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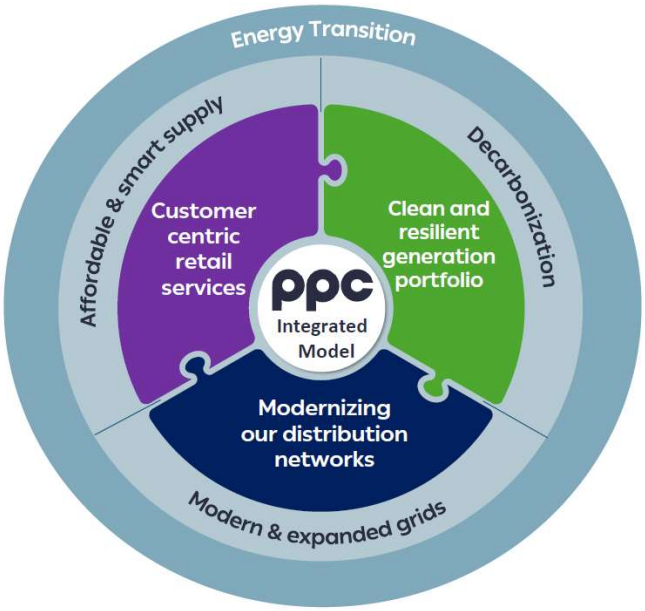
Strategic Management in Energy Transition: Leveraging Digital Transformation and Cross-Border Expansion – The case study of PPC in Greece



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Patras, Greece, March 2025

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Management in Energy Transition: Leveraging Digital Transformation and Cross-Border Expansion – The case study of PPC in Greece

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"Many thanks to the two men of my life, my husband and my son for being suportive"

Abstract

This dissertation aims to explore the way that strategic management navigates the shift toward energy transition. Focusing on companies like PPC in Greece, the study will outline, how innovative strategies (such as digital transformation, geographic expansion, and sustainable energy investments) are employed in order to achieve growth and to maintain competitive advantage. The strategic management decisions around decarbonization will be examined in addition to renewable energy adoption and risk management in the volatile energy market. Moreover, it will be examined how digital solutions like smart grids and e-mobility enhance operational efficiency. Additionally, the thesis will explore the strategic value of cross-border expansion and international synergies of PPC to improve its market positioning in Southeast Europe and beyond.

Keywords

Energy transition
Decarbonization
Digital transformation
Renewable Energy
Georgraphic Expansion

Στρατηγική Διαχείριση για την Ενεργειακή Μετάβαση: Αξιοποίηση του Ψηφιακού Μετασχηματισμού και της Διασυνοριακής Επέκτασης στις Εταιρείες Ενέργειας – Η περίπτωση στης ΔΕΗ στην Ελλάδα

Γεωργαντάκη Άννα

Περίληψη

Αυτή η μεταπτυχιακή διπλωματική εργασία έχει ώς στόχο να διερευνήσει τον τρόπο με τον οποίο η στρατηγική μιας επιχείρησης στον τομέα της ενέργειας, καθοδηγεί τις δράσης αυτής ώστε να επιτύχει ενεργειακή μετάβαση. Εστιάζοντας στην Δημόσια Επιχείρηση Ηλεκτρισμού Α.Ε (ΔΕΗ Α.Ε) στην Ελλάδα, η μελέτη θα αναδείξει πώς καινοτόμες στρατηγικές (όπως ο ψηφιακός μετασχηματισμός, η γεωγραφική επέκταση και οι επενδύσεις σε ανανεώσικες μορφές ενέργειας) εφαρμόζονται για την επίτευξη περεταίρω ανάπτυξης και της διατήρησης του ανταγωνιστικού πλεονεκτήματος. Θα εξεταστούν επίσης οι στρατηγικές αποφάσεις που σχετίζονται με την απολιγνητοποίηση, μαζί με την επέκταση στις ανανεώσιμες πηγές ενέργειας καθώς και η διαχείριση κινδύνων που μπορεί να εμφανιστούν στην ασταθή αγορά της ενέργειας – ηλεκτρισμού. Επιπλέον, θα διερευνηθεί και ο τρόπος που διάφορές ψηφιακές λύσεις, όπως τα έξυπνα δίκτυα και η ηλεκτροκίνηση, βελτιώνουν την επιχειρησιακή αποδοτικότητα. Τέλος, θα εξεταστεί και η στρατηγική αξία της διασυνοριακής επέκτασης και των διεθνών συνεργασιών της ΔΕΗ για την ενίσχυση της θέσης της στην αγορά της Νοτιοανατολικής Ευρώπης και πέρα από αυτήν.

Λέξεις – Κλειδιά

Ενεργειακή Μετάβαση
Απολιγνιτοποίση
Ψηφιακός μετασχηματισμός
Ανανεώσιμές μορφές ενέργειας
Γεωγραφική επέκταση

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List of Abbreviations & Acronyms

PPC	Public Power Corporation
HEDNO	Hellenic Electricity Distribution Network Operator
RWE	Rheinisch-Westfälisches Elektrizitätswerk
RBV	Resource-Based View
R&D	Reaserch and Developemt
EBITDA	Earnings Before Interest, Tax, Depreciation, and Amortization
VRIO	Value, Rarity, Imitability, Organization
RES	Renewable Energy Sources
AI	Artificial Inteligence
EU	European Union
EERA	European Energy Research Alliance
EVs	electric vehicles
ETS	Emissions Trading System
CCUS	Carbon Capture Utilization and Storage
DTs	Digital Twins
AMI	Advanced Metering Infrastructure
NECP	National Energy and Climate Plan
SBTi	Science Based Targets initiative
CCGTs	Combined Cycle Gas Turbines
RAAEW	Regulatory Authority for Waste, Energy, and Water
DPI	Digital Performance Index
IT	Information Technology
EIB	European Investment Bank
CEO	Chief Executive Officer
FTTH	Fiber-to-the-Home
IoT	Internet of Things
SEE	Southeast Europe
BESS	Battery Energy Storage
RAB	Regulated Asset Base
CAPEX	Capital Expenditure

FCF	Free Cash Flow
ESG	Environmental, Social and Governance
D/E	Debt to Equity ratio
ICR	Interest Coverage Ratio
EBIT	Earnings Before Interest and Taxes
ROIC	Return on Invested Capital
IRR	Internal Rate of Return
GDPR	General Data Protection Regulation
P2P	peer-to-peer
EaaS	Energy-as-a-Service
GRI	Global Reporting Initiative
TCFD	Task Force on Climate-related Financial Disclosures

1. Introduction

1.1 Overview of the global energy transition and its impact on the utilities sector

The worldwide energy transition is a process of transformation that characterized by the shift from the traditional energy systems based on fossil fuels to renewable and sustainable energy sources. This shift is guided by the need to contend climate change, enhance security in energy supply by meeting the continiously increasing energy demands. On top of that, the energy transition is also aligned with global commitments, such as the Paris Agreement, which aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels (UNFCCC, 2015;Hakovirta et al., 2024).

What is more, utilities play a crusial role to the energy transition scene due to their duty in power generarions and distribution and also in consumption management. No one can deny that this sector sector deals with significant challenges, such as the intermittency of renewable energy sources, the need for substantial infrastructure investments which must be in accordance with the evolving regulatory framework. Nevertheless, the energy transition itroduces substantial opportunities for innovation, cost reduction through energy efficiency, and the development of new business models. For instance, the integration of digital technologies such as smart grids and energy storage solutions enables utilities to optimize operations and provide more reliable services (Neofytou, Nikas, & Doukas, 2020; Chipangamate & Nwaila, 2024; Hakovirta et al., 2024; Araújo et al., 2024; Benedetti et al., 2023).

In this contex, the case of Public Power Corporation S.A (PPC) in Greece, reflects both global trends and local challenges. PPC is one of the largest companies in Greece, with approximately 17,500 employess and accounts for about 62% of the total turnover in the energy sector in the country. According to data from the Hellenic Electricity Distributor Network Operator S.A (HEDNO), it retains a market share of 72.58%. In other words, PPC is the largest utility provider in Greece and it is well known, that this leading company in Greece is navigating the energy transition by adopting ambitious decarbonization targets with investments in renewable energy infrastructure, and also by leveraging digital technologies. As Greece transitions away from lignite-based power generation, PPC's

strategies illustrate how utilities can align with national and global sustainability goals (Hakovirta et al., 2024; Creutzig, Goldschmidt, & Lehmann, 2014; Pfeifer et al., 2023). Also, PPC's investments in Southeast Europe exemplify the opportunities and challenges associated with geographic diversification in the energy transition.

1.2 Introduction to strategic management concepts on integrated energy utilities.

Strategic management contains the development and implementation of long-term actions to support enterprises achieve their goals, especially in especially in fast-changing and uncertain environments. In the energy sector, this process is necessary to achieve the adoption to the complex challenges of transitioning to sustainable energy systems. For integrated energy utilities like PPC, strategic management must address key facorts such as regulatory compliance, customer expectations, and competition.

The Key strategic management framework can be compined with several theories. The main focus on:

A. Porter's Five Forces: This framework helps analyze industry dynamics through five key factors:
   - the bargaining power of suppliers, which examines wheter suppliers can influence costs and quality and can be often determined by their market dominance
   - the bargaining power of buyers which evaluates the customers ability to negotiate prices and service terms
   - the threat of substitutes which considers the availability of alternative products or services that could replace current offerings
   - the threat of new entrants, which analyzes how easy is for competitors to enter the market
   - the competitive rivalry, which examines the intensity of competition among existing players in the industry.

   For PPC, this framework identifies potential market pressure such as the shift towards renewable energy sources, the role of policy changes, and the impact of technological advancements the fiel of energy production and distribution.

B. Resource-Based View (RBV): The Resource-Based View (RBV) is a strategic management tool that assesses the importance of the internal resources and capabilities of a firm. Those can be used as the foundation for achieving competitive advantage. RBV is leveraging resources that are valuable, rare, inimitable, and non-substitutable (often named as VRIN). These resources may include technological expertise, proprietary knowledge, skilled workforce, operational efficiency, strong brand identity, or strategic assets such as infrastructure or patents. For PPC, this perspective highlights the importance of its existing infrastructure, technical know-how in both fosil fuel and renewable energy production, and the ability to innovate in areas such as digital grids and e-mobility, which are critical for gaining a rapidly evolving energy market. By focusing on continuous improvement and by utilizing those internal resources, PPC can maintain its barriers against the pressure that the external market can cause and capitalize on emerging opportunities in the energy transition landscape.

C. Stakeholder Theory: This tool is an approach to emphasize to the need to balance the expectations and interests of all parties affected by the operations of an organization. Those parties can be regulators, consumers, investors, employees, environmentalists, and local communities. According to this theory, enterprises must create value not only for shareholders but also for all external members involved, in order to achieve sustainability and success. For PPC, this means staying compliant with regulations, delivering reliable and sustainable energy, fullfilling customer expectations, maintaining investors trust, and reducing environmental impact as well. By focusing on these diverse needs, a company such PPC can build trust, enhance its reputation, and secure its competitive position in the evolving energy market (Chipangamate & Nwaila, 2024; Creutzig, Goldschmidt, & Lehmann, 2014; Song et al., 2024).

Insights from the Greek energy market highlight PPC's strategic maneuvers, including its focus on decarbonization and the integration of innovative energy solutions. Notably, PPC gives emphasis on sustainability, technological advancement, and economic growth, facts that mirror the company's best practices in strategic management tailored to high-regulation sectors like energy (Kodona, 2023).

For PPC, integrating digital technologies, such as smart meters and e-mobility solutions, aligns with these strategic frameworks and besides, lead to the enhancement of the operational efficiency and customer satisfaction. Geographic diversification also plays a pivotal role in mitigating risks and seizing growth opportunities in new markets (Neofytou, Nikas, & Doukas, 2020; Creutzig, Goldschmidt, & Lehmann, 2014; Araújo et al., 2024).

1.3 Research questions and objectives, based on PPC's transformation case study.

The case study of PPC in Greece, is an intersection of digital transformation, geographic diversification, and the global energy transition. As Greece has adopted and works toward its energy transition goals, PPC's strategy reflects both the challenges and opportunities of this journey that include decarbonization, renewable energy intergration, and leverage of new technologies. This research focuses on analyzing how PPC's strategies align with these global trends while addressing local market dynamics.

Bellow are presented the main key research question that this thesis will focus.

Key Research Questions

A. **Digital Transformation**:
   - How can digital transformation improve PPC's operational efficiency and enable it to meet growing demands for sustainable energy solutions?
   - In what ways can digital technologies like smart grids, e-mobility platforms, and predictive analytics enhance PPC's customer engagement and service delivery?

B. **Geographic Diversification**:
   - What role does geographic diversification play in mitigating risks and fostering competitive advantage for PPC in regional and international energy markets?
   - How can PPC adapt its strategies to navigate the complexities of cross-border expansion, such as regulatory differences and market conditions?

C. **Alignment with Global Trends**:

- How can PPC leverage global best practices in renewable energy adoption and energy transition to achieve its sustainability and growth objectives?
- What lessons can be drawn from PPC's case to inform similar utilities navigating the energy transition?

Research Objectives

This research is centered around the following objectives:

A. **Evaluate Current Strategies of PPC**:
   - Assess the ongoing digital transformation actions, including initiatives such as the usage of smart meters, the development of e-mobility, and changing into a more modern way the energy infrastructure.
   - Analyze PPC's geographic expansion into Southeast Europe and beyond, focusing on the challenges of entering new markets and potential synergies with existing operations.

B. **Identify Opportunities and Challenges**:
   - Explore the opportunities for PPC group to adopt emerging technologies such as energy storage, blockchain-based energy trading, and AI-driven grid management.
   - Identify all the key challenges that PPC faces, including regulatory barriers, financial constraints and the complexities of adopting new technologies.

C. **Propose Strategic Insights**:
   - Provide actionable insights and recommendations for PPC to optimize its energy transition strategies while maintaining competitive.
   - Highlight the importance of stakeholder engagement and collaboration in the success of PPC's transformation steps.

The research outcomes aim to offer a comprehensive understanding of how energy utilities like PPC can become leaders in the global energy transition. This analysis also contributes to the broader discourse on sustainable energy management and strategic innovation in high-regulation industries.

