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Summary of WP Individual Part

Understanding Consumer Priorities: Strategic Pathways for Energy-as-a-Service Providers in Europe

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Abstract

The Energy-as-a-Service (EaaS) model is reshaping the renewable energy sector, transitioning from traditional energy delivery to integrated, consumer-centric solutions. This research investigates the attributes that most significantly drive consumer adoption of EaaS in Europe and explores strategies for effective market positioning. Using perceptual mapping and conjoint analysis, informed by expert interviews and consumer surveys, the study uncovers critical trade-offs, such as technological innovation versus affordability and community engagement versus accessibility. Key findings emphasize the importance of seamless transitions, technological sophistication, and contract flexibility. The research offers strategic insights for EaaS providers navigating consumer priorities in an evolving energy market.

Keywords: Energy-as-a-Service (EaaS), Renewable Energy Adoption, Consumer Preferences, Perceptual Mapping, Conjoint Analysis, Market Positioning Strategies

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Table of Content

Introduction

If you could design the ideal energy system for the future, what would it look like?
It would be clean, seamlessly integrated, and tailored to community needs, offering flexibility and accessibility to all. The traditional model of centralized energy generation, where power flows one way to passive, rate-paying consumers, is giving way to a more dynamic and consumer-focused approach. In this evolving landscape, Energy-as-a-Service (EaaS) redefines energy consumption by packaging renewable energy solutions into tailored, subscription-based services designed to meet diverse consumer needs while prioritizing sustainability.

The Energy-as-a-Service (EaaS) model represents a significant transformation in how energy is consumed and managed, shifting the focus from ownership of energy-generating assets to a service-oriented relationship between providers and consumers. Similar to the rise of electric vehicle leasing, this new energy model allows providers to offer a comprehensive suite of services beyond just supplying power. Consumers can now subscribe to a full package, including system installation, maintenance, monitoring, and expert consulting. (Enel X, 2023). By removing the need for upfront capital expenditure, EaaS is democratizing access to renewable energy technologies, such as solar and wind power, by shifting the financial burden of ownership to the provider.

The EaaS model is particularly well-suited to the renewable energy sector, where capital-intensive infrastructure, such as solar panels or wind turbines, often represents a significant barrier to entry for consumers. By offering these technologies as a service, providers are lowering the financial barriers that prevent widespread adoption, while also offering continuous maintenance and system upgrades. This

approach fosters a long-term relationship with customers, ensuring energy efficiency and cost-effectiveness over time. Moreover, as the European market increasingly emphasizes energy sustainability, this model is emerging as a solution that aligns with regulatory mandates and consumer preferences.

Relevance of the Research

The relevance of studying the adoption of EaaS models in the European residential market cannot be overstated. From a business perspective, this represents a lucrative opportunity. The European residential EaaS market, valued at EUR 2.1 billion in 2023, is projected to grow at a robust compound annual growth rate (CAGR) of 9.7% through 2032 (Global Market Insights, 2024). Key market players like Enel X, Iberdrola, and Siemens AG are capitalizing on this growth by expanding their service offerings, which now include solar PV installations, energy storage systems, and energy management software (Enel X, 2023). As these companies diversify their solutions, they cater to an expanding audience that demands energy independence, resilience, and efficiency.

This shift towards EaaS models is not only a business opportunity but also an essential driver for environmental sustainability. The increasing adoption of renewable energy technologies is a direct response to the urgent need to mitigate climate change. The European Union has set aggressive targets for carbon neutrality by 2050, which requires a 55% reduction in greenhouse gas emissions by 2030 compared to 1990 levels (European Commission, 2021). The energy sector is central to achieving these goals, as it is responsible for over 75% of total EU emissions (European Environment Agency, 2020). EaaS models can significantly contribute to reducing carbon emissions from homes. By simplifying access to renewable energy technologies, these models encourage a shift away from fossil fuels and towards cleaner energy sources. By facilitating the transition to decentralized and electrified energy systems, EaaS

promotes the use of low-carbon technologies and contributes to global climate change mitigation efforts.

Beyond regulatory and environmental factors, consumer behavior is also shifting. Rising energy costs, driven by fluctuating utility tariffs and increasing demand, are pushing homeowners to seek out long-term solutions that offer financial stability and efficiency. In this context, EaaS provides a unique value proposition: it offers consumers predictable energy costs, enhanced operational transparency, and reduced carbon footprints—all without the need for large, upfront investments.

Research Question

Given the growing importance of these trends, this research addresses the question: **Which attributes of Energy-as-a-Service (EaaS) models most significantly influence consumer adoption in the European renewable energy market, and how can suppliers effectively position and differentiate their services to align with emerging consumer demands?**

Methodology

To address this research question, our study will employ two crucial methodologies: perceptual mapping and conjoint analysis. Both are highly effective tools in marketing research, particularly for understanding consumer preferences and decision-making in complex markets like EaaS.

Perceptual Mapping will allow the research to visualize how consumers perceive different EaaS providers and service attributes along multiple dimensions. By mapping these perceptions, we can identify the psychological associations consumers hold with

various service features, such as cost, technological sophistication, environmental impact, and reliability. This method helps us detect "white spaces" in the market, where untapped opportunities for differentiation exist. Identifying these dimensions will be key to understanding where current players excel and where they may be falling short in meeting consumer expectations.

Conjoint Analysis, on the other hand, is designed to simulate real-world decision-making by presenting consumers with a series of trade-offs between different service attributes. This method allows us to quantify the relative importance of each attribute in driving consumer choices—whether it's cost savings, environmental benefits, or ease of use. By evaluating how consumers prioritize these features, suppliers can fine-tune their service offerings to better align with market demand. The insights from conjoint analysis will be critical for determining which attribute combinations are most likely to result in increased adoption of EaaS models.

These methodologies will be supplemented by expert and consumer interviews. Industry experts will provide insight into broader market trends, technological innovations, and strategic priorities within the renewable energy space, while consumer interviews will offer a ground-level perspective on the factors that influence adoption. Together, these qualitative and quantitative approaches will create a comprehensive understanding of both the supply and demand sides of the market.

Structure of the Research

This report begins with a foundational context section, offering a detailed overview of key market trends, regulatory drivers, and the evolving landscape of Energy-as-a-Service (EaaS). This section serves as a primer for readers who may be unfamiliar with the industry, breaking down the complexities of EaaS and its role

within the broader renewable energy transition. Establishing this context is critical for understanding the significance of the research and the strategic opportunities it seeks to address.

Building on this groundwork, the literature review delves into the current state of knowledge on EaaS models, the adoption of renewable energy technologies, and the regulatory and environmental dynamics shaping the market. By reviewing a diverse range of academic, industry, and governmental sources, this section identifies existing insights into the research question while highlighting gaps that this study aims to address. The literature review also provides a theoretical basis for the use of perceptual mapping and conjoint analysis, situating these methodologies within the broader field of consumer behavior and marketing research.

Following the literature review, we conduct expert interviews with professionals across the energy and renewable sectors, including individuals from the companies under study. These interviews, involving roles such as product managers, marketing strategists, and sustainability officers, offer a practitioner's perspective on how EaaS providers currently position their services and address consumer demands. The insights gained will shape the subsequent phases of the research, ensuring relevance and practical applicability.

The next phase involves consumer interviews, which are designed to segment consumers into defined personas based on demographic, behavioral, and psychographic characteristics. These interviews will yield preliminary insights into consumer priorities, enabling the refinement of attributes for perceptual mapping and conjoint analysis.

The report then transitions to perceptual mapping, a visual tool that illustrates consumer perceptions of EaaS models along critical dimensions. This analysis will uncover how consumers evaluate various providers relative to important attributes, identifying gaps in the competitive landscape and opportunities for strategic differentiation.

Finally, the research culminates in conjoint analysis, which quantifies the trade-offs consumers are willing to make between different EaaS attributes. This phase provides robust, data-driven insights into the factors most influential in driving adoption, such as ease of transition, technological sophistication, affordability, and flexibility. These findings will guide providers in tailoring their offerings to align with consumer needs, delivering actionable recommendations for market positioning and differentiation in the EaaS space.

Preview of the Results

The adoption of Energy-as-a-Service (EaaS) models is shaped by a complex set of consumer priorities, where cost savings—though important—are only part of the equation. Our findings indicate that ease of transition, technological sophistication, flexibility, and affordability are central to consumer decision-making. These preferences reveal a nuanced hierarchy, where seamless onboarding and accessible solutions often take precedence over advanced features or community-driven initiatives, particularly in the initial stages of adoption.

EaaS represents a pivotal shift for energy providers, combining renewable energy delivery with service-oriented models to address consumer needs while aligning with Europe's regulatory and sustainability objectives. The study highlights the importance of reducing barriers to adoption, such as by offering flexible contracts and intuitive

onboarding processes, to attract a broader audience. Additionally, while sustainability and community-oriented solutions remain valued, these attributes are often secondary considerations when compared to practical factors such as affordability and accessibility.

To succeed, providers must adopt a phased approach. The initial focus should be on streamlining adoption by simplifying the consumer journey and enhancing accessibility through digital transformation. As consumer familiarity grows, providers can expand their portfolios with innovative technologies and community-focused solutions that align with broader environmental goals. This research provides a foundation for actionable recommendations, helping providers tailor their offerings to meet evolving consumer expectations in the European EaaS market while achieving differentiation in an increasingly competitive landscape.

Preliminary Interviews: Insights, Hypothesis Formation, and Consumer Personas

In preparation for the perceptual mapping survey, **six expert interviews** were conducted to provide a deeper understanding of the Energy-as-a-Service (EaaS**)** market. These interviews were pivotal in refining our hypotheses and pinpointing the key dimensions for deeper analysis, particularly regarding how EaaS providers can strategically position their services to align with evolving consumer needs and shifting market dynamics. The selected participants, representing major industry players such as Schneider Electric, Enel X, Engie, Siemens, Veolia, and an academic expert from KU Leuven, provided a diverse range of perspectives from both the corporate and academic spheres. Comprehensive company profiling and background research were conducted to gain insights into the organizational structures and market approaches

of these entities, which are detailed in ***Appendix 1***. This preparatory work ensured that our discussions were both targeted and relevant, allowing us to explore the strategic nuances each company brings to the EaaS landscape..

