Contemporary Economy

Contemporary Economy
Electronic Scientific Journal
Współczesna Gospodarka (ug.edu.pl)

Vol.19 Issue 1 (2025) 135-151
*ISSN*2082-677X
DOI 10.26881/wg.2025.1.10

INNOVATIVE ENERGY MARKETS: MICROGRID COMPANIES MARKET STRATEGIES

Volkmar Kunerth, Przemysław Borkowski

Abstract

Purpose – This article investigates how different microgrid suppliers compete. The focus is on the key business strategies of the 5 top market innovators, and the conclusions could be useful for countries where incumbent microgrid operators start their businesses.
Methodology – Primary data was gathered through interviews with industry experts and microgrid company executives. To ensure depth and comprehensiveness, this study also incorporates secondary data sources, including industry reports, company websites, and scientific research papers. The subsequent analysis is conducted through the lens of comparative case study analysis. Structured case studies reveal how companies develop their operations and strategies to capitalize on the evolving energy landscape, offering insights into the economic and organizational aspects of the microgrid industry.
Findings – Companies like Siemens, Schneider Electric, Enchanted Rock, ComAp, and Scale Microgrids each carve out their niches through distinct go-to-market strategies. Siemens and Schneider Electric emerge as leaders, demonstrating a comprehensive approach that balances technological innovation with robust service offerings, catering to both commercial and government sectors. Enchanted Rock's focus on commercial sectors and Energy-as-a-Service (EaaS) models illustrates a targeted approach, preferring to serve niche markets with high demands for energy resilience. ComAp's emphasis on hardware and technology signals a commitment to the foundational aspects of microgrid systems, prioritizing innovation in components over broader market engagement.

Keywords: microgrids, innovative energy markets, business models, energy market strategies

JEL classification: O31, O33, L1, L2

Introduction

The demand for electricity is poised to rise markedly as new data centers emerge, electric vehicle sales grow, and more households switch from fossil fuels to electricity for heating and cooking. In this transition, microgrids will play a crucial role by decentralizing energy supply and stabilizing the grid, thereby supporting this increasing electricity demand efficiently. What dictates the development of microgrids is technological innovation driven by competition among microgrid companies. With increasing focus on climate change and sustainability, microgrid companies contribute to these goals through innovative technology solutions, knowledge-based approaches, and new investment models. Understanding the competitive landscape of microgrid companies can help in shaping relevant policies and that support sustainable energy development while fostering a healthy market environment.

Microgrids are smaller-scale, localized energy systems capable of operating independently or in conjunction with the traditional centralized electrical grid. They have gained significant attention due to their potential to improve energy efficiency, reliability, and resiliency, especially in response to extreme weather events and other emergencies (Debouza et al., 2022). The economic impact of microgrids in the future can be substantial, as they can help reduce energy costs, provide revenue through energy sales, and stimulate local job creation. Moreover, microgrids can play a critical role in reducing greenhouse gas emissions, which has broader economic implications by helping mitigate climate-related risks. Microgrids integrate Distributed Energy Resources (DERs) in an optimized manner, especially benefiting remote or isolated areas by enhancing reliability, reducing costs, and promoting sustainability through local renewable resources and minimized transmission losses. Additionally, microgrids offer energy independence, scalability, improved power quality, and foster local economic development by reducing reliance on conventional grid infrastructure (Robertson et al., 2023).

The term Distributed Energy Resources (DER) encompasses a variety of technologies including diesel engines, micro turbines, fuel cells, photovoltaic systems, and small wind turbines among others. Central to the microgrid concept is the orchestrated operation and control of these DERs, in conjunction with controllable load and storage apparatuses such as flywheels, energy capacitors, and batteries. The operational modalities of microgrids are dual-faceted: they can function while interconnected to the primary distribution grid or autonomously in an islanded mode (Jiayi et al., 2008). Microgrids integrate distributed renewable energy sources, storage devices, and load management to actively control internal distribution networks. They represent a sustainable solution aimed at minimizing carbon emissions, particularly through the strategic planning of hybrid systems that leverage clean energy and efficient storage (Raff et al., 2022).

This article focuses on the US market, which holds the largest global market share (35% by revenue) and exemplifies advanced technology and competitive dynamics in the microgrid sector. This focus allows for a comprehensive analysis of what market strategies prove successful in the rapidly evolving microgrid market. Understanding the role and operations of microgrid companies within the broader energy market is essential for shaping effective energy policies and strategies and the lessons learned could benefit other countries microgrid development strategies.

Considering the current literature on the subject the following research question could be formulated: what market strategies prove successful for microgrid companies operating in environments characterized by technological innovation, diverse customer profiles, varied financial models? Microgrid companies achieve market success through combining a variety of strategic focuses, with some excelling due to technological leadership, others through strong government relationships and incentives, and still others via innovative financial models. The effectiveness of a particular strategy is contingent upon the company's core competencies, company size, target market characteristics, and external market conditions.

The remainder of the paper is as follows. The first part delves into the literature review uncovering different environments and forces as keystones for success in the microgrid market. The next section provides the methodology for case studies, while the subsequent parts present results allowing for verification of the effects microgrids have on the energy sector economy, nature of effective market strategies and internal strengths of the different companies.

1. Literature review

1.1. Microgrids

There are several factors that influence the chance of success of innovative energy sector companies. Microgrid (MG) technologies offer users attractive characteristics such as enhanced power quality, stability, sustainability, and environmentally friendly energy through a control and Energy Management System (EMS). Microgrids are enabled by integrating such distributed energy sources into the utility grid. The microgrid concept is proposed to create a self-contained system composed of distributed energy resources capable of operating in an isolated mode during grid disruptions. With the Internet of Things (IoT) daily technological advancements and updates, intelligent microgrids, the critical components of the future smart grid, are integrating an increasing number of IoT architectures and technologies for applications aimed at developing, controlling, monitoring, and protecting microgrids (Albarakati et al., 2022).

Microgrid companies are navigating a market where success hinges on addressing technological, operational, and business risks. Key strategies include standardization, offering microgrids as total solutions, and aligning with various stakeholders such as customers, financial institutions, utilities, and regulators. The role of technological innovation in shaping market entry and expansion strategies is extensively discussed in the literature. For instance, Jiang (2023) emphasizes that companies with advanced technological products often adopt aggressive market penetration with differentiation strategies to establish a competitive edge. This is supported by Lysek (2019), who argues that technology-driven firms are more inclined towards diversification and horizontal integration aiming to revolutionize existing market dynamics. Lysek's argument suggests that firms which embrace technological advancements are better positioned to innovate and lead in their markets.