2. Literature Review

2.1 Examination of strategic management theories relevant to the energy sector.

Strategic management theories provide a valid framework for understanding the challenges and opportunities faced by energy utilities during the global transition. Key theories include as discusses in chapter 1.2:

Porter's Five Forces: This model privides insights into the competitive dynamics of the any business sector, considering supplier power, buyer power, threat of substitutes, threat of new entrants, and industry rivalry (Porter, 1980). The transition to more environmental energy production, reshapes these forces, introducing new competitors and altering supply chain relationships. Therefore, this model can be used to analyze competitive dynamics this, such as the entry of renewable energy companies and the bargaining power of suppliers of critical materials like lithium and cobalt Supplier Power. For Instance, Neofytou et al. (2020) highlight the critical importance of securing raw materials like lithium and cobalt for renewable energy technologies. The scarcity and high demand for these materials amplify supplier bargaining power. They also describe how the renewable energy transition intensifies competition among energy providers. In addition, Hakovirta et al. (2024) emphasize the disconnect between renewable energy targets and supply chain transparency that increase further the influence of suppliers and they also highlight, how government incentives and technological advancements create lower barriers for new renewable energy firms. What is more, Pfeifer et al. (2023) discuss the growing influence of consumers and investors demanding sustainable energy solutions since increased awareness and regulatory support enhance the power of buyers emphasize and also underline the importance of collaborative strategies to manage industry rivalry effectively. Moreover, Chipangamate & Nwaila (2024) note the rise of decentralized energy solutions like rooftop solar panels and off-grid systems, which threaten traditional utility models.

By taking all the above into consideration , bellow is presented the approach of Porter's Five Forces Analysis for PPC, with information gathered from the official website of the company.

A. Threat of New Entrants - Moderate

Barriers to Entry: The energy sector requires large upfront investments, advanced technological infrastructure, and compliance with regulatory frameworks. All rhose factors, pose significant challenges for new entrants.

Market Liberalization: Greece's energy market liberalization has facilitated the entry of private firms, especially in renewable energy. PPC has proactively responded by expanding its renewable energy portfolio. It is well known, that PPC with join venture with the German RWE, Meton Energy S.A., is developing five photovoltaic projects in Western Macedonia that will prodice over 200 MW of electric power.

Economies of Scale: PPC's large infrastructure and wide customer base provide a strong advantage over new competitors. This position is further strengthened by strategic moves such as instance the acquisition of Enel Romania which is part of the global energy company Enel, a major player in Romania's energy market and operates in electricity distribution, supply, and renewable energy. By this aquisution, PPC gains access to an already established market with a customer base of over 3 million, and a well-developed distribution network and increases its assets portfolio with the addition of additional valuable renewable energy assets. This acquisition enhances PPC's competitive edge in Southeast Europe and shows the character of its broader growth strategy.

B. Bargaining Power of Suppliers - Moderate to High

Fuel Dependence: PPC has traditionally rellied on lignite and other fossil fuels. Therefore the company was vulnerable to fluctuations in global fuel prices. PPC responded promptly to address the challenge, significantly increasing its commitment to reducing carbon emissions. For this reason, the set company set a target to lower CO_2 emissions by 40% by 2022.

Renewable Technology Suppliers: PPC is relying more and more on providers of renewable equipment such as solar panels and energy storage systems (batteries). PPC's partnership with RWE for solar projects, indicate the strategy of the company to secure reliable sources for such equipment.

C. Bargaining Power of Buyers - High

Consumer Expectations: Growing environmental consciousness has led consumers to seek greener energy solutions. In response of this need, PPC has greener energy production at the center of its strategic framework. The company has currently renewable energy projects of 6 GW, including solar, wind, and hydropower. Those projects are at varying stages from planning to construction, and reflect PPC's commitment to a sustainable energy transition.

Competitive Options: The availability of alternative energy providers expands consumer choice and as a result of this their bargaining power is becoming stronger. PPC has addressed this by pursuing initiatives like acquiring Kotsovolos, a retailer specializing in electrical and electronic appliances, positioning itself as an integrated provider of energy-related products and services.

D. Threat of Substitutes - Moderate

Alternative Energy Sources: Independent renewable energy producers are gaining ground, offering consumers additional electricity options. To address this, PPC develops renewable projects with targer to increase its capacity 1.3 GW of by 2023.

Energy Efficiency Solutions: Technological advancements enable consumers to reduce their reliance on traditional grid systems. For this reason, PPC is exploring innovative solutions such as energy storage systems and AI-driven grid management to enhance its service offerings.

E. Industry Rivalry - High

Intensified Competition: Market deregulation has increased competition from private energy providers. PPC is strengthening its market position through regional expansion.

Price Sensitivity: Economic conditions in Greece have made consumer focusing on pricing and that causes competition among energy providers. PPC's approach focuses on operational efficiency and the development of cost-effective projects to sustain its market presence.

Resource-Based View (RBV): Is a method that emphasizes the importance of utilizing internal capabilities in order to gain competition. Chipangamate & Nwaila (2024) highlight the role of local institutional knowledge and human capital as critical resources for addressing energy transition challenges in emerging markets. Additionally, Creutzig, Goldschmidt, & Lehmann (2014) emphasize that fact that the leverage of regional natural resources (e.g., solar and wind potential in Southern Europe) can create a strategic advantage. In addition , they underline the role of investing in research and development (R&D) to enhance technical capabilities and improve renewable energy efficiency. What is more, Song et al. (2024) Discuss China's renewable energy strategy as an example of RBV, where internal capabilities such as policy frameworks and state-backed R&D are leveraged to dominate global markets.

For PPC, the perspective of RBV highlights the importance of its existing infrastructure, its technical know-how in energy production and distribution, and its ability to innovate in modern areas such as digital grids and e-mobility, which are critical for staying competitive in energy market. The analysis for PPC is as follows:

A. Tangible Resources

- **Financial Resources:** PPC has a strong financial performance and has also shown increase in adjusted earnings before interest, tax, depreciation, and amortization (EBITDA) to €1.35 billion in the first nine months of 2024, up from €0.94 billion in the same period of 2023. This growth is attributed to higher contributions from its distribution business and the inclusion of its Romanian operations and the recent acquisition of electronics retailer Kotsovolos [14].
- **Physical Assets:** PPC holds an extensive infrastructure portfolio that includes power generation facilities and the distribution network as well. Notably, PPC is investing in renewable energy sources (RES), with an installed capacity of 4.9 GW by the end of September 2024 and plans for further expansion [14].

B. Intangible Resources

- **Technological Capabilities:** PPC is actively advancing its digital transformation effords. It has established a partnership with Microsoft to leverage cloud technologies, to enhance digital process security, and to digitize the work environment [15].
- **Brand Reputation:** PPC is well-known for its leadership in transitioning to greener energy solutions..The company's commitment to sustainability and innovation enhances its brand value [16].

C. Human Resources

- **Expertise in Energy Sector:** PPC's workforce brings extensive know - how in energy production, distribution, and management. This expertise is essential for executing complex projects.

D. Organizational Capabilities

- **Strategic Partnerships:** PPC has formed significant partnerships to make stronger its capabilities. For instance, the joint venture with EDGNEX Data Centers, to develop a state-of-the-art data center in Spata - East Attica - Greece, reveals the efforts of the company to enhance digital infrastructure and to position Greece as a key player in Southeast Europe's data ecosystem [17].
- **Cross-Border Expansion:** The acquisition of Enel's operations in represents a major step in PPC's strategy to expand into Southeast Europe. This move helps the company diversify its market presence and gain a stronger competitive position [18].

E. Innovation and R&D

- **Renewable Energy Projects:** PPC is committed to increasing its renewable energy capacity, with plans to add 4.1 GW in Greece, Romania, and the broader Southeast Europe region. This ambitious goal is supported by the aforementioned pipeline of projects, with the majority of them to be at an advanced stage of maturity [19].

Conducting a VRIO (Value, Rarity, Imitability, Organization) analysis of PPC also helps to identify the company's internal resources and capabilities that provide a sustaimable competitive advantage.

Value

- **Financial Resources:** financial performance and strength that enables PPC to invest in alternative projects that align with the global energy transition trends.
- **Renewable Energy Portfolio:** meets regulatory requirements and respondes to the increasing consumer demand for greener solutions.

Rarity

- **Market Position:** The largest electricity producer and supplier in Greece, serving approximately 5.6 million customers .
- **Integrated Operations:** integrated services from in electricity generation, to distribution network operation, and supply to end consumers.

Imitability

- **Established Infrastructure:** extensive and diverse infrastructure, including a total generation capacity of 11.1 GW encompassing thermal, hydro, and RES power plants
- **Brand Reputation:** recognition in the Greek market with a reputation that fosters customer trust and loyalty

Organization

- **Strategic Initiatives:** focuses on the fastest lignite phase-out plan in Europe and a parallel increase in RES as the dominant generation technology, invests in digitalization and operational efficiency.
- **Cross-Border Expansion:** acquisition of Enel's operations in Romania

PPC's financial strength, its extensive infrastructure, and its strategic focus on renewable energy and digital transformation, allow PPC to navigate the challenges and opportunities presented by the global energy landscape.

Stakeholder Theory: Freeman's Stakeholder Theory (1984) highlights the importance of balancing the expectations and interests of all stakeholders affected from the operations of an organization. For instance, those stakeholders can be authorities, clients, investors, employees, environmental advocates, and local communities. Therefore, this theory argues that business operations must create value for both shareholders and stakeholders to achieve lifetime success. The application to PPC includes factors such as regulatory compliance, fulfilling customer expectations, ensuring investor confidence, and minimizing environmental impacts. By focusing on these diverse needs, a company can build trust, reputation, security that can hold its competitive position in the evolving energy market (Chipangamate & Nwaila, 2024; Creutzig, Goldschmidt, & Lehmann, 2014; Song et al., 2024).

Applying stakeholder theory to PPC, examines how the company identifies and manages its various stakeholder groups, especially during significant transitions such as privatization and market liberalization. No one can deny that the privatization of PPC marked a pivotal shift in its operational and strategic approach. Burnes, Katsouros, and Jones (2004) analyzed this transition, highlighting that the move towards privatization and market liberalization was significantly influenced by the European Union's commitment to free market competition. This shift necessitated PPC to broaden its focus beyond traditional stakeholders, such as government entities and employees, to include new stakeholders like private investors, regulatory bodies, and a more diverse customer base. The study underscores the importance of effective stakeholder management in navigating the complexities introduced by privatization and aligning corporate strategies with the expectations and interests of these varied groups.

In addition , according to Pedrini and Ferri (2019) that conducted a systematic literature review on stakeholder management, emphasizing that the integration of stakeholder considerations into corporate activities is increasingly essential.

By adopting systematic stakeholder management practices, PPC can navigate the complexities of the energy sector, foster sustainable relationships, and achieve long-term success.

2.2 Review of energy transition strategies, decarbonization, and renewable energy adoption.

Energy transition is characterized the the shift from traditional energy production from fossil fuels to sustainable and renewable energy source and for Europe, the road map for achieving net-zero greenhouse gas emissions by 2050 is guided by the European Green Deal (Borghesi & Vergalli, 2022). At this point, it is remarkable that energy transition is not only vital for addressing climate challenges and environmental sustainability but also for enhancing energy security and economic growth (European Commission, 2021). The key strategies from such transision , are focused on Integration of Renewable Energy, Policy and Regulatory Frameworks and Cross-Border Collaborations. To introduce variety and promote decarbonization in energy systems, the expansion of renewable energy technologies, such as wind, solar, and hydropower is required. Additionally, a very important parameter is the Legislative structure. Policy initiatives, such as the REPowerEU Plan for Europe, aim to reduce the dependence on imported fossil fuels. This can happen by providing financial incentives and establishing supportive legal frameworks to accelerate the adoption of green energy (European Commission, 2022). What is more, cross-border collaborations also play a vital role. European Energy Research Alliance (EERA) for instance, is a program to facilitate joint research and innovation in renewable energy technologies. Moreover, cross-border electricity interconnectors enhance grid reliability and enable the seamless exchange of renewable energy between regions, fact that fosters greater resilience and integration within Europe's energy networks (European Energy Research Alliance, 2021).

Energy transition and decarbonization are interrelated concepts since decarbonization is definitely a mean to mitigate climate change and global warming. Europe for instance, has set ambitious goals, including a 55% reduction in greenhouse gas emissions by 2030 compared to 1990 levels, making this initiatives and actions a model for other regions to follow (European Commission, 2021). Also, decarbonization includes some key actions,

such as electrifying major sectors (transportation and heating for instance) that tradidionally used fossil fuels. For example, the adoption of electric vehicles (EVs) has grown rapidly, with the European EV market expanding by 44% in 2023, while heating systems are being transformed through the use of heat pumps (Borghesi & Vergalli, 2022). Additionally, Europe has established the another tool for decarbonization with is the Emissions Trading System (EU ETS) than industries to cut emissions by assigning a monetary value to carbon dioxide. As a result of this an effective in reducing emissions from heavy industries and power generation is provided (European Commission, 2022). Furthermore, technologies for carbon capture, utilization, and storage (CCUS) provide practical solutions for sectors with hard-to-abate emissions, as seen in initiatives like Norway's Northern Lights project, which captures and stores carbon dioxide underground or repurposes it for industrial applications (European Commission, 2021).

But both energy transision and decarbonization require the adoption of renewable energy systems. That requires in many cases, upgrades to the regional power grids to manage the intermittent nature of wind and solar energy successfully, and also investments in smart grids and advanced energy storage technologies for ensuring a reliable and stable energy supply.

2.3 Discussion of digital transformation in utilities: smart grids, e-mobility, and customer-centric models.

Smart grids are a combination of advanced communication and automation technologies that enable atwo-way energy flow and real-time data exchange between utilities and consumers. The benefit of these systems is that they enhance grid resilience, reliability, and efficiency, creating opportunities for the integration of renewable energy sources (Mou et al. 2024, Herman at al. 2025). In addition, the implementation of innovations such digital twins (DTs) in smart grids allows utilities to simulate and predict energy flow and system behavior, improving operational efficiency and stability and also such systems support predictive maintenance that leads to downtime minimization and cost reduction (Opy et al, 2024). Additionally, developments like advanced metering infrastructure (AMI) enable consumers to track their real-time energy usage, empowering them with all the information

they need to make data-driven decisions about their energy consusmption (Sunawar et al., 2025).

Furthermore, e-mobility plays a crucial role for decarbonization in the transport sector. Moreover, electric vehicles (EVs) can act as distributed energy storage units through bidirectional charging technology, fact that leads to grid stability. This integration could possibly optimize the energy usage during the peak of the demand and promote renewable energy adoption. Additionally, EVs reduce significantly greenhouse gas emissions, fact that aligns with the global climate goals. Policies such as the European Green Deal emphasize the development of extensive charging infrastructure to facilitate the widespread adoption of e-mobility solutions (Mou et al. 2024, Sunawar et al., 2025).

