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Energy Transition Readiness: A Practical Guide

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ABSTRACT

This paper addresses the challenge of assessing Energy Transition Readiness levels in businesses. It identifies gaps in existing literature concerning energy transitions and readiness levels. To tackle this, the paper employs organizational learning theory as its foundational model and introduces a new taxonomy of key energy readiness indicators. This taxonomy offers a practical guide for business professionals to implement targeted interventions effectively. Additionally, it enables benchmarking and comparison of sector and industry actors. In summary, the integration of organizational learning theory expands the discourse on strategically managing global challenges.

Keywords

Energy transition;
Readiness level;
Practical guide;
Taxonomy

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1. Introduction

The need for structural change in our global energy system is directly related to the current impact of global climate change. The urgency to respond adequately to this change is evident in the increasing number of severe weather events we have experienced in recent decades. Heavy rainfall, extreme droughts, and severe storms have a devastating impact on society and the economy. Additionally, mono-culture food production systems and deforestation have negatively affected biodiversity and rapidly depleted natural resources, further exacerbating the negative climate trend. Overall, climate change is impacting our natural ecosystems, societal well-being, and economic prosperity.

A sustainable and structural change in our energy system is therefore a crucial part of the solution to significantly reduce global CO_2 emissions. Transitioning from fossil fuels to more sustainable energy sources will play a vital role in decarbonizing and mitigating climate change.

Global industry needs to quickly adopt existing and new renewable energy sources and thereby play a crucial role in this transition. Energy transitions play a critical role in the public sector, particularly in cities [1]. Furthermore, as pointed out by previous studies [2], the private sector has recognized climate change as a source of risk for business continuity. Decarbonization energy strategies can therefore reduce risk exposure and benefit business by stimulating new markets, novel services, innovations and business resilience.

Companies are currently taking on an important role in this energy transition, despite the organizational complexities it poses. Energy transitions impact both supply and demand, making implementation even more complex when considering a company within its value chains. Decisions on energy transitions have interconnected effects on others. Therefore, an internal perspective must be coupled with the ability to respond to external factors. It is unclear if and to what degree organizations are prepared for these changes.

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This study aims to investigate energy transition readiness at the business level and examine the company's position within its relevant value chain. We developed a taxonomy to evaluate and cluster an organization's readiness level in energy transition processes. This taxonomy will generate an industry-specific application for benchmarking and peer review.

We reviewed the literature on energy transitions and identified gaps in previous studies. We explored the concept of readiness and considered energy transitions from a business perspective to design a multilevel tool for readiness in the energy transition process. We then developed a conceptual framework which links insights from the foundations of strategic management, identifying two key dimensions: capacity and agility. Based on this framework, we developed a taxonomy for benchmarking and industry-level analysis. By dissecting these dimensions into associated factors, we provide guidance for companies to track progress and identify areas for intervention. In the conclusion, we discuss limitations and future research.

2. Background

In the following section, we provide a comprehensive overview of pertinent studies concerning energy transitions and readiness levels. This section aims to elucidate the current state of the field, emphasizing the existing body of knowledge and underscoring areas that remain unexplored or inadequately addressed.

2.1 Energy Transitions

Energy transitions are phenomena at the intersection of macro, meso and micro levels. In this context, we refer to macro levels as those involving countries and regions, meso levels as those involving industry evolutions and micro levels as those involving organizations.

Studies on energy transitions have mostly approached the issue from a macro level, investigating how nations or regions are progressing in their shift to more sustainable energy sources (e.g. [3–6]), how the political systems influence these transitions [7,8] or regarding the development of ecosystems (e.g. [9]). At the meso level, studies focus on methods to model industry evolution [10], describe how specific sectors have evolved [11], or discuss industry changes from a country's viewpoint [12]. They have also analyzed the mechanisms hampering the speed of energy transition, such as the resistance of declining industries delaying the changes needed for the transition [13].

Acknowledging that energy transitions involve more than one level, we have adopted a multi-level perspective as the main conceptual framework. This perspective focuses on the interdependencies of socio-technological transitions at three levels: niche, regime, and landscape. Niche refers to emerging novelties, regime describes mainstream business, and landscape indicates the exogenous context, including policies. Long term system change may be driven by niche developments at a local level, coupled with shrinking opportunity spaces in the current regime, and new developments in the external framework [14]. The three levels therefore co-evolve, interact, and, over time, lead to transformation as the result of an innovation process. Interactions occur and for example, changes in the landscape and niche evolutions may generate policy regimes shifts or coordination across levels in the governance of energy transitions [e.g. 15,16]. As illustration, Zhang and Lucia [17] employed an analytical framework rooted in the multi-level perspective on socio-technical transitions to analyze the Chinese heating sector.

