	27
	Photovoltaics	40	103	138
	Wind energy (onshore)	-	6	63
	Wind energy (marine)	130	160	333
TOTAL		663	1018	2181
Electricity consumption				
Renewable energy sources	Biofuels	16	47	111
	Direct use, including heating	57	34	98
Energy efficiency	Biofuels	16	47	111
	Direct use, including heating	57	34	98
	Buildings	237	418	935
Electrification	Industry	40	212	424
	Transport	19	201	147
	Electric charging infrastructure	8	118	314
Hydrogen	Heat pumps	60	29	230
	Transport	-	82	50
Technologies for CO ₂ capture, storage, and disposal		-	3	107
Technologies for the use of secondary energy resources		4	4	18
TOTAL		442	1173	2605

The trends presented in Table 2 show a strong correlation with those activities that energy companies implement in terms of the non-core activities. It can, therefore, be argued that one of the key factors in achieving the goals of the energy transition is the development of supplementary activities by energy companies.

3.3. *The Unregulated Activities Content Analysis of Energy Companies*

Within this paragraph, 30 energy companies from England, Belgium, Germany, France, Italy, Israel, Canada, and the USA were reviewed. The main areas of their non-core activities can be divided as follows:

1. Energy efficiency improvement services.

As a rule, these are consulting services for private and corporate customers. These include real-time monitoring of energy consumption using energy management systems. Some energy companies focus on heat recovery solutions that help industrial customers reuse waste heat from production processes.

For example, the German company EnBW provides consulting services to municipalities, advising them on improving the energy efficiency of public buildings and infrastructure. They also help to optimize the use of energy in street lighting and district heating systems and reduce operating costs. The Japanese generation and distribution company Chubu Electric Power Group provides heat recovery technologies that allow the reuse of waste heat generated during production processes, cutting the need for additional consumption.

2. Renewable energy projects.

Energy companies are actively involved in projects for the development of solar, wind, geothermal, and biogas energy technologies. For example, Chubu Electric Power Group is developing closed-loop geothermal technology, which is a highly efficient method of using geothermal energy without depleting underground resources. It is worth noting that this type of activity can be considered non-core only for traditional companies engaged in the production of energy from fossil fuels and its distribution. For companies primarily engaged in the production of electricity from renewable energy sources, such activities are considered regulated.

3. In-house production of electrical equipment.

Energy companies often produce transformers, cables, and metering devices for energy infrastructure. By manufacturing this equipment on their own, companies reduce their dependence on third-party suppliers and maintain control over quality and productivity, as well as provide additional income through the sale of products to other enterprises. For example, the Italian company Terna manufactures transformers and high-voltage cables, while EnBW manufactures and supplies smart meters for households and businesses. These meters allow customers to monitor energy consumption in a real-time manner, which allows for a more efficient use of energy. EnBW is also developing photovoltaic systems. The Canadian company Hydro-Québec designs and manufactures equipment for its hydropower and wind energy projects, including turbines and generators.

4. The construction of electric charging stations for cars.

This area is gaining popularity due to the growing demand for electric vehicles. Thus, EnBW operates more than 500.000 charging points in 17 European countries through its EnBW HyperNetwork and Mobility+ product line. The Company invested significant funds, approximately EUR 200 million in this area. In 2023, more than 4.000 fast charging points were installed. Specific data on revenues from the charging infrastructure are not disclosed by the companies, EnBW defines this area as strategic.

5. Smart grids and energy storage systems.

Companies are implementing Smart Grid technologies to improve the efficiency of electricity distribution and improve electric grid stability. Energy storage solutions, in particular, large-scale battery systems, are being implemented to stabilize power grids and store excess electricity from renewable sources. Here are some examples: Terna invests in

large-scale renewable energy storage battery systems that ensure increased sustainability of energy supply during periods of high demand or unstable generation from renewable energy sources. Vattenfall developed a smart energy management system that integrates with distributed renewable energy sources and allows businesses and households to track and optimize energy consumption using digital platforms, both in homes and on a wider scale of smart cities.

6. Telecommunication services.

Some energy companies provide their assets for the deployment of fiber-optic networks by telecommunications companies providing Internet and communication services. A typical example is the Kyuden Group of Companies that expanded its activities in the telecommunications sector by offering broadband Internet access through its fiber optic network. This network, originally created to support energy infrastructure, is now used to provide high-speed Internet services in underserved regions, contributing to the digital capital and supporting the development of smart infrastructure. Through its subsidiary Acronym Solutions Inc., Hydro One offers information and communication technology services. These services, originally developed for internal energy management, have been commercialized to provide data transmission services, including the Internet.

7. Technologies for reducing harmful emissions.

Energy companies are actively involved in the development of decarbonization solutions, helping industrial sectors to move from fossil fuels to clean alternatives such as electricity and hydrogen. These activities include consulting services to help businesses reduce their carbon footprint, the provision of CO₂-neutral electricity, and the development of new technologies such as hydrogen co-combustion for power plants. Companies are also working on carbon capture, recovery, and storage (CCS) technologies that prevent CO₂ emissions into the atmosphere.

For example, RWE offers consulting services to industrial customers, helping them switch to cleaner energy sources and reduce CO₂ emissions. They specialize in the development of customized solutions such as the integration of renewable heating systems, energy efficiency optimization, and the introduction of smart technologies for tracking and reducing emissions.