What is more, the rise of "prosumers," i.e individuals who both consume and produce energy, is reshaping the utility sector. Smart grids enable peer-to-peer energy trading and decentralized energy generation and foster a more inclusive and participatory energy ecosystem (Herman at al. 2025, Asit et al. 2024). Means like digital platforms and advanced analytics provide utilities with insights into consumer behavior, enabling personalized services and demand response strategies. Real-time energy monitoring through smart meters encourages informed energy usage, reducing costs and enhancing customer satisfaction (Asit et al. 2024).

2.4 Geographic diversification and its role in risk management and competitive advantage.

Expanding across regions can be a mean of reducing localized risks such as economic downturns, regulatory changes, or supply chain disruptions. Geographic diversification, minimizes the dependency of a company on any single market and can balance losses in one region with gains in another. In energy sector, companies face considerable geopolitical challenges, especially when operating in resource-dependent regions. According to Gozgor & Paramati (2022) and Bakhsh et al. (2024), energy diversification across geographies mitigates market-specific risks and supports economic stability since diversified economies with multiple trade partners are better positioned to navigate disruptions in energy imports and exports (Bakhsh et al. 2024). Also, geographically diverse operations strengthen the

flexibility of supply chain and allow firms to source materials or distribute products across multiple regions and thus, to minimize exposure to localized disruptions. In addition, Wang et al. (2022) emphasize that diversification strengthens resilience and provids access to alternative suppliers and markets.

Also, another benefit from expanding operations into emerging markets is that firms can access untapped consumer bases and lead to growth (Bakhsh et al. 2024). Geographic diversification allows firms to exploit regional resources and advantages, such as abundant renewable energy sources or favorable regulatory environments. For example, Enel Group has invested significantly in regions with strong solar and wind energy potential, which has reduced costs and enhanced operational efficiency (Ghorbani et al. 2024). What is more, an expanded presence enhances a company's reputation, particularly in industries like energy, where sustainability is a strong adventage. Companies that are considered as leaders in renewable energy and innovation are better positioned to attract investments and build long-term stakeholder relationships (Bakhsh et al. 2024).

Moreover, expanding into diverse regions introduces cultural and operational challenges, including differing business practices, regulatory landscapes, and customer preferences. Addressing these complexities requires local expertise and adaptable strategies . Additionally, the financial costs of geographic diversification, such as infrastructure investments, must be carefully weighed against all the potential benefits. Further challenges that should not be neglected are social challenges, such as resource conflicts or community opposition, parameters that require engagement with local stakeholders to mitigate such risks (Pedrini and Feri, 2019).

3. Case Study: PPC's Strategic Transition

3.1 Analysis of PPC's strategic management practices using data Examination of PPC's decarbonization targets, including the phase-out of lignite and increased renewable capacity.

The National Energy and Climate Plan (NECP, NOG 4893/B/2019), scpecifies the complete lignite phase-out action, which is nation-wide by 2028. It is a policy that aligns fully with the EU's goal to make making Europe the first climate-neutral continent by 2050 and envisages the complete phase-out of lignite in Greece by 2028. However, PPC has decided to accelerate the decommissioning of its existing lignite units, totaling 3.9 GW, by 2023. Only the new Ptolemaida V Unit is expected to operate with lignite fuel until 2025, after which it is planned to be converted into a natural gas unit, increasing its capacity to 1,000 MW. The decommissioning schedule of the existing lignite units, as outlined in the NECP, is provided in the table below:

Table 1 : Decommissioning schedule of the existing lignite units

Lignite-fired power unit	Nominal capacity (MW)	Year of Decomission
Kardia 1	275	2019
Kardia 2	275	2019
Kardia 3	280	2021
Kardia 4	280	2021
Agios Dimitrios 1	274	2022
Agios Dimitrios 2	274	2022
Agios Dimitrios 3	283	2022
Agios Dimitrios 4	283	2022
Agios Dimitrios 5	342	2023
Amyntaio 1	273	2020
Amyntaio 2	273	2020
Florina/Meliti	289	2023
Megalopolis 3	255	2022
Megalopolis 4	256	2023

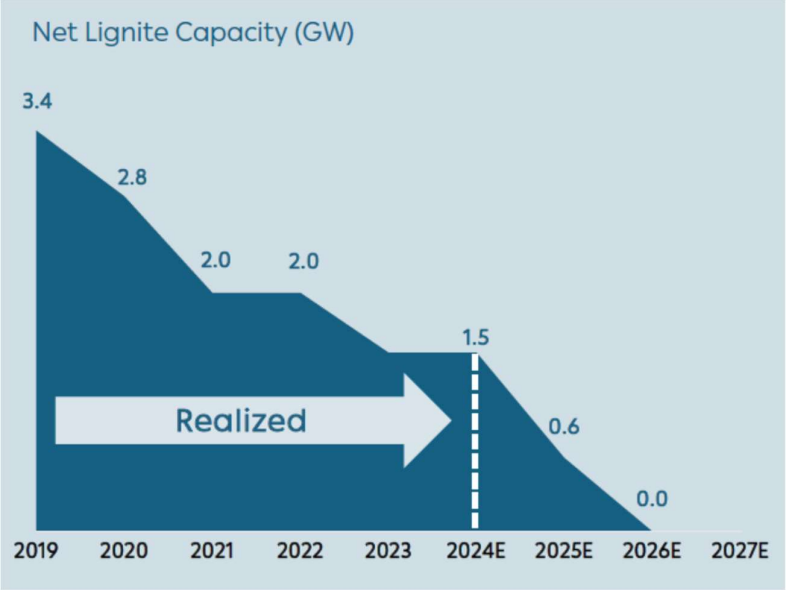

Figure 1 : Decarbonization program (source PPC)

In Greece lignite was historically used for power generation but nowadays, lignite is unviable due to its significant environmental impact and due to the rising costs associated with CO2 emissions rights under the EU Emissions Trading System (ETS). Therefore, PPC was committed to phase out all lignite-based power generation and become Lignite free by 2026. Since 2021 until end of 2023, the company has managed to phase out 2,8 GW of lignite and increased the renewable energy sources capacity by 2,8 GW.

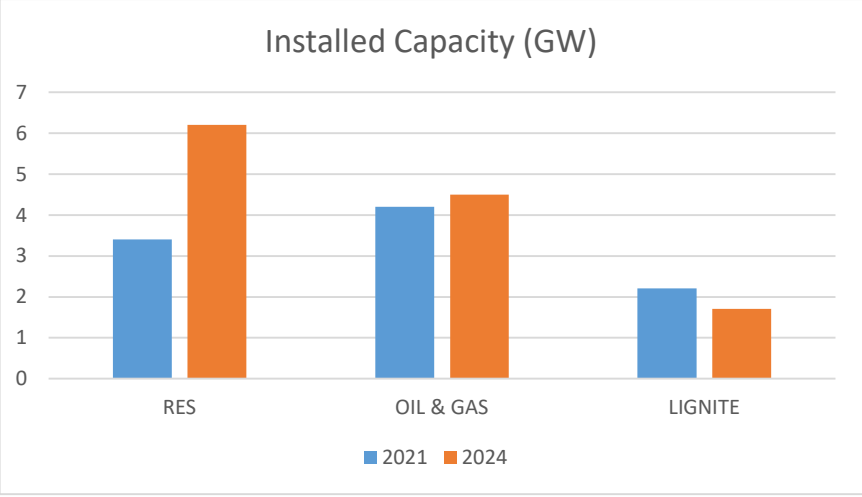

Figure 2 : Installed Capacity (GW) of RES and Fossil power plants in 2021 - 2024

Above that, PPC plans to double its installed RES capacity from 4,5 GW in 2023 to 11 GW until 2027. This will happen with significant investments in solar, wind, and hydroelectric power projects. What is more, the company also aims to reduce its Scope 1* and Scope 2* emissions by 73.7% per MWh generated until 2030, in comparison to 2021 levels as a base year, and for Scope 1 and Scope 2 by 73.7% per MWh sold. Also, all other absolute Scope 3 emissions will be reduced by 42% and all the aforementioned targets are verified by SBTi (Science Based Targets initiative), a global organization that helps businesses to set science-based emissions reduction targets in line with climate science.

* Scope 1 emissions refer to direct greenhouse gas emissions from activities controlled by an organization, as outlined by the Greenhouse Gas Protocol. This protocol also includes Scope 2 (indirect emissions from purchased energy) and Scope 3 (indirect emissions from supply chains, waste, or product use). Scope 1 emissions are more often highlighted since they are the easiest to measure and manage.

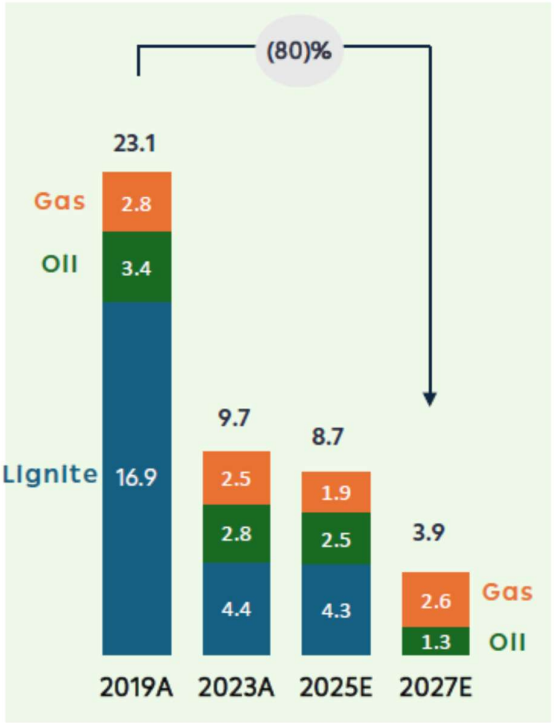

Figure 3 : CO_2 Emissions (tons) (source PPC)

Key highlights of PPC's RES expansion that enhances decarbonization include as shown at figure 4:

- A RES pipeline exceeding 20 GW, with 3.8 GW under construction or ready-to-build by 2024.
- Increased diversification of RES sources, with a focus on wind, solar and hydro projects
- Enhancing installed capacity in Greece, Romania, and other SEE markets through regional partnerships.

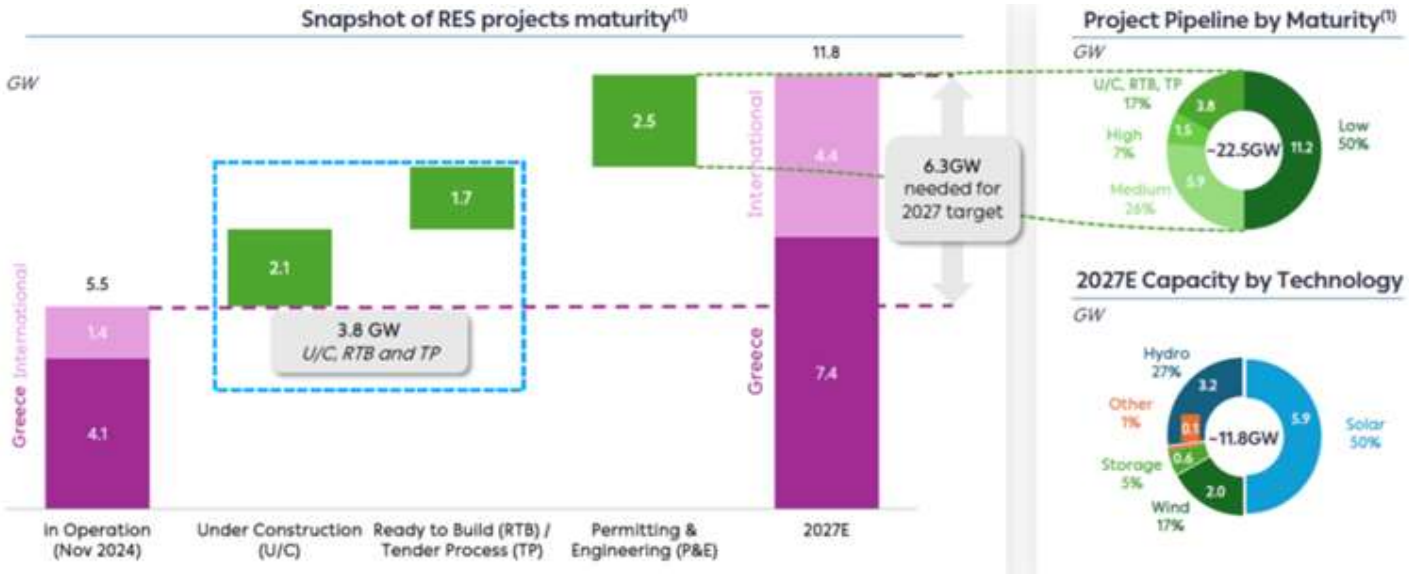

Figure 4 : PPC's RES Pipeline (source PPC)

It is remarkable, that the phase-out of lignite represents one of the most significant transformations in PPC's history and is comparable to transitions undertaken by global utilities such as Germany's RWE, which committed to exiting coal by 2030 (RWE, 2023), and the UK's Drax Group, which has transitioned its power stations to biomass (Drax Group, 2023).

PPC, RWE, and Drax Group each take its own paths to achieve energy transition that is led by their national policies and global climate regulations. PPC is phasing out lignite as part of Greece's decarbonization goals by expanding renewables. RWE plans to stop using coal by 2030 since Germany's Energiewende policy guides to support the EU's renewable energy targets. Drax, on the other hand, has already moved from coal to biomass, benefiting

from UK government subsidies but faces scrutiny over whether biomass is truly sustainable and how long subsidies should continue. While PPC and RWE are still transitioning away from fossil fuels, Drax's shift highlights the ongoing debate about what makes an energy source genuinely green. Together, these companies show the different challenges and strategies shaping Europe's clean energy future.

The above comparison highlight PPC's proactive stance in the energy transition landscape. This decision was driven by:

- **Environmental priorities**: the usage of lignite contributes to greenhouse gas emissions.
- **Financial considerations**: the cost of lignite-based power generation has increased dut to rising carbon prices under the Emissions Trading System (ETS).
- **Regulatory demands**: power generation with Lignite and generally with fossil fuels must be reduces according to the EU climate policies.

Additionally, the transition away from lignite faces several challenges, including:

A. **Economic Impact**: Lignite mining and Lignite power plants have historically been significant sources of employment particularly in regions like Western Macedonia the Municipality of Megalopolis in the Region of Peloponnese. No one can deny that the phase-out poses risks of job losses and economic downturns in these areas. Therefore, the closing of those facilities requires the adoption of the workforce to the new conditions. For this reason, PPC has introduced workforce retraining programs to help employees' transition to roles in the renewable energy sector. For example, training programs focused on solar panel installation and wind turbine maintenance have been launched in lignite-dependent regions facilitating the transition of the workforce into emerging energy industries (PPC, 2025). Also, beyond retraining, the Greek government established a Fair Transition Fund in 2018, financed by 6% of revenues from EU Emissions Trading System allowance auctions, amounting to approximately €20 million annually. This fund supports the diversification of local economies and job creation in lignite-dependent areas (IEA, 2023).