These interviews provided both **macro-level insights** into regulatory and market dynamics and **micro-level insights** into consumer behavior, technology adoption, and service differentiation strategies. Below, we discuss the most critical questions we asked during each interview and the insights obtained. The findings will inform the perceptual mapping study that follows, guiding the identification of key **associative dimensions** that influence consumer perception of EaaS offerings.

Project Engineer – Schneider Electric (France Office)

Schneider Electric has established itself as a leader in energy management and automation, offering comprehensive EaaS solutions that emphasize energy efficiency and smart grid technologies. Our discussion with their Project Engineer aimed to uncover the technical constraints Schneider Electric faces in scaling EaaS services and how they plan to overcome these obstacles through technology and market strategy.

Key Questions Asked:

1. How does Schneider Electric address the technical challenges of integrating renewable energy systems into existing infrastructures?
2. What role do predictive maintenance and real-time data analytics play in improving the EaaS model's value proposition?
3. How do performance guarantees through energy performance contract**s** (EPC) influence customer adoption in Europe?

Key Insights:

- **Interoperability between old and new systems** was identified as a significant challenge in the mass rollout of EaaS solutions. Schneider Electric's existing infrastructure, built on legacy systems, often needs to be integrated with modern IoT-based energy management tools. This presents a friction point, especially for residential consumers who require seamless, plug-and-play solutions.
- **Predictive maintenance**, facilitated by AI-driven analytics, was highlighted as an essential value driver for Schneider's EaaS offerings. Consumers—particularly in commercial settings—are more likely to adopt EaaS if they can see measurable operational savings through automated energy optimization and proactive issue detection. This insight is timely, given the increased focus on reducing operational costs in post-pandemic Europe, where businesses are being forced to optimize processes for efficiency.
- **Energy performance contracting (EPC)** is crucial for driving adoption in both commercial and residential contexts. Schneider Electric's use of EPCs, which offer performance guarantees on energy savings, helps reduce risk for clients. This is increasingly important in an energy market where cost volatility and regulatory pressure (such as carbon pricing) make long-term energy planning more complex. EPCs ensure predictable outcomes, which is a key concern for risk-averse industries.

Senior Energy Market Analyst – Enel X (Germany Office)

Enel X, a subsidiary of Enel Group, focuses on digital energy solutions and smart energy infrastructure. Our interview with the Senior Energy Market Analyst centered

on how European regulations and evolving consumer preferences are influencing the company's EaaS strategy, particularly in the areas of pricing, sustainability, and smart infrastructure deployment.

Key Questions Asked:

1. How are regulatory policies like the European Green Deal influencing EaaS adoption in Germany and Europe more broadly?
2. What pricing models resonate most with consumers, particularly those driven by sustainability goals?
3. How is Enel X differentiating itself through the integration of smart technologies in a crowded market?

Key Insights:

- **Regulatory incentives** are a significant driver of EaaS adoption in Germany, where energy policies are aligned with decarbonization goals. Enel X sees subsidies for renewable energy installations and energy efficiency mandates as key levers for accelerating consumer interest in EaaS, especially for households looking to reduce their dependence on traditional energy suppliers. Moreover, carbon taxation and penalties for exceeding emission targets are pushing businesses toward EaaS as a way to manage energy demand more efficiently.
- **Pricing models** that emphasize dynamic pricing and cost transparency have shown the greatest traction. In particular, time-of-use pricing, where consumers are charged different rates based on peak and off-peak energy usage, has been effective in shifting consumption patterns and encouraging more responsible energy use. As energy costs become increasingly volatile due to geopolitical factors (such as the 2022 Russian energy crisis), these flexible

pricing mechanisms are becoming more attractive to both residential and commercial consumers.

- Enel X is focusing heavily on **smart home integration**, offering consumers end-to-end energy management solutions that integrate renewable energy generation, storage, and usage optimization within the home. This includes the deployment of smart thermostats, automated lighting, and appliance monitoring systems that communicate with one another to optimize energy consumption in real time. The expert emphasized that consumers are increasingly seeking holistic energy solutions that provide both comfort and efficiency through seamless integration. This insight suggests that smart home integration will likely be a critical dimension in our perceptual mapping, as consumers will associate the convenience and simplicity of such systems with higher value propositions in EaaS offerings.

Internal Consultant – Engie (Belgium Office)

Engie is a major player in Europe's transition to renewable energy and decentralized energy systems. The internal consultant provided insights into how decentralization is reshaping the traditional energy model and how renewable energy integration is driving the EaaS model's appeal, particularly for residential consumers.

Key Questions Asked:

1. How is decentralization changing the energy value chain, and how does Engie leverage this trend in its EaaS offerings?
2. What are the most critical consumer drivers for adopting decentralized, renewable energy systems?
3. How is Engie managing the challenge of integrating intermittent renewable energy into its EaaS platforms?

Key Insights:

- **Decentralization** is one of the most disruptive trends reshaping the European energy market. Engie's approach to decentralization involves the integration of microgrids and distributed energy resources (DERs), such as solar panels and battery storage, into its EaaS offerings. This not only enables greater energy independence for consumers but also reduces grid congestion, a growing issue as energy demand increases across Europe..
- The **demand for renewable energy** is particularly high among younger consumers and eco-conscious segments. Engie has observed that energy independence is becoming a primary driver for residential consumers adopting EaaS, as they look for ways to buffer themselves against grid volatility and price increases. This aligns with broader European trends, where the pursuit of energy sovereignty has accelerated due to geopolitical instability and climate policies that prioritize renewable energy over fossil fuels.
- A significant challenge lies in managing the **intermittency** of renewable energy sources. Engie is addressing this by leveraging advanced energy storage solutions and predictive analytics to smooth out fluctuations in energy supply. The ability to ensure energy reliability in the face of intermittency will likely emerge as a critical dimension in the perceptual mapping survey, as consumers increasingly value both energy independence and reliability.

Strategy and GTM Officer – Siemens (Netherlands Office)

Siemens is recognized for its cutting-edge smart grid technologies and digital energy platforms. Our interview with the Strategy and Go-To-Market (GTM) Officer centered on Siemens' approach to market differentiation and consumer education, particularly in competitive and tech-driven markets like Europe.

Key Questions Asked:

1. What unique value propositions differentiate Siemens' EaaS offerings in the competitive European market?
2. How does Siemens approach the education of consumers about the benefits of EaaS?
3. How does Siemens manage the balance between affordability and technological sophistication in its EaaS services?

Key Insights:

- Siemens differentiates itself by offering highly **customized solutions** for different market segments. The company uses advanced predictive maintenance and real-time energy management systems to offer higher levels of service reliability, which is especially appealing to commercial and industrial consumers.
- **Consumer education** is a central pillar of Siemens' EaaS strategy. The expert emphasized that many consumers still lack a clear understanding of what EaaS entails and its long-term benefits. Siemens invests in digital platforms and interactive tools that allow consumers to simulate potential cost savings and environmental impact from switching to EaaS. Educating consumers on the value of energy optimization and long-term savings is crucial in driving adoption.
- **Affordability** vs. **sophistication** is a balancing act Siemens manages through modular service offerings. Consumers are given flexibility to start with basic energy management services and scale up to more advanced features—like

smart home integration or automated energy trading—as their energy needs evolve.

Academic Researcher – KU Leuven (Belgium)

The academic perspective was provided by a researcher from the Master in Energy for Smart Cities program at KU Leuven, which focuses on the integration of renewable energy technologies into urban environments. This interview offered valuable insights into the research and development trends shaping the future of EaaS, with particular emphasis on the intersection of smart cities and energy management.

Key Questions Asked:

1. What emerging trends in smart cities and energy management will most impact the growth of EaaS?
2. How are academic institutions contributing to the development of new technologies and frameworks for EaaS?
3. What consumer behavior trends are most relevant when studying adoption patterns for EaaS models?

Key Insights:

- The expert highlighted the role of **smart city integration** as a key driver for the advancement of EaaS solutions. As European cities invest heavily in smart grids, renewable energy infrastructure, and urban energy storage, EaaS becomes essential for managing these interconnected systems. Urbanization and the rapid growth of smart cities create a demand for scalable, intelligent energy solutions that not only address environmental challenges but also enhance the quality of life for urban residents. In this context, EaaS offers a powerful framework for managing complex urban energy flows, ensuring sustainability,

resilience, and energy efficiency. The smart city agenda plays a pivotal role in shaping consumer expectations. The move toward urban digitalization has heightened consumer awareness of smart energy solutions, making technological sophistication a key dimension for EaaS providers to consider. The researcher suggested that technological adoption and user experience would likely emerge as critical variables in the perceptual mapping survey, especially for younger, tech-savvy urban consumers who value efficiency, convenience, and innovation in their energy solutions.

- **Collaboration between academia and industry** is crucial in advancing EaaS technologies. Research institutions like KU Leuven are actively involved in R&D partnerships with energy companies, focusing on the development of next-generation technologies such as AI-driven energy optimization, blockchain-enabled peer-to-peer energy trading, and advanced energy storage solutions. The researcher noted that these academic-industry collaborations are playing a significant role in creating the technological underpinnings that will support the future scalability of EaaS across Europe.
- Regarding **consumer behavior**, the researcher identified three core dimensions that are most relevant for studying EaaS adoption patterns: environmental consciousness, cost sensitivity, and technology adoption. European consumers, particularly in urban settings, are increasingly prioritizing sustainability in their energy choices, with a growing willingness to invest in technologies that reduce their carbon footprint. At the same time, cost savings remain an essential factor, particularly in light of rising energy prices and economic uncertainty. Finally, the researcher emphasized that the successful adoption of EaaS will depend on how well consumers perceive the ease-of-use and integration of the technological tools—such as smart home systems and automated energy management platforms—within their daily lives.

Strategic Insights and Hypotheses: A Multi-Dimensional Exploration of Drivers and Perceptions in the EaaS Market

The insights gathered from these six expert interviews have provided a comprehensive, multi-dimensional perspective on the Energy-as-a-Service (EaaS) landscape. By synthesizing insights from the technical, regulatory, and consumer behavior perspectives, we have identified several key dimensions that will be explored in greater depth through our perceptual mapping and conjoint analysis. These dimensions include **cost sensitivity**, **environmental impact**, **technological integration**, and **energy independence**.