TEPCO Energy Company is actively involved in decarbonization projects, focusing on the provision of carbon-neutral energy solutions. These include the expansion of hydrogen-based energy production, especially by co-burning hydrogen and ammonia in existing thermal power plants to reduce CO₂ emissions. In addition, TEPCO is developing carbon capture, recycling, and storage technologies to capture emissions from industrial processes and prevent them from entering the atmosphere.

8. Waste-to-energy.

Many regulated energy companies use waste-to-energy processes and secondary energy resources as part of their initiatives to ensure sustainable development and achieve zero CO₂ emissions by converting waste into useful energy such as heat or electricity. This helps to reduce dependence on fossil fuels, solves the problems of waste disposal and harmful emissions, and also serves as an additional source of income. Israel Corporation Ltd. manages waste-to-energy plants generating electricity by burning municipal solid waste to produce steam that powers turbines.

9. Infrastructure projects.

Energy companies are diversifying their activities in the field of urban development, often taking on real estate projects such as the construction of commercial and residential buildings. These projects focus on the principles of sustainability and ecology, society, and

governance (ESG), aiming to create smart, energy efficient buildings and infrastructure. In some cases, energy companies also manage airports and other critical urban infrastructure, helping to integrate renewable energy and smart grid technologies into these environments, as well as entering the healthcare market by offering solutions such as nursing homes and human resources services as part of their broader diversification strategy.

Companies are expanding their activities in various support services, such as the installation of 5G networks and street lighting.

Drone technology is used to maintain and inspect energy infrastructure, increasing operational efficiency. In addition, energy companies are developing digital services that include data analytics and cybersecurity for smart city projects.

For example, the Korden Group participates in various urban development initiatives, including the construction of commercial real estate and logistics centers using energy-efficient technologies. In addition, the Korden Group uses drones to inspect and maintain energy infrastructure such as power lines and substations. This increases the efficiency and safety of operations, reducing the need for human inspections in hard-to-reach areas. Drones provide real-time data and visual images that help identify maintenance needs, preventing outages and reducing operating costs.

The Vattenfall company participates in the implementation of smart city projects, integrating smart energy management systems into urban infrastructure. This includes the construction of district heating systems powered by renewable energy sources, as well as smart grids that enable real-time monitoring and optimization of energy consumption in buildings and public infrastructure.

In an attempt to diversify, TEPCO turned to healthcare services, offering solutions for nursing homes and recruitment services. This expansion into non-energy sectors is part of their broader strategy to diversify income sources and use their expertise in managing large-scale operations to provide basic public services.

In addition, TEPCO helps local governments and businesses build infrastructure that can withstand natural disasters, paying special attention to energy security in regions prone to earthquakes, tsunamis, and floods. The company offers disaster preparedness consulting services, including backup power supply solutions and energy storage systems for critical infrastructure such as hospitals and emergency centers. Figure 1 shows a summary of the areas of non-core activity and the companies that are most active in each of them. The most popular areas are energy efficiency services and the construction of EV charging stations.

Based on the degree of association with the main one (generation and distribution of electricity), non-core activities and infrastructure are divided into three categories:

1. Activities closely related to the main business activity. This category includes the installation of charging stations, the design and construction of smart grids and the installation of smart metering devices, the organization of street lighting, and the construction of renewable energy sources.
2. Activities indirectly related to the main activity. This category includes the production of their own power equipment, the installation of 5 G points, services (mainly consulting) in the field of energy efficiency, waste recycling for energy production, the provision of Internet services, and broadband access via fiber-optic networks.
3. Activities unrelated to the main one. This may include activities related to education, renting out real estate, surveying the area using drones, etc.

Company profile	Energy efficiency improvement services	Construction of electric charging stations for cars	Telecommunication services	Smart grid and energy storage systems	Renewable energy projects	Infrastructure projects	Technologies for reducing harmful emissions	Electrical equipment in-house production	Waste recycling
A2A									
EnWB									
Tepco									
Hydro-Quebec									
The Kyuden Group									
Vattenfall									
Electricite de France									
BC Hydro									
Southern California Edison									
Chubu Electric Power Group									
E.ON									
RWE									
UK Power Networks									
Consolidated Edison									
Israel Corporation Ltd.									
Terna									
Hydro one									
Florida Power & Light									
Electricity North West Limite									
ORES									
TOTAL	14	10	9	9	9	8	6	4	3

Figure 1. Types of non-core activities of energy companies.

3.4. Unregulated Activities: Economic Effects

The analysis of financial and economic effects from the sale of non-core services was carried out on the basis of data provided in open sources. Below is a summary of data on the companies and the economic effects achieved as a result of unregulated activities, which demonstrate the most common entrepreneurship practices in energy companies.

For example, the Italian company A2A, with a total EBITDA in 2023 of EUR 1.971 million, received a significant part of its profit from non-core activities. The business of recycling waste for energy production allowed the company to make a profit (EBITDA) of EUR 395 million, and activities related to the development of smart infrastructure (urban lighting and construction of electric charging stations) yielded another EUR 534 million, although this figure is partly due to the business of electricity transmission.

Another Italian company, Terna, received revenues from non-core activities to the amount of EUR 516.8 million in 2023, with a total revenue of EUR 3.9 billion for the entire group of companies. These indicators were achieved thanks to the performance of the following subsidiaries:

- Tamini Group, an affiliated company specializing in the development, production, and repair of transformers;
- Brugg Cables Group, an affiliated company specializing in the manufacture of cable products;
- the parent company's business of energy efficiency improvement, telecommunications, and the construction of smart grids for third parties.