B. **Energy Security**: Traditionally, lignite plants have provided base-load power critical for grid stability. For this reason and in order to mitigate the risk of disturbing the grid stability, PPC is investing in flexible generation assets such as Combined Cycle Gas Turbines (CCGTs) and energy storage systems. The investments in CCGT power plants enhance to enhance Greece's energy efficiency and support the transition to cleaner energy sources because they offer a more efficient and lower-emission alternative to lignite (brown coal). CCGT are a part of PPC's energy transition strategy for the following reasons:

- They produce Lower Carbon Emissions Compared to Lignite: CCGT plants consume natural gas, which emits 50-60% less CO_2 compared to lignite .
- They are units of Higher Efficiency: CCGT technology uses both a gas turbine and a steam turbine, which increases efficiency.These plants achieve efficiency of 55-60%, compared to lignite plants, which typically operate at 35-40%.
- They provide Flexibility & Fast Response: energy sources (like solar and wind) require backup power for grid stability and CCGT plants ramp up and down quickly, making them ideal to support renewables when solar or wind output drops suddenly.
- They Support Energy Security: can be used as baseload power and provides reliable power generation while reducing dependence on imported coal.
- Are in alignment with EU & Government Policy Alignment: The EU Green Deal and Greek decarbonization plans encourage transitioning to lower-carbon energy sources. Natural Gas is considered a "transition fuel" until energy storage and renewables can fully replace fossil fuels.

Some relevant projects of PPC are:

1. Komotini CCGT Power Plan of 665 MW capacity. Construction commenced in 2021, with an commercial operation date starting in December 2024 (Power Technology, 2024).
2. Alexandroupolis CCGT Power Plant of 540 MW. Construction began in February 2023, with an anticipated start of production by the end of 2025. (NS Energy, 2023).

Also, as mentioned before, PPC is expanding in energy storage solutios to enhance grid stability and support the integration of renewable energy sources.. This can be either hydropower projects or battery storage solutions. Two characteristic examples of such projects are:

- South Field Mine Project is a pumped storage hydropower facility at the South Field Mine in Kozani, northern Greece. The proposed facility will have a generation capacity of 227 MW (Balkan Green Energy News, 2024)
- In a bidding process by the Regulatory Authority for Waste, Energy, and Water (RAAEW), PPC Renewables secured investment grants and operating aid for two battery energy storage projects. These projects have capacities of 50 MW/100 MWh and 48 MW/96 MWh, respectively and both storage stations will be constructed in Western Macedonia, and in areas where PPC Renewables' photovoltaic parks are under construction. The construction is expected to take place in 2024 with the aim of being into operation in 2025 (PPC, 2023).

C. **Community Resistance**: no one can neglect that there are also socio-economic challenges for communities that were historically dependent on mining and power generation from lignite, particularly in regions like Western Macedonia and Megalopolis. To mitigate the negative impacts, PPC is committed to the "Just Transition Development" initiative, which includes the following key strategies:

- **Funding Local Infrastructure Projects**: is applied to the affected areas and includes improvements to road and railway networks, district heating infrastructure to the habitants, and high-speed broadband. Such projects aim to enhance connectivity and support new economic activities in these regions (SDAM, 2020).
- **Offering Subsidies for Small Businesses**: To stimulate economic diversification and job creation, PPC provides financial incentives to small and medium-sized enterprises (SMEs). These subsidies are designed to encourage entrepreneurship and support businesses in sectors such as clean energy, industry, smart agriculture, and technology (SDAM, 2020).
- **Creating Eco-Tourism Opportunities on Redeveloped Lignite Sites**: includes the transformation of former mining areas into sites for eco-tourism. This

involves land restoration and the development of sustainable tourism activities, aiming to attract visitors and generate alternative income streams for local communities (SDAM, 2020).

3.2 Exploration of PPC's investments in digital infrastructure and their role in energy efficiency.

PPC's digital transformation is divided mainly on three core branches: technology, which modernizes infrastructure; skills development, which enhances workforce capabilities; and process optimization, which improves operational efficiency. These pillars form the foundation of PPC's digital roadmap, positioning the company as a leader in energy transition and digital innovation. PPC's Chief Strategy Officer, Ms Giannakopoulou Elena, in an interview with Enlit, highlighted the company's ambitious digital transformation plan as a "small Greek miracle" , a definission given firstly from the Greek prime minister to emphasize that PPC is strategically leveraging cutting-edge digital infrastructure to streamline operations, integrate renewables, and strengthen its market presence in Southeast Europe (Enlit, 2024). Additionally, Mr. Nasos Athanasoulas, Head of Digital Strategy and Innovation at PPC, highlighted this transformation, since it is consider to be one of the greatest and europe and outlined the eight guiding principles behind PPC's digital transformation (Economistas, 2024) which are:

i. Digital First – Prioritizing digital solutions across all operations.
ii. End-to-End Automation – Ensuring complete automation of internal processes and customer services.
iii. Agility – Applying best practices to enhance flexibility in the organization.
iv. Customer Centricity – Placing customer needs at the forefront through digital solutions.
v. Data-Driven Decision Making – contains data analytics to optimize internal and customer-facing processes.
vi. Online Presence – Strengthening PPC's digital footprint and online interactions.
vii. Innovative Methodologies – Promoting a culture of innovation through new digital technologies.

viii. Sustainability – Adopting digital solutions that have a positive environmental and social impact.

Additionally, Accenture noted the success story behind this transformation, explaining the progress by analyzing the Digital Performance Index (DPI) that was introduced to guide and measure the company's digitalization efforts. In the first year, PPC's DPI increased by 37%, with an additional 15% growth from 2022 to 2023 as projects with over €9 billion in investments entered more complex phases (Netweek, 2024).

To maintain this momentum, PPC's IT department shifted from a support role to becoming the central driver of the company's digital transformation. Collaborating with Accenture, PPC focused on three key areas:

i. **Cloud Development**: Migrated 170 applications to the cloud, leading to the closure of two physical data centers.
ii. **Central Data Warehouse**: Established a new central repository housing 140 terabytes of data, analyzed through 750 different PowerBI reports.
iii. **Security**: Enhanced security measures, now handling 25,000 security incidents and 360,000 suspicious emails annually.

At this section, the key initiatives undertaken by PPC will be explored , including smart grids, cloud computing, artificial intelligence (AI)-driven analytics, data centers, and cybersecurity measures, as well as digital platforms for customers and e-mobility.

Smart Grid Implementation

A crucial aspect of PPC's digital infrastructure projects is the implementation of smart grids which are actually advanced networks that leverage digital communication and automation to enhance energy distribution reliability and efficiency. The usage Advanced Metering Infrastructure (AMI), enables real-time monitoring of energy consumption and facilitates the incorporation of renewable energy sources into the grid. As a mater of fact, the Advanced Metering Infrastructure (AMI) provides a two-way communication between the utility and its customers while smart meters provide detailed insights into energy consumption, allowing consumers to manage usage effectively and PPC to optimize energy distribution. For all those investments, PPC was probided funding by The European Investment Bank

(EIB) of 330 million €. This financing will support the expansion and modernization of thousands of kilometers of power distribution lines and the deployment of smart meters all over Greece. The Greek Minister of Environment and Energy, Kostas Skrekas, emphasized that those investments are a decisive step in PPC's green transition since the closure of lignite plants is supported and renewable energy penetration will be increased. Additionally, According to PPC's CEO, Georgios Stassis, this financing strengthens the company's role in Greece's energy transformation towards green energy. Furthermore, HEDNO's CEO Anastasios Manos, also highlighted that such investments would further improve electricity services across Greece. In addition, this financing will enable the construction of 6,600 km of new power lines and the upgrade of 7,600 km of existing infrastructure, increasing network reliability and expanding wind and solar power integration into the national grid. This builds on the EIB's 57-year partnership with PPC, during which it has provided over €4.3 billion for energy investments, including renewables, interconnectors, and energy efficiency projects (European Ivestment Bank, 2021).

Data Center Development

As part of its digital infrastructure expansion, PPC has invested in cloud-based platforms that facilitate efficient energy management and data-driven decision-making. A major milestone in this initiative is the establishment of a high-capacity data center in Spata, East Attica, in collaboration with EDGNEX Data Centers by DAMAC. This initiative led to the creation of Data In Scale SA, a joint venture (DAMAC 55% - PPC 45%) aimed at developing a state-of-the-art digital infrastructure in Greece. The first phase of the project involves an investment of EUR 150 million to develop a 12.5MW data center, with plans to expand to 25MW in subsequent phases.

The facility is expected to become a key digital hub between Europe, Asia, and Africa and it provides for Greece an opportunity to become a leader in IT capacity in Southeastern Europe. The project is currently in the design and licensing stage, and its construction is expected to commence in the first 4 months of 2025 while the completion of the first phase is expected to be completed within two years. The collaboration between DAMAC's expertise in real estate and PPC's leadership in clean energy ensures the project's successful delivery.

The data center aligns with PPC's broader digital transformation strategy, complementing its Fiber-to-the-Home (FTTH) initiative via FiberGrid, participation in the East-to-Med Data Corridor, and the Olympus AI project, which focuses on AI-driven energy management. Through these ventures, PPC is integrating its energy expertise with cutting-edge digital infrastructure to drive economic growth and position itself as a leader in Southeast Europe's digital and energy transformation (PPC, 2024)

Predictive Maintenance - Asset Management and Artificial Intelligence

PPC aims to adopt predictive maintenance schedules through IoT sensors (Internet of Things) and AI-based analytics that allow real-time monitoring of critical infrastructure (power generators for instance). The definition of IoT refers to a network of devices that are interconnected and embedded with sensors, software, and communication technologies and they enable data collection and exchange.

In addition, predictive maintenance is a proactive approach that uses data analysis and artificial intelligence algoritmhs to predict equipment failures before they occur. By analyzing data collected from machinery such as sensor readings, operational history, and various other parameter such as environmental conditions (continuous heat in the summer for instance) AI algorithms can identify patterns and forecast when a part of equipment is likely to show a malfunction (ppcrao, 2024).

Incorporating AI into predictive maintenance offers several benefits such as:

- **Cost Reduction**: AI-based predictive maintenance can cut maintenance expenses by 20% and unscheduled breakdowns by half (Kanerika, 2024).
- **Improved Efficiency**: By continuously monitoring equipment conditions, AI algorithms can detect subtle deviations from normal operation, indicative of potential issues, thereby preventing costly downtime (Electropages, 2024).

Additionally, the implimenetation of AI-driven predictive maintenance involves several key components such as Data Collection and Processing, decision making models, communication and integration between systems and stakeholders and finaly, the interfaces for users. By leveraging AI in predictive maintenance, organizations can transition from reactive to proactive maintenance strategies, leading to increased equipment reliability, optimized maintenance schedules, and significant cost savings (Ucar et al. 2024).

Digital Platforms for Customer Engagement

It is an omni-channel digital transformation that includes the redesign and redevelopment of its public website (www.dei.gr), its official mobile application, and various self-service transactional portals, such as e-bill, e-procurement, and e-appointment. The goal of this initiative is to provide state-of-the-art customer experiences and innovative digital services that align with PPC's evolving corporate identity and commitment to technological advancement. A key component of this strategy is the development of user-friendly digital platforms that offer personalized services and tools for energy management (such as 'myEnergyCoach') . The redesigned public website, for instance, emphasizes a human-centric, goal-focused customer experience. PPC knows that competition in the energy industry is fierce, with power companies providing competitive pricing strategies and self-care services through digital channels. Therefore, this transformation was needed since customers today are knowledgeable, digitally savvy, and demand innovative energy solutions that are cost-effective and environmentally sustainable (Linakis.digital, 2024).

E-mobility

Since 2020, e-mobility has become a core business activity for PPC because the trend for using electric cars is becoming more and more popular and the goal for PPC is to become the leading player in Greece's e-mobility market. For this reason, the company is investing in the largest and most geographically extensive network of publicly accessible EV chargers. Also, PPC promots and expansion of e-mobility through strategic partnerships with supermarket chains, shopping centers, service providers, and airports. These collaborations aim to accelerate the development of Greece's e-mobility network by increasing the availability of EV charging infrastructure and supporting the country's sustainability in transportations.

In July 2021, PPC introduced DEI Blue, its e-mobility brand, designed to offer integrated infrastructure and charging solutions across Greece. The DEI Blue network has since become the fastest-growing charging network in the country, with more than 1,700 accessible charging points already installed and there is a target to increase the DEI Blue network significantly, committing to installing 10,000 chargers over the next 4 to 5 years at key locations all over the country.

To further enhance the environmental benefits of e-mobility, DEI Blue through PPC's GreenPass certification,ensures that electricity supplied to DEI Blue chargers is sourced from 100% green energy, reinforcing the company's commitment to sustainable and clean mobility solutions.

By investing in cutting-edge EV infrastructure and ensuring green energy sourcing, PPC's DEI Blue is playing a pivotal role in shaping the future of e-mobility in Greece, making electric transportation more accessible, efficient, and environmentally friendly (PPC Group, 2024).

3.3 Study of PPC's regional expansion into Southeast Europe.

This section focuses on the expansion of PPC in Southeast Europe (SEE) and mainly in Romania, Bulgaria, and Italy. The target of the expansion is to diversify the company's revenue streams and reduce any possible dependency only on the domestic market. Also, PPC takes advantage of the growing energy demand, as well as of the opportunities created by European Union energy integration and green transition goals.

PPC's regional expansion strategy revolves around two main pillars:

A. Investments in Renewable Energy: acquisition and further delopment of solar, wind, and hydro assets to broaden its RES portfolio.

B. Electricity Distribution and Supply Growth: strong presence in the retail and distribution sectors.

PPC expands to countries with existing assets because:

- South Eastern Europe is an increasingly interconnected market with high power prices and RES investment Plans
- There are many opportunities to become the leading player in generation, sypply and distribution in countries with existing footpring.
- There is also a regional stategy in renewables/ power across attractive markets with unique and favorable characteristics.

Additionally, the company expands to other countries and creates new assets since:

- In those countrys the power prices are higher compared to other markets in SEE region.
- There is an increasing governemt focus on decarbonization and shift to RES
- Entering a newly developing renewable energy market with a strong portfolio of projects that have high electricity generation potential compared to other similar devepoments.

The following map shows the regions of PPC'S expansion to SEE.