Moreover, these interviews have allowed us to form several refined **hypotheses** that push beyond the obvious drivers, offering a more nuanced exploration of how consumers and businesses will approach EaaS:

1. **Cost Sensitivity vs. Long-Term Value Hypothesis**: While cost savings remain important, we hypothesize that long-term value creation—including aspects such as predictive energy optimization and performance guarantees (as seen in Schneider Electric's approach)—will increasingly outweigh immediate cost concerns. Consumers may prioritize services that offer long-term stability, risk reduction, and measurable performance outcomes, particularly in regions with volatile energy markets or tight regulatory constraints.
2. **Sustainability as a Trust Marker Hypothesis**: Beyond simple environmental awareness, we hypothesize that consumers will view sustainability as a marker of trust and brand integrity. Companies that authentically align their services with broader environmental commitments (e.g., Engie's decentralized renewable energy integration) will be seen as more reliable and future-proof, influencing both adoption rates and **brand loyalty**. Consumers are likely to

differentiate between superficial "greenwashing" and genuine, embedded sustainability practices.

3. **Technological Sophistication and Consumer Control Hypothesis**: We anticipate that technological sophistication will not just be an enabler but a key differentiator in consumer empowerment. Consumers who are drawn to EaaS will likely place a high value on their ability to monitor, control, and optimize their energy consumption in real time (as noted by Enel X's smart home integration). However, the hypothesis extends further: we expect that the perceived ease-of-use and seamless integration of smart home technologies will create a distinct advantage for providers, tipping the scales in favor of those who offer user-friendly, plug-and-play solutions.
4. **Energy Independence and Psychological Security Hypothesis**: Beyond the technical benefits of energy independence, we hypothesize that consumers' desire for autonomy over their energy supply will be driven by a need for psychological security. In light of geopolitical instability and volatile energy markets, consumers will increasingly view self-sufficiency as a safeguard against external disruptions. This shift in mindset may be more pronounced among residential users in decentralized energy systems (like Engie's model) and those in countries with aggressive renewable energy targets.

Additionally, these expert interviews have revealed critical industry challenges such as navigating diverse regulatory environments, the complexities of integrating decentralized systems, and the need for effective consumer education to demystify the EaaS model and emphasize its long-term value. These challenges will be central to our analysis, informing how EaaS providers can strategically position their offerings to meet consumer expectations while adhering to regulatory constraints.

Developing Consumer Personas from Expert Insights: Refining Market Segmentation for EaaS

The expert interviews conducted across industry leaders and academic voices provided crucial insights into the evolving dynamics of the Energy-as-a-Service (EaaS) market. These interviews did not merely confirm the known drivers of consumer behavior but revealed nuanced perspectives on how different consumer segments approach energy consumption, technology adoption, and sustainability. The creation of **consumer personas** based on these insights allows us to systematize our understanding of the market and apply targeted analysis to our subsequent perceptual mapping and conjoint analysis.

While our research will engage all participants through a **single survey**, the personas we developed will enable us to segment the data effectively. This segmentation will illuminate distinct consumer needs and motivations, ensuring that our analysis is attuned to the diverse approaches consumers take toward adopting EaaS solutions. Below, we explain the rationale behind the creation of these personas and how they will enhance the depth and applicability of our research.

Extracting Consumer Drivers from Expert Insights

The expert interviews with key figures from Schneider Electric, Enel X, Engie, Siemens, Veolia, and KU Leuven highlighted the multifaceted nature of consumer engagement in the EaaS market. What emerged was a set of **core behavioral drivers** that cut across various demographic and psychographic profiles. These include cost sensitivity, environmental consciousness, technological comfort, and the pursuit of energy independence.

- **Cost sensitivity**, as identified by Schneider Electric, is an overriding concern for many consumers, particularly in regions where energy prices fluctuate due to external factors like geopolitical instability. Performance guarantees, such as those embedded in energy performance contracts, appeal strongly to consumers seeking long-term financial predictability and reduced operational costs.
- **Environmental consciousness** was repeatedly stressed by experts from both Engie and Veolia, who noted that a growing segment of consumers is driven by a deep commitment to sustainability. These consumers prioritize the reduction of carbon footprints and are willing to invest in services that align with their ethical and environmental values.
- **Technological comfort** is another critical dimension. As discussed by Enel X and Siemens, the rapid evolution of smart home systems and real-time energy management platforms is redefining how consumers engage with energy. Consumers are no longer passive recipients but active participants in their energy consumption, empowered by IoT and AI-driven solutions.
- Finally, **energy independence**, as emphasized by Engie, is increasingly appealing to consumers seeking autonomy from traditional grid systems. This driver is especially pronounced in decentralized systems where individuals can generate, store, and even sell back excess energy, giving them more control over both costs and supply.

Developing Consumer Personas: Key Dimensions

Based on these interviews, we identified four key dimensions—price sensitivity, environmental consciousness, technological comfort, and energy independence—that allow us to craft distinct consumer personas. These personas serve as heuristic tools

to conceptualize different consumer mindsets and behaviors, creating a foundation for segmentation even within a unified survey design.

Each persona embodies a specific blend of these key dimensions, reflecting the varying degrees of emphasis that different consumer segments place on these factors:

1. **Cost-Conscious Optimizer**:
   This persona is defined by a relentless focus on financial prudence. Motivated primarily by cost savings, the Cost-Conscious Optimizer seeks out EaaS solutions that offer predictable financial benefits, such as dynamic pricing models and energy performance guarantees. This segment is particularly sensitive to pricing transparency and will be drawn to services that minimize upfront costs and optimize energy usage over time. Schneider Electric's emphasis on performance contracting suggests that this persona would value services that provide quantifiable, long-term return on investment. For this group, energy is a cost center to be managed with precision.
2. **Eco-Conscious Consumer**:
   This persona places sustainability at the forefront of decision-making. Willing to pay a premium for environmentally friendly services, the Eco-Conscious Consumer is deeply motivated by ethical considerations and the desire to minimize their environmental impact. This segment responds to renewable energy integration, carbon footprint tracking, and transparency around environmental benefits. Both Engie and Veolia emphasized that eco-conscious consumers seek clear, measurable outcomes in terms of reducing their contribution to global warming. For this group, energy consumption is not merely a utility but a moral choice, and they are particularly responsive to brands that prioritize environmental transparency.

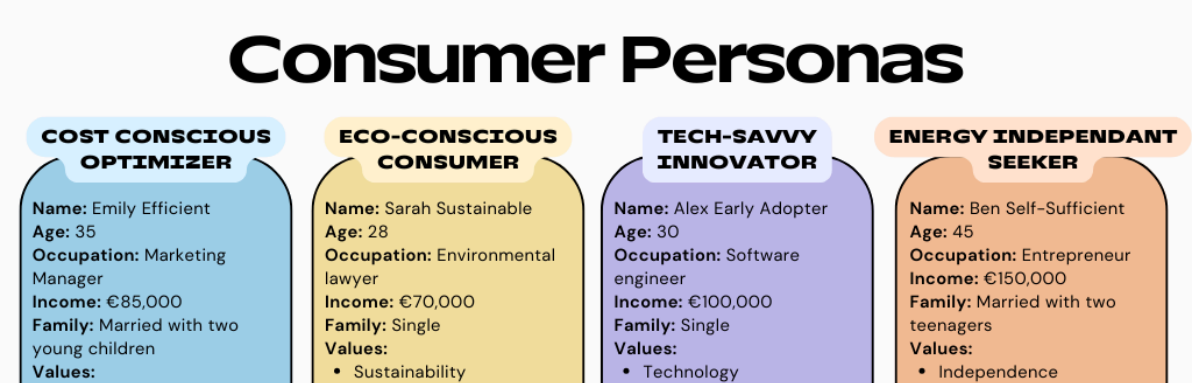
3. **Tech-Savvy Innovator**:

   A highly engaged and forward-thinking persona, the Tech-Savvy Innovator is drawn to technological sophistication and user control. They are not just adopters of EaaS; they are looking for integrated smart home systems, real-time data on energy consumption, and seamless interaction between devices. As identified in Enel X and Siemens interviews, these consumers view technology as a pathway to convenience and optimization. The ability to monitor, adjust, and automate energy use through a unified platform appeals to their desire for efficiency and control. This persona would be more likely to adopt cutting-edge solutions and seek out brands that offer an intuitive, tech-centric user experience.

4. **Energy Independent Seeker**:

   This persona is driven by a desire for autonomy and resilience. Energy Independent Seekers prioritize systems that allow them to generate, store, and manage their energy, reducing their reliance on traditional grids. Engie's emphasis on decentralized energy systems underscores the appeal of independence for this segment, particularly in the face of geopolitical instability and rising energy prices. These consumers view EaaS as a tool for achieving self-sufficiency and mitigating external risks, and they are likely to be early adopters of microgrid and energy storage solutions.

Below is a representation of the four consumer personas identified. These personas highlight the key demographic and behavioral segments targeted, offering insights into their unique motivations, values, and needs within the European EaaS market.



Refining the Survey with Personas in Mind

Although we will deploy a **single survey** across the consumer base, our four personas will guide the **framing of questions** and the **interpretation of results**. By ensuring that the survey covers a broad range of concerns—from pricing to technology adoption and environmental sustainability—we can ensure that it speaks to the needs of different segments without explicitly siloing the respondents into distinct categories. The personas will also help us segment and analyze the data more effectively post-survey.

For instance:

- **Cost-conscious consumers** will be drawn to questions about **pricing models** and **performance guarantees**.
- **Eco-conscious consumers** will respond strongly to questions about **renewable energy use** and **carbon footprint reduction**.
- **Tech-savvy consumers** will value insights on **smart home integration** and the **user experience** of energy management tools.
- **Energy-independent consumers** will be interested in topics around **self-sufficiency**, decentralized systems, and **energy storage solutions**.

Thus, the survey becomes a **multi-dimensional tool**, capable of capturing the diverse priorities of all consumer types, while enabling us to conduct a more granular segmentation during the analysis phase.

How Personas Serve the Research

The creation of these personas serves several critical functions in our research:

- **Refining Hypotheses**: Each persona reflects different value propositions that are likely to influence EaaS adoption. By segmenting the market into these

groups, we can better test our hypotheses on cost sensitivity, sustainability, technological adoption, and energy independence.

- **Improving Perceptual Mapping**: Personas will inform how we visualize consumer perceptions in our perceptual mapping survey, enabling us to identify distinct market gaps and opportunities for service differentiation.
- **Guiding Strategic Recommendations**: The personas provide a structured framework for tailoring recommendations to EaaS providers. By understanding the unique drivers behind each consumer segment, providers can develop more targeted marketing strategies, optimize product offerings, and address specific market needs.