The consolidated EBITDA from Terna's non-core activities in 2023 is EUR 86.9 million, and the entire activity of the groups of companies as a whole is EUR 2.17 billion.

The E.ON division (Germany), which is engaged in innovative decentralized energy solutions, energy efficiency improvement, consulting, and installation of electric charging

stations, made a profit of EUR 525 million, or 6.5% of the total profit of all companies, amounting to EUR 8.1 billion in 2023. The segment of activity of another German energy company, EnBW “Smart Infrastructure for Customer”, allowed the company to earn EUR 239.5 million in 2023, with a total profit of EUR 5.738 million. The activity of this segment is focused on the development of EV charging stations, decentralized energy solutions (including using renewable energy sources), telecommunications services, and improving the energy efficiency of the company’s customers.

Some interesting cases of the development of non-core activities in a very strict regulatory environment can be found in developing countries.

For Chinese equipment manufacturers, the overseas export of equipment, including turbines and solar panels for generation, is an important market. Chinese manufacturers supply the main units for 18% of all projects being implemented in a partnership with overseas companies in Asia. For example, China Southern Power Grid (CSG) produces electrical equipment through its affiliated company, namely China Southern Power Grid Technology Co., Ltd. The company specializes in the production of equipment for energy generation, distribution, and management. Key segments include the production of power equipment and the development of solutions for smart systems. In 2020, CSG Technology Co. generated revenue of CNY 2.84 billion, and its net profit amounted to CNY 349.96 million.

In Russia, the Rosatom State Corporation is expanding its activities through projects in wind energy, hydrogen, and biogas energy. Rosatom plays an important role in nuclear medicine, producing medical isotopes for diagnosis and treatment, and is actively developing the production of batteries for energy storage and electric vehicles, building a factory in the Kaliningrad region with a design capacity of 4 GWh per year. The plant will supply batteries for about 50,000 electric vehicles per year. The company is also involved in creating an ecosystem for recycling used batteries. In the Nizhny Novgorod region, Rosatom is creating a specialized technology park where lithium-ion batteries will be recycled. Revenue from the sale of new products (outside the nuclear industry) amounted to RUB 697.5 billion, and in 2023 RUB 1.1 trillion.

Another giant in the field of commercial services is JSC “Inter RAO UES”. The company is actively growing in the areas of design and construction of energy facilities, with revenue from commercial services amounting to RUB 7.9 billion in 2023. That year, the company intensified its activities in the field of energy engineering. This segment specializes in the design and manufacture of key energy equipment, such as turbines and transformers for both the domestic and international markets. Revenue reached RUB 14 billion.

The Russian electric grid company “Rosseti” has also been actively developing supplementary services in recent years. Its subsidiary, Rosseti Lenenergo, received revenue from such services to the amount of RUB 1069 million. The most demanded services were technical and maintenance services (the share of the services in the revenue received was 28%), as well as construction and installation works, which account for 23% of the total amount of revenue received. Revenue from the sale of supplementary (non-core) services grew by 120% against 2022 (RUB 583 million). As of 2023, its own network of EV charging stations included 73 gas stations, of which 62 were of the fast type.

Another electricity distribution company is JSC “Grid Company”. The company invests heavily in environmental projects such as reduction in carbon dioxide emissions, water conservation, and biodiversity. As part of its energy saving initiatives, the company implements programs to reduce energy consumption in various sectors, including social facilities such as schools and kindergartens (the volume of investments in this area in 2023 amounted to RUB 1032 million). The company also pays great attention to the development

and adoption of innovative technologies; in particular, the installation of smart meters and the development of smart grid technologies. The company also invested in the development of charging infrastructure for electric vehicles in the Republic of Tatarstan. As of the end of 2023, the company operated more than 130 charging stations all over the region.

Examples of the economic effects achieved by international energy companies in terms of the implementation of non-core types of business are shown in Table 3.

Table 3. Economic effects from the implementation of non-core services of energy companies.

Company	Type	Country	Unregulated Business Type	Revenue	
				Consolidated	From Non-Core Activities
Terna Group	Electric grid company	Italy	Smart grids and energy storage systems. Renewable energy sources Projects. Electrical equipment in-house production	EUR 3190 million in 2023	EUR 516 million (16%)
Endesa	Multi energy company	Spain	Energy efficiency improvement services	EUR 1471 million in 2023	321 million due to the provision of services to third-party organizations (22%)
Rosatom	Power generation company	Russia	Infrastructure projects. Smart grids and energy storage systems. Waste Recycling. Electrical equipment in-house production.	RUB 2.64 trillion	RUB 1.1 trillion in 2023 (42%)
Inter RAO UES	Multi energy company	Russia	Electrical equipment in-house production. Infrastructure projects.	RUB 1.36 trillion	amounted to RUB 7.9 billion
Rosseti	Distribution company	Russia	Telecommunication services. Construction of electric charging stations for cars. Infrastructure projects.	RUB 108.84 billion	RUB 20 billion
China Southern Power Grid	Multi energy company	China	Electrical equipment in-house production. Renewable energy projects	USD 118.8 billion	SG Technology Co. revenue of USD 401.21 million

Not all companies publish data on revenue from non-core activities in their statements, but other economic indicators are available in open access. For example, the profit of SSE Group (UK) in 2023 amounted to GBP 755 million from regulated activities and GBP 1612 million from unregulated activities. E.ON (Germany) reported earnings before interest, taxes, depreciation, and amortization (EBITDA) of EUR 525 million from all non-core areas, and EnBW (Germany) made a profit of EUR 239.5 million from developing EV charging stations and projects for decentralized energy solutions, including the use of renewable energy sources.