Recently, the multi-level perspective has been used as framework to zoom in on the decision process associated with energy transitions: Nwanekezie and colleagues adopted it to develop a transition-based Strategic Environmental Assessment (SEA) tool [18,19]. This literature stream has the merit of highlighting the need for strategic thinking when deciding on policy decisions. The tool maps the transition progress by linking the guiding vision of the transition to the institutional and governance context in order to assess the opportunities and risks of the sustainability pathways. In this context, strategic orientation is mainly applied to policy making processes. In the quest for accelerating transitions, studies note that policies have to become more integral and engage a broad range of actors like policymakers, companies, consumers, civil society, as well as a broad mix of initiatives [13].

While national policies have a primary function in supporting energy transitions, the (positive) role of business embracing and actively engaging in these transitions is equally relevant. Ultimately, organizations are the unit where transitions are implemented that, collectively, define the system evolution. Loorbach and Wijsman [20] confirmed this point and claimed that social change and organizational internal shifts are intertwined in a co-evolutionary approach. A greater focus on the micro level and specifically on the business process of energy transitions represents a much-needed complementary approach.

Although focusing on businesses is not, *per se*, completely new, the endeavor of supporting energy transitions from a business perspective is still in its infancy. Existing business approaches focus on the decision process. For a systematic review of multi-criteria decision making see the work of Sousa, Almeida and Calili [21], or on the governance of the transitions, classifying from an historical perspective the "extent" and the "timing" with which multinationals engage in change [22].

Sabidussi [23] reviewed previous endeavors, offering a tool for measuring the advances at the business, industry, and country level along six key dimensions. Although relevant, this study focuses on the nature of the transition itself and does not shed light on which factors contribute to the current advance of an organization in the transition journey or which factors need to be fostered.

Energy transitions involve various aspects for companies, ranging from strategic to operational. We contend that in order for a business to successfully undergo an energy transition, it is crucial to assess their progress and evaluate factors that will drive future advancements. It is essential for companies to comprehend which strategic decisions contribute to these advancements, address any potential bottlenecks within their organization, identify key competencies to leverage, and allocate resources efficiently.

Consequently, comprehending a company's readiness level for an energy transition can facilitate progress, identify and anticipate critical areas, define effective self-imposed activities and serve as a benchmark for industry advancements.

2.2 Readiness Levels

With specific reference to energy transitions, most of the focus to date has been on measuring progress at the country level (see the work of Elavarasan and colleagues [24] for an overview). An effort has been made to create indexes assessing countries' readiness levels [25]. The World Economic Forum Energy Transition Index developed in collaboration with Accenture is widely used as an assessment tool to benchmark advances at a country level [26]. These measurements, however, are focused on assessing achievements rather than on the underlying drivers.

Alternatively, the focus is on the technological readiness of the transitions. The technology readiness level (TRL) is one of the most common models adopted for this purpose. Readiness levels are derived from the NASA assessment tool which mainly aims at classifying technology closeness to market applications. On a scale from 1 to 9, the tool classifies the maturity level of a given technology. Given that energy transitions have a technological component, it is unsurprising that the tool has gained interest from both scholars and practitioners. An example is the study of De Luca and colleagues [27] mapping the presence on the Italian territory of companies and research centers involved in development of technologies with different levels of TRL and potential for mitigating effects on climate.

Technologies for carbon capture are assessed using the TRL model [28]. With respect to CO_2 emissions, studies note that technology readiness needs to be considered conjointly with its adoption potential, namely market readiness and regulatory readiness [29]. Technology readiness answers the question "can we build it?". Policy readiness considers the question "can we accept it?" and market readiness addresses the question "will they adopt it?" [29, pp. 216]. Over time, the TRL approach has been further refined by reviewing or extending it with other measures of technology readiness. Here, it is also worth mentioning the "Acceptance Readiness Level (ARL)" which captures the level of "legitimation" of a technology, or the "Organizational Readiness Level (ORL)" which refer to a technology's "domestication" and ease of introduction in an existing organizational setting [30, pp. 4]. Despite their contribution to the current debate, these 'readinesses' mainly focus on technological aspects, and overlook business aspects.