Technological integration involves combining various technologies to integrate comprehensive solutions. Mehlig & Rosén (2023) contend that for microgrid companies to effectively compete, merely developing components is insufficient. Instead, their focus should be on designing integrated systems rather than relying solely on standardization and driving innovation for the future. Spair (2023) argues that this approach facilitates scalability and adaptability in dynamic market environments. Golden (2020) points out that by streamlining technologies across multiple projects, costs are significantly reduced, making these innovative power solutions more accessible and economically viable. This standardization is not only benefiting consumers but also capturing the interest of investors, who are now keener than ever to back these sustainable and resilient energy systems.

Hunt & Arnett (2004) point out that to achieve competitive advantage and, thereby, superior financial performance, firms should (1) identify segments of demand, (2) target specific segments, and (3) develop specific marketing "mixes" for each targeted market segment. In a recent study, three microgrid types were identified, representing typical commercial adopters: commercial operations, critical infrastructure, and a campus setting. (Hanna et al., 2017). Commercial settings often prioritize energy efficiency and cost savings, critical infrastructure focuses on reliability and resilience, while campus microgrids typically blend these priorities, emphasizing sustainability and self-sufficiency. Sioshansi (2011) states that the adoption of renewable energy in microgrids within the Commercial and Industrial (C&I) sector is affected by technological advancements and market trends. A key factor driving this adoption is the declining cost of solar photovoltaic (PV) and energy storage systems, which enhances the appeal of microgrids to C&I customers, primarily focused on cost reductions.

1.2. Microgrid business models

There are different economic- financial business models on the market with various options and possible outcomes for stakeholders. The traditional model of microgrid implementation involves substantial initial capital outlay, which can be a deterrent for many organizations considering a shift towards more reliable and sustainable energy sources. The mains business models are Facility Owner Financing and Maintenance, Pure Hardware Component Sales, Software as a Service, Government Energy Service Contracts, Power Purchase Agreements (PPA's), Operations and Maintenance Contracts, and Design-Build-Operate-Maintain DBOOM (Asmus & Lawrence, 2016). These business models are interconnected in the sense that they operate synergistically in the development, deployment, and management of energy projects, particularly in the context of microgrids. Their interrelation reflects the complexity and multifaceted nature of modern energy systems, where different models address various needs and stages of energy projects. Partnerships with system integrators, contractors, and value-added resellers are prevalent, facilitating the delivery of integrated solutions or turn-key products. This collaborative approach enhances product integration into larger systems and extends market reach.

Asmus & Lawrence (2016) are also pointing out that numerous technology vendors consider microgrids as an additional market for their products. This perspective is especially common among companies that specialize in selling energy storage units, smart meters, switchgear, and similar hardware equipment.

1.3. Microgrid financial models

Lessambo (2022) asserts that over centuries, project financing has evolved primarily into a vehicle for assembling a consortium of investors, lenders, and other participants to undertake infrastructure projects that would be too large for individual investors to underwrite. Microgrid energy projects fall under the project-based category where stakeholders have a common goal: having a properly running project company that allows a distribution of returns that includes all of them (Mohamadi, 2021).

In the microgrid industry CAPEX and OPEX models are used. CAPEX models focus on the upfront investment required to design, construct, and commission the energy assets. Understanding the nuances of CAPEX models is essential for long-term project viability. CAPEX models are offered by different players in the field which team up with investment partners companies to offer those to their customers as part of their competitive market approach. OPEX models spread costs over time, which can be advantageous for budgeting and cash flow management. Expenses are treated as operational costs, affecting the income statement. OPEX Models transfer some risks to the service providers, especially if maintenance and operational responsibilities are outsourced. This can reduce the burden on the owner. In summary, OPEX models are more focused on operational efficiency and flexibility with lower upfront costs, while CAPEX models emphasize long-term investment and ownership with higher initial expenses (Cai et al., 2025).

Energy as a Service or also named microgrid as a service model are becoming increasingly common for microgrid applications in commercial business settings. The Energy as a Service (EaaS) model provides end-to-end energy solutions, including energy supply, optimization, and management, through a subscription-based service, reducing the need for upfront capital investment (Microgrid Knowledge, 2019). The industry is increasingly moving towards third-party financing options like EaaS and energy/microgrids-as-a-service (MaaS), making microgrids more accessible to smaller businesses. This trend is partly due to the standardization of microgrid technologies, which has driven down costs and increased investor appetite. Companies like Schneider Electric have partnered with investors to cater to commercial buildings seeking energy reliability without the burden of upfront cost. Golden (2020) argues that new third-party financing options for microgrids in which the energy off taker does not own or maintain the asset — known as energy-as-a-service (EaaS) or microgrids-as-a-service (MaaS) are increasingly penetrating the market (Microgrid Knowledge, 2019). Schurr (2018) exemplifies this by Enchanted Rock's service model which addresses this barrier by offering electrical reliability as a service. This approach effectively shifts the financial burden from the client to the service provider, allowing enterprises to adopt advanced microgrid solutions without incurring significant upfront costs. This financial model aligns with the findings of recent studies, which emphasize the need for innovative financing mechanisms in the microgrid sector to increase adoption rates among a broader range of users designs and build the microgrids but also operates them. This operational model relieves client organizations from the complexities and technicalities of running a microgrid, allowing them to focus on their core business activities.

2. Research method

The potential variety of successful factors discussed by microgrid companies in the literature must be narrowed to identify critical ones or to identify critical sets of factors which (under differing circumstances) might prove to be essential. The method to solve this dilemma proposed in this study is based on a Comparative Case Study Analysis (Goodrick, 2019). This approach involves a detailed, systematic comparison of different go-to-market strategies used by various companies. The information for this research was collected through a review of publicly available resources, such as official company websites, to obtain financial metrics, corporate profiles, product offerings, and market activities. Furthermore, unstructured interviews were held with industry experts and company representatives to obtain detailed insights and confirm secondary data. Existing case studies, academic papers, and market reports were reviewed to supplement empirical findings with both qualitative and quantitative data. Different go-to-market strategies are compared using qualitative and quantitative data from various companies. Five prominent market players, each employing distinct market strategies, were selected for analysis: Schneider Electric, Siemens, Enchanted Rock, ComAp, and Scale Microgrids.