Additionally, the development of unregulated activities has a stabilizing effect on financial performance. The following case study of a typical electric grid company that usually operates in a monopolistic sector proves the above thesis.

The following factors impact on the company financial conditions:

- the regulator is late in increasing the tariff or even puts a cap on it (regulatory inertia) while production costs increase;
- when production costs are reduced, the regulator proportionally reduces tariffs in order to maintain the established rate of profitability.

As a result, profitability and total profits decrease, which makes it difficult to attract private investment for upgrading fixed assets and expanding the service area. This has a special effect on large energy companies.

By starting unregulated businesses, energy companies seek to offset regulatory risks and increase their investment attractiveness by generating additional income with low initial costs. It is essential to make sure that the diversification is carried out on the basis of

business processes that are organizationally and technologically related to the main type of activity, and ultimately increase its effectiveness. One example here is a combination of the development of small-scale generation in electric power companies with the development of energy saving services for customers (Figure 2).

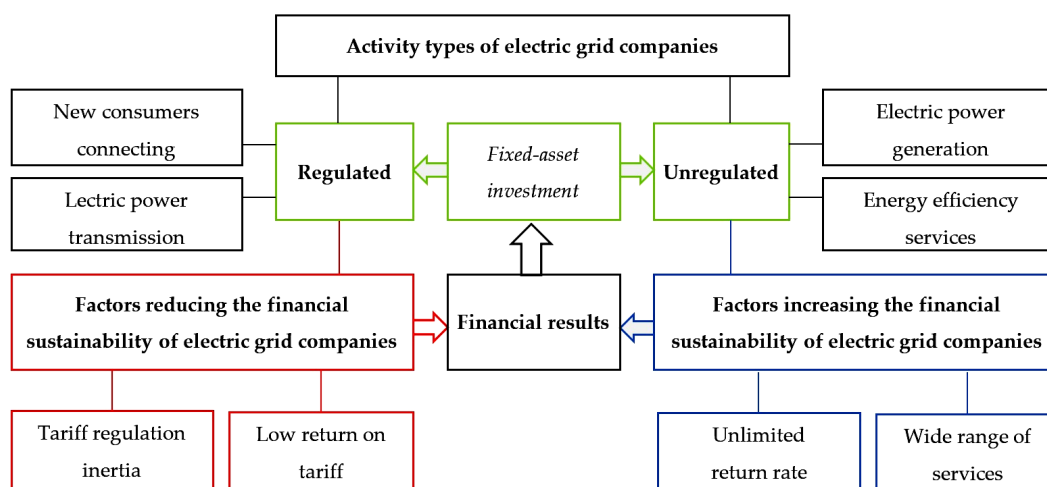


Figure 2. The formation scheme of the energy company financial results in the diversification of business processes using the example of the electric grid distribution company.

In general, it can be stated that a well-conducted diversification will ensure an annual revenue growth of 10–20% [58], an increase in the cost of capital of 1–3% [59], an increase in return on assets of 3–5% [60], and most importantly, it will mitigate the risks of demand volatility and prices for energy resources and services [60,61].

3.5. Impact of Non-Core Activities on the Energy Company's Investment Attractiveness

Investment attractiveness is, on the one hand, a prerequisite for the financial stability of a business, and on the other, its objective consequence. Thus, the development of non-core activities has an observable impact on the share price of energy companies. Such activities diversify the company's revenue flows, reducing its dependence on traditional markets that are subject to strict regulation and control over pricing, reducing the risks of volatility in energy prices and changes in legislation. Non-core activities also help companies manage costs and gain competitive advantages through innovation.

For example, TC Energy emphasized that the diversification of renewable energy and energy infrastructure projects had a positive impact on its financial performance, contributing to a significant profit growth in 2023. The company increased its profit by 22% per share in the fourth quarter of 2023. By 2026, the ENGINE Group expects growth in the renewable energy segment due to investments, and the annual EBIT, according to their forecasts, will increase from 1.0 to EUR 1.5 billion. Battery manufacturing activities are expected to contribute increasingly to the Group's results starting in 2024. Enphase Energy, a leader in the production of solar panels and storage systems, noted an increase in investor confidence due to its strategic diversification in the field of energy storage and international expansion, which contributed to further revenue growth in the fourth quarter of 2023.

Bloom Energy reported record revenue of USD 1.3 billion in 2023, helped by its focus on distributed energy generation and hydrogen energy solutions. These initiatives helped Bloom expand its sales market, consolidating its position as a leader in the field of low-carbon energy, which had a positive impact on the dynamics of the company's shares (Bloom Energy). The results of a more detailed analysis of energy companies are presented

in Tables 4–6 [62–64]. The conclusion is unambiguous: companies that are actively engaged in non-core activities and offer their customers a wide range of services show sustainable growth in their value, EBITDA, and also, mainly, the growth of stock prices.

Table 4. Capitalization dynamics at the reviewed companies (in millions of dollars).