Overall, we claim that designing an energy transition readiness level assessment tool from a business perspective would be beneficial to support energy transitions.

3. Theory

We conceptualized energy transition readiness levels by embracing insights from the strategic management literature. The conceptual frameworks we adopted include the Resource Based View of the firm [31], and Organizational Learning [32] and in particular, Dynamic Capabilities [33].

In line with the Resource Based View of the firm [31], we argue that in order to successfully engage in energy transitions, organizations need to have suitable resources and competences in place. These then form the base for ensuring an effective journey towards shifting the company energy system, and ultimately, they define the capacity of a company to realize a successful shift. Capability therefore refers to the set of resources and competences available to the organization in order to realize its goals. Both tangible and intangible assets contribute to defining an organization's capability, including managerial processes and organizational routines [34].

Assessing the renewable energy capacity of the organization provides an indication of the adoption potential of an organization in the energy transition. Although essential, capacity is not alone sufficient to engage in the profound transformations associated with energy transitions. Energy transitions are complex endeavors requiring a company to be able to learn from and adapt to changing circumstances. In this sense, to build our theoretical foundation, we also used insights from Organizational Learning [32] and specifically Dynamic Capabilities [33]. Companies benefit from having a certain level of agility to be ready to address the challenging energy transition journey. Dynamic capabilities are associated with the concept of agility [35], which refers to an organization's ability to adapt "easily and fast" to new needs as they emerge. According to Walter [36], the above definition dates to the early eighties [37, pp. 29] and has been adopted by the literature about agile management, paving the way for studies on organizational agility. The terminology has been adopted in a variety of contexts and it can be confusing as it has been addressed, over time, from many different perspectives, often used interchangeably [36]. Given the relevance of agility for organizations to address unpredictable circumstances and navigate uncertain environments, the concept has been researched from many angles. Agility is particularly relevant for energy transitions thanks to the need to manage continuous technological advances as well as evolving competitive and policy frameworks. It is, therefore, worth noting that, "an agile organization is both internally and externally oriented" [36, pp. 381].

By comparing the two dimensions of Capacity and Agility, we can identify how well equipped an entity is to move forward with an energy transition and therefore assess its overall, company-level, readiness level. Based on these two main dimensions, we have developed a taxonomy clustering the readiness levels of organizations for energy transitions (Figure 1).

3.1 A Taxonomy

Depending on the levels of agility and capacity displayed by an organization, we can classify an organization's energy transition levels. We have identified a quadrant with four transition profiles or positions:

1. Transformative (high capacity and high agility): These companies are the drivers transforming their industry, spreading innovation, and creating new standards.
2. Adaptive (high capacity and low/moderate agility): These companies struggle to adapt to the technological advances and market or