The analysis focuses on the four key dimensions market segmentation, financial business models, go-to-market strategies, and technology. This is essential for answering the research question about successful market strategies for microgrid companies. Table 1 shows the dimensions of the case study conducted.

Table 1. Dimensions of case studies

Market Segmentation	Financial and Business Models	Microgrid Technology
Details on how each company approaches the Commercial & Industrial and Institutional & Governmental sectors	Traditional CAPEX based models, Power Purchase Agreement (PPA), Energy as a Service (EaaS), Public-Private Partnerships (PPPs), uses Grants and Subsidies, or Hybrid Models. Outright Purchase/Ownership Model	Energy Management System (EMS), integrate distributed energy sources AI and IoT advancements to create intelligent, self-contained systems capable of operating independently during grid disruptions

Source: Own elaboration.

Further we assess each of the market strategies of those companies using three-dimensional scoring matrix. We posit that the dimensions of Microgrid Technology, Financial Models and Market Segmentation are critical to the success of microgrid companies. We chose those three dimensions based on the theoretical findings of the Resource-Based View (RBV) framework for technology (Madhani, 2010) and Porters 5 Forces Model (Porter, 1980) and the Diffusion of Innovations Theory (Rogers, 1962) for the remaining two. The RBV framework suggests that a company's internal resources and capabilities, not just external factors, are the primary drivers of competitive advantage, and in the context of microgrid companies, RBV helps assess technological capabilities, intellectual property, and organizational competencies. This approach emphasizes the importance of unique and hard-to-replicate attributes of a company as the key drivers of superior performance and competitive edge such as technology and inventions (Madhani, 2010). Diffusion of Innovations Theory by Rogers explains how, why, and at what rate new ideas and technologies spread across cultures, emphasizing that the adoption of innovations is influenced by factors such as perceived advantages, compatibility, complexity, trialability, and observability (Rogers, 1962). Porter's Five Forces Theory is particularly applicable to renewable energy financing models like Energy as a Service (EaaS) and leasing because it helps analyze the competitive dynamics within the industry. By assessing the bargaining power of buyers microgrid companies can strategize to enhance their market position and profitability in the renewable energy sectorby offering innovative financing. The adaptability of EaaS and related financing models to different customer needs and market conditions makes them powerful and competitive, enhancing tools for microgrid companies aiming to enhance their market position and profitability in the renewable energy sector (Cleary & Palmer, 2019).

To each of the abovementioned dimensions, we apply scoring as assessed based on the case studies and interviews conducted. The scoring highlights both the technical depth (IoT/AI integration) and the business delivery model (how projects are financed and delivered), as these are essential for market success in the microgrid space. Strong financial and business models are important because microgrids are capital-intensive, and customers often can't afford large upfront investments (Gridscape, 2023). Flexible models like EaaS make microgrids more accessible, accelerating adoption and market growth. Ultimately, even the best technology needs the right financing approach to be successfully deployed and scaled. The scoring system gives the highest weight to Financial & Business Models (up to 9 points) because flexible financing approaches are critical to enabling widespread adoption of capital-intensive microgrid projects. While Microgrid Technology (up to 3 points) is equally high in strategic importance, its impact is only realized when paired with business models that support deployment and scalability across diverse customer segments.

3. Results

3.1. Case study Schneider Electric

Schneider Electric's importance in the microgrid market stems from its considerable size and influence, as evidenced by its global workforce of 135,000 employees and annual revenues exceeding $32 billion. Leveraging these substantial resources, the company has adeptly maneuvered within the microgrid sector while also playing a key role in advancing the market (Schneider Electric, 2023).

Schneider Electric is focusing on developing microgrids for small to medium-sized buildings, specifically targeting those with an electrical load below 5 megawatts (MW). This segment is substantial, encompassing about 90% of buildings in the United States and Canada. Schneider

Electric has strategically positioned its market approach by integrating cloud data and analytics into microgrid development, coupled with the pioneering of an "energy-as-a-service" model, while concurrently expanding its collaborative ventures and emphasizing the development of modular microgrid solutions. Building on its significant market presence, Schneider Electric has further driven technological innovation in the microgrid sector with its EcoStruxure Microgrid Flex solution. This system integrates microgrid control, electrical distribution, software, and battery storage systems into a unified framework, effectively simplifying the complexity traditionally associated with microgrid management and operation. This holistic approach not only enhances efficiency but also offers a scalable and adaptable solution, catering to the evolving needs of modern energy landscapes (Mora et al., 2012).
The integration of different technologies in microgrids, as exemplified by Schneider Electric, is a critical factor in addressing market needs efficiently. By combining renewable energy sources, energy storage, and smart control systems, companies like Schneider can offer more adaptable and resilient microgrid solutions. This flexibility is crucial in catering to markets with varying energy needs and infrastructure challenges.
One example exemplifying the technology integration approach is the port of Long Beach. In collaboration with Schneider Electric, a project encompassing a microgrid and electrification was conceptualized and executed. A 300-kW solar array was installed to harness renewable energy. Complementing this was a 250-kW microgrid-extending mobile battery energy system, offering flexible energy storage solutions (Hitchens, 2022). Schneider Electric's approach in the microgrid market is characterized by a blend of technological innovation, distributor channels, and a focus on customer-centric solutions. At the core of their microgrid strategy is integrating advanced technologies, exemplified by their EcoStruxure Microgrid Flex solution, which combines microgrid control, electrical components, software, and battery storage systems into a cohesive framework. This is supported by their pioneering EaaS model and cloud data and analytics, enhancing their service offerings and operational efficiency.
Their market approach is supported by a robust distribution network, including strategic partnerships and training programs for distributors, ensuring widespread accessibility and implementation of their solutions. This comprehensive approach positions Schneider Electric as a leader in the microgrid sector. While a multi-faceted approach can be managed financially and organizationally by a multinational conglomerate like Schneider there might be concerns with their market operations. There is a potential for conflicting interests between the distribution business and the project business. Distribution partners may focus on immediate sales and shorter-term goals, while project financing and execution demand a long-term perspective. Inconsistent pricing policies might be the biggest threat to the company development. If Schneider Electric does not maintain a consistent pricing policy across all channels, it can lead to confusion and frustration among distributors. Regional economic disparities, varying transportation costs, and localized competitive dynamics can lead to significant price discrepancies across regions or among different distributors, further complicating the company’s channel management strategy. These challenges necessitate a carefully orchestrated approach to ensure coherence and equity in Schneider Electric's distribution and project execution strategies.