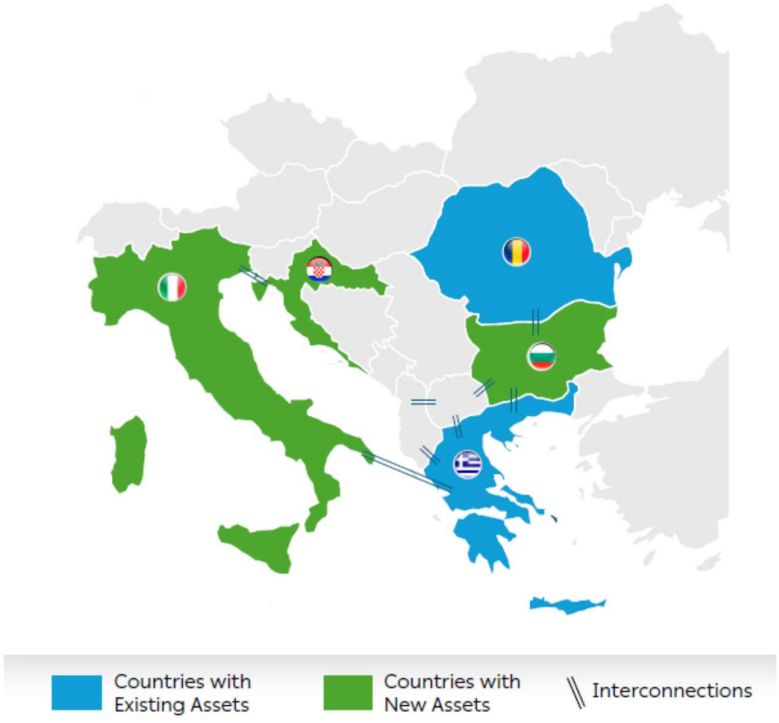

Figure 5 : Progress in PPC's Regional Strategy (Source PPC).

Bellow are analyzed the key investments of PPC'S expansion.

PPC has successfully completed the acquisition of Enel's operations in Romania on March 2023 and it's the company's first step for major international expansion. This acquisition actually represents a milestone in PPC's growth strategy, as it secures a significant portfolio of renewable energy assets (both operational projects and those under development), as well as distribution and supply activities. Besides, Enel holds a leading market position in Romania and PPC has acquired 100% of Enel's shares and subsidiaries after fulfilling

certain conditions precedent, which are typical in such transactions. Under this agreement, PPC paid a total amount of approximately €1.24 billion, corresponding to a total enterprise value of approximately €1.9 billion (for 100%).

With the completion of this acquisition, PPC Group serves nearly 9 million customers across Greece and Romania (PPC operates 134,000 km of electricity distribution lines in Romania, servicing 3.2 million customers locally), and its total installed renewable energy capacity (including hydro, wind, and solar projects) increased to approximately 4.4GW. Additionally, the Regulated Asset Base (RAB) for distribution expands by 40%. Moreover, all electricity generation from Enel's assets in Romania comes from renewable sources, significantly boosting PPC's green EBITDA percentage (PPC Group, 2023).

After acquiring Enel's assets in Romania, PPC has solidified its presence in Romania as a key pillar of its operations. Along with the 1.5 GW of wind and solar power plants currently under construction or planned, the utility is also looking to develop two or three gas peaker plants with a combined capacity of 300 MW. These gas plants would be designed to quickly ramp up production during peak electricity demand periods and price surges in Romania. PPC is also counting on the North-South electricity corridor through Bulgaria to enhance its regional flexibility. This infrastructure would allow the gas peaker plants to supply power to Greece when needed. With the planned upgrades to existing lines and new connections, a high-capacity Balkan corridor is expected to be operational within the next few years. (Balkan Green Energy News, 2024).

On August 2024, PPC has announced a another very importatnt move for expanding its renewable energy footprint. The company signed a binding agreement with Evryo Group, which is owned by funds managed by Macquarie Asset Management. Through this deal, PPC will acquire Evryo Group's renewable energy portfolio in Romania, which includes a ragne of 629MW of operational assets and an additional 145MW in development.

The agreement is valued at approximately €700 million and no an can deny that this acquisition is a significant step forward in PPC's growth strategy for Romania and Southeast Europe, since it doubles the company's renewable energy capacity in Romania. The newly acquired portfolio includes 600MW of onshore wind farms, 22MW of hydroelectric plants, 6MW of battery energy storage systems (BESS), 1MW of solar PV, and pipeline projects totaling 145MW.

With this expansion, the total renewable energy capacity in operation of PPC will grow to 5.3GW. Once completed, this acquisition is expected to contribute approximately €100 million in annual EBITDA, reinforcing PPC's position as a leading renewable energy player in the region.

As a matter of fact, PPC is currently the first energy supplier in Romania and the second operator, as shown at the following figure presented from PPC at the company's strategic plan 2025-2027 on 14th of November 2024.

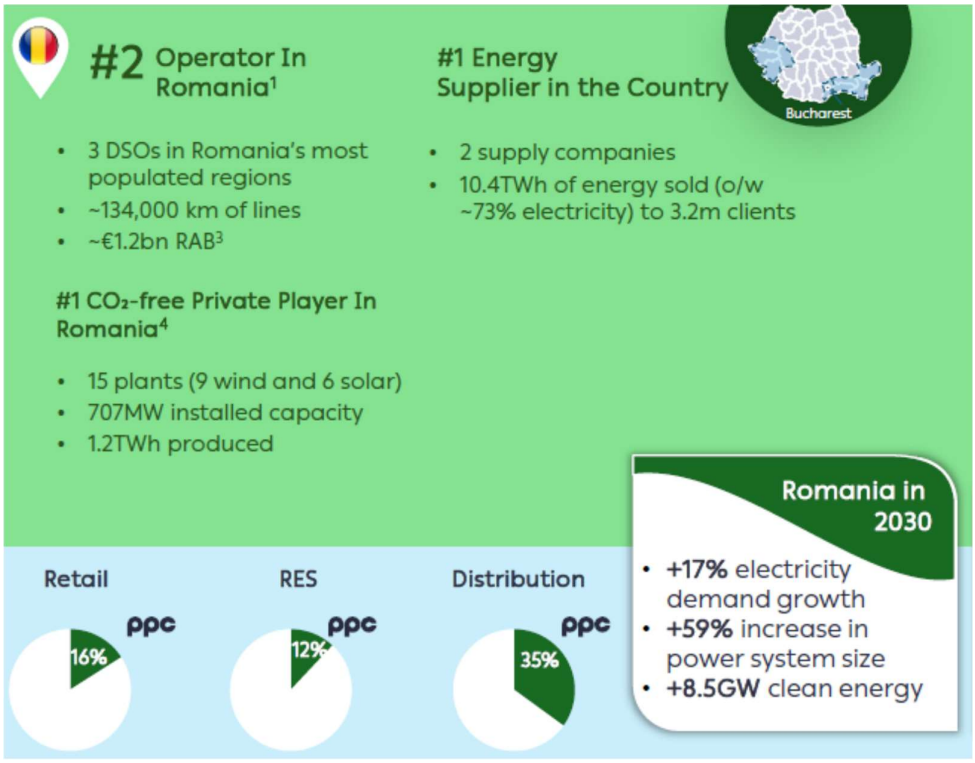

Figure 6 : The position of PPC as leading SEE Utility (Source PPC).

The asset portfolio all over Romania, as well as the installes capacity in the generation mix of the first 9 monthes of 2024 are shown at the following Figures.

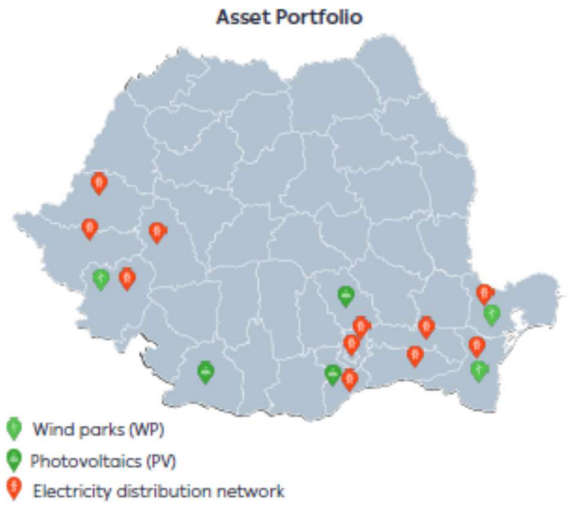

Figure 7 : PPC'S Asset Portfolio (Romania) (Source PPC).

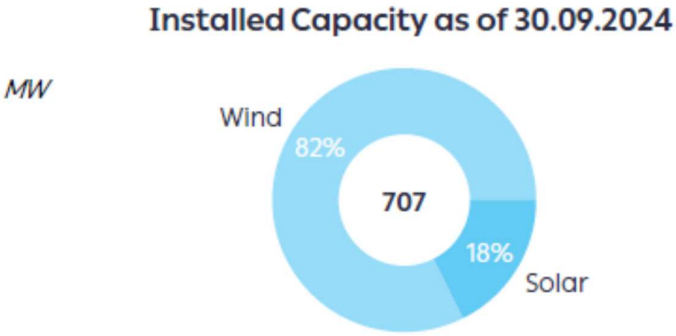

Figure 8 : Installed Capavity in Romania (Source PPC).

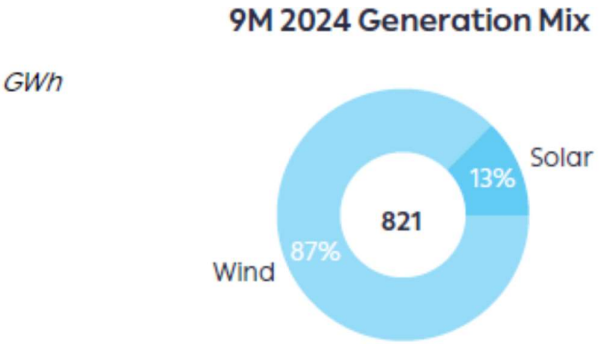

Figure 9 : 9M 2024 Generation mix in Romania (Source PPC).

Currently, PPC is still increasing its portfolio in Romania by installing more RES Projects that are in progress of installation such a solar park of 210 MW capacity in Souh Romania and Wind turbines of 140 MW in North Romania.

Figure 10 : RES projects under constuction in Romania (Source PPC).

Also, the expansion of PPC does not end in Romania. The company also operates in other countries of SE, such as Italy, Boulgaria and Croatia.

Italy

In 2025, PPC Group has officially entered the Italian renewable energy sector with the launch of two photovoltaic plants, Carcarello (20 MW) and Luxenia (12 MW), which are located in central Italy. Those PV plants, are expected to produce over 60 GWh of clean energy annually, enough quantity to supply nearly 15,000 households, and to prevent approximately 37,200 tonnes of CO_2 emissions.

PPC Group's Deputy CEO for Renewable Energy Sources, Mr. Konstantinos Mavros, emphasized the company's strategic expansion into Italy, stating:

"PPC Group's entry into the Italian energy market is a clear testament to our commitment to become a key energy pillar in Southeastern Europe. The launch of these two photovoltaic plants marks is just the beginning. Our strategic plan includes the continuous completion of projects until 2027. By expanding our green portfolio with geographic and technological diversification, we aim to maximize the benefits of the green transition and the interconnected energy market."

The Carcarello and Luxenia PV plants are part of a broader collaboration with Metlen Energy & Metals, focusing on renewable energy developments across four Southeastern European countries (PPC Group, 2024).

Bulgaria and Croatia

Beyond Romania and Italy, Bulgaria and Croatia are potential growth markets. In April 2024, PPC signed a Cooperation Framework Agreement with MYTILINEOS Energy & Metals to develop and construct a portfolio of solar projects of 2,000 MW across Italy, Bulgaria, Croatia, and Romania. This agreement contains approximately 90 solar projects at various stages of development, with a clear implementation within the next three years. Under this agreement, MYTILINEOS will handle the development and construction of these projects and PPC will acquire them after their completion and connection to the electricity grid (Metlen, 2024). Through this partnership, PPC will expand its renewable energy portfolio beyond Romania.

4. Strategic decisions in Financial Planning and Risk Management

4.1 Financial strategies to support investments in RES.

PPC has implemented a series of financial strategies to support its investments in Renewable Energy Sources (RES), aligning with its broader goal of transitioning to a greener energy portfolio. Below are presented the key financial strategies and mechanisms utilized by PPC which are:

A. Massive Capital Expenditure (Capex) Allocation

PPC has committed to an investment plan of approximately €9 billion for the period 2024-2026 and €10.1 billion for 2025-2027, with more than 50% dedicated to RES projects, and that reflects one of the largest energy transition commitments in Southeast Europe. This plan primarily also focuses on infrastructure modernization, and flexible generation.

The following table shows the breakdown of Capex expenditures with the relevamt strategic importance.

Table 2 : Capex expenditures with the relevant strategic importance

Investment Area	% of Total Capex (2025-2027)	Strategic Importance
Renewables (RES)	51%	Dominates PPC's investment focus, ensuring long-term sustainability and reducing CO_2 exposure.
Grid & Distribution	27%	Essential for RES integration, grid stability, and smart energy solutions.
Flexible Generation	9%	Supports grid reliability amid fluctuating renewable supply.
Telecom & Digitalization	13%	Enhances efficiency, cybersecurity, and digital energy service

This capital investment supports both organic growth and strategic acquisitions in Greece and internationally (PPC Strategic Plan 2025-2027). PPC's Capex strategy prioritizes renewable expansion and digitalization, reinforcing its transition from a traditional fossil fuel-based model to a tech-driven, low-carbon energy leader**.**

B. Funding Mix: Leveraging Internal and External Resources

PPC has multiple funding sources to support RES investments, including:

- **Free Cash Flow Generation** (FCF): PPC expects €7 billion in operational cash flows over 2025-2027 covering ~70% of its Capex needs.

  Some cash flow optimization strategies are:

  - The Increased profitability from higher EBITDA (targeted at €2.7 billion by 2027).
  - The Expansion in Romania, where 22% of EBITDA is now generated, improving cash reserves.
  - The Coal phase-out target by 2026 which reduces CO_2-related costs, improving operational margins.

- **Leverage and Debt Managment**: PPC uses corporate bonds, syndicated loans, and supranational funding (e.g., EU Recovery and Resilience Facility, EIB loans, and international commercial banks) and carefully manages leverage to avoid excessive debt while maintaining sufficient liquidity for growth. The Net Debt/EBITDA ratio Maintained below 3.5, despite aggressive investments, while in 2023 it was 2.0, in 2024 was 2.3 and the target for 2027 is to be ≤ 3.