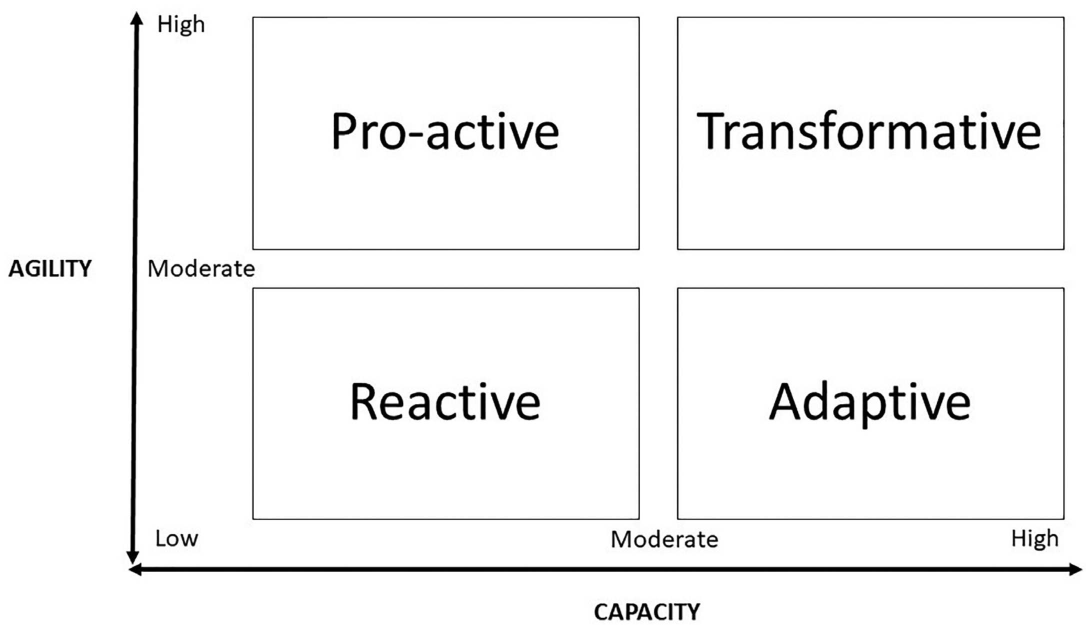

Figure 1: Taxonomy of Readiness Levels for Energy Transitions (ETRL)

political developments to which they are confronted despite their capacity.
3. Pro-Active (high agility and low/moderate capacity): Companies in this category take responsibility for and undertake autonomous initiatives, within the limitations of their capacity.
4. Reactive (low/moderate capacity and low/moderate agility): This category includes companies that align with regulations and with existing legislative obligations or those that use new technologies only when they become mainstream.

To further elaborate on our taxonomy, we identify how the key dimensions of Agility and Capacity are articulated. For this purpose, we have linked and integrated theoretical insights from strategic management literature to the specific context of energy transitions.

4. Capacity

At the business level, our focus is on organizational resources, decision processes, managerial approaches, and culture.

4.1 Resources

A company's resources include financial resources such as slack, intangible resources such as labor force skills and knowledge, and tangible resources such as its assets base.

4.1.1 Slack

Financial resources play a critical role in energy transitions, particularly when significant investments are required. Previous research (e.g., [38]) suggests that excess resources can create opportunities for investing in Corporate Social Responsible projects. Biresselioglu and co-authors [39] confirmed that costs and financial restrictions are major barriers to energy transitions.

Organizational slack, defined as "excess capacity" [40, pp. 26)] is necessary for engaging in the required investments for energy transitions. Generally, organizations are prepared to take action when the energy transition is both necessary and profitable.

If a company lacks slack resources, it may still be able to access external funding. External financial support [41] is a common means to support energy transitions. Fiscal policies and economic incentives, including subsidies, can create conditions that make energy transitions feasible. Companies with access to these funding opportunities are more likely to succeed. However, it is important to note that not all sectors may respond equally to these incentives. Sectors vary in their sensitivity to the availability of green capital in the economy [3].

4.1.2 Labor force skills

In addition to financial means, the unique competences of the firm are pivotal when creating competitive advantage. In challenging contexts, intangible assets such as employee knowledge and expertise can also be critical, as well as the company's ability to continuously attract new talent. Bray, Montero, and Ford argue that for an equitable net-zero energy transition a "wide range of skilled people to manufacture, install, operate, maintain, regulate and use the emerging energy system technologies and approaches" is needed [42, pp. 395–396]. These skills and expertise are valuable intangible resources that organizations should nurture and develop. This qualified workforce must fulfill "new energy system functions, including the implementation of new smart technologies for flexibility and grid balancing services, the use of automation and self-regulation through AI (artificial intelligence) or machine learning, and more local forms of energy system management, operation, governance, ownership and engagement" [42, pp. 397].

4.1.3 Assets base

The literature [43] warns us about the implications of inadequate infrastructures and how they can create lock-in effects, delaying or preventing the necessary changes when switching to sustainable energy sources. While this is true at a country level, it is also applicable at a business level. The assets chosen by a company can play a fundamental role in the success of energy transition. The existing infrastructure may be responsible for negative environmental effects, like high CO_2 emissions. To be able to use new energy sources, the infrastructure needs to be modernized. An older and less-advanced assets base may be incompatible with technological solutions such as smart grids and energy storage systems. In this sense, the technology and the type of infrastructure are intertwined and represent the basis for the diffusion of more sustainable energy practices [44]. Overall, slack resources together with internal competences and assets represent the key resources for a successful energy transition.

4.2 Decision Process

The internal perspective focuses on the decision process for strategic decisions. Companies that use broader criteria are more likely to support energy transitions. Energy transitions may not directly increase efficiency [45], so depending on the decision criteria, this could affect the commitment to extending sustainable energy sources. Companies that prioritize long-term goals like energy self-sufficiency are more ready to take the necessary and often costly steps for energy transitions.