3.2. Case study Siemens

Like Schneider, Siemens is an international conglomerate intensely engaged in developing microgrids. It is a global company with more than 300,000 employees and over $100bn in revenue (Siemens AG, 2024). Siemens has been identified as a leader in the microgrid segment by industry reports such as Guidehouse Insights (Rodriguez Labastida, 2023). Guidehouse further ranked Siemens as the top provider of distributed energy resources management systems

(DERMS) in 2020, affirming its industry-leading position. Siemens has a strong focus on larger customers, with over 1 MW microgrids in the off grid commercial, educational, military and government space (Murray, 2023). Military installations prioritize microgrids for energy security, focusing on reliability and availability to meet stringent energy policy targets. Universities, colleges, and research facilities are increasingly adopting green energy solutions leveraging microgrid technologies as both a sustainable energy solution and an educational tool for students and researchers.

Both the military and educational microgrid markets receive large subsidies and incentives to build microgrids and are therefore very profitable segments. Due to their significant energy consumption, these institutions are particularly apt for adopting microgrids and district heating and cooling systems and are therefore ideal market segments for Siemens, which is also a large government and infrastructure provider. State-level support is also evident, with states finding creative ways to fund microgrids that support military bases, such as Connecticut issuing a bond for a microgrid project and Texas creating a defense infrastructure fund (Cohn, 2022). Those are primarily Capex-driven projects where the government is the total or partial investor, offers subsidies and purchases the microgrid outright after the installation. Government and military microgrid installations offer significant advantages, particularly financial support and energy security. State and local policies, like renewable portfolio standards (RPS), play a crucial role in this process. They can increase the value of renewable energy certificates (RECs), enhance net metering benefits, and make energy storage more financially viable. For instance, states like California and Massachusetts offer specific incentives for battery energy storage systems. Siemens has a large interest in the energy business and microgrids are an important but only small part of the Siemens energy portfolio. Siemens utilizes a multi-layered go-to-market approach regarding microgrids. Their segmentation strategy is focused on large projects in the government, military education, and tribal land space. Those projects allow Siemens to collect large incentives and those customers typically pay and own their microgrids, so Siemens does not need to provide financing. In addition, Siemens has a strong consulting approach where it helps customers from the project feasibility, engineering to the deployment stage with microgrid planning.

Siemens' microgrid go-to-market strategy reflects a comprehensive and targeted approach. Their focus on large-scale projects in specific sectors like government, military, education, and tribal lands capitalizes on these segments' high value and stability, including significant incentives and the ability to self-finance. Key examples include the Princeton Microgrid for the education sector and the Guantanamo Microgrid in the military domain. Siemens supplements this with a robust partnership strategy, collaborating with various industry stakeholders such as electrical and solar contractors, utilities, and energy storage systems providers. Additionally, Siemens enhances its market presence through a strong consulting arm that guides customers from project inception to completion, showcasing a full-spectrum engagement in microgrid space.

3.3. Case study Enchanted Rock

Enchanted Rock, founded in 2006 and headquartered in Houston, Texas, is a leading provider of Electrical Resiliency-as-a-Service, specializing in fully managed clean microgrids that ensure power reliability for businesses, critical infrastructure, and communities during grid outages (LeadIQ, 2025). Their focus is on offering Electrical Resiliency-A-Service to various industries, including data centers, healthcare, and government infrastructure. They emphasize the advantages of their microgrids over traditional diesel-powered backups, highlighting cleaner, quieter, and more environmentally friendly solutions. Enchanted Rock's approach integrates innovative technologies and operational excellence, ensuring uninterrupted power supply even during severe weather or other challenging conditions (Enchanted Rock, 2023).

Over the years, Enchanted Rock has commissioned over 530 MW of distributed generation across more than 250 sites. Initially starting with emergency diesel, the company has transitioned to what is now considered the cleanest resiliency microgrid in the market. Enchanted Rock has demonstrated a substantial impact in the field of microgrid installations, particularly through their notable partnership with H-E-B, a major supermarket chain. In this collaboration, Enchanted Rock has successfully installed 184 microgrids, showcasing their capability in providing large-scale energy solutions. But their market segmentation includes also data centers, electric vehicles, energy and water utilities, government infrastructure, grocery and distribution, healthcare and hospital facilities, local communities, and manufacturing (Rickerson & Kallay, 2022).

Enchanted Rock utilizes innovative financing models to support its microgrid projects. One of their critical approaches is the "resiliency-as-a-service" (RaaS) model. The energy off-taker does not own or maintain the asset in this arrangement. Instead, Enchanted Rock builds, operates, and maintains the microgrid, providing electrical resilience as a service. This model is particularly advantageous as it makes microgrids accessible to a broader range of customers, including small businesses, without the burden of significant upfront investment. The Resiliency-as-a-Service model, as offered by companies like Enchanted Rock, is a comprehensive approach to energy management where the service provider designs, installs, and operates a microgrid for a client. This model typically involves no upfront costs for the client; instead, they pay a regular service fee. The provider takes on the responsibility of ensuring that the microgrid operates efficiently and reliably, offering backup power and enhancing energy resilience. This is particularly advantageous for businesses that require uninterrupted power but want to avoid the capital expenditure and operational complexities of owning and maintaining a microgrid system (Hitchens, 2023b).

Enchanted Rock's success reflects a significant shift towards service-oriented solutions in the energy sector, attracting a diverse range of clients seeking reliable, efficient, and sustainable energy management (Hitchens, 2023a).

One part of Enchanted Rock's go-to-market strategy for its microgrid solutions focuses on partnering with water utilities to deliver high-value resiliency services for critical infrastructure customers. This approach addresses common deterrents utilities faced in adopting microgrids, such as cost, regulatory barriers, and technology risks. Enchanted Rock's comprehensive support helps utilities overcome challenges and align microgrid adoption with their grid modernization efforts, enhancing resilience and customer satisfaction. Enchanted Rock's go-to-market strategy for retailers (e.g., Walmart, H-E-B), and data centers, is tailored to emphasize the high costs associated with downtime and the importance of continuous power supply. For food retailers, the focus is on preventing perishable goods loss due to power outages, which can have significant financial implications. In the case of water utilities and data centers, the strategy highlights the critical need for uninterrupted operations, as outages can lead to severe community and data loss. It could be concluded that Enchanted Rock's go-to-market strategy for its microgrid solutions aligns well with the five pillars of a typical GTM strategy: product analysis, product messaging, sales proposition, marketing strategy, and sales strategy (Dias et al., 2017). This approach underlines Enchanted Rock's keen grasp of market demands and its capability to provide tailored, cost-effective solutions.