Company	2019	2020	2021	2022	2023	Growth by 2019
A2A	4536	6442	4423	6238	6860	51%
Terna	13,395	15,311	16,268	14,723	16,928	26%
Israel Corporation Ltd.	7800	6580	6960	7310	6030	−23%
Chubu Electric Power	12,021	11,087	8567	6721	8477	−29%
The Kyuden Group	12,285	11,640	9570	7828	9775	−20%
Tepco	6006	5529	5264	4408	5228	−13%
Stadtwerke München	7280	8296	8208	8560	9435	30%
E.ON	28,000	32,940	33,060	32,100	34,965	25%
EnBW	11,200	13,420	13,680	13,910	15,540	39%
RWE	19,040	24,400	28,614	28,676	33,855	78%
Vattenfall	20,608	24,400	25,650	24,931	27,750	35%
Électricité de France (EDF)	34,720	40,870	38,760	33,705	37,740	9%
Elia	7840	9760	10,260	10,700	11,655	49%
Hydro One	17,000	16,000	15,000	14,000	19,000	12%
CLP Group	13,000	12,350	11,700	11,050	10,400	−20%
Hongkong Electric Company	6500	7150	6890	6760	6370	−2%
Electricity North West Limited	3696	3973	4050	3751	4032	9%
UK Power Networks	9636	10,275	10,800	10,285	11,340	18%
UK National Grid	50,160	54,800	56,700	52,635	56,700	13%
Southern California Edison	20,856	23,290	24,975	23,595	25,200	21%
Florida Power & Light	58,000	60,000	62,000	65,000	70,000	21%
Consolidated Edison	29,000	30,000	32,000	34,000	36,000	24%

Table 5. Stocks' price dynamics (in dollars).

Company	2019	2020	2021	2022	2023	Growth by 2019
A2A	1.85	1.73	2.04	1.63	2.04	10%
Terna	6.35	7.48	8.23	7.48	8.27	30%
Israel Corporation Ltd.	350.50	311.26	307.44	303.24	274.17	−22%
Chubu Electric Power	13.11	12.27	9.79	9.23	11.73	−11%
The Kyuden Group	9.15	8.44	7.13	5.93	7.23	−21%
Tepco	4.23	3.88	3.65	3.12	3.83	−10%
E.ON	9.38	11.12	11.65	10.43	11.60	24%
RWE	28.09	34.75	36.95	37.24	40.18	43%
Électricité de France	10.73	10.75	12.05	10.49	12.43	16%
Vattenfall	14.83	16.39	15.95	15.68	18.00	21%
UK National Grid	12.61	11.96	13.40	12.34	13.67	8%
Southern California Edison	70.20	68.50	72.30	75.10	78.45	12%

Table 6. Profit dynamics (in billions of dollars).

Company	2019 EBITDA	2023 EBITDA	Growth
A2A	1.38	2.14	55%
Terna	1.95	2.35	20%
Israel Corporation Ltd.	1.04	1.75	68%
Chubu Electric Power	3.86	3.65	−6%
Tepco	6.07	5.23	−14%
E.ON	8.87	8.99	1%
EnBW	5.28	7.10	35%
RWE	3.59	6.11	70%
Vattenfall	4.02	3.97	−1%
Électricité de France	17.97	18.32	2%
Hydro-Québec	4.15	3.84	−7%
Hydro One	2.05	2.13	4%
UK National Grid	6.90	6.93	0%
Southern California Edison	8.09	7.81	−3%
Consolidated Edison	4.88	5.29	8%

4. Discussion

In a number of foreign countries, primarily developing ones, attempts to diversify in the electric power industry encountered resistance from both regulatory authorities and the management of energy companies, who believe that in this extremely socially responsible industry, it is necessary to approach the issue of organizing parallel business activities with extreme caution [19,65]. This point of view is supported by a survey specially conducted by the authors (Figure 3). The arguments of the interviewed experts boil down to the idea that entrepreneurial activity in this socially responsible infrastructural industry comes into conflict with its traditional culture which prioritizes the reliability of electricity supply; a failure to comply with this rule can lead to negative consequences, which primarily mean a delayed renewal of assets and incidents causing significant economic damage. On the other hand, it is important to note that there is a number of objective limitations highlighted by the respondents, which currently prevent the development of additional business areas in an energy company.

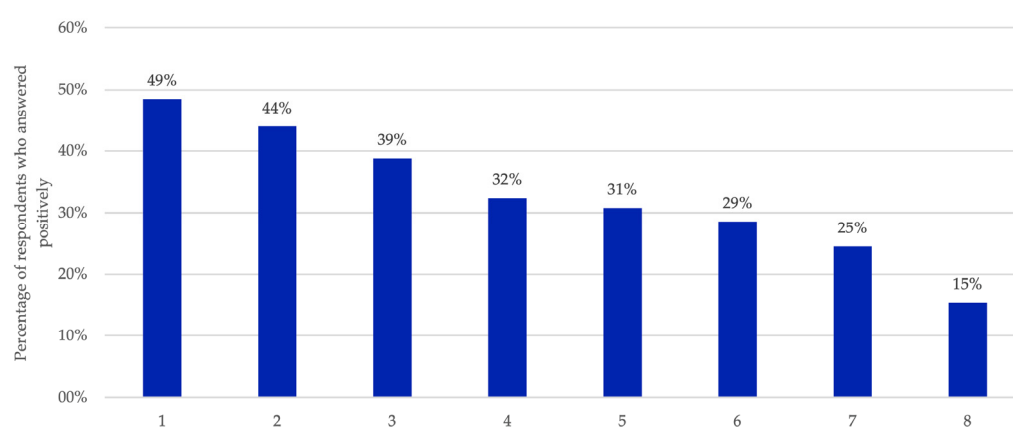


Figure 3. Development challenges of unregulated energy business: 1—lack of understanding of commercial prospects and potential demand; 2—lack of necessary knowledge and competencies; 3—lack of a culture of developing and implementing projects of new products (services) that are not related to the main production; 4—the company's unpreparedness for organizational transformations; 5—lack of experience in business analysis and feasibility studies of innovative solutions; 6—lack of personnel (including competent management); 7—prohibition of the regulator and difficulties in obtaining licenses; and 8—the need for significant investments.