A similar reasoning applies to another key aspect of energy transition decisions: risk tolerance reflected in financial investment evaluation. While using only financial criteria has limitations, many companies heavily rely on hurdle rates or payback periods to assess their strategies [46]. These criteria tend to be risk averse. Strict adherence to them may lead to a focus on short-term investments, aversion to loss, avoidance of uncertain projects, and limited engagement in longer-term commitments like energy transitions. For SMEs, risk aversion can be related to intense competition due to a lack of regulatory support (e.g., grid congestion management contracts available for large energy producers and consumers) and customer cost-driven behavior. Therefore, long-term goals and risk tolerance are crucial in decision-making for energy transitions.

4.3 Managerial Approaches

4.3.1 Energy Management Systems

Energy management systems optimize the match between energy generation and consumption, positioning companies with such systems to succeed in their energy transition efforts. Being energy self-sufficient supports operational efficiency and business continuity in the long term. These systems provide fact-based energy profile insights, facilitating the transfer to a new supply-driven renewable energy system.

An energy management system is crucial for flexibility in a weather-related power generation system. The growing demand for sustainable energy requires increased flexibility. Additionally, the demand for sustainable electric energy sources will partially replace fossil fuel-driven demand for heating and cooling, such as natural gas. The transition is driven by factors like the increased volatility of fossil fuel energy pricing, a growing global population, higher risk of global energy supply shocks, and the negative climate impact of fossil fuels. Moreover, the availability and pricing of sustainable electric energy will be immediately influenced by the increased supply from weather-related sources, such as wind turbines and solar panels, both in terms of time and geography. Peak supply resulting from favorable weather conditions has already led to negative intraday pricing levels. Grid management companies must take preventive actions to avoid grid congestion and balancing issues caused by peak supply and demand. An energy management system enhances flexibility, ensures more affordable sustainable energy in a supply-driven system, and supports a reliable grid energy supply for both consumers and producers.

An important factor related to an energy management system is that it facilitates energy transitions by optimizing cost efficiencies [47]. For example, it can help use energy when prices are lower and control machinery to take advantage of lower tariffs. To maximize the benefits of flexibility, adjustments to the production process and machinery base are needed to align with sustainable energy demand and supply. An energy management system can be implemented by a single company or incorporated into a virtual smart grid, connecting multiple energy users and producers in a business park. Owning various local machinery and assets can create additional flexibility and cost efficiencies by aligning local energy consumption with the production profiles of multiple users.

4.3.2 Monitoring Systems

Having a monitoring system can be a competitive advantage. The objective of the energy transition is not just about governments and policy makers switching to new energy sources and managing energy prices. A long-term strategy based on a harmonized taxonomy of green activities and investments, clear guidance on tax incentives, CO_2 pricing structures, and reliable subsidy schemes are all important for businesses to make economic decisions that reduce CO_2 emissions. Climate change is a global problem, so a multinational and coordinated approach is needed. Local and regional energy transition initiatives are important but should align with national and international programs. Harmonized protocols and standards on energy grids, production, and storage will facilitate a smooth transition.

Policy and legislative frameworks are essential elements of transitioning to sustainable practices in general and energy transitions in particular [48]. The literature suggests that frameworks and policies can facilitate energy transitions, increasing the likelihood of success for companies operating within supportive frameworks. Positive policy interventions include subsidies, tax incentives, and negative interventions include emissions restrictions (e.g., CO_2 limits). Furthermore, policy stability creates favorable conditions, allowing for more predictable and reliable risk/investment estimations.

Companies that have a monitoring system in place to gather information about policy developments have a competitive advantage over those that lack this internal competence.

4.4 Organizational Culture

We argue that the strategic orientation of the company is a fundamental dimension of its culture and therefore a relevant resource for facilitating energy transitions. Company culture can be oriented towards stakeholders' or shareholders' benefits. A Stakeholders Approach [49] can be reflected in the company's ESG (Environmental, Social, and Governance) orientation.

Embracing multiple stakeholder perspectives contributes to corporate sustainability practices and is crucial for energy transitions [50]. A stakeholder perspective represents a driver for rethinking the role of business, the value it generates, and its intended contribution for a variety of stakeholders [51]. This perspective enables companies to enlarge their strategic goals beyond the pure fulfillment of shareholder expectations. From a stakeholder perspective, "social responsibility, and more widely, social issues management, is presented as a key element of successful management" [52, pp.12]. An ESG approach is crucial for ensuring that energy transition becomes a core aspect of company strategy. With respect to the strategic management literature, the literature shows that those companies with an ESG strategy are those that create greater societal well-being [53].