  PPC's Net Debt/EBITDA ratio is a key indicator of financial stability, ensuring that its high RES investments do not compromise debt sustainability. In General this ratio indicates:

  i. Leverage & Debt Burden

  - Shows how many years it would take for PPC to repay its debt if EBITDA remains constant.
  - A higher ratio (>3.5) suggests a company is highly leveraged (riskier for lenders).
  - A lower ratio (<2.5) indicates a healthier balance sheet and greater financial stability.

  ii. Financial Health & Liquidity

- A low ratio (<3.0) means PPC has strong cash flow generation, making it easier to finance new projects and cover obligations.
- A high ratio (>4.0) signals potential financial distress and could lead to higher borrowing costs.

It is critican for PPC'S strategy because:

- It Ensures debt remains at sustainable levels, supporting future investments.
- Keeps borrowing costs lower, attracting cheaper financing (e.g., Green Bonds, EIB Loans).
- Protects against energy market volatility, ensuring financial flexibility.
- Maintains investor confidence, signaling PPC's ability to manage its debt responsibly.

Debt Financing: Green Bonds & Supranational Loans

PPC strategically leverages Green Bonds, European Investment Bank (EIB) loans, and syndicated commercial loans to fund its renewable energy (RES) expansion policy while maintaining financial stability and leverage control**.**

Given PPC's €10.1 billion Capex plan (2025-2027) focused on renewables and smart grid investments, securing cost-effective and sustainable financing is critical.

The choice of Green Bonds and EIB Loans aligns with:

- Lower borrowing costs vs. traditional debt instruments
- Sustainability-linked targets, enhancing PPC's ESG profile
- Flexible repayment terms, improving financial stability

The capital allocation from Green Bonds & EIB Loans is shown at the following table.

Table 3 : Capital allocation from Green Bonds & EIB Loans

Financing Source	Amount (€)	Primary Use
Green Bonds	€500 million	RES expansion, grid modernization
European Investment Bank	€35 million	Renewable project funding
Syndicated Bank Loans	Multi-year facility	Liquidity management

The key features of PPC's **Green Bonds** are:

- Such Bonds are tied to CO_2 Reduction Targets. PPC must achieve specific emissions reduction goals (e.g., -74% CO_2 intensity by 2030) and a possible failure to meet these targets could result in higher interest payments (step-up penalties).
- They provide lower Interest Rates than Conventional Bonds. Investors accept a lower yield in exchange for environmental impact guarantees.
- The have strong Institutional Demand. Institutional investors, pension funds, and sovereign wealth funds favor Green Bonds due to ESG mandates. PPC's issuance was oversubscribed, reflecting high confidence from global capital markets.

And the benefis from such bonds are:

- Cost-Effective Financing – Lower interest rates reduce overall borrowing costs.
- Stronger ESG Profile – Enhances PPC's sustainability reputation, attracting more investors.
- Long-Term Stability – Extended maturities match PPC's long-term investment plans.
- Regulatory Compliance – Aligns with EU's Sustainable Finance Taxonomy, ensuring access to future funding.

Also, PPC has received fundings from the European Investment Bank (EIB). EIB provides low-interest, long-term loans to projects that align with Europe's climate and infrastructure goals. Therefore, PPC secured €35 million in EIB loans for its renewable energy expansion and benefits from:

- Lower Interest Rates – EIB loans come at below-market interest rates, reducing debt servicing costs.
- Flexible Repayment Terms – Loan terms are longer and more adaptable than private market financing.
- EU Institutional Support that strengthens PPC's ability to access future EU grants and funding.
- De-Risking RES Investments – EIB's backing provides financial security for large-scale RES projects.

Additionally, another source of funding for PPC are Syndicated Bank loans. Syndicated loans involve multiple banks pooling funds to provide financing to PPC. These multi-year credit facilities help PPC manage short-term liquidity needs**.** PPC uses Syndicated Loans for:

- Working Capital Needs that cover day-to-day cash flow fluctuations.
- Short-Term Debt Refinancing that helps PPC manage bond repayments and interest obligations.
- Bridge Financing for RES Projects, It funds new projects until long-term financing is secured.

C. Capital Markets & Equity Strategy

PPC's capital markets strategy is needed for balancing capital expenditure (Capex), shareholder returns, and financial stability. Capex is balanced with shareholder returns, having as a target a 35%-55% payout ratio from 2024 onwards. A sustainable dividend policy has to be maintained while avoiding excessive equity dilution and any reliance on organic cash flow and strategic debt instruments as fundings to the €10.1 billion investment plan (2025-2027) of the company.

A strong dividend policy is essential for attracting and retaining investors. PPC targets a 35%-55% payout ratio from 2024 onwards, ensuring that shareholders benefit from earnings growth while maintaining sufficient retained earnings for investment needs.

At the following table is presented PPC's dividend strategy compared to European Utilities.

Table 4 : PPC's dividend strategy compared to European Utilities

Company	Dividend Payout Ratio (%)	Dividend Yield (%)	Equity Dilution Risk
PPC (Greece)	35%-55% (2024 Target)	2.5%-4.0% (est.)	Low (organic funding focus)
Enel (Italy)	65%-70%	5.2%	Moderate
RWE (Germany)	40%-60%	3.8%	Low
EDF (France)	55%-70%	4.5%	High (Government-backed capital injections)

Generally, a Lower Payout Ratio (<35%) signals focus on reinvestment in growth (e.g., RES & grid modernization) and a Higher Payout Ratio (>55%) indicates greater shareholder returns but could limit internal financing for Capex.

By comparing data from the table above, we observe that PPC's payout ratio is more conservative than Enel and EDF, ensuring financial flexibility. Also, it seems that the company avoids excessive payouts that coud jeopardize investment capacity for RES expansion and shows that its sustainable approach aligns with investor expectations for stable growth.

PPC's financial strategies for supporting RES investments are comprehensive and well-structured, combining substantial capital commitments, diversified funding sources, vertical integration, international expansion, and operational efficiency improvements. These strategies ensure high returns, financial sustainability, and alignment with decarbonization goals.

4.2 Analysis of how PPC balances capital expenditure with financial stability and leverage

PPC's investment strategy is aligned with the targets of the company to increase RES, to modernize infrastructure, and to enhance its operational efficiency. Key components of its Capex strategy include as discussed before:

- **RES:** PPC targets to increase its installed renewable capacity up to 8.9GW by 2026. This requires investments in solar, wind, and hydroelectric power .
- **Grid Modernization:** Significant resources are allocated towards upgrading transmission and distribution networks, integrating smart metering, and thus reinforcing grid stability.
- **International Expansion:** PPC's recent expansion into Romania has resulted in additional Capex requirements.
- **Digital Transformation:** PPC invests in digital infrastructure to improve operational efficiency.

Therefore, managing high capital expenditures (Capex) alongside a strong balance sheet and controlled leverage is critical to its sustainability and at this section will be examined the

way how PPC strategically balances investments, funding sources, debt management, and financial stability, ensuring long-term growth without compromising solvency.

Despite significant Capex, PPC ensures financial stability through:

- **Prudent Debt Management:** PPC maintains a self-imposed leverage ceiling of 3.5 Net Debt/EBITDA, ensuring sustainable borrowing (PPC, 2024). This threshold allows PPC to effectively manage its financial obligations while pursuing its capital-intensive projects. By keeping leverage within a controlled range, PPC aligns itself with industry best practices, similar to European counterparts like RWE and Enel, which maintain Net Debt/EBITDA ratios below 3.5 (RWE, 2024, Enel, 2024). Furthermore, the debt of PPC is structurally banalced with with both fixed and floating interest rates fact that protects from market volatility and ensures long-term financial resilience.
- **Liquidity Management:** PPC has a strong liquidity position through through effective treasury management, optimization of working capital cycles, and a well-structured debt maturity profile (EDF, 2024). The company utilizes short-term credit facilities and revolves credit lines to meet operational requirements while strategically manages bond issuances and loan repayments to prevent liquidity constraints. Additionally, PPC conducts stress testing and scenario planning to evaluate liquidity risks under different economic conditions.
- **Cost Control Measures:** PPC employs strategic cost management initiatives to boost profitability and ensure long-term financial stability (ING, 2024). A part of those actions is the optimization of procurement proces which is essential for expense management, providing cost-efficient sourcing of materials and services through supplier contracts and bulk purchasing agreements. Additionally, asset optimization is also a component of PPC's financial strategy and involvs liquidization of non-core assets, the modernization of outdated infrastructure, and the repurposing of existing facilities to improve asset utilization and operational effectiveness. Such efforts collectively allow PPC to channel more resources into high-yield investments while maintaining strong financial discipline.
- **Dividend Policy:** PPC balances Capex with shareholder returns, targeting a payout ratio of 35%-55% from 2024 onwards (PPC, 2024). The company carefully

evaluates its dividend payments based on profitability, free cash flow generation, and capital investment needs. Unlike heavily leveraged utilities such as EDF, which have historically had higher payout ratios but also greater debt burdens, PPC takes a more conservative approach, ensuring that dividends do not compromise long-term financial stability (EDF, 2024). Furthermore, PPC follows a flexible dividend strategy that adjusts to market conditions, allowing it to reinvest in growth opportunities while maintaining investor confidence. By linking its dividend policy to operational performance and strategic goals, PPC maintains a sustainable equilibrium between delivering shareholder value and financing its renewable energy and infrastructure growth initiatives.

To reinforce PPC's financial discipline and its capability to balance capital expenditures with financial stability, key financial ratios are analyzed and compared with those of leading European energy companies:

Table 5 : Financial ratios with comparison with other EU Companies

Company	Net Debt/EBITDA	Debt-to-Equity (D/E)	Interest Coverage	ROIC	FCF to Debt
PPC (Greece)	≤3.5	0.9 - 1.2	>4.0	7%-9%	30%-40%
Enel (Italy)	2.8	1.1	5.2	6.5%-8%	35%
RWE (Germany)	3.0	1.0	4.8	8%-10%	40%
EDF (France)	4.2	1.3	3.5	5%-7%	25%

From the data at the table above, it is clear that PPC aligns well with other major European utilities, showcasing strong financial discipline and sustains competitive investment levels. The financial health of PPC can be assesed with to the following ratios:

- Net Debt/EBITDA Ratio: measures the ability of a company to repay its debt using its EBITDA. This ratio for PPC is calculated below 3.5 and is similar to Enel and RWE and signals a strong debt management policy. In general, a lower ratio indicates a healthier debt position and less financial strain.

- Debt-to-Equity (D/E) Ratio: measures the financial leverage with the comparison of total debt to shareholders' equity. D/E ratio for PPC remains within a safe range (0.9 - 1.2). It indicates that the company maintains for financing a bananced mix of debt and equity. This balance allows the company to deal with debt effectively without increasing any financial risk, which is particularly important in capital-intensive industries like utilities.
- Interest Coverage Ratio (ICR): evaluates a company's ability to cover interest expenses with its earnings before interest and taxes (EBIT). Interest Coverage Ratio for PPC exceeds 4.0 and suggests that PPC generates at least four times the earnings needed to cover its interest expenses.
- Return on Invested Capital (ROIC): ROIC measures how effectively a company generates returns from its invested capital. PPC's ROIC is competitive (7%-9%) compared to the other utilities, showing effective capital allocation and investment efficiency.
- Free Cash Flow (FCF) to Debt Ratio: This ratio indicates the quantity of cash flow that is available to cover outstanding debt. PPC's FCF to Debt ratio of 30%-40% supports liquidity management, placing PPC in a strong position relative to the other utilities.

Also PPC has specific criteria referring a project, which are outlined by rgw Internal Rate of Return (IRR), particularly in the Renewable Energy Sources (RES) sector. IRR is a critical financial metric that is used to evaluate the profitability of an investment. project. A higher IRR indicates that a project is expected to generate significant returns relative to its costs.

According to PPC's August 2024 Corporate Presentation, the company anticipates an average unlevered IRR of approximately 8.7% for its RES projects. Furthermore, PPC's vertical integration model is expected to enhance returns by an additional 4-5% that potentially brings the total IRR to around 11-14%. What is more, in the context of international expansion, PPC's recent acquisition of renewable energy assets in Romania is projected to yield an IRR of approximately 10% (To Vima newspaper, 2024). These IRR figures indicate that PPC's focuses on investments that not only align with its sustainability

goals but also offer returns exceeding its capital costs, thereby contributing to the company's financial stability and growth objectives.

PPC effectively balances capital-intensive investments in RES with strict financial discipline and leverage management. The strategy ensures:

- Strong cash flow generation (~€7bn over 2025-2027) to fund over 70% of Capex.
- Leverage control (Net Debt/EBITDA ≤3.0x) to maintain an investment-grade profile.
- Strategic debt financing (green bonds, EIB loans) to optimize borrowing costs.
- Prioritized Capex allocation with phased execution for maximum return on investment.
- Revenue diversification from international expansion (Romania, Italy, Bulgaria, Croatia, etc.).

PPC's financial strategy secures long-term profitability, sustainability, and investor confidence, positioning it as a leader in Europe's energy transition.

4.3 Risk management strategies in navigating volatile energy markets

The energy market is influenced by unpredictable factors like for instance fuel price fluctuations, changes in regulatory policies, geopolitical tensions, growing environmental concerns and therefore, it is a constantly changing environment. For companies like PPC, the requirement to follow successfully such challenges is to recognize potential risks early with the establishment of proactive strategy to manage them effectively.

Market Risk

PPC faces risks from price fluctuations in natural gas, oil, and CO_2 emission allowances and all of them are traded in global energy markets. On top of that, electricity prices can changes due to the law of supply and demand. Therefore, any changes in prices or availability can impact the company's operations and financial health. To minimize such risks, PPC employs several strategies such as:

- **Hedging Mechanisms:** PPC uses financial derivatives to reduce the impact of market fluctuations such as:

  A. **Future Contracts** that are agreements to buy or sell electricity, natural gas, or other commodities at a predetermined price for a forthcoming date. For this reason PPC locks prices for fuel and electricity purchases to avoid sudden cost increases. For example, securing a natural gas supply at a fixed price for six months prevents unexpected price surges from affecting operating costs. The benefit of predictable pricing is that provides a more stable financial planning.

  B. **Options Contracts** that contain the right (but not the obligation) to buy or sell energy resources at a specific price before a certain date. This avoids commitments to fixed purchases and allows purchases at favorable rates while avoiding exposure to adverse price movements. The result is flexibility in purchasing decisions and gives PPC the opportunity to capitalize on lower prices when available.

  C. **Swaps and Interest Rate Hedging** that allow PPC to exchange variable interest rate payments for fixed-rate payments, reducing exposure to interest rate volatility. Since PPC relies also on loans to fund projects, interest rate swaps overcome the risk of rising borrowing costs by ensuring a stable repayment schedule.

  D. **Foreign Exchange Hedging** that is used because PPC is exposed to currency risk, particularly from its recent expansion into Romania since it protects against fluctuations in the Euro/Romanian Leu exchange rate. By using currency hedging, PPC minimizes the risk of losses due to unfavorable exchange rate movements.