Ultimately, these personas will allow us to engage with the complexities of the EaaS market more effectively, ensuring that our research captures the diverse consumer perspectives that shape the market's future. They will guide both the interpretation of survey data and the strategic conclusions we draw regarding market positioning and service customization.

Consumer Perceptions: Principal Component Analysis and Perceptual Mapping

Data Collection and Sampling Strategy

To gain a deep understanding of consumer perceptions regarding the leading Energy-as-a-Service (EaaS) providers, we conducted a survey targeting individuals within relevant consumer groups. These groups were carefully selected based on the previously defined personas representing various demographics and psychographics with distinct energy needs and preferences. To enhance authenticity and relevance, we

used LinkedIn and other social networking platforms, reaching out to individuals who actively engaged with the pages or other online communities of companies such as Schneider Electric, Siemens, Enel X, Engie, and Veolia. **This approach ensured that respondents had a baseline familiarity with the companies under study,** allowing us to collect informed opinions that reflected the perceptions of potential or current customers within the EaaS market. We were able to collect a total 63 responses over a period of 4 weeks.

Methodology: Principal Component Analysis (PCA)

Our survey was designed to capture a wide range of perceptual dimensions, covering attributes such as **Good Value**, **Green Commitment**, **Honesty**, **Consistent Service**, **Trustworthiness**, **Helpful Customer Service**, **Ease of Transition**, **Innovation**, **Flexibility**, and **Community-Centeredness** (see ***Appendix 2*** for detailed descriptions of each attribute). These attributes were chosen to reflect both functional aspects (e.g., service quality, affordability) and emotional aspects (e.g., trust, alignment with community values) of the consumer-brand relationship in the EaaS sector, providing a holistic view of consumer perceptions.

To analyze these dimensions, we employed **Principal Component Analysis (PCA)** in SPSS, a statistical method used to simplify complex data sets by reducing multiple correlated variables into a smaller set of core components. This approach, known as **factor reduction analysis**, identifies patterns among the variables, helping to uncover underlying structures in consumer perceptions. By doing so, PCA reveals which attributes are most closely associated with each other and distills them into a few overarching components or factors. This process is especially valuable in market research, as it allows us to condense an array of related attitudes into meaningful, manageable categories that highlight the primary drivers of consumer preferences.

To further refine these components, we applied **Varimax rotation**—a technique that maximizes the variance of loadings across variables on each component. In simple terms, Varimax rotation adjusts the orientation of the components to make the relationships between variables and components as clear and distinct as possible. This rotation ensures that each attribute is strongly associated with only one component, making the results easier to interpret by aligning each component with the most relevant attributes. Ultimately, Varimax rotation enhances the clarity of the analysis, providing a more focused understanding of the key perceptual dimensions that shape consumer attitudes within the EaaS market.

By using PCA with Varimax rotation, we distilled the original set of perceptual attributes into two primary components, each representing a unique dimension of consumer perception.

PCA Output: Scree Plot and Total Variance Explained

The scree plot and Total Variance Explained table (refer to ***Appendix 3*** for the complete PCA output) indicate that two primary components effectively capture over 91% of the total variance in consumer perceptions. Specifically, **Component 1** explains approximately **74.88%** of the variance, and **Component 2** accounts for an additional **16.17%**, yielding a cumulative variance of **91.05%**. This high cumulative variance demonstrates that these two components provide a comprehensive and insightful summary of the data, encapsulating the key differentiators in consumer perceptions among the surveyed companies. In other words, the two components serve as the primary perceptual dimensions that shape how consumers evaluate and compare EaaS providers.

Interpretation of the Rotated Component Matrix

The Varimax-rotated component matrix offers clearer insights into how different attributes relate to each component, highlighting two primary dimensions of consumer perception:

1. **Component 1: Innovation and Trust vs. Affordability, Flexibility, and Consistency**
    - **Attributes with Positive Loadings**: Trustworthy, Innovative, Honest, Helpful
    - **Attributes with Negative Loadings**: Flexible, GoodValue, Consistent
    - **Interpretation**: Component 1 captures a **Trust and Innovation Orientation** but reflects **trade-offs regarding flexibility, affordability, and consistency**. Brands that score high on this component are perceived as highly innovative, transparent, and customer-focused. However, these same brands may be viewed as less flexible, more premium-priced, and potentially less consistent due to the complexity associated with innovative offerings. **This aligns with the idea that advanced technology solutions in the energy sector can require rigid structures and higher costs, possibly limiting the flexibility of service packages.**
2. **Component 2: Community and Environmental Focus vs. Ease of Transition**
    - **Attributes with Positive Loadings**: CommunityCentered, GreenCommitment
    - **Attributes with Negative Loadings**: TransitionEase

- **Interpretation**: Component 2 captures a **Community and Environmental Orientation**, where brands are perceived as eco-conscious and community-focused. However, the negative loading on TransitionEase suggests that consumers may find it challenging to switch to these brands, likely due to the community-specific or sustainable nature of their offerings, which may require greater adaptation. The positive loading on GreenCommitment in this component aligns well with community-centered companies often focusing on environmental goals, even though the loadings are close enough to suggest a small overlap in green perceptions across both components.

Addressing Component Rotation in the Perceptual Plot

The rotated component plot visually represents the components in rotated space. Interestingly, Component 1 and Component 2 appear to have swapped orientations, which is a typical outcome of Varimax rotation. In this process, Varimax rotation repositions the axes to maximize the variance of loadings on each component, aligning each with its strongest defining attributes. This adjustment enhances interpretability by making it easier to see which attributes are most associated with each component, but it does not alter the underlying structure or meaning of the components themselves.

As a result, while the plot may visually flip the axes, the interpretations of each component remain consistent with the data's inherent structure:

- **Component 1 - Innovation vs. Contract Flexibility and Value for Money**

Component 1 highlights the tension between attributes such as innovation, trustworthiness, and helpfulness, which are perceived as indicators of advanced,

cutting-edge offerings, and attributes like contract flexibility and affordability. Providers that emphasize technological sophistication and innovation often gain trust and are seen as highly reliable, but this focus may come at the expense of offering adaptable contractual terms or being perceived as cost-effective. For instance, brands positioning themselves as "innovative" may be associated with rigid contracts and premium pricing, which could deter consumers who value the ability to customize service terms or prioritize affordability in their decision-making.

- **Component 2 - Community Orientation vs. Accessibility and Ease of Transition**

Component 2 underscores the balance between community-focused and environmentally sustainable attributes versus accessibility and ease of transition. Providers that lead in community engagement and environmental commitment—such as those supporting local energy projects or promoting sustainability initiatives—are valued by consumers with strong environmental and social priorities. However, these offerings may be perceived as less accessible due to potential complexities in onboarding or perceived exclusivity in service delivery. Consumers prioritizing seamless transitions may view highly community-centric models as more demanding, particularly if they require significant behavioral changes or infrastructure adjustments.

This blending of dimensions arises from the natural relationships within the data, where certain attributes consistently co-occur, shaping each component into a mix of factors that reflect consumer perceptions in a more nuanced way. The Varimax rotation simply clarifies these relationships, making the distinct yet blended nature of each component easier to interpret.

The resulting components illustrate the intricate interplay of consumer priorities within the EaaS market. Providers face the dual challenge of aligning advanced innovation with adaptable, consumer-friendly contract options while balancing community engagement and sustainability with straightforward, accessible service models.

Perceptual Mapping and Positioning of EaaS Providers

The perceptual map (*Figure 4*) offers a visual representation of each EaaS provider's positioning along the two main perceptual dimensions:

- **Schneider Electric** and **Siemens**: Positioned in the lower left quadrant, these companies score relatively low on **Innovation Meets Value** but high on **Community Orientation Balanced with Accessibility**. This reflects their broad, established presence and large network of branches, which enhance accessibility and ease of transition for consumers. Their extensive global reach and ability to offer personalized, localized services make them approachable options for a wide range of consumers, who view them as accessible and community-oriented. However, they are perceived as less innovative compared to newer, specialized players in the EaaS sector, potentially due to a focus on traditional service structures and established technology rather than cutting-edge solutions.
- **Enel X**, **Engie**, and **Veolia**: In contrast, these companies are positioned in the upper right quadrant, indicating a high score on **Innovation Meets Value** but relatively low on **Community Orientation Balanced with Accessibility**. As newer, more specialized providers, they are seen as leaders in innovation and advanced technology but are perceived as less accessible or affordable. Their technology-driven, specialized offerings may not cater as broadly to

community-based initiatives, and the limited affordability may further restrict their appeal to consumers seeking accessible solutions. This positioning highlights a trade-off: while these brands are viewed as innovative, they have yet to establish the same accessibility and community integration as larger, traditional providers like Siemens and Schneider Electric.

- **Potential Market Opportunity**: The perceptual map reveals an underrepresented area in the upper right quadrant for brands capable of combining **technological innovation, affordability, flexibility, and community engagement**, all within an environmentally sustainable framework. The data suggests that most providers tend to excel in only a subset of these attributes—either focusing on innovation and premium offerings or emphasizing community-centered, accessible solutions at the expense of advanced technology. This gap indicates a potential demand for EaaS providers that can offer an integrated value proposition, balancing high-tech solutions with affordability and ease of adoption. Successfully occupying this space could appeal to a broad consumer segment seeking advanced, eco-friendly energy options that are both adaptable and rooted in community values, setting such a provider apart in the EaaS market.