3.4. Case study ComAp

ComAp is a Czech Republic-based company specializing in the design and delivery of smart control solutions for power generation and energy management, supporting the global transition to sustainable energy. ComAp employs over 550 people worldwide, including more than 200 dedicated to research and development and operates 26 offices globally, maintaining a strong local presence to support its customers' power control needs anytime, anywhere (ComAp, 2024c). ComAp specializes in energy control for diverse sectors. ComAp caters to various market segments, including Power Generation, Energy Management, and Marine. They offer solutions providing sophisticated control systems for applications such as CHP, Biofuel & Hydrogen, Fuel Cells, and AC/DC Power Management (ComAp, 2024a).

ComAp specializes in manufacturing advanced control systems for energy management and power generation but does not provide financial services or engage in financing microgrids. Their expertise lies in creating hardware solutions like controllers for various applications, including renewable energy sources, gensets, and hybrid systems, focusing on enhancing operational efficiency and sustainability. ComAp does not provide financing, leasing or other models like "Energy as a Service" to their customers as they focus on selling hardware and not projects. Customers must pay when they purchase their hardware and controllers, and no financing is offered.

ComAp is structuring partners into tiers based on their performance, engagement, or specific roles is crucial. Different partner types can include resellers integrators and affiliates each playing a unique role in the channel ecosystem. ComAp's channel strategy includes forming strategic partnerships to enhance their product offerings and market reach. An example of this strategy is their partnership with Nedstack, a leading provider of fuel cell solutions. Together, they aim to advance fuel cell power system control by developing control solutions that integrate and harmonize fuel cell technology with power generation systems (ComAp, 2024b).

ComAp utilizes a robust distribution network of over 70 distributors and operates through its 13 subsidiaries worldwide to sell its energy control solutions. This extensive network allows ComAp to reach various markets and industries globally, ensuring clients have local access to their advanced control solutions and support services. This multi-channel approach and a focus on strategic collaborations position ComAp well for addressing evolving energy demands globally. ComAp is focused on a distribution centric go-to-market strategy, focusing on selling their hardware.

3.5. Case study Scale Microgrids

Scale Microgrids employs only slightly above 100 individuals. The company's estimated annual revenue is around $25.8 million, with a revenue per employee of approximately $210,000 (Growjo, 2025). Scale Microgrids specializes in designing, building, financing, operating, and maintaining solar, battery storage, and dispatchable generation microgrids. Their services promise an average energy expense reduction of 10-15% for their customers. Their market strategy is emphasizing sustainability, resilience, cost-effectiveness, and simplicity, linked to the commitment to reducing greenhouse gas emissions, minimizing environmental impacts, and ensuring energy independence for businesses (Scale Microgrids, 2024). They offer modular and custom microgrid designs, integrating solar PV, battery storage, dispatchable generation, utility-integrated controls, and system monitoring. Their purchasing options include Microgrid Service Agreements (MSAs) for financial ease, aimed at industries seeking energy resilience, operational efficiency, and sustainability without upfront costs.

Scale Microgrids follows a structured process for deploying custom microgrids, beginning with feasibility studies and ending with long-term operations and maintenance. They focus on understanding client needs, designing a tailored energy solution, executing the construction with minimal disruption, and ensuring the microgrid's optimal performance through continuous monitoring and maintenance. This comprehensive approach ensures that each project delivers on its promise of resilience, sustainability, and cost efficiency. Scale Microgrids serves various industries, focusing on enhancing energy resilience and independence. They work in sectors such as water, distribution centers, healthcare, indoor agriculture, grocery & cold storage, hospitality, EV infrastructure, education, and municipalities (Scale Microgrids, 2024). Scale Microgrids adds value across different verticals by developing energy solutions tailored to each sector's unique needs, enhancing resilience, sustainability, and cost-efficiency. For instance, they support water treatment facilities with reliable energy, ensure uninterrupted power for healthcare and distribution centers, offer energy-efficient solutions for indoor agriculture, and support the EV infrastructure with sustainable energy sources.

Scale Microgrids offers innovative financing through their Microgrid Service Agreements (MSAs), aligning with Energy Service Agreements (ESAs) and Power Purchase Agreements (PPAs), to alleviate customers from the risks of technology, construction, and performance of complex power systems. With no upfront or ongoing maintenance costs for customers, Scale owns and operates the microgrid charging for the energy services provided. This model ensures cost savings and risk management for customers, simplifying the transition to sustainable energy solutions.

Scale utilizes direct sales and strategic partnerships, providing capital and technical support to developers, OEMs, and technology providers. The company positions itself uniquely by addressing common market barriers, such as financing challenges and technical complexities, thus enabling rapid scale-up and customer adoption.

While assessing Scale Microgrids market strategy, it should be highlighted that while the company delivers robust modular and custom solutions integrating solar, battery storage, and dispatchable generation, they are not necessarily a technology provider but rather an investment and financing company with integration capacities

4. Assessment of key success factors for microgrid market strategies

Case studies of companies like Siemens, Schneider Electric, Enchanted Rock, ComAp, and Scale Microgrids allow for uncovering how they have navigated the complex interplay of technological innovation, market strategies, and regulatory environments. This analysis explores how these companies have succeeded or faced challenges in the rapidly evolving microgrid market, providing a nuanced understanding of the factors driving growth, innovation, and resilience in this critical sector.