  E. **Carbon Credit Trading.** PPC is actively participating in carbon markets by purchasing and trading emissions credits, as the Emissions Trading System (ETS) requires. The benefit of this option is that it ensures compliance with EU regulations while optimizing costs related to emissions and offsets regulatory costs.

- **Diversification of Energy Sources:** The increase of production in renewable energy can shield PPC from unpredictable fuel price swings. Also, this policy makes PPC

complient with its environmental goals for climate targets that require energy producers to transition towards cleaner energy sources. Additionally, by investing in RES that are abundant in Greece, PPC gains greater control over its energy production and supply and reduces reliance on external markets. Additionally, while renewable energy projects require substantial initial investments, their operational costs are significantly lower than fossil fuel plants. Over time, this leads to greater financial stability and reduced dependency on fluctuating fuel prices.

- **Flexible Procurement Strategies:** PPC continuously analyzes energy market fluctuations, supply chain dynamics, and regulatory trends to make strategic purchasing decisions which ensure efficiency and reliability in energy procurement.

Macroeconomic and Geopolitical Risks

Business operations of PPC are significantly affected by the economic conditions in all the countries where PPC operates because business activities and operational results depend on residential and commercial electricity demand which is significantly influenced mainly by disposable income levels, consumer spending capacity and labor market trends.

Any potential future downturn in economic activity could lead to a decline in electricity demand and/or an increase in unpaid and overdue bills, as well as higher provisions for expected credit losses. Such incidents could only impact the business operations, financial position, and operational results of PPC negativly.

Additionally, events such as the war in Ukraine and the tensions in Middle East, have disrupted energy supply chains and caused high increases in energy prices especially electricity and natural gas.

PPC deals with such risks through:

- **Strategic Storing of Fuel Reserves:** PPC ensures an adequate supply of critical commodities to avoid potential shortages.
- **Cross-Border Energy Cooperation:** Grecce has established interconnections with neighboring countries to enhance energy security and market integration.

- **Monitoring Geopolitical Developments:** PPC proactively adjusts operational strategies to deal with supply chain disruptions.

Supply Chain and Operational Risks

PPC faces several challenges when constructing or even maintaining power generation units. These challenges include difficulties in sourcing equipment from suppliers, in securing necessary construction materials and components, and in finding specialized technical personnel. Additionally, delays in project timelines, budget and specifications pose further risks. What is more, possible project delays and unplaned expenses can create further complications, making it harder to meet the initial required specifications.

On top of that, general economic fluctuations could possibly lead to financial or operational difficulties to key suppliers and contractors and this could pottentialy disrupt the supply of liquid fuels, materials, and spare parts. Such disruptions could lead to higher operational costs and reduce the company's overall efficiency.PPC addresses these risks through:

- **Supplier Diversification**
- **Investment in Workforce Development**
- **Advanced Project Management Techniques**
- **Regulatory and Legislative Risks**

PPC Group operates within a complex regulatory framework that influences various operational fields, including energy production, market structure, power plant construction and every day operation, energy trading, financial derivatives, market competition, and health & safety, and environmental regulations. PPC has shaped its bussiness according to these policies but any possible change in laws, regulations, or decisions by government authorities and regulators has a direct impact on the company's activities and overall performance. The key regulatory risks and their relevant impact are:

- **Changes in Market Structures:** The evolution of the European energy market (e.g., the revision of the Target Model) impacts PPC's competitiveness.
- **Environmental Compliance Costs:** Stricter emissions regulations lead to the increase of operational costs.

- **Uncertainty in Licensing Procedures:** Lengthy and unpredictable licensing processes can delay investments in renewable energy projects.

To navigate regulatory risks, PPC:

- **Engages in Policy Advocacy** as the company Collaborates with regulatory authorities and policymakers to align regulations with business needs.
- **Monitors Legislative Developments** and ensures compliance with new regulations while proactively adapting business models.
- **Implements Sustainable Practices** and aligns operations with the European Green Deal and emissions reduction targets to maintain regulatory compliance.

Financial Risks

PPC faces several financial risks which are presented at the following main categories:

1. **Investment Plan Execution Risk:** PPC invests in infrastructure and energy projects and therefore, any rising costs or delays could negatively impact the company's ability to achieve its growth targets and at the same time, such deviations could affect its financial health and long-term sustainability.
2. **Working Capital Risk:** PPC faces price volatility and variations in customer payment behavior that results from the nature of the electricity market. Also, regulatory decisions may lead to increased working capital requirements that affect cash flow. Additionally, higher capital expenditure needs could affect liquidity.
3. **Credit Risk:** PPC is rated with a BB- with a stable outlook by Standard & Poor's and Fitch (Fitch Ratings, 2024). This rating reflects the company's financial position, performance, and ability to meet debt obligations and any downgrade in credit rating could increase borrowing costs and limit access to financing**.**
4. **Interest Rate Risk:** As discussed before, PPC holds a mix of bank loans and bonds, with both fixed and floating interest rates. Therefore, market fluctuations in interest rates could increase financing costs.
5. **Foreign Exchange Risk:** PPC is exposed to currency fluctuations, especially due to fuel purchases and its expansion into Romania. The Euro/US Dollar exchange rate affects the cost of imported fuels like diesel, mazut, and natural gas and the

Euro/Romanian Leu exchange rate affectes the result from the operations in Romania.

6. **Debt Covenant Risk:** PPC's current debt agreements contain financial covenants that impose restrictions on certain business activities. These covenants require the company to uphold specific financial ratios, and any failure to meet these obligations could affect PPC's ability to obtain funding, pursue acquisitions, or expand its operations.

To overcome all the aforementioned financial risks, PPC utilizes Strict Budget Planning and Cost Control measures and monitors closely to ensure that projects remain on budget and on time and also, the company prioritizes investments with long term financial and stability goals, such as RES projects. Morover, the company is funded through a mix of EU grants, green bonds (with both fixed and variable interest rates), and strategic partnerships to reduce dependency on a single source of capital and maintains sufficient cash reserves and credit lines to cover fluctuations in working capital needs, but also PPC works to sustain a favorable credit rating through prudent financial management and to maintain sufficient capital reserves to ensuring debt servicing in the future. On the top of that, the company Uses financial derivatives to manage exposure to rising interest rates and Locks in favorable borrowing terms to reduce sensitivity to market fluctuations. Moreover, since the company operates in other countries as well, employs foreign exchange risk management strategies to minimize losses from currency fluctuations and adjusts pricing models in foreign markets to account for exchange rate volatility. In addition, compliance with loan covennats and financial ratios are often review the company balances debt and equity financing to maintain financial stability and avoid restrictions on future investments. Finally, PPC has set an efficient biling process that enhances customer payment mechanisms to minimize delays and overdue payments.

Cybersecurity and IT Risks

As PPC digitalizes its energy systems it is generally recognized that the exposure to cyber security threads is possible and can cause data breaches, system failures, and cyberattacks targeting critical infrastructure. To safeguard its operations, PPC takes proactive measures such as:

- The enhancement of eyber resilience with the implementation of security measures.
- Regular security audits in order to identify vulnerabilities and strengthen security protocols.
- Training of employees on cybersecurity best practices to minimize the risk of human error in cyber attacks.

Despite these efforts, cyber threats are constantly evolving, requiring PPC to continuously adapt and invest in new security measures to stay protected.

Sustainability and Climate Change Risks

PPC faces several sustainability and climate change risks. The key risks include:

1. **Environmental Compliance and Regulatory Risks:** PPC is subject to strict environmental permitting processes, requiring continuous alignment with environmental laws. As a result of this, compliance costs, particularly for preventive measures and environmental restoration could be increased by stricter environmental laws. Also, scientific and technological advancements in environmental sciences usually lead to regulatory changes and therefore, PPC should to proceed to adjustments in infrastructure and operations in order to be compliant. On top of that, a possible failure to meet environmental regulations could lead to administrative penalties, fines, permit revocation, or legal actions.
2. **Reputational and Legal Risks**: Compiance with environmental regulations or involvement laws is very important for a company's reputation and as a result of that, any legal dispute related to environmental concerns could damage PPC's prestige especially nowdays that public perception and stakeholder expectations regarding sustainability efforts are increasing. Additionally, legal actions arising from environmental disputes may result in financial liabilities and especially if negative media coverage occurs.
3. **Climate-Related Operational Risks**: Extreme weather conditions such as heatwaves, floods, or storms are linked to climate change and could impact PPC's infrastructure and operational efficiency.

To mitigate these risks, PPC:

- **Invests in Renewable Energy Projects:** PPC is continuously expanding its solar, wind, and hydroelectric portfolio.
- **Improves Energy Efficiency:** PPC upgrades its power generation facilities and grid infrastructure.
- **Implements Carbon Pricing Strategies:** PPC intergrates the cost of emissions into investment decisions.

Conclusion: PPC has a robust risk management framework

PPC's risk management strategy is well-structured and forward-looking, ensuring resilience in volatile energy markets. By combining financial prudence, technological investments, and regulatory adaptability, PPC mitigates energy market uncertainties while driving long-term growth & profitability.

5. Challenges and Opportunities in Energy transition

5.1 Challenges faced in decarbonization, in digital transformation and in market expansions

The energy sector is changing very fast and PPC adapts to the new contitions but during this transformation journey, it faces challenges in three key areas: decarbonization through a drastc shift in RES, digital transformation through integrating advanced digital technologies, and market expansion with establishing operations in South East Europe. However, these efforts deal with operational, financial, and regulatory challenging obstacles that must be carefully managed to ensure sustainable growth. Bellow are anaysed the main challenges observed in the 3 areas.

A. Challenges in Decarbonization

Transitioning from Fossil Fuels to Renewable Energy

The decarbonization strategy of PPC contains actions to phase out lignite-based power generation. However, this transition presents several key challenges:

- **Investment Intensity:** Shifting to renewable energy sources requires substantial capital investment. PPC is financing this shift through a mix of internal resources, EU funding, and strategic partnerships.
- **Intermittency of Renewable Energy:** Renewables Energy Sources such as solar and wind are strongly dependend to weather conditions and that results to uncertainty and energy supply fluctuations. Therefore, PPC must invest in grid stability measures, such as battery storage and hydroelectric power to provide more reliable power supply.
- **Regulatory Uncertainty:** Policies surrounding carbon emissions, subsidies for renewables, and carbon pricing are constantly evolving. Unexpected changes could impact PPC's long-term planning and return on investment.
- **Infrastructure and Grid Modernization:** A high penetration of renewable energy sources necessitates significant upgrades to Greece's electricity grid, requiring coordination with regulators and grid operators

Carbon Pricing and Compliance Costs

PPC operates in the European carbon market, where it must purchase carbon allowances under the EU Emissions Trading System (ETS). The cost of carbon credits fluctuates, creating financial uncertainty. While PPC is actively managing these costs through emissions trading and efficiency improvements, unexpected price surges could strain its budget.

Social and Economic Implications of Coal Plant Closures

The planned shutdown of lignite plants affects local economies reliant on coal-related jobs. PPC faces social and political pressure to ensure a just transition, necessitating workforce reskilling programs and investment in alternative industries.

B. Challenges in Digital Transformation

Integrating Advanced Digital Technologies

PPC's digital transformation strategy includes automating operations, deploying smart meters, and leveraging artificial intelligence for energy management. (PPC – Annual Report 2023) However, several obstacles hinder its progress:

- **Legacy Systems:** The existing infrastructure of PPC needs to modernized for digital innovations which include investments in automation, grid modernization, and AI-driven energy management systems.
- **Cybersecurity Risks:** The operations of PPC become digitalized and therefore more exposed to cyber threats (i.e hacking attempts, data breaches, system vulnerabilities etch). For this reason, in order to be shield PPC needs to establish enhanced cybersecurity measures.
- **High Implementation Costs:** As PPC is in process of incorporating digital technoilogies in its operations, the company faces also the challenge of high implementation costs which are associated with developing and deploying digital

infrastructure through investments in multiple areas, including hardware, software, workforce training, and cybersecurity.

- **Consumer Adoption:** The targer is to encourage consumers to use digital platforms and smart meters, which is a challenge, particularly among elders who are less familiar with modern technology and prefer the traditional customer service channels **(**physical service points and call centers).

The Role of Smart Grids and E-Mobility

The transition to renewable energy requires smart grids which require the modernization of the existing infrastructure. For this reason, PPC is heavily investing in smart grids and at the same time, PPC Blue, the company's e-mobility brand, is expanding its network of electric vehicle (EV) charging stations to accelerate the adoption of zero CO_2 emmissions transportation. The main challenges for both smart grids and e-mobility include:

- **Grid Stability Concerns:** Integrating distributed energy resources while maintaining grid reliability. Also, upgrading the power distribution network requires extensive deployment of smart meters and real-time monitoring systems .
- **Infrastructure Development:** Expanding the charging stations network, requires partnerships with municipalities and private stakeholders such as malls or supermarkets.
- **Competition:** The energy market is an open competitive market, therefore, there other energy providers who are also entering the e-mobility and smart grid space, as PPC's competitors.

C. Challenges in Market Expansion

PPC's acquisition of Enel Romania is a significant step of the company's strategy for international expansion. However, risks appear whan attempting entering new markets, the main of them are:

- **Regulatory Compliance:** Different markets have unique regulatory frameworks that PPC must navigate. The differences refer to varied environmental standards,

necesseraring licencing processes and data protection laws (such as the GDPR in the European Union).

- **Currency Risks:** The exchange rate fluctuations between the Euro and the Romanian Leu for instance may impact financial stability.
- **Operational Integration:** Merging newly acquired companies into PPC's existing operations requires significant administrative effort.

Competition in New Markets

PPC faces competition from established energy providers in Romania and other potential markets. Success in these regions depends on offering competitive pricing, reliable energy supply, and superior customer service.

Logistics and Supply Chain Risks

Expanding operations across borders means dealing with complex supply chain dynamics. Challenges include:

- **Energy Imports and Cross-Border Trading:** Ensuring seamless energy trading between Greece, Romania, and other Southeast European countries. Grid access rules and tariffs differ, making electricity trade agreements challenging. Also, The capacity of interconnection lines between Greece and neighboring countries limits the volume of energy traded. Adittionally, electricity prices vary significantly across borders, impacting the profitability of energy imports and exports. Besides, energy cooperation between countries can be influenced by political relations and regional stability issues**.**
- **Supply Chain Disruptions:** Political instability and global economic conditions could impact fuel and equipment imports. That could be political conflicts (e.g., the Russia-Ukraine war) that affected natural gas and oil prices and thus making fuel procurement unpredictable, trade restrictions & sanctions and situations like the Middle East instability or disputes over the Red Sea trade route that affect fuel transportation and lead to higher costs for importing raw materials. Negatice

economic conditions could be fluctuations in Currency Exchange Rates, delays in shipping, customs clearance, and transportation.