An important issue also arises regarding the measures that the state should plan for in order to eliminate the risks from excessive involvement of an energy company in business activities to the detriment of its core production and possible reduction in the reliability of electricity supply [66]. It is noteworthy that countries that for many decades encouraged private ownership in the electricity sector (and in some cases prioritized its total dominance as a goal) are now beginning to consider switching over to public–private partnerships or complete nationalization of energy assets [67]. The growing role of the state has been observed in the United States and Japan, where tighter supervision is being exerted over the nuclear power industry, primarily in the areas of R&D and advanced development. In many European countries, the state bought shares and/or stakes in the capital of major energy producers. The examples are Sweden, which currently owns 100% of Vattenfall, Norway (100% of Statkraft), and France (100% of Electricite de France). These and some other countries (Switzerland, Finland, Austria, etc.) are guided by the following logic: amid the energy crisis, it is necessary to closely monitor the financial situation of the electric power industry as, despite the fact that this tighter control limits the freedom of

non-core business and reduces the investment appeal of energy companies to some extent, it ultimately leads to an increase in the energy security of the state [68,69].

Therefore, the conditions that would permit the creation of unregulated businesses in the energy sector are brought to the forefront of the paper's agenda. The relevant measures that have been formulated based on the results of the analysis of the respondents' responses are illustrated by Figure 4.

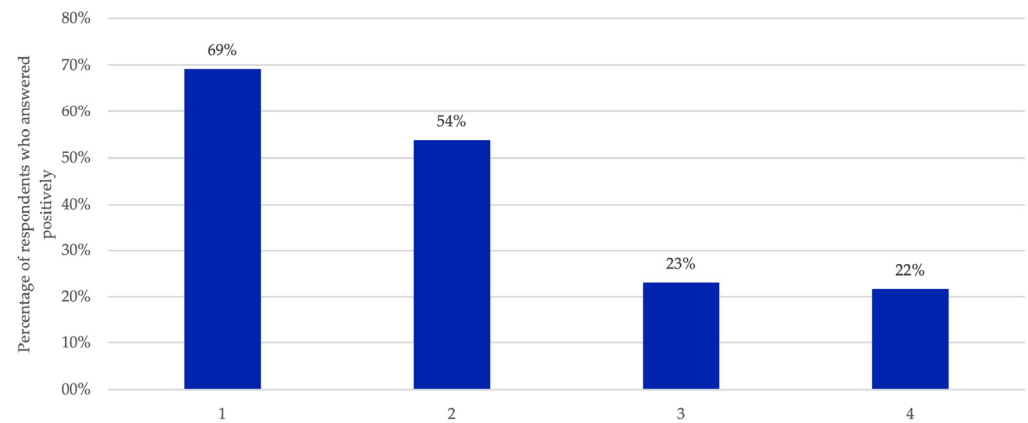


Figure 4. Key government measures regulating the energy business in non-core areas: 1—entrepreneurship should be encouraged only in areas that are directly related to the profile of the energy company—the main production technologies and competencies; 2—the separation of unregulated business into an independent entity; 3—the creation of a registry of permitted types of entrepreneurial activity and the introduction of licensing for them; and 4—entrepreneurship to be encouraged in areas that have socially significant-economic importance for the territory.

Nevertheless, we would like to emphasize that the development of unregulated activities makes the investment climate in the industry more attractive and contributes to staff retention, which becomes an additional motivational factor, especially under the conditions of personnel shortage [70].

It should also be emphasized that many unregulated activities have positive environmental effects. For example, the provision of energy-saving services by an energy company to consumers, including through demand-side management programs or direct technological assistance as a result of reduced electricity generation at low-efficiency TPPs, as well as reduced condensing generation at CHP plants, leads to an increase in the fuel utilization factor [71]. Another example is the construction of small-scale generation facilities (small CHPPs) in power grid companies, which makes it possible to minimize aerial emissions of all kinds due to the possibility of full automation of production processes and high efficiency. As an additional benefit, small-scale generation requires small-sized sites, which leads to less land being taken from other economic uses [72,73].

The strategy of diversification is becoming more and more widespread not only in the electric power industry, but also in the fuel and energy sector as a whole, with industry leaders considering the production of electricity based on renewable energy sources as the most attractive direction. For example, in 2020, British company Total announced a new strategic goal: to become a global leader in renewable energy [74]. British Petroleum, which is also engaged in the development of renewable energy, has scheduled for 2026 to increase its generating capacities (wind power plants and solar power plants) to 20 GW, and by 2030 to 50 GW [75,76]. Other popular segments include hydrogen production, installation and maintenance of electric charging stations, and industrial and energy decarbonization services [77,78].