A recent review of the literature has shown, however, that particularly in the manufacturing sector, SMEs primarily focus on measuring economic performance, while environmental performance is secondary, with even less attention paid to the third pillar of sustainability, social performance [54]. It should be acknowledged this has a serious negative impact on the overall sustainability readiness levels of these SMEs.

5. Agility

The above factors are pivotal to creating competitive advantage and supporting energy transitions. However, these resources should not be interpreted as static but as evolving and adapting assets. Therefore, from an organizational learning perspective, a business must have a dynamic capability to sense new emerging information, seize opportunities, and reconfigure, especially when addressing the complex challenges of energy transitions.

From a strategic perspective, learning is a key source of competitive advantage and is critical in sustainability transitions [14]. Learning favors adaptation, it supports greater flexibility of the organization, and it fosters agility. Strategic flexibility is particularly valuable as it allows an organization to adapt to changing circumstances while ensuring performance continuity [55].

5.1 Adopting Explorative endeavors

Learning is associated with two key twin activities: the exploitation of existing knowledge and the exploration of new knowledge [32]. To innovate, it is necessary to explore and develop new competences, especially in dynamic environments [23,56].

To successfully engage in energy transitions, a company needs to engage in profound transformations. These transformations are the result of entering into new territories and may include experimenting with new business models. In the case of energy transitions, especially in an international context, business model innovation is a critical factor for defining a company's specific competitive advantage [57]. We deduct that companies that are more oriented towards exploring and adopting new business models are better positioned for successful energy transitions.

A similar logic applies to the role of technology. Energy transitions are complex phenomena intertwined with technological changes and techno-economic paradigm shifts [58]. Exploring new technological frontiers is therefore intrinsically associated with advancing energy transitions. Companies oriented towards adopting innovative technology are better prepared to embrace the changes needed to succeed in energy transitions. The need for a company to embrace both new business models and technological advances is therefore critical for learning and advancing energy transitions.

Finally, in agile organizations the creation of innovations embodies the dynamic essence of a company, signifying its continuous generation of novel products and services. This showcases the organization's agility in adapting to the ever-evolving landscapes of the market.

5.2 Learning from Peers

The context in which a business operates is critical. External conditions are relevant, and how a company reacts to them may facilitate or hamper energy transitions. We also embrace a multilevel approach, including the macro level (e.g., policy) and the meso level (e.g., industry) perspectives.

Assessing the conditions under which a company operates generates insightful perspectives, as each company has a unique perspective on its specific context. At a meso industry level, the context creates the conditions for the transition to occur. Specifically, a company should focus on the role of suppliers, customers, alliance partners, and competitors.

The supplier-buyer relationship is fundamental to fostering sustainable operations. For energy transitions, it is critical that they are embedded in operations along the entire chain [59]. By leveraging legitimacy and aligned focus, the buyer can foster a supplier's sustainable performance [60]. Moreover, growing customer pressure for ESG is one of the main drivers of sustainable practice adoption along the value chain [48,61,62].

The value chain indicates the interconnectedness between suppliers and customer demand. Decisions regarding the energy transition, such as using renewable energy sources instead of fossil fuels, can have an immediate impact on both supply and demand. Specific asset occupancy rates may decrease due to factors like insufficient renewable energy or dynamic energy pricing (i.e. peak shaving to avoid grid congestion), the obsolescence of installed machinery, and changes to delivery. However, transitioning to renewable energy can also attract new market demand and lower purchase prices as suppliers reward environmentally friendly companies. In addition to positive and negative effects on the value chain, both performance and pricing significantly influence a company's competitive position. Therefore, the impact of the energy transition should not be viewed in isolation, but rather through a comprehensive lens that considers both internal and external perspectives.

Furthermore, the literature clearly shows that peers such as competitors and alliance partners represent important reference groups, fostering learning from another perspective [63]. A company therefore should observe what its competitors and partners are doing and align their strategic orientation accordingly. When sustaining competitive advantage, ESG orientation plays an important role [64]. Companies should review their competitors' ESG orientation and learn from them, as this can potentially influence their own competitive position. Similarly, in recent years we have witnessed initiatives (e.g. Illuminem) that foster alliances which support global ESG transitions. In this sense, ESG alliances with partners can stimulate energy transitions.