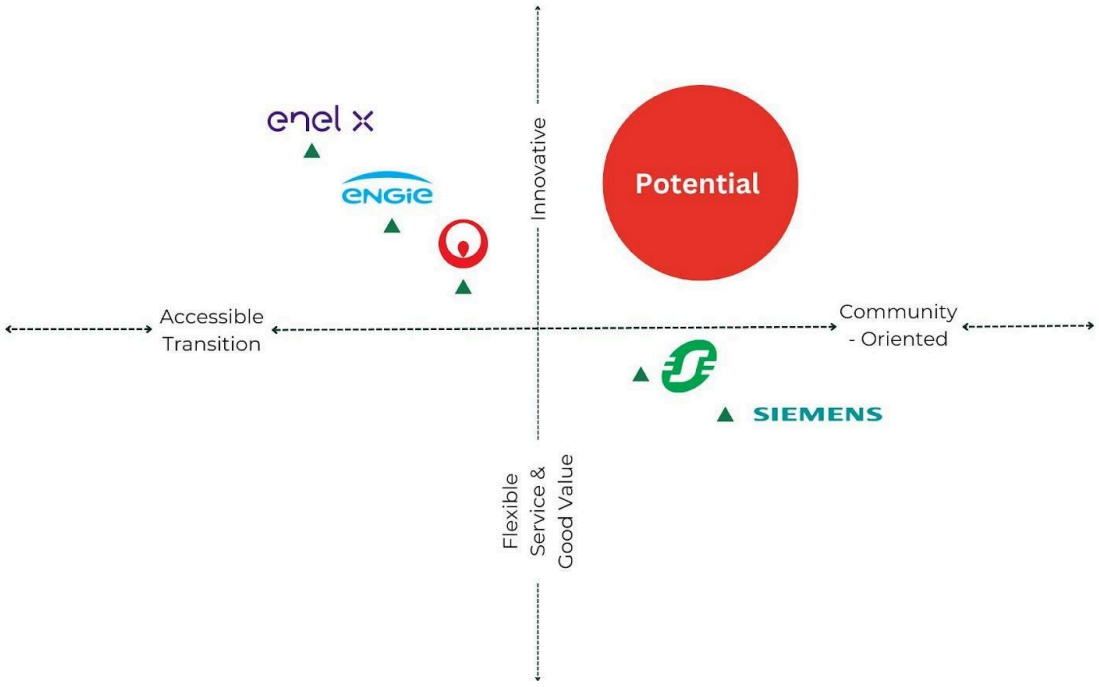


Figure 4: Perceptual Map

Results Recapitulation: Key Consumer Perception Trade-Offs and Strategic Implications

The analysis of consumer perceptions in the Energy-as-a-Service (EaaS) market unveils two critical trade-offs that underpin how providers are evaluated. These findings highlight the nuanced and multidimensional priorities of consumers, offering valuable insights into the drivers of adoption within this emerging sector. By examining these trade-offs, we identify not only the key attributes that shape consumer preferences but also the inherent tensions providers must navigate to effectively position their offerings.

The first trade-off revolves around the balance between technological innovation and the provision of flexible and affordable services. Providers that emphasize advanced technological solutions—such as cutting-edge energy management systems

or AI-driven optimization tools—are often perceived as innovative, trustworthy, and forward-thinking. These attributes strongly appeal to early adopters and tech-savvy consumer segments who prioritize technological sophistication as a marker of reliability and market leadership. However, the prioritization of innovation can inadvertently limit flexibility in service design and customization, creating rigidity in areas such as contract terms or service modularity. Moreover, the premium pricing associated with technologically advanced solutions can alienate cost-sensitive consumers, restricting broader market penetration. This trade-off underscores a fundamental tension within the EaaS market: while technological advancement is a powerful driver of perceived value, its benefits must be carefully balanced with affordability and adaptability to meet the needs of diverse consumer segments.

The second trade-off emerges from the interplay between community orientation and sustainability versus accessibility and ease of transition. Providers that adopt a community-centered approach—focusing on localized renewable energy initiatives such as neighborhood solar arrays or wind energy projects—are often viewed as eco-conscious and socially responsible. This alignment with consumer values fosters trust and loyalty, particularly among those who prioritize environmental stewardship and community engagement. However, the localized nature of these offerings can create barriers for consumers seeking standardized, easily accessible energy solutions. The perceived complexity of community-oriented models, coupled with the potential need for specific infrastructure or resources, may deter individuals who prioritize convenience and a seamless transition process. This trade-off illustrates the challenges faced by providers striving to align with both sustainability-driven values and the growing demand for effortless consumer experiences.

These findings have profound implications for EaaS providers seeking to differentiate themselves in an increasingly competitive landscape. Innovation-driven providers may

attract early adopters but must address the limitations of inflexibility and high costs to expand their appeal. Incorporating adaptable contract options, modular service packages, or tiered pricing models can enhance accessibility without compromising the innovative edge that defines their value proposition. Similarly, community-focused providers, while resonating strongly with environmentally conscious consumers, should invest in simplifying the onboarding experience and standardizing aspects of their service delivery to broaden their reach. By doing so, they can bridge the gap between sustainability and convenience, ensuring that their offerings remain relevant to a wider audience.

These trade-offs underscore the complexity of consumer decision-making within the EaaS market. Providers that can effectively balance advanced technological offerings with flexibility and good value for money, or community engagement with accessibility and ease of transition, are better positioned to differentiate themselves meaningfully. Addressing these competing priorities not only enhances market appeal but also positions providers to capture a larger and more diverse consumer base.

Looking forward, the next stage of this research will involve conducting a conjoint analysis to quantitatively assess the relative importance of individual attributes—such as innovation, affordability, sustainability, and ease of transition—in shaping consumer preferences. While the perceptual mapping analysis has illuminated broad perceptual dimensions and revealed critical trade-offs, conjoint analysis will provide granular, data-driven insights into the specific trade-offs consumers are willing to make. This methodological progression will enable a deeper understanding of how consumers prioritize various service features, offering actionable intelligence for EaaS providers to refine their strategies. By leveraging these insights, providers can tailor their offerings to align with consumer priorities more precisely, ultimately fostering greater adoption and positioning themselves as leaders in the evolving EaaS market.

INDIVIDUAL SECTION:

Foundational Context: Analyzing Key Trends and Geographical Market Dynamics

The Global Energy Transition: Decarbonization and the Digital Revolution

The global energy sector is undergoing a profound transformation, shaped by the dual forces of **decarbonization and digitalization**. These macro trends, now central to the global agenda, are reshaping how energy is generated, distributed, and consumed, giving rise to new business models like Energy-as-a-Service (EaaS). These models are increasingly seen as pivotal in achieving the sustainability goals set by governments and global institutions. According to the International Renewable Energy Agency (IRENA), renewable energy sources could meet more than 90% of global electricity demand by 2050 (IRENA, 2020), a projection that underscores the scale of the transition and its reliance on innovation across industries.

This transition is not merely about replacing fossil fuels with renewables; it involves a fundamental restructuring of the energy system itself. The move toward decarbonization—driven by the urgent need to combat climate change—is inextricably linked to digitalization, which facilitates more efficient energy use, management, and distribution (Dwivedi, 2022). This interconnection between sustainability and technology presents an unprecedented opportunity for energy providers to redefine their roles and value propositions. Energy-as-a-Service (EaaS) is one such innovative model, designed to address the complexities of this energy transition by shifting from traditional ownership-based frameworks to service-oriented energy models. In the EaaS model, energy is no longer a mere commodity but a fully integrated service that includes energy generation, monitoring, optimization, and long-term maintenance.

The decarbonization imperative is clear. According to the Intergovernmental Panel on Climate Change (IPCC), limiting global warming to 1.5°C requires rapid and deep emissions reductions across all sectors, particularly energy, which is responsible for approximately 75% of global greenhouse gas emissions (IPCC, 2021). Governments are responding with increasingly stringent regulatory frameworks that accelerate the transition to renewable energy sources. For example, the European Green Deal aims for Europe to be the first climate-neutral continent by 2050, mandating substantial reductions in greenhouse gas emissions, promoting energy efficiency, and prioritizing the deployment of renewable energy technologies (European Commission, 2021). These regulations are a driving force behind the adoption of EaaS, as they encourage both consumers and businesses to adopt more sustainable energy practices.

At the same time, digitalization is revolutionizing the energy landscape by enabling smarter, more dynamic energy systems. Technologies like the Internet of Things (IoT), artificial intelligence (AI), and big data analytics are integral to the EaaS model, as they allow for real-time energy management and optimization. For instance, IoT sensors embedded in energy infrastructures can continuously monitor consumption patterns and environmental conditions, providing detailed, granular data that enables more efficient energy use (Oulefki et al., 2024). These sensors also enable predictive maintenance, reducing downtime and enhancing system reliability by identifying potential failures before they occur. Moreover, AI-driven algorithms can forecast energy demand, optimize supply chains, and balance energy loads in real-time, leading to increased efficiency and reduced waste. The ability to harness vast amounts of data and convert it into actionable insights allows EaaS providers to offer personalized, data-driven services that not only meet but anticipate consumer needs.

As the energy market becomes increasingly **decentralized**, with more distributed energy resources (DERs) like solar panels and home battery systems, the role of EaaS

becomes even more significant. Traditionally, energy flowed in a linear fashion—from large centralized power plants to passive consumers. However, this is rapidly changing. With decentralized systems, consumers are generating their own power, storing it, and even feeding it back into the grid. This complexity demands sophisticated management tools, which EaaS delivers through its digital infrastructure. This shift represents a move away from the traditional "one-size-fits-all" model of energy provision to a more flexible, consumer-centric approach where energy is delivered as a customized service (Liu et al., 2022).

Furthermore, blockchain technology is emerging as a key enabler of EaaS by facilitating peer-to-peer energy trading, allowing individuals and businesses to buy and sell excess energy directly, bypassing traditional utilities. Blockchain ensures the transparency, security, and decentralization of these transactions, which aligns with the broader trend toward energy democratization. This technology not only supports the financial transactions within the EaaS model but also enhances consumer engagement, providing new revenue streams and contributing to the overall decentralization of energy markets (Zedan et al., 2024).

The consumer experience is also central to the EaaS model. By leveraging digital tools, EaaS providers create a seamless, outcome-based energy service where consumers no longer simply pay for kilowatt-hours. Instead, they subscribe to a fully managed energy service that adjusts to their needs in real time. Consumers benefit from greater transparency, control, and flexibility, as their energy usage can be optimized continuously, lowering costs and improving sustainability (Valcon, 2023). Importantly, these consumer-centric models align with the growing demand for personalization and sustainability in energy consumption, particularly in markets like Europe, where environmental awareness is high and regulatory pressures are strong (HSBC, 2018). This aligns with the increasing expectation that energy providers should not only

deliver energy but also support environmental and social objectives, making EaaS a compelling solution for the modern energy consumer.

As illustrated in Figure 1, the convergence of digital infrastructure, regulatory frameworks, and technological advancements is accelerating the adoption of EaaS, positioning it as a critical component of the future energy market. The model is gaining traction because it offers a holistic solution to both consumers and businesses, addressing the complex challenges of energy consumption, decarbonization, and digital integration simultaneously.