The detailed breakdown of different market strategies presented through the case studies demonstrates how each company approaches the Commercial & Industrial (C&I) and Institutional & Governmental sectors, categorizing their financial strategies into traditional CAPEX models, Power Purchase Agreements (PPA), Energy as a Service (EaaS), Public-Private Partnerships (PPP), grants and subsidies, or hybrid models, including outright purchase/ownership models. The go-to-market models categorize each company’s role as a technology provider, integrator, technology supplier, or energy company, indicating whether they offer distribution, direct sales of components, and software/control systems for integrating microgrids. The microgrid technology section highlights companies' use of Energy Management Systems (EMS) and their integration of distributed energy sources, AI, and IoT advancements to create intelligent, self-contained systems capable of operating independently during grid disruptions. This information could now be put into the context of Table 2, which offers an analytical tool that breaks down the dimensions highlighted in the case studies, offering a detailed comparison of the services and strategies each company employs. It assesses the level of emphasis each company places on different sectors, such as commercial and military/government, and evaluates their business and ownership models, including outright ownership, energy as a service (EaaS), and participation in power purchase agreements (PPPs). Additionally, it examines whether the company acts as a hardware supplier and their emphasis on IoT and AI technology, culminating in a competitive score for each company based on these factors. The dimensions of Table 2 proof results for the aspects discussed in Table 1. For instance, the strong emphasis on institutional and governmental sectors in Table 1 is reflected in Table 2's military/government category. Similarly, the financial models in Table 1, such as PPA, PPP, and EaaS correspond to the ownership models in Table 2, illustrating how companies utilizing these strategies are represented under PPP and EaaS. The go-to-market strategies and categorizations, such as technology suppliers, integrators, or energy companies in Table 1 are reflected in Table 2's hardware supplier and IoT/AI technology offerings, showing a strong emphasis on IoT/AI technology for companies providing software and control systems for microgrids. This analysis is directly related to the research question: "What market strategies prove successful for microgrid companies operating in environments characterized by technological innovation, diverse customer profiles, and varied financial models?" By comparing and contextualizing the data from Table 2, it is possible to derive insights into the market strategies that are successful for microgrid companies. Table 2's detailed breakdown and competitive scores help validate the effectiveness of the various market approaches, financial models, and technological integrations. This analysis leads to a deeper understanding of each company's competitive landscape and strategic positioning, addressing the research question by identifying the successful market strategies in the context of technological innovation and diverse customer and financial environments.

Tabel 2. Case study results

Dimensions	**Market Segmentation**		**Financial and Business Models**			**Microgrid Technology**		**Competitive Score**
	Financial and business model							
	Commercial	Military/ Government	Ownership	EaaS	PPP	Hardware Supplier	IoT /AI Technology	
Siemens	2	3	2	2	2	3	3	17
Schneider Electric	3	2	2	3	2	3	3	18
Enchanted Rock	3	1	2	3	2	1	1	16
ComAp	2	2	0	0	0	3	3	10
Scale Microgrids	2	2	0	3	2	0	0	9

No offering – 0, offered – 1, some emphasis – 2, strong emphasis -3

Source: (Author's own).

Siemens emerges with a competitive score of 17, showcasing a balanced yet robust emphasis on military/government services, hardware supply, and IoT/AI technology. This profile suggests Siemens's strategic commitment to being a technology leader with significant engagements in government and military contracts. Schneider Electric leads the pack with a score of 18, indicating a slightly more comprehensive and balanced approach across the analyzed categories. Its strong focus on commercial sectors, EaaS, hardware supply, and IoT/AI technology underscores Schneider Electric's ambition for market leadership in technology and energy services. Enchanted Rock scores 16, emphasizing commercial sectors and EaaS while showing less engagement in military/government services, hardware supply, and IoT/AI technology. This focus points to a niche market strategy, prioritizing commercial applications and service-oriented models over broader technological or hardware developments. ComAp reflects a more concentrated strategy with a score of 10, marked by the absence of offerings in ownership, EaaS, and PPP. Its strengths lie in hardware supply and IoT/AI technology, indicating a preference for technological innovation over service model diversification or government sector engagement. Scale Microgrids attain the lowest score of 9, primarily emphasizing EaaS. The absence of military/government services, ownership, and hardware supply highlights a strategic choice to focus on commercial markets and energy services, sidelining hardware or broader technology integration.

Regarding market focus Schneider Electric emerges as the most versatile competitor, engaging actively in commercial and government sectors with a comprehensive service model. Siemens closely matches this versatility but with a slight tilt towards technology and government contracts. In contrast, Enchanted Rock presents a more niche orientation, with a strong focus on commercial sectors and EaaS. ComAp and Scale Microgrids display specialization, with ComAp gravitating towards technology and hardware and Scale Microgrids concentrating on service models.

Service vs. hardware orientation criteria show that both Schneider Electric and Siemens demonstrate a balanced inclination towards services and hardware, bolstered by their strong IoT/AI capabilities. This dual focus supports their competitive edge in the market. Conversely, Enchanted Rock leans more towards service, especially in the commercial domain. ComAp and Scale Microgrids manifest a clear specialization, with ComAp accentuating hardware and Scale Microgrids emphasizing services.

Technology emphasis analysis reveals that Siemens, Schneider Electric, and ComAp's pronounced emphasis on IoT/AI technology, signaling their strategic bets on technological innovation to secure a competitive advantage. Enchanted Rock and Scale Microgrids, however, place less emphasis on these technologies, indicating a strategy more rooted in market-specific solutions rather than forefront technology leadership.

Conclusion

This competitive analysis underscores the diverse strategic orientations of microgrid service providers, with Schneider Electric and Siemens portraying themselves as all-rounders with a strong technological and service-oriented approach. Enchanted Rock, while more niche, shows potential in the commercial and service sectors. ComAp and Scale Microgrids, despite their focused strategies, highlight the importance of specialization in a competitive market. Understanding these dynamics offers valuable insights into the microgrid industry's competitive landscape, pointing towards areas of growth, potential collaborations, and market opportunities.

Siemens and Schneider Electric have effectively utilized market segmentation strategies by identifying and targeting specific customer segments that benefit most from their advanced microgrid solutions, such as industrial complexes, big military installations, universities, and cities looking to enhance their energy efficiency and reliability. Their success can be attributed to their ability to develop tailored solutions that meet the distinct needs of these segments, as suggested by (Hunt & Arnett, 2004).

The analysis of industry structures and competitive dynamics, drawing on the work of (Karabag & Berggren, 2014), reveals how these companies position themselves within the microgrid market. Siemens and Schneider Electric, being large, established players, leverage their comprehensive product portfolios and global networks to exert a strong influence on industry standards and practices. This strategic positioning allows them to shape the competitive landscape to their advantage.

Enchanted Rock focuses on providing resilience-as-a-service to commercial and industrial clients, emphasizing the critical infrastructure segment. This approach aligns with the segmentation theory by targeting a niche market that highly values reliability and uninterrupted power, demonstrating an understanding of specific customer needs.