Energy companies see as the main goal of diversification the expansion of the services and projects portfolio to reach out to more consumers not only within the classical industry value chain (generation—distribution—transportation—sales), but also beyond it within an integrated regional infrastructure (electricity, heat, gas and water supply, telecommunications, and transport) [79].

At the same time, it is emphasized that the diversification carried out by an energy company in a turbulent external environment that is characterized by geopolitical and macro-economic shocks can also lead to negative economic effects [80]. One of the main factors stabilizing the process of expanding business activities is the availability of special government mechanisms that make it possible to compensate (insure) potential financial losses of energy market players and maintain the stability of their functioning.

Summarizing the results of the conducted analysis, it is possible to identify several key conditions under which an energy enterprise can diversify into unregulated activities with the necessary organizational and economic efficiency. These conditions generally correlate with expert opinions set out in publications and analytical reports [48,66,81–83]:

1. licenses for the provision of relevant works (services);
2. regulatory approval (including compliance with a list of requirements);
3. the actual opportunity to sell these products and services. This has to be economically justified before creating a production base for additional businesses;
4. formation of the necessary divisions within the organizational structure of the energy company;
5. providing newly organized unregulated businesses with investment and personnel with relevant competencies.

At the same time, the regulator should contribute to increasing the profitability of the main (core) activity; for example, it is very important to keep the tariff unchanged while reducing costs over a certain period, as well as to provide funding and tax incentives for equipment overhaul. Therefore, the organization of additional businesses is advisable if it occurs against the background of the increasing efficiency of the main production. Additionally, of course, the energy company should have a sound cost management system in its core business—this is the key requirement of the regulator when allowing additional activities [84]. The main advantage of business diversification is the possibility of cross-financing of certain types of activities, which creates a synergistic effect for energy companies as a whole. However, it is imperative for resources not to flow into supplementary business areas, even if they turn out to be more profitable compared to the main activity, as this could damage the reliability of electricity supply. For example, if an electric grid company is transformed into several integrated or multi-energy companies, all types of activities there are considered equal; that is, core and subject to regulation.

5. Conclusions

The study allowed the authors to confirm their hypothesis and substantiate a direct correlation between the degree of development of unregulated activities (entrepreneurship) and the financial stability of the energy company. This is the main theoretical significance of the article.

A step-up in entrepreneurial activity of energy enterprises allows them to compensate for the regulatory inertia that do not prevent them from increasing the profitability of core activities and diversifying financial sources of profit, which would solve the investment problem of asset overhaul and better overall stability of the functioning of energy companies.

An analysis of the statements of energy companies operating in the traditional sectors of generation, transmission, and transportation of electricity shows that an increasing

number of them are seeking to enter new markets. The most popular areas are energy efficiency services, construction of EV charging stations, and telecommunications services. The vast majority of such players show significant growth in EBITDA, capitalization, and share prices, which indicates the economic efficiency of their unregulated activity.

Two main limitations came to the surface during the study. Firstly, some companies that have been operating in competitive energy markets for a long time do not divide their activities into regulated and unregulated ones in their financial statements. Secondly, not all of the companies are public, and therefore, they do not disclose information about their activities. Accordingly, in order to objectively determine the amount of revenue and other economic indicators achieved from non-core business, the authors had to study a large amount of additional sources (aggregators of statistical information, official press releases of companies, and analytical reports of consulting agencies). The main practical contribution of the research is expressed in the substantiation of specific areas of non-core business that have the greatest positive impact on the financial results and investment attractiveness of the energy business, as well as in determining the range of conditions that stimulate entrepreneurial activity in the energy sector.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

#	Name	Country	Headquarters	Sector	Reference (Web-Site)
1	A2A	Italy	Brescia	Multi-energy	www.gruppoa2a.it/en/investors/financial-sustainability-documents/financial-integrated-reports (accessed on 9 January 2025)
2	Terna	Italy	Rome	Distribution	www.terna-reports.it/2023/en/ (accessed on 9 January 2025)
3	Israel Corporation Ltd.	Israel	Tel Aviv-Yafo	Multi-energy	https://www.chuden.co.jp/english/resource/corporate/ecsr_report_2023_all.pdf (accessed on 9 January 2025)
4	Chubu Electric Power Group	Japan	Nagoya	Multi-energy	https://www.chuden.co.jp/english/resource/corporate/ecsr_report_2024_all.pdf (accessed on 9 January 2025)
5	The Kyuden Group	Japan	Fukuoka	Multi-energy	https://www.kyuden.co.jp/var/rev0/0467/5082/en_integratedreport_2023_b.pdf (accessed on 9 January 2025)
6	Tepco	Japan	Tokyo	Multi-energy	https://www.tepco.co.jp/en/hd/about/ir/library/integratedreport/pdf/TP2023_en_web.pdf (accessed on 9 January 2025)