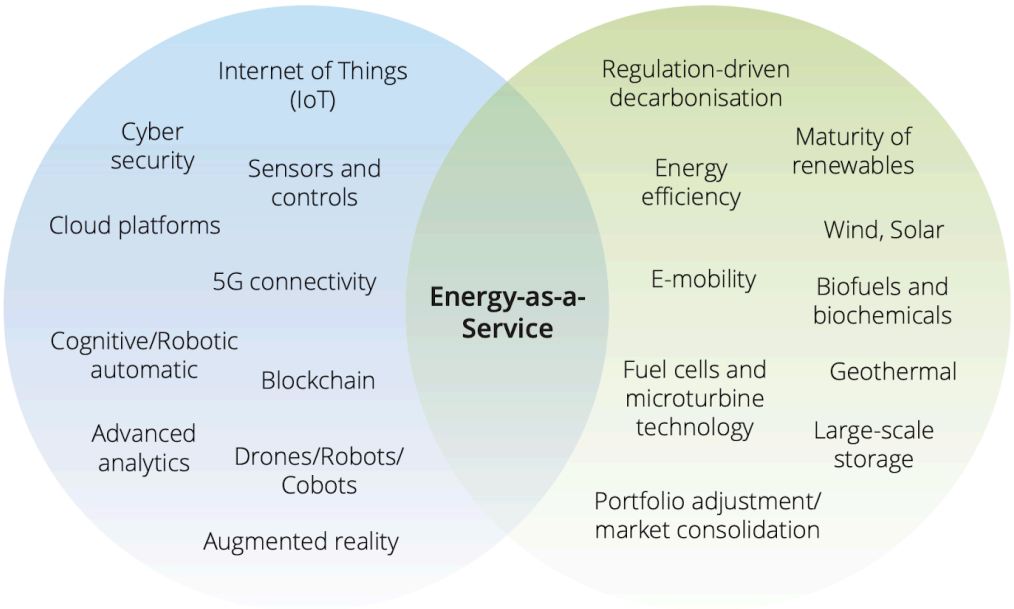


Figure 1: Converging Technological and Regulatory Drivers Shaping the Energy-as-a-Service (EaaS) Market (Source: Deloitte)

Evolution from Centralized Systems to Decentralized, Service-Oriented Models

The traditional centralized energy system, which has long been the dominant structure of energy production and distribution, is rapidly being replaced by

decentralized energy systems (Judson et al., 2020). In centralized systems, large power plants (often coal, gas, or nuclear) generate electricity, which is then delivered to consumers through an extensive, unidirectional transmission grid. Consumers in this model are largely passive recipients of energy—paying for the energy they use, with little control over its source, generation, or distribution. This system, while efficient in its time, is increasingly seen as outdated due to its lack of flexibility, inefficiency in terms of energy loss over long distances, and its reliance on fossil fuels.

The rise of distributed energy resources (DERs), such as solar panels, wind turbines, and energy storage technologies, is driving the shift toward decentralization. These technologies enable consumers—whether residential, commercial, or industrial—to not only generate their own energy but also store and even sell excess energy back to the grid, fundamentally transforming the dynamics of the energy market (Jenkins, 2023). This change marks a significant departure from the top-down, utility-controlled energy landscape to a more flexible, consumer-driven model where energy flows in multiple directions, reflecting the growing trend towards energy democratization.

The implications of this shift are profound. Decentralized systems offer several advantages over centralized ones, including greater resilience, reduced transmission losses, and enhanced flexibility (Javid et al., 2020). By localizing energy generation, decentralized systems reduce the need for extensive infrastructure and offer a buffer against grid disruptions caused by extreme weather or technical failures. This is particularly relevant in the context of climate change, where increasing incidences of natural disasters can disrupt centralized grids for extended periods (Mohanty et al., 2024). The resilience offered by decentralized systems, in which communities or individuals can generate and store their own energy, ensures a more robust energy infrastructure capable of withstanding disruptions.

However, the transition to decentralized systems also presents significant challenges. The integration of intermittent renewable energy sources, like solar and wind, into a grid designed for continuous, centralized energy generation is complex. These intermittent energy sources require sophisticated energy storage solutions and real-time balancing to ensure the grid remains stable and reliable. Here, Energy-as-a-Service (EaaS) models emerge as a critical enabler, offering the technological integration and management services necessary to handle this complexity. By combining predictive maintenance, demand response, and real-time energy monitoring, EaaS turns decentralized energy systems into seamless, manageable ecosystems for consumers (Panda et al., 2023).

In a decentralized system, consumers become **prosumers**—actively participating in both energy production and consumption. This shift empowers individuals and businesses alike, as they are no longer beholden to utility companies for their energy needs (Poudou et al., 2024). Consumers who produce their own energy, often through renewable sources, can store excess energy in batteries or sell it back to the grid through peer-to-peer energy trading platforms, further contributing to the democratization of energy systems. As prosumers, individuals can now leverage their own energy assets not only to save on utility bills but also to generate income. Blockchain technology, for instance, is being used to facilitate transparent and secure peer-to-peer energy trading, supporting the transition to decentralized models (Perger et al., 2021).

EaaS plays a pivotal role in this transition by bundling energy generation with management services. The decentralized energy system introduces a layer of complexity that most consumers are not equipped to manage. EaaS addresses this by offering integrated services that simplify the process of generating, storing, and distributing energy. For example, EaaS providers can manage distributed energy

resources (DERs) using smart grids, enabling real-time adjustments to energy flows, and IoT devices that continuously monitor energy consumption patterns. These services include not only energy generation but also energy optimization, maintenance, and demand-side management, offering consumers a comprehensive, hands-off solution (El-Afifi et al., 2024).

Moreover, as renewable energy generation grows, the importance of energy storage becomes even more pronounced. Technologies like lithium-ion batteries and hydrogen storage are essential to smoothing out the variability of renewables, such as solar and wind, which depend on weather conditions (Amir et al., 2023). EaaS models are particularly well-suited to integrating storage solutions into consumer energy systems, providing on-demand access to stored energy when renewable generation is low. This not only ensures energy continuity but also optimizes energy use by allowing consumers to draw from stored energy during peak demand periods when energy prices are typically higher.

As shown in Figure 2, the energy market is evolving from a vertically integrated, centralized system to a more horizontally networked, distributed structure. In this new model, energy flows are no longer unidirectional; rather, they are multidirectional, facilitated by smart technologies that allow for greater flexibility and control. This shift is supported by regulatory incentives in regions like Europe, where policy frameworks such as the European Green Deal encourage the adoption of decentralized, renewable energy solutions. These frameworks are creating favorable market conditions for EaaS providers to offer flexible, innovative solutions that meet the diverse needs of both consumers and businesses.

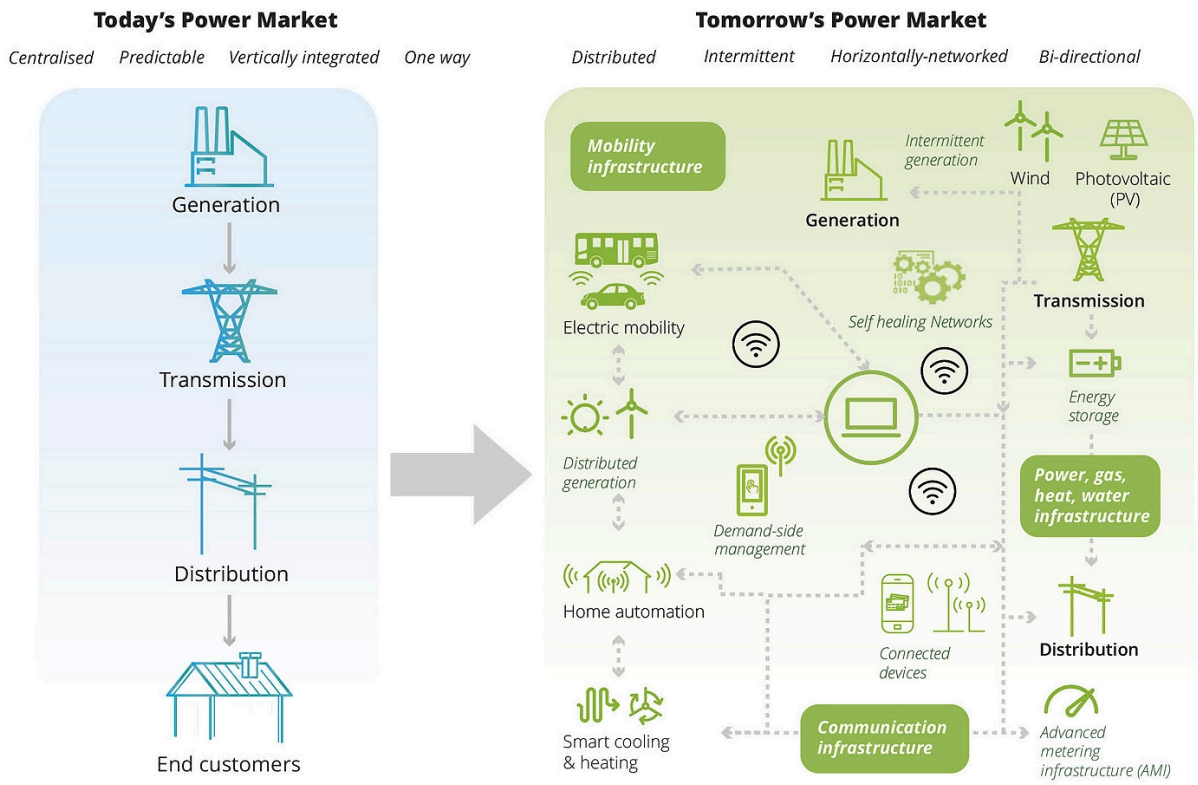


Figure 2: The Shift from Centralized to Decentralized Power Markets: Enabling a Bi-Directional, Digitally-Driven Energy Future (Source: Deloitte)

EaaS providers are particularly well-positioned to take advantage of this evolution by offering scalable, service-oriented models that accommodate the growing demand for decentralized energy. These services not only address the complexities of integrating multiple energy sources but also offer the flexibility needed to respond to the fluctuating supply of renewable energy and the changing demands of consumers. In doing so, EaaS ensures that decentralized systems can operate efficiently and effectively while providing consumers with greater control over their energy use.