ComAp and Enchanted Rock highlight the importance of adopting cutting-edge technologies, such as advanced control systems, gas turbines and storage systems, to enhance the appeal of their microgrid offerings. This strategy reflects the insights of (Sioshansi, 2011)regarding the significance of technological advancements in driving the adoption of microgrids. By integrating these technologies, Enchanted Rock can offer more cost-effective and efficient solutions and ComAp can focus on channel strategies, appealing to a broader range of customers focused on sustainability and energy savings.

Acknowledgment

List of interviewed company representatives for the case studies:

Director Business Development Siemens Energy, October 6, 2023
Sustainability Manager and VP of Project Development, Schneider Electric, November 17 and December 2, 2022
Global Director Business Development and Sales Manager, ComAp, June 29, 2023, and September 21, 2023
Global Account Director, Enchanted Rock, January 10, 2023
Clean Energy Project Developer Scale Microgrids, October 6, 2023

References

Albarakati, A. J., Boujoudar, Y., Azeroual, M., Eliysaouy, L., Kotb, H., Aljarbouh, A., Khalid Alkahtani, H., Mostafa, S. M., Tassaddiq, A., & Pupkov, A., (2022), Microgrid energy management and monitoring systems: A comprehensive review, *Frontiers in Energy Research*, https://doi.org/10.3389/fenrg.2022.1097858.

Asmus, P., Lawrence, M., (2016), *Emerging Microgrid Business Models 1. Executive Summary*, Navigan Consulting.

Cai, C., Zhang, L., Lai, G., Zhou, J., Zhou, L., Qin, Y., Tang, Z., (2025), Optimal sizing and cost-benefit assessment of stand-alone microgrids with different energy storage considering dynamic avoided GHG emissions, *Journal of Energy Storage,* doi: 109. 115128. 10.1016/j.est.2024.115128.

Cleary, K., Palmer, K., (2019), *Energy-as-a-Service: A Business Model for Expanding Deployment of Low-Carbon Technologies The Low-Carbon Technology Deployment Challenge*, Resources for the Future, Washington.

Cohn, L., (2022), *Look at these microgrid funding options — and think big*, Microgrid Knowledge, https://www.microgridknowledge.com/distributed-energy/article/11427148/look-at-these-microgrid-funding-options-and-think-big, accessed: December 2024.

ComAp, (2024a), *ComAp - Application areas*, ComAp Website, https://www.comap-control.com/application-areas/, accessed January 2025.

ComAp, (2024b), ComAp business initiatives (Interview).

ComAp, (2024c), ComAp - Microgrids and Hybrid Power Generation. ComAp Homepage. https://www.comap-control.com/insights/microgrids-and-hybrid-power-generation/, accessed January 2025.

Debouza, M., Al-Durra, A., EL-Fouly, T. H. M., & Zeineldin, H. H., (2022), Survey on microgrids with flexible boundaries: Strategies, applications, and future trends, *Electric Power Systems Research*, https://doi.org/10.1016/j.epsr.2021.107765.

Dias, J., Khanna, S., Paquette, C., Rohr, M., Seitz, B., Singla, A., Sood, R., & Van Ouwerkerk, J., (2017), McKinsey on Digital Services Introducing the next-generation operating model.

Enchanted Rock, (2023), Microgrid Knowledge (Interview).

Golden, S., (2020), *Financial models that will get you that on-site microgrid*, https://www.greenbiz.com/article/financial-models-will-get-you-site-microgrid, accessed January 2025.

Goodrick, D., (2019), Comparative Case Studies, *SAGE Research Methods Foundations*, https://doi.org/10.4135/9781526421036849021.

Gridscape, (2023*), Microgrid Financing in California: Addressing Challenges and Harnessing Opportunities – Gridscape*, https://grid-scape.com/microgrid-financing-in-california-addressing-challenges-and-harnessing-opportunities/, accessed December 2024.

Growjo, (2025), *Scale Microgrid Solutions: Revenue, Competitors, Alternatives*. https://growjo.com/company/Scale_Microgrid_Solutions?utm, accessed January 2025.

Hanna, R., Ghonima, M., Kleissl, J., Tynan, G., & Victor, D. G., (2017), Evaluating business models for microgrids: Interactions of technology and policy, *Energy Policy*, 103, pp. 47-61, https://doi.org/10.1016/j.enpol.2017.01.010.https://doi.org/10.1016/j.enpol.2017.01.010

Hitchens, K., (2022), *Port of Long Beach, Schneider Electric start construction on $12.2 million microgrid project*, Microgrid Knowledge, https://www.microgridknowledge.com/google-news-feed/article/11427396/port-of-long-beach-schneider-electric-start-construction-on-122-million-microgrid-project, accessed January 2025.

Hitchens, K., (2023a), *Breaking Historical Power Norms: Energy and Resiliency as a Service,* Microgid Knowledge, https://www.datacenterfrontier.com/special-reports/article/11427522/breaking-historical-power-norms-energy-and-resiliency-as-a-service, accessed December 2024.

Hitchens, K., (2023b), *Resiliency-as-a-Service: Solutions for a More Resilient Future*, Microgid Knowledge, https://www.microgridknowledge.com/reliability-resilience/article/33005216/mesa-solutions-resiliency-as-a-service-solutions-for-a-more-resilient-future, accessed December 2024.

Hunt, S. D., Arnett, D. B., (2004), Market segmentation strategy, competitive advantage, and public policy: Grounding segmentation strategy in resource-advantage theory, *Australasian Marketing Journal, 12(1),* https://doi.org/10.1016/S1441-3582(04)70083-X.

Jiang, Z., (2023), Comparison and Analysis between the Different Social Software, *Advances in Economics, Management and Political Sciences*, 8(1). https://doi.org/10.54254/2754-1169/8/20230270.

Jiayi, H., Chuanwen, J., & Rong, X., (2008), A review on distributed energy resources and MicroGrid, *Renewable and Sustainable Energy Reviews*, 12(9), https://doi.org/10.1016/j.rser.2007.06.004.

Karabag, S. F., & Berggren, C., (2014), Antecedents of firm performance in emerging economies: Business groups, strategy, industry structure, and state support, *Journal of Business Research*, 67(10), https://doi.org/10.1016/j.jbusres.2014.01.004.

LeadIQ, (2025), Enchanted Rock Company Overview, Contact Details & Competitors, LeadIQ, https://leadiq.com/c/enchanted-rock/5a1d7ffa24000024005af882?utm, accessed January 2025.