#	Name	Country	Headquarters	Sector	Reference (Web-Site)
7	Stadtwerke München	Germany	München	Multi-energy	https://www.swm.de/dam/doc/english/swm-annual-report.pdf (accessed on 9 January 2025)
8	E.ON	Germany	Essen	Multi-energy	https://www.eon.com/content/dam/eon/eon-com/eon-com-assets/documents/investor-relations/en/annual-report/EON_GB23_engl_gesamt_final.pdf (accessed on 9 January 2025)
9	EnBW	Germany	Karlsruhe	Multi-energy	www.enbw.com/integrated-annual-report-2023/ (accessed on 9 January 2025)
10	RWE	Germany	Essen	Power generation	https://www.rwe.com/-/media/RWE/documents/05-investor-relations/finanzkalender-und-veroeffentlichungen/2023-Q4/2024-03-14-rwe-annual-report-2023.pdf (accessed on 9 January 2025)
11	Vattenfall	Sweden	Stockholm	Multi-energy	group.vattenfall.com/investors/financial-calendar/annual-and-sustainability-report-2023 (accessed on 9 January 2025)
12	Électricité de France (EDF)	France	Paris	Power generation, distribution	www.edf.fr/en/the-edf-group/dedicated-sections/investors/regulated-information (accessed on 9 January 2025)
13	Elia	Belgium	Brussels	Distribution	https://investor.eliagroup.eu/en/reports-and-results/reports-for-elia-group (accessed on 9 January 2025)
14	ORES	Belgium	Gosselies	Distribution	https://media.ores.be/ores-cms/gg5flam1/oressc-rapport_annuel-2023-fr.pdf (accessed on 9 January 2025)
15	Hydro-Québec	Canada	Montreal	Power generation, distribution	https://www.hydroquebec.com/data/documents-donnees/pdf/annual-report-2023-hydro-quebec.pdf (accessed on 9 January 2025)
16	Hydro One	Canada	Toronto	Distribution	https://www.hydroone.com/investorrelations/Reports/Hydro%20One%20Limited%20Annual%20Report%202023.pdf (accessed on 9 January 2025)
17	BC Hydro	Canada	Vancouver	Multi-energy	https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/accountability-reports/financial-reports/annual-reports/2023-24-annual-service-plan-report-cs-5002.pdf (accessed on 9 January 2025)
18	CLP Group	Hong Kong	Hong Kong	Multi-energy	https://www.clpgroup.com/content/dam/clp-group/channels/investor/document/3-3-financial-reports/2023/e_2023Annual%20Report.pdf (accessed on 9 January 2025)
19	Hongkong Electric Company	Hong Kong	Hong Kong	Distribution	https://www.hkelectric.com/documents/en/InvestorRelations/Documents/Financial%20Reports/2023/ARa/2023_HKEI_ARa_E_Full.pdf (accessed on 9 January 2025)
20	Electricity North West Limited	UK	Stockport	Distribution	https://www.enwl.co.uk/globalassets/investor-relations/documents/financial-reports/enw-limited/electricity-north-west-limited-annual-report-and-financial-statements-31-march-2024.pdf (accessed on 9 January 2025)
21	UK Power Networks	UK	London	Distribution	https://annualreview2023.ukpowernetworks.co.uk/annualreview2023/assets/ukpn-annual-review-2023-c1db8c70.pdf (accessed on 9 January 2025)
22	UK National Grid	UK	London	Distribution	https://www.nationalgrid.com/document/152081/download (accessed on 9 January 2025)
23	Southern California Edison	United States	Rosemead	Distribution	https://download.edison.com/406/files/202403/2023-eix-sce-annual-report.pdf?Signature=7A2TvX0cbADEKr0HTwBNQ5voZ9U=&Expires=1730099970&AWSAccessKeyId=AKIAJX7XEOOELCYGIVDQ&versionId=gKDvYbNV5xy6ZD4A6Mk_7QipIn4o0KPs&response-content-disposition=attachment (accessed on 9 January 2025)

#	Name	Country	Headquarters	Sector	Reference (Web-Site)
24	Florida Power & Light	United States	Juno Beach	Power generation, distribution	https://www.floridapsc.com/pscfiles/library/Financials/EI802-DOCS/ANNUAL-REPORTS/EI802-23-AR.pdf (accessed on 9 January 2025)
25	Consolidated Edison	United States	New York City	Distribution	https://investor.conedison.com/static-files/f53f00f0-94eb-4e98-9736-9dd4aea9124c (accessed on 9 January 2025)
26	Endesa	Spain	Madrid	Multi-energy	https://www.endesa.com/content/dam/enel-es/endesa-en//home/investors/financialinformation/annualreports/documents/2024/Individual%20Annual%20Financial%20Report%20ENDESA%202023.pdf (accessed on 9 January 2025)
27	SSE	UK	Perth	Multi-energy	https://www.sse.com/media/pf3fsfak/sse-plc-annual-report.pdf (accessed on 9 January 2025)
28	Rosatom	Russia	Moscow	Power generation	https://report.rosatom.ru/go/rosatom/go_rosatom_2023/rosatom_2023_key_results_ru.pdf (accessed on 9 January 2025)
29	JCS “Inter RAO UES”	Russia	Moscow	Multi-energy	https://www.interrao.ru/upload/InterRAO_AR2023_RUS_2.pdf (accessed on 9 January 2025)
30	PJSC Rosseti Lenenergo	Russia	Saint-Petersburg	Distribution	https://storage.rosseti-lenenergo.ru/iblock/d49/d490b68ac1042aaf6aa7c197ebe7c1ed/Rosseti-Lenenergo_Godovoy-otchet-2023.pdf (accessed on 9 January 2025)
31	China Southern Power Grid	China	Guangzhou	Distribution	https://english.sse.com.cn/markets/equities/announcements/detail.shtml?seq/1395726/date/20240330 (accessed on 9 January 2025)
32	JSC “GRID COMPANY”	Russia	Kazan	Distribution	https://www.e-disclosure.ru/portal/files.aspx?id=1830&type=2 (accessed on 9 January 2025)

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