EaaS in the European Context: Regulatory Support and Market Leadership

Europe's leadership in the global energy transition is underpinned by a combination of ambitious climate policies, regulatory frameworks, and early adoption of renewable energy technologies. The continent's commitment to sustainability is evident in its stringent decarbonization targets, which are designed to reduce carbon emissions, drive the adoption of renewable energy, and create a resilient, low-carbon economy. At the heart of this strategy is the European Green Deal, an unprecedented policy initiative aimed at making Europe the first climate-neutral continent by 2050. This ambitious plan outlines a comprehensive roadmap to reduce greenhouse gas emissions by 55% by 2030, implement carbon pricing mechanisms, and promote energy efficiency across all sectors (European Commission, 2021). These goals reflect Europe's recognition that urgent and systemic changes are needed to mitigate the impacts of climate change and accelerate the transition to renewable energy.

The European Green Deal is not merely a political statement; it represents a well-structured framework that is driving real change in how energy is produced, distributed, and consumed. Central to this plan are financial incentives, regulatory measures, and legislative frameworks that promote the deployment of renewable energy technologies, smart grids, and energy efficiency measures across Europe. Financial instruments such as the Innovation Fund and the Modernisation Fund, alongside carbon pricing mechanisms like the Emissions Trading System (ETS), are catalyzing investments in clean energy technologies and infrastructure (Ernst & Young Global, 2023). These policies are not just stimulating demand for renewable energy but are also creating favorable conditions for Energy-as-a-Service (EaaS) providers to

offer new, integrated energy solutions. The regulatory landscape in Europe is thus a major driver of the region's role as a global leader in the energy transition.

In this evolving context, Energy-as-a-Service (EaaS) is emerging as a critical enabler of the European energy transition. EaaS models, which bundle energy generation, management, and optimization into a seamless service offering, are particularly well-suited to the complex demands of the European market. Europe's ambitious sustainability targets require innovative approaches to decarbonize the energy sector, improve energy efficiency, and integrate distributed energy resources (DERs) such as wind, solar, and battery storage systems. EaaS providers are stepping in to fill this gap, offering comprehensive energy solutions that allow consumers and businesses to access clean energy without the burden of ownership or large capital investments.

Leading companies such as **Siemens**, **Schneider Electric**, and **Engie** are at the forefront of this movement. These companies are leveraging their expertise in renewable energy and digital technologies to offer tailored solutions that combine energy generation, distribution, and optimization in a single service package (Deloitte, 2019). For instance, Schneider Electric's EaaS portfolio integrates energy performance contracting, demand-side management, and smart home automation, enabling consumers to benefit from real-time energy optimization and cost savings. This approach not only supports Europe's decarbonization goals but also addresses the growing demand for sustainable, flexible, and scalable energy solutions.

What sets Europe apart is its advanced digital infrastructure, which enables the seamless integration of smart technologies into energy service offerings. This infrastructure includes smart meters, IoT devices, and cloud-based energy management platforms that allow EaaS providers to collect and analyze vast amounts of data in real-time. These technologies offer real-time insights into energy

consumption patterns, helping providers optimize energy use and predict future demand. For instance, IoT-enabled sensors can monitor energy usage across entire smart grids, identifying inefficiencies and opportunities for cost savings. By leveraging advanced analytics and artificial intelligence (AI), EaaS providers can offer personalized energy services that adjust dynamically to consumer behavior, ensuring that energy is delivered more efficiently (SAP, 2024). This convergence of regulatory support, technological innovation, and consumer demand positions Europe as a leading market for EaaS and a global model for sustainable energy transition.

One of the most significant aspects of Europe's regulatory landscape is the emphasis on digitalization and smart grids as a means to achieve climate targets. Smart grids—enabled by digital technologies like IoT and AI—are pivotal to ensuring that renewable energy sources are efficiently integrated into the grid. These grids allow for bidirectional energy flows, meaning that consumers can both consume energy and sell excess energy back to the grid, a concept central to the decentralized energy system. This is where EaaS providers offer critical value. By managing and optimizing these distributed energy resources, EaaS providers not only ensure grid stability but also empower consumers to take an active role in energy generation and consumption, creating a more dynamic and resilient energy ecosystem.

The consumer side of this equation is equally important. The European energy market is increasingly characterized by consumer demand for personalized energy solutions that align with sustainability goals. Consumers are becoming more aware of their carbon footprints and are actively seeking ways to reduce them. This has created a market ripe for EaaS providers, who offer tailored services that allow consumers to optimize their energy use, reduce costs, and contribute to the broader goal of decarbonization. Companies like Enel X and Siemens AG are offering cutting-edge solutions that enable consumers to make data-driven decisions about their energy

consumption while benefiting from predictive maintenance and long-term cost savings (Ahmad et al., 2022). As Figure 3 shows, these key players are driving innovation in the European energy market, addressing both environmental and economic challenges through the adoption of EaaS models.

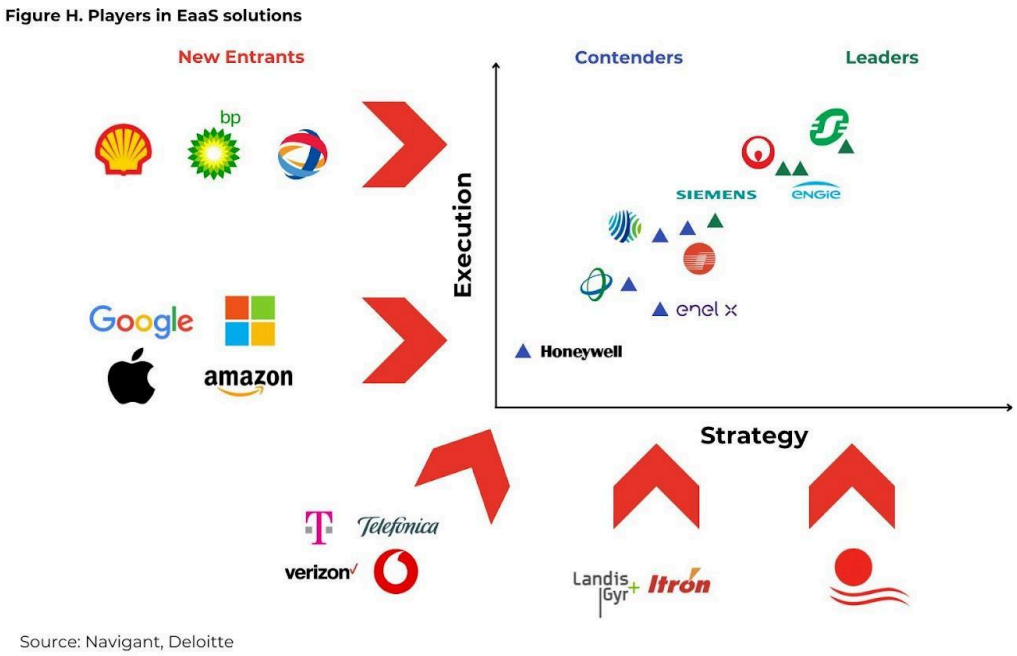


Figure 3: Competitive Landscape of EaaS Solutions: Key Players and Market Positioning

By integrating digital tools and sustainable technologies, EaaS providers are playing a pivotal role in accelerating Europe's energy transition. These companies are not just offering energy solutions—they are providing holistic energy management systems that align with Europe's climate goals while delivering tangible benefits to consumers and businesses. As Europe continues to lead the world in decarbonization efforts, the role of EaaS in providing flexible, data-driven, and scalable energy solutions will only grow in importance

Literature Review: Examining and Advancing the Understanding of Consumer Preferences for Energy-as-a-Service (EaaS)

The Emergence of Energy-as-a-Service (EaaS)

Energy-as-a-Service (EaaS) is an emerging business model designed to address the complexities of the energy transition. It integrates renewable energy generation, digital technologies, and consumer-centric solutions into a seamless service-oriented offering (Dwivedi, 2022). Unlike traditional energy systems, EaaS bundles energy delivery with ancillary services such as real-time energy optimization, predictive maintenance, and demand-side management. This approach transforms energy from a commoditized product into a flexible, outcome-based service tailored to consumer needs.

EaaS represents a significant evolution in the energy industry, offering a response to growing consumer demand for personalization, sustainability, and efficiency. By addressing the limitations of traditional energy models, EaaS aligns with broader trends in decentralization and digitalization, enabling consumers to engage actively with their energy usage (Wang et al., 2023). This model is particularly well-suited to contemporary challenges, as it allows providers to integrate renewable energy sources, manage distributed energy systems, and offer customized energy solutions that cater to diverse consumer preferences (Zedan et al., 2024).

Despite its rapid rise, much of the current momentum behind EaaS adoption stems from the novelty of the concept. Companies often market EaaS solutions by emphasizing cutting-edge technologies, sustainability, and cost savings without fully

understanding the nuanced preferences of their target consumers. The lack of systematic, empirical research into consumer priorities and decision-making processes has left providers to rely on broad assumptions about what drives adoption.

Current Understanding of Consumer Behavior in EaaS Markets

Existing literature on consumer behavior in renewable energy markets provides valuable insights but falls short of addressing EaaS-specific preferences. For instance, studies on renewable energy adoption often highlight cost savings, environmental benefits, and accessibility as key motivators (Del Rio et al., 2021; Kinoshita, 2020). However, these studies typically examine traditional renewable energy solutions, such as rooftop solar panels or community solar programs, rather than integrated service models like EaaS.

Research by Mamkhezri, Thacher, and Chermak (2019) used a choice experiment to assess consumer preferences for solar energy. Their findings revealed that consumers were willing to pay a premium for renewable energy, with cost, environmental impact, and reliability emerging as significant factors. Similarly, a 2020 study in Slovenia employed latent class analysis to identify consumer segments based on preferences for energy services. This research highlighted that energy-efficient consumers valued additional services, energy efficiency, and green energy more highly than other groups, emphasizing the need for tailored marketing strategies (Sustainability, 2020).

Further advancements in understanding consumer behavior were made in a 2023 study focusing on smart energy services. By leveraging Advanced Metering Infrastructure (AMI) data, researchers employed a choice experiment to explore consumer acceptance of smart energy services. Attributes such as service provider, quality, and pricing were central to consumer preferences. The study demonstrated

that providing detailed energy consumption information could drive behavioral changes, leading to improved energy efficiency (Energies, 2023).