Lessambo, F. I., (2022), Introduction to Project Finance, in: *International Project Finance* (pp. 1–10), Springer International Publishing, https://doi.org/10.1007/978-3-030-96390-3_1.

Lysek, M., (2019), Disguising diversification for innovation, *International Journal of Innovation Science*, 11(1). https://doi.org/10.1108/IJIS-05-2018-0051.

Madhani, P., (2010), Resource Based View (RBV) of Competitive Advantage: An Overview. https://www.researchgate.net/publication/45072518_Resource_Based_View_RBV_of_Competitive_Advantage_An_Overview, accessed November 2024.

Mehlig, J., Rosén, S., (2023), From photovoltaics to microgrids A case study on Loccioni and how its tailored solutions compete with standardized products in the energy utility industry, http://www.teknik.uu.se/education/, accessed January 2025.

Microgrid Knowledge, (2019), Understanding the Energy-as-a-Service Model for Microgrids, https://www.microgridknowledge.com/editors-choice/article/11429901/understanding-the-energy-as-a-service-model-for-microgrids?utm, accessed January 2025.

Mohamadi, F., (2021), Introduction to Project Finance in Renewable Energy Infrastructure, in: *Introduction to Project Finance in Renewable Energy Infrastructure*, Springer International Publishing. https://doi.org/10.1007/978-3-030-68740-3.

Mora, D., Taisch, M., Colombo, A. W., (2012), Towards an energy management system of systems: An industrial case study. *IECON Proceedings (Industrial Electronics Conference*), https://doi.org/10.1109/IECON.2012.6389588.

Murray, D., (2023), Foothill Consultant Network Introduction to Microgrids (Interview).

Porter, M. E., (1980), Industry Structure and Competitive Strategy: Keys to Profitability, *Financial Analysts Journal*, 36(4), pp.30–41. https://doi.org/10.2469/faj.v36.n4.30.

Raff, R., Golub, V., Knežević, G., Topić, D., (2022), Modeling of the Off-Grid PV-Wind-Battery System Regarding Value of Loss of Load Probability, *Energies*, 15(3), https://doi.org/10.3390/en15030795

Rickerson, W., & Kallay, J., (2022), *Future Proofing The Texas Grid With Distributed Energy Resources.* Texas Advanced Energy Business Alliance.

Robertson, M., Palmer, K., Srishti, S., (2023), Expanding the Possibilities: When and Where Can Grid-Enhancing Technologies, Distributed Energy Resources, and Microgrids Support the Grid of the Future?, https://www.rff.org/publications/reports/expanding-the-possibilities-when-and-where-can-grid-enhancing-technologies-distributed-energy-resources-and-microgrids-support-the-grid-of-the-future/, accessed December 2024.

Rodriguez Labastida, R., (2023), *Guidehouse Insights Leaderboard: Microgrid Integrators Assessment of Strategy and Execution for Nine Microgrid Integrators*, Guidehouse Research.

Rogers, E. M., (1962), *Diffusion Of Innovations*, Macmillan.

Scale Microgrids, (2024), Scale Microgrids Business Activities (Interview).

Schneider Electric, (2023), Quarterly financial results | Schneider Electric Global, https://www.se.com/ww/en/about-us/investor-relations/financial-results.jsp, accessed January 2025.

Schurr, A., (2018), Enchanted Rock Background (Interview).

Siemens AG, (2024), 2024 Annual Report Siemens AG. https://www.siemens.com/global/en/company/investor-relations/events-publications-ad-hoc/annualreports.html, accessed March 2024.

Sioshansi, F. P., (2011), Smart Grid: Integrating Renewable, Distributed and Efficient Energy, in: *Smart Grid: Integrating Renewable, Distributed and Efficient Energy*, https://doi.org/10.1016/C2010-0-68348-9.

Spair, R., (2023), *Understanding IoT: Tips, Recommendations, and Strategies for Success*, self-published e-book.

INNOWACYJNE RYNKI ENERGETYCZNE: STRATEGIE RYNKOWE MIKROSIECI

Abstrakt

Cel – W tym artykule zbadano, jak różni dostawcy mikrosieci konkurują ze sobą. Skupiono się na kluczowych strategiach biznesowych 5 innowatorów rynkowych, a wnioski mogą być przydatne dla krajów, w których obecni operatorzy mikrosieci rozpoczynają działalność.
Metoda – dane pierwotne zebrano poprzez wywiady z ekspertami branżowymi i dyrektorami firm mikrosieciowych. Aby zapewnić głębię i kompleksowość, badanie to uwzględnia również źródła danych wtórnych, w tym raporty branżowe, strony internetowe firm i prace naukowe. W kolejnym kroku została przeprowadzona analiza porównawcza. Ustrukturyzowane studia przypadków ujawniają, w jaki sposób firmy rozwijają swoje operacje i strategie, aby wykorzystać ewoluujący krajobraz energetyczny, oferując wgląd w aspekty ekonomiczne i organizacyjne branży mikrosieciowej.
Wyniki– Firmy takie jak Siemens, Schneider Electric, Enchanted Rock, ComAp i Scale Microgrids wytyczają sobie nisze poprzez odrębne strategie wprowadzania na rynek. Siemens i Schneider Electric wyłaniają się jako liderzy, demonstrując kompleksowe podejście, które równoważy innowacje technologiczne z solidną ofertą usług, obsługując zarówno sektor komercyjny, jak i rządowy. Skupienie Enchanted Rock na sektorach komercyjnych i modelach Energy-as-a-Service (EaaS) ilustruje ukierunkowane podejście, preferujące obsługę niszowych rynków o wysokich wymaganiach dotyczących odporności energetycznej. Nacisk ComAp na sprzęt i technologię sygnalizuje zaangażowanie w podstawowe aspekty systemów mikrosieci, stawiając innowacje w komponentach ponad szersze zaangażowanie rynkowe.

Słowa Kluczowe: mikrosieci, innowacyjne rynki energii, modele biznesowe, strategie rynkowe mikrosieci

JEL classification: O31, O33, L1, L2

Volkmar Kunerth
CEO Accentec Technologies LLC/ IoT Business Consultants
Address: 2040 Martin Ave #2702, Santa Clara, CA 95050, U.S.A.
E-mail address: kunerth@accentectechnologies.com

Przemyslaw Borkowski (corresponding author)
University of Gdansk
Armii Krajowej 11/121, 81-824 Sopot
przemyslaw.borkowski@ug.edu.pl