Additionally, having a system for accessing external resources and competences enables a company to adapt to changing needs and environments. While these competences may already be in place, as discussed in previous sections, they may also be recruited externally. A company can also learn by accessing and acquiring external talents. Finally, the internal sharing of knowledge among teams and departments is crucial for harnessing talents and perspectives critical for energy transitions as it allows the transfer of knowledge acquired externally [65]. This approach facilitates the development and execution of successful programs while ensuring a comprehensive understanding of the opportunities and challenges associated with energy transitions. Organizations can enhance the integration of sustainable practices in various business areas by promoting seamless knowledge exchange through cross-functional resources.

Overall, adapting to supplier and customer demands, learning from peers, having access to external competences and cross-functional internal knowledge support the agility of an organization and are favorable for energy transitions. These key areas and factors are listed in Figure 2.

The taxonomy's significance lies in the internal assessment process and discussions that the practical guide presented herein stimulates within the company. The tool streamlines the process of inputting scores for each factor, utilizing a 4-point Likert scale (from very low to high). To ensure a thorough assessment, we suggest conducting evaluations in various departments and using the average score to determine the organization's overall position. It also emphasizes the importance of analyzing individual departments/functions to provide insights into their unique positions within the matrix. Businesses can also evaluate average scores and their dispersion across functions. High dispersion may reveal variations in perceptions within the organization, warranting special attention to deviating departments. This enables organizations to efficiently allocate resources, define effective self-imposed measures, and implement targeted interventions to enhance their overall effectiveness.

At the second level, the practical guide presented here serves as a benchmarking tool. The described procedure is iteratively applied to multiple companies, and their respective company scores are subsequently recorded in the matrix.

	Cohort #1 *Participant A*	Cohort #1 *Participant B*	Cohort #1 *Participant C*	Cohort #1 *Participant D*	Cohort #1 *Participant E*
CAPACITY					
Resources					
Slack Resources	4	2	1	2	2
Labor force skills	2	3	3	4	1
Assets base	1	4	4	1	4
Decision Process					
Long term goals	1	2	4	4	1
Level of financial risk tolerance	1	4	1	3	2
Management					
Energy Management System	3	4	3	2	1
Monitoring system	4	4	4	1	1
Organizational Culture					
ESG orientation	2	3	4	4	1
Stakeholder orientation	4	2	1	4	2
CAPACITY AVERAGE SCORE			**23**		

AGILITY					
Adopting Explorative Endeavors					
New business models	1	1	3	2	4
New technology	2	1	2	4	1
Generating Innovation	1	2	4	3	1
Learning from peers					
Learning from partners	1	4	1	4	1
Learning from competitors	3	1	4	2	4
Adapting to ESG supply chain	1	3	2	4	4
Adapting to ESG customer demand	4	1	4	1	1
Access to external competences	1	2	1	2	1
Access to internal knwoledge sharing	1	1	1	1	1
AGILITY AVERAGE SCORE			**19**		

Figure 2: Key areas and scores for Capacity and Agility' factors

The tool provides a platform for organizations to compare their position within the framework to their peer group, considering factors such as the adaptive deployment of assets. This allows them to leverage the evidence-based positioning of their peers who have a similar installed asset base. Such comparisons may motivate organizations to proactively implement flexible deployment strategies for their installed machinery. Furthermore, they can also foster investment in sustainable energy usage or production, resulting in greater benefits derived from an energy management system For policymakers, this approach offers a visual representation of the current state of energy transition advancements by clustering geographical areas, business activity or sectors to which businesses belong. Figure 3 provides an illustration.

6. Discussions and Conclusion

Our research provides a practical tool for evaluating readiness levels and designing interventions to transition towards renewable energy. Additionally, our study contributes to the global initiative to achieve the United Nations' Goals, particularly SDG7, by prioritizing the engagement of the private sector in the energy transition.

Unruh draws attention to carbon lock-ins as barriers to energy transitions, attributing them to "path-dependent processes driven by increasing returns to scale" [66,67, pp. 317]. He emphasizes that escaping carbon lock-in requires a complex interplay of interconnected changes across multiple variables. Our research identifies these factors that enable organizations to navigate energy transition challenges.