These studies underline the multifaceted nature of consumer decision-making in energy services and the critical role of data-driven insights in designing effective service models. While cost remains a dominant factor, non-monetary drivers such as trust, transparency, and alignment with personal values are increasingly influencing adoption decisions (Hess & Sovacool, 2021).

Analytical Tools for Understanding Consumer Preferences

Perceptual mapping and conjoint analysis are widely recognized as powerful methodologies for studying consumer preferences and market positioning. Their application in the context of EaaS is particularly promising, as they provide insights into how consumers perceive, prioritize, and trade off different attributes of energy services. These tools offer unique advantages in addressing the complexity of EaaS offerings, which combine multiple features such as sustainability, technological sophistication, and contract flexibility into a single service package.

Perceptual Mapping: Visualizing Market Dynamics

Perceptual mapping allows researchers to visualize how consumers perceive competing offerings along key dimensions, such as cost, sustainability, and convenience (Harvard Business Review, 2020). This method is particularly valuable in the EaaS market, where diverse service attributes can create varying consumer perceptions. By plotting these perceptions on a two-dimensional map, providers can identify gaps in the market and opportunities for differentiation (Green & Krieger, 1991).

In renewable energy markets, perceptual mapping has been used to explore consumer attitudes toward traditional energy providers and renewable energy technologies . However, its application to EaaS remains limited. In this study, perceptual mapping will help identify how consumers perceive the key attributes of EaaS offerings, such as cost-effectiveness, technological innovation, and environmental impact. This approach is crucial for understanding how EaaS providers can position their services to align with consumer expectations and preferences.

Conjoint Analysis: Quantifying Trade-Offs

Conjoint analysis complements perceptual mapping by quantifying the relative importance of different attributes in consumer decision-making. This method simulates real-world decision-making scenarios, allowing researchers to assess how consumers prioritize and trade off attributes such as price, flexibility, and sustainability (Green & Srinivasan, 1990). Conjoint analysis has been successfully applied in renewable energy research to evaluate preferences for green energy tariffs, community solar programs, and electric vehicles (Tabassum et al., 2024).

In the context of EaaS, conjoint analysis offers a robust framework for understanding the trade-offs that consumers are willing to make between competing attributes. For example, how do consumers balance the cost of EaaS subscriptions with the perceived value of advanced technological features or environmental benefits? By capturing these trade-offs, conjoint analysis provides actionable insights that can guide service design and marketing strategies.

Why These Methods Are Essential for EaaS Research

The complexity of EaaS offerings necessitates analytical tools that go beyond surface-level insights. Perceptual mapping and conjoint analysis together provide a

comprehensive understanding of consumer preferences, enabling providers to identify market opportunities and tailor their offerings effectively. Perceptual mapping captures the "why" behind consumer perceptions, while conjoint analysis quantifies the "how" of decision-making, offering a balanced approach to addressing both qualitative and quantitative aspects of consumer behavior.

Additionally, these methods align with the dynamic nature of the EaaS market, where consumer preferences are influenced by rapidly evolving technological, economic, and regulatory factors. By integrating perceptual mapping and conjoint analysis, this study aims to bridge the gap between provider-driven innovation and consumer-driven demand, ultimately contributing to the sustainable growth of the EaaS market.

Barriers to Adoption and Market Opportunities

Research highlights several barriers that could hinder the widespread adoption of EaaS. These include concerns about upfront costs, lack of trust in service providers, and perceived risks associated with long-term contracts (PwC, 2024). The perceived complexity of EaaS offerings can deter adoption, as consumers often prioritize simplicity and transparency in energy solutions (Schweizer-Ries, 2022). Addressing these barriers requires a deeper understanding of consumer concerns, as well as tailored strategies to communicate the value proposition of EaaS clearly and effectively.

The role of socio-demographic factors also warrants closer examination. Younger, tech-savvy consumers are more likely to adopt innovative energy solutions, while older consumers may be more resistant to change (IEA, 2023). Regional and cultural differences in energy consumption patterns and attitudes toward sustainability could also influence adoption rates, underscoring the need for localized strategies in EaaS marketing.

Addressing the Research Gap

This study addresses the gap in existing literature by applying perceptual mapping and conjoint analysis to the EaaS market for the first time. These methodologies will provide a comprehensive understanding of consumer preferences, revealing the trade-offs that consumers are willing to make between attributes such as cost, flexibility, sustainability, and technological innovation. Furthermore, this study incorporates insights from consumer interviews and surveys to contextualize the quantitative findings, offering actionable recommendations for EaaS providers seeking to align their offerings with consumer needs and expectations.

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Appendix 1: Company Profiles and EaaS Context

Schneider Electric

Headquarters: Rueil-Malmaison, France

Industry Focus: Energy management, automation, and digital solutions

EaaS Role: Schneider Electric is a global leader in **energy management** and **automation**, with a strong focus on **sustainability** and **energy efficiency**. Their EaaS offerings are integrated with **IoT-enabled smart grid technologies**, allowing businesses and residential consumers to optimize energy usage through **predictive analytics** and **automated maintenance**. Schneider is also pioneering in **energy performance contracting (EPC)**, which guarantees energy savings and mitigates risk for its customers.

Strategic Positioning: Schneider Electric is heavily invested in **digital transformation**, enabling real-time monitoring and optimization of energy systems. Their strength lies in providing **customized solutions** that ensure both **operational efficiency** and **sustainability**, particularly for large-scale commercial and industrial consumers.

Key Strength: Strong emphasis on integrating **sustainability** and **digital technologies** to enable efficient energy usage and reduce costs.

Enel X

Headquarters: Rome, Italy

Industry Focus: Smart energy solutions, renewable energy, and digital infrastructure

EaaS Role: Enel X is at the forefront of **digital energy innovation**, focusing on **smart grids**, **energy storage**, and **distributed energy solutions**. They offer a wide array of

EaaS services, from **dynamic pricing models** to **demand response management** and **smart home integration**. Their services target both residential consumers and businesses, emphasizing **energy independence** and **sustainability** through **renewable energy integration**.

Strategic Positioning: Enel X differentiates itself by offering **end-to-end smart energy solutions** that combine renewable generation with digital infrastructure, including **real-time energy optimization**. The company has been a key player in **Europe's energy transition**, leveraging regulatory frameworks like the European Green Deal to drive consumer adoption.

Key Strength: Expertise in integrating **smart home technologies** and leveraging **data-driven pricing models** to enhance energy efficiency and optimize cost savings for consumers.

Engie

Headquarters: La Défense, France

Industry Focus: Renewable energy, decentralized energy systems, and energy services

EaaS Role: Engie is focused on promoting **renewable energy** and the development of **decentralized energy systems**. Their EaaS offerings include services that enable customers to generate and store their own energy through **solar panels**, **wind turbines**, and **battery storage solutions**. They also manage decentralized energy through **microgrids** and **distributed energy resources (DERs)**. Engie plays a leading role in helping businesses and residential consumers reduce their carbon footprints and gain energy independence.

Strategic Positioning: Engie's strategic advantage lies in its commitment to **renewable energy integration** and decentralized systems. The company is well-positioned in

Europe's energy landscape, offering solutions that align with both **sustainability goals** and the growing consumer demand for **energy independence**.
Key Strength: Leadership in **renewable energy generation** and decentralization, which aligns with the global push for **sustainability** and **grid resilience**.

Siemens

Headquarters: Munich, Germany
Industry Focus: Industrial automation, smart grid solutions, and digital energy systems
EaaS Role: Siemens is recognized for its **smart grid technologies** and **digital energy platforms** that support both commercial and residential sectors. Their EaaS offerings include **real-time energy management systems**, **predictive maintenance**, and **automated energy trading**. Siemens' focus on **customization** allows them to offer scalable solutions that can meet the needs of both **large industrial clients** and **smaller businesses**.
Strategic Positioning: Siemens' EaaS services are designed to integrate seamlessly into both legacy and modern energy infrastructures, providing **real-time data analytics** and **predictive tools** that optimize energy usage and ensure reliability. The company is known for its strong **technological expertise**, particularly in **automated energy management** and **smart city applications**.
Key Strength: Strong capabilities in **customized smart grid integration** and **technological innovation**, positioning them as a leader in offering **cutting-edge digital energy solutions**.

Veolia

Headquarters: Paris, France
Industry Focus: Environmental services, waste management, and renewable energy
EaaS Role: Veolia has expanded its environmental services portfolio to include **renewable energy** and **energy efficiency solutions** through EaaS. Their EaaS model focuses on **sustainable resource management** by integrating **renewable energy generation** with energy services like **energy performance contracting** and **demand-side management**. Veolia's expertise in **environmental sustainability** enables them to position EaaS as part of a broader effort to reduce waste and improve **circular economy** principles.
Strategic Positioning: Veolia's unique positioning as both an environmental services provider and an energy services company gives it a competitive edge. By offering EaaS within the context of **sustainability** and **waste reduction**, Veolia can target **eco-conscious consumers** and businesses that are seeking to meet sustainability targets.
Key Strength: Expertise in **sustainability** and **resource efficiency**, positioning their EaaS solutions as a key tool for consumers and businesses focused on environmental impact reduction.

KU Leuven (Faculty of Engineering Science - Master in Energy for Smart Cities Program)

Location: Leuven, Belgium
Academic Focus: Smart city integration, energy systems, and digital infrastructure for sustainable urban environments

EaaS Role: KU Leuven's **Master in Energy for Smart Cities program** emphasizes the role of EaaS in urban environments. The institution focuses on **smart grid development**, **distributed energy management**, and **energy storage systems**, contributing to the technological advancements required for scalable EaaS solutions. Through R&D collaborations with industry partners, KU Leuven is pioneering **blockchain-enabled peer-to-peer energy trading** and **AI-based energy optimization** systems that are transforming how cities manage their energy use.

Strategic Positioning: KU Leuven plays a critical role in shaping the future of EaaS through its research initiatives, focusing on the **intersection of smart cities and energy systems**. Their research not only advances the technological tools required for EaaS but also addresses the **socio-economic factors** influencing consumer behavior and market adoption.

Key Strength: Leading academic research on the integration of EaaS within **smart city frameworks**, driving innovation in **distributed energy systems** and **digital energy management**.