- **Investment in Local Infrastructure:** PPC must develop local partnerships and invest in distribution networks to compete effectively. But during the various stages of an investment, PPC can face regulatory barriers like complex approval processes and also there are high capital requirements

5.2 Opportunities for innovation to create a competitive advantage in a continuously changing landscape

The energy market is changing rapidly, and allcompanies in the energy sector should adopt their operations to stay competitive in souch evolving framework. For this reason, PPC, PPC has incorporated in its strategy decarbonization, digital transformation, and international expansion. At this sections, are analyzed the key oporrtunities that PPC can capitalize to stay competitive in the long – term. These opportunities refer to advancements in renewable energy, smart grids, energy storage, market expansion, financial innovation, and regulatory adaptation.

Renewable Energy Expansion

PPC expands its renewable energy capacity with target to reach 8.9GW portfolio by 2026, with a current 4.7GW already in operation and an additional 3.3GW under construction or ready to build. This shift towards renewables needed because of regulatory pressures and the market trend for cleaner energy.

Key innovations in this space include:

- **Advanced Photovoltaic and Wind Technologies**: There is always space to invest in high-efficiency solar panels and offshore wind projects to enhance a greener power generation. Solar PVs is one of the fastest-growing renewable technologies, since the costs of such an investment are not extremely high and also its efficiency has been significantly improved, while offshore wind technology offers higher

capacity factors compared to onshore wind farms and provides stable, large-scale electricity generation.

- **Hybrid Renewable Systems**: It is the combination of battery storage with renewable generation that provides grid stability and reliability. Additionally, hybrid projects could also be a mixture of hydroelectric power with renewable energy sources (as the one in Ikaria Island that integrates a small wind farm with a pumped-storage hydroelectric system). Such systems provide continuously renewable energy production even when wind or water supply fluctuates. Such hybrid projects could be implemented successfully on other non-interconnected islands in Greece.
- **Hydrogen and Energy Storage Solutions**: Hydrogen can be a sustainable clean energy solution since it can store energy for weeks or months. Especially for PPC, that has the ability to use surplus electricity from wind and solar farms to power electrolyzers to split water into hydrogen and oxygen, the produced hydrogen can be used on demand afterwords for electricity production, heat generation, or as fuel. On the other hand, investmemys in large-scale battery storage enhance energy security.
- **Floating wind and Solar Farms:** RES power generation can be expanded with projects in water bodies (lakes, and coastal areas) in order to maximize space utilization and reduce land-use conflicts.

By prioritizing these innovations, PPC can lower its carbon footprint and strengthen its sustainability strategy, which are vital for investor trust and regulatory complience.

Digital Transformation and Smart Grids

PPC is actively goings under a digital transformation through investments in smart grid technologies, automation, and customer-centric digital solutions as a step to gain competitive advantage in the energy sector. During the 1st 6 months of 2024, the company allocated a significant percentage of its investments to digitalization demonstrating a strong commitment to modernizing its infrastructure.

The key areas of digital innovation include:

- **Smart Meters and IoT Integration**: Souch innovations enhance real-time monitoring and energy management for both residential and industrial consumers and also improve demand forecasting and enable dynamic pricing.
- **AI and Predictive Maintenance**: The usage of artificial intelligence (AI) can analyze equipment health and consequently predict equipment failures. Also it can optimize asset maintenance (predictive maintenance) and thereby reduce operational or unexpected costs.
- **Blockchain for Energy Trading**: This technology explors decentralized trading platforms to enable peer-to-peer (P2P) energy transactions and improve transparency in the energy market. P2P energy trading platforms alloW consumers to buy and sell electricity independently.
- **5G Connectivity and Edge Computing:** Facilitate **ultra-fast and real-time energy monitoring as well as control** for improved grid management.

The integration of these innovative technologies can significantly affect PPC's operational efficiency by reducing energy losses and they can also improve customer engagement.

Market Expansion and International Growth

The acquisition of Enel's assets in Romania marks for PPC a strategic move towards international expansion. This acquisition increased its market share and also provided an opportunity to implement business models across different regulatory frameworks.

Opportunities for market expansion include:

- **Cross-Border Energy Trading**: For PPC, energy trading between various neighboring countries (such as Italy, Bulgaria, Turkey, and Albania) is an opportunity to optimize energy exports from the excess of it RES production, and therefore to maximize revenue since it can be benefited from demand fluctuations and price differences across borders. Besides, this can also lead to regional energy stability.

- **Energy-as-a-Service (EaaS) Model**: According to this innovative model customers and businesses get tailored energy solutions that optimize efficiency, lower costs, and increase flexibility. As a result of this, customers can reduce energy bills by accessing lower rates during off-peak hours. Additionally, demand and response programs help the balancing between supply and demand and thus, preventing blackouts and reducing strain on the grid. Also, such options encourage the use of renewable energy and energy-efficient solutions, helping the reduction of carbon footprints (GridX, 2024).

- **Strategic Partnerships: P**artnerships with technology firms and research institutions accelerate the adoption of innovative solutions (such as technologies, AI, smart grids, battery storage, and energy management software) which are definitely needed to stay competitive in energy field. Additionally, the co – operation with research institutions can provide PPC with access to cutting-edge research in fields such as Hydrogen technology, Energy storage solutions and decarbonization strategies.

Regulatory Compliance and Risk Management

A proactive approach to managing risks is required to stay aligned with a complex regulatory framework,. For this reason, PPC aligns its operations with the EU decarbonization policies and at the same time the company ensures financial and operational stability.

Key innovations driven by regulations include:

- **Automated Compliance Systems**: AI can be used to track regulatory changes and thus offers real-time compliance.
- **ESG Reporting and Transparency**: AI-driven can be implemented to data collection and analysis, resulting to the improvement of the accuracy of ESG reports and the alignment of reporting standards with global frameworks like the Global Reporting Initiative (GRI) and Task Force on Climate-related Financial Disclosures (TCFD). Additionally, increasing real-time disclosure to regulators and investors can enhance enhance accountability. What is more, enhancing stakeholder

communication through detailed sustainability reports, investor briefings, and public disclosures is also of great importance.

- **Cybersecurity in Energy Infrastructure via AI**: By adopting AI-driven cybersecurity solutions, PPC can protect its energy assets, prevent operational disruptions, and comply with evolving security regulations.

6. Conclusion

6.1 Summary of key findings

This section presents the summary of the key findings derived from the case study of Public Power Corporation's (PPC) strategic management approach in navigating the energy transition. The findings are categorized into three main areas: digital transformation, geographic expansion, and alignment with global energy trends. Additionally, it highlights the challenges faced and the strategic opportunities identified throughout the research and are described short at following bullets.

Digital Transformation and Technological Advancements

This case study has pointed out the critical role of digital transformation in PPC's strategy. The company has adopted modern digital technologies in its operatios to efficiency, to enhance customer experience, and to support further renewable energy integration. This transformation journey includes:

- Smart Grids and Automation: refers to the impimentaion of Advanced Metering Infrastructure (AMI) that enhances real-time monitoring of energy consumption and additionally ensures the stability of the grid.
- Artificial Intelligence and Predictive Analytics: refers to the AI-driven systems adoption to improve predictive maintenance and to reduce downtime and operational costs.
- Cybersecurity and Digital Infrastructure: Significant investments have been made in cloud-based data management, IT security, and real-time monitoring tosecure operations against cyber threats.
- Customer-Centric Digital Solutions: Initiatives such as the development of digital platforms and self-service portals have improved customer engagement and service delivery.

Geographic Expansion and Market Diversification

PPC's has expanded its operations in Southeast Europe in order to achieve long-term growth and to mitigate business risk. The key findings regarding geographic diversification include:

- Entry into New Markets: PPC has expanded operations into Romania, Italy, Bulgaria, and Croatia with target to secure a strong position in the region's renewable energy sector.
- Cross-Border Energy Trading: the surplus of renewable energy production can be exported to neighbouring counties thus leading to enhanced revenue.
- Strategic Partnerships: Collaborations with technology firms and research institutions have accelerated the adoption of emerging technologies that bring innovation in the energy field.

Alignment with Global Energy Trends

Global trends in the energy sector are aligned with the strategy of PPC and are expressed by:

- Decarbonization and Renewable Energy: PPC phases out lignite-based power generation and increases its reliance on Renewable energy sources (i.e solar, wind, and hydroelectric power) with various relative projects, many of them are already completed.
- Regulatory Adaptation: PPC is in alignment with the EU decarbonization policies and therefore, the company has implemented mechanisms such as the EU Emissions Trading System (ETS) to manage carbon pricing risks.
- Energy Storage: Large-scale investments in battery storage and pumped hydro projects have been completed or are planned to increase the usage of renewable energy sources.

Challenges and Risk Management

Despite these advancements, PPC faces several challenges that require strategic responses and the most important are:

- Financial Constraints: the transition to renewable energy requires capital investments and thus, the need financing.
- Regulatory Uncertainty: any changes in policies related with carbon emissions and subsidies create financial and operational risks.
- Infrastructure Modernization: the electricity grid of Greece needs to be modernized to accommodate a higher share of renewable energy and that is a complex and resource-intensive process.
- Cybersecurity Risks: The increasing digitalization of leads to heightened cybersecurity concerns that requires ongoing investments in IT.

Strategic Opportunities

Despite the challenges mentioned before there are several strategic opportunities that have been identified such as:

- The adoption of Energy-as-a-Service (EaaS) Models: PPC can utilize such energy solutions that provide flexibility and cost savings for customers.
- Hydrogen and Energy Storage Technologies: such options offer promising options for sustainable energy transition.
- Expansion of E-Mobility Solutions: PPC investments in electric vehicles (EV) infrastructure, including the DEI Blue charging network with target to become a leader in zero CO_2 solutions.
- Enhanced Stakeholder Engagement: Transparent ESG reporting and sustainable business practices enhance PPC's reputation and success and builts trust among regulators, investors, and consumers.

Conclusion

This disertation ais to highlight the strategic approach of PPC in Greece, that leverages digital transformation, geographic diversification, and sustainability initiatives to navigate the energy transition. Despite the fact that company faces considerable challenges, it shows commitment to innovation, regulatory adaptation, and is proceeds to strategic investments in order to create a strong foundations for long-term growth. What is more, the insights gained from PPC's case study offer valuable lessons for other energy utilities seeking to transition toward a sustainable and competitive future.

6.2 Strategic Recommendations for utilities managing energy transitions through innovation and expansion

The global energy transition contains at the same time both challenges and opportunities as the trend requires moving away from fossil fuels. This shift requires a strategic approach to innovation, to successful investments, and in many cases, geographic expansion is also needed to ensure sustainable growth while maintaining financial health and stability. Therefore, this sections presents strategic recommendations for utilities which are originated from the model of Public Power Corporation (PPC) in Greece, as it navigates energy transition through digital transformation, decarbonization, and geographic diversification successfully.

At first, **Digital Transformation** can provide a Competitive Advantage. This transormations contains the imlimentation of smart grids, which are one of the most critical steps in energy transition. Smart grids are used for distribution efficiency since that allow real-time monitoring and they also integrate renewable energy sources more effectively. Additionally, utilities can enhance real time data collection with investments in Advanced Metering Infrastructure (AMI). What is more, the implementation of AI in the infrastucture's predictive maintenance is essential to reduce costs and downtime. But as digital transformation accelerates, cybersecurity becomes a crucial component in safeguarding operations. Therefore, utilities must establish robust cybersecurity frameworks to protect against cyber threats. Furthermore,iImplementing cloud-based data management will improve resilience and operational efficiency, while utilizing blockchain technology

can secure energy trading and smart contracts, ensuring transparency and reliability in transactions.

Then, invreasing electricity production with **Renewable Energy Sources** is also of Great Importance in order to reach decarbonization goals. For this reason, utilities must not only increase their renewable energy capacity but also thet must ensuring grid stability as well. On that account, large-scale solar and wind projects in various locations can provide a more resilient energy mix. Moreover, energy storage solutions, such as battery storage and Hybrid Power Plants (combination of hydropower with solar and or wind), can mitigate intermittency issues and provide energy stability. On top of that, green hydrogen production can be a long-term solution for energy storage.

What is more, PPC's expansion in Romania and Italy demonstrates the benefits of **geographic diversification**. To elevate this strategy, utilities should target high-potential markets that offer robust renewable energy incentives and well-developed infrastructure. Also, markets with favorable regulatory environments and interconnection potential are attractive for investments in ordewr to enhance competitiveness. Besides, developing regional energy corridors will enable cross-border electricity trading which strengthens energy security and economic integration.

Additionally, **strategic collaborations** help utilities scale operations and enter new markets efficiently. Acquiring or partnering with renewable energy firms can strengthen their green portfolio. Leveraging local expertise will facilitate navigation of regulatory complexities in new markets. Apartt from that, integrating supply chains and distribution networks will optimize cost structures and ensure competitive pricing, improving overall financial sustainability and growth potential.

Moreover, **funding strategies** are also of great importance since that to ensure financial sustainability. Issuing Green Bonds for instance, can finance renewable energy projects at lower capital costs, while expanding syndicated loans and credit facilities can provide additional liquidity management options and allow utilities to sustain their investments in energy transition in the long run. In general, maintaining a Net Debt/EBITDA ratio below 3.5 ensures financial stability and operational resilience.

On top of that, **risk management strategies** are required due to their high volatility. Such strategies for example can be, the implementation of hedging mechanisms that can mitigate

exposure to energy price fluctuations. Also, long-term contracts with energy suppliers and grid operators can stabilize revenue streams. Additionally, staying compliant with EU policies (i.e the European Green Deal for instance) avoids regulatory penalties.

Also, such transition requires **balancing economic with social and environmental considerations**. Therefore, in regions that will be affected from lignite plants closures, utilities should implement reskilling programs to support workers (to learn now skills in RES operations for instance). In many cases, investing in community projects and infrastructure will help those areas to maintain their economic resilience.

Finally, **transparency** in sustainability reporting by adhering to the Global Reporting Initiative (GRI) will improve accountability. Setting clear Science-Based Targets (SBTi) for emission reductions will align corporate actions with climate commitments. Establishing biodiversity conservation initiatives alongside renewable energy projects will further strengthen a utility's environmental responsibility.

Conclusion

Managing energy transitions effectively requires utilities to embrace innovation, expand strategically, and maintain financial discipline. The case of PPC shows that undergoing digital transformation, geographic expansion, and investments in renewable energy sources can create a long-term value. By implementing such strategic actions, utilities can deal successfully with the evolving energy landscape while achieving sustainability and economic prosperity.

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