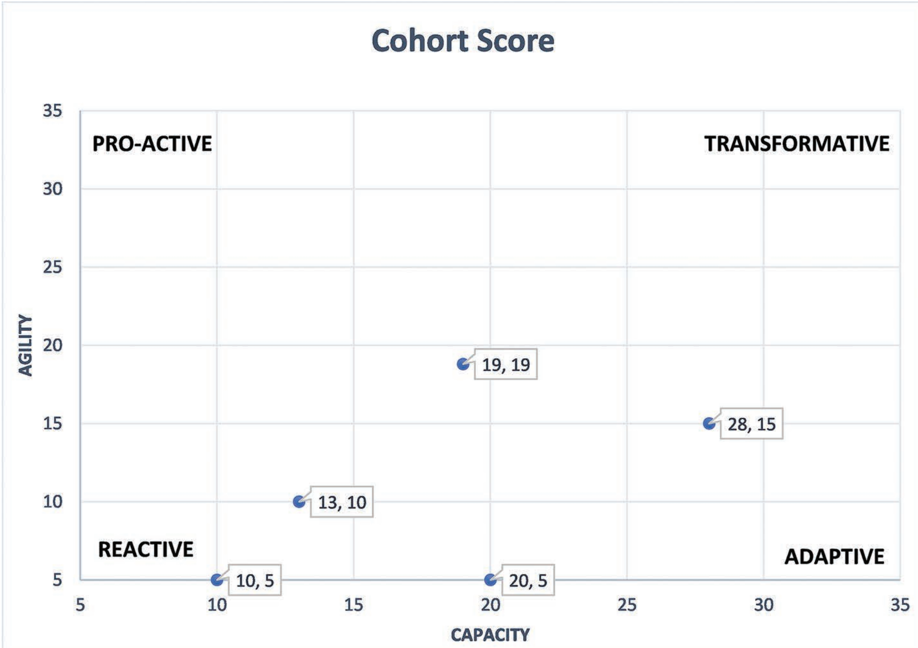

Figure 3: Benchmarking of various organizations

While Unruh [67] emphasizes the significance of exogenous technological factors and institutional change, we also recognize their insufficiency. Our research goes further by identifying key areas and factors essential for successful energy transitions. We argue that carbon lock-ins are driven not only by returns to scale but also by various organizational factors.

In line with Unruh's insights, our practical guidelines for assessing a company's readiness provide a valuable tool. Through this, we aim to identify intervention areas beyond the conventional drivers, offering a more comprehensive approach to addressing the complexities of energy transitions.

Our approach is based on strategic management literature and organizational theory. The value of our work lies in applying this framework to create a practical tool for facilitating energy transitions, bridging theory and practice. This tool provides guidelines for interventions, monitoring, and benchmarking, demonstrating how theoretical insights inform applied research and drive model development.

In our study, we expand on the Competing Values Framework (CVF) [68]. Both CVF's model and our approach focus on developing tools for organizational analysis. Both models employ two paradigms of organizational analysis: CVF's model uses the control/flexibility and internal/external orientation, while our approach centers on agility and capacity. While CVF emphasizes criteria for evaluating performance, we also focus on criteria to assess and guide effectiveness. Both models refer to organizational theory. However, there are distinctions as well. In CVF's work, dimensions are differentiated in terms of means and ends, whereas in our approach, we use a list of factors for differentiation. For instance, CVF's internal dimensions correlate with capacity in our approach, and external dimensions partially align with our concept of learning from peers. One key difference lies in the scope of analysis. CVF model offers a generic analysis, while our approach is comprehensive and tailored specifically for energy transitions. CVF's emphasis on values and culture is similar to our approach, where culture is related to values but in our framework, culture is just one of several factors considered. Additionally, CVF features orthogonal dimensions, while our approach allows for the simultaneous presence of all dimensions. For example, related capacity factors like Energy Management System and Slack Resources can coexist across various business cultures mapped in Quinn and Rohrbaugh's model. Our approach recognizes the simultaneous necessity of specific elements, particularly in complex phenomena like energy transitions. Business renewal is complex as it often implies a conflict with ordinary capabilities and is beneficial when associated with an immediate rather than a permanent state of change [35]. This is also the case for energy transition processes, which require organizations to adapt to profound changes while remaining competitive. Importantly, our approach extends beyond mere analysis; it incorporates benchmarking among organizations. This emphasizes our commitment to not only understanding organizational dynamics but also facilitating comparative assessments, especially in the context of energy transitions.

Future research could further develop the present work and test the tool in different contexts, add predictability, and include minimum thresholds (like a risk diagram). Overall, the study paves the way for further development and empirical validation of our taxonomy.

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