Strategic Approaches to Disruptive Innovations in Regulated Markets: Two Cases of State-owned Electric Utilities

Submitted for the requirement of a PhD

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DECLARATION

I, Kubeshnie Bhugwandin, declare that the entire body of work contained in this thesis is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by the University of The Witwatersrand will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any other qualification.

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ABSTRACT

Both state- and privately-owned electric utilities are currently navigating a wave of disruptive innovations that are reshaping the energy sector. While the overarching goals of profit and shareholder value apply to both, state-owned utilities have a distinct set of challenges in that their objectives also encompass social welfare, economic growth, and national development. Thus, their survival is a matter of national interest.

An interpretivist paradigm guided this research, and a qualitative multi-case study was used to investigate strategic approaches to disruptive innovations in the regulated electricity markets of South Africa and France. The theoretical interrelationships between Disruptive Innovation theory, Dynamic Capabilities and Ambidexterity were holistically explored within the regulated markets. The data comprised documentation and interviews with the electric utilities, Eskom and Électricité de France and the national energy regulators in each country.
The study's key findings indicated that disruptive innovations are multi-organisational and multi-dimensional, impacting the industry at the macro- and meso-levels, transforming the entire ecosystem via concurrent interconnected actions. Hence, there are many pathways to disruption, and state-owned electric utilities must reposition themselves in the market and respond with multifaceted approaches.

State-owned electric utilities are recommended to engage in coopetition strategies such as investing in disruptive innovations with start-ups and building strong partner interdependence via joint activities or investments to facilitate the exchange of resources and capabilities and build trust. This research recommends an integrated response when faced with a wave of disruptive innovations, e.g. (i) investing in an existing business to improve efficiencies and retain customers, or extending the life of power plants and converting coal-fired power plants to biomass technology, whilst at the same time (ii) adopting disruptive innovations which have emerged in the market to offer new products

and services such as e-mobility, energy efficiency, solar photovoltaic and energy storage services and (iii) investing in continuous research and innovation to compete with disruptors such as the piloting of floating wind turbines and lightweight solar photovoltaic structures.

Furthermore, ambidexterity and dynamic capability can be used as tools by electric utilities to strategise effectively under VUCA conditions. Dynamic capabilities should be built to support sensing, sensemaking, shaping, seizing and transforming the organisation to retain competitive advantages and market leadership. The study identified risk-taking, negotiating ability, and organisational agility as dynamic capabilities required to seize opportunities. The research also identified the ability to modify and reconfigure human resources, organisational structure, assets, processes and culture as dynamic capabilities required to compete and maintain market leadership. Lastly, this study presented an alternative pathway to achieve ambidexterity. Electric utilities can utilise a hybrid ambidextrous approach, which entails simultaneously combining different modes at both the meso and micro levels, such as (i) creating structural separation, forming intra and inter-organisational alliances, (iii) building dynamic capabilities to accelerate exploration activities, and (iv) establishing dual executive management roles.

This study has made theoretical contributions by proposing a new definition of disruptive innovations for the electricity industry and has widened the domains for Strategy-as-Practice research by extending the levels of praxis from micro, meso and macro to include an industry level. This moves strategising actions beyond the firm to incorporate wider practices in society. Furthermore, the dynamic capability theory was extended to include sensemaking and shaping as micro foundations to respond to disruptive innovations and maintain competitive advantages. This finding also contributed to the understanding of the resource-based theory by providing a source of heterogeneity. In addition, the research suggested that simultaneous use of casual and effectuation decision-making logic can be a source of heterogeneity for firms. The study clarified that shaping capabilities are used not only during sensing and seizing opportunities but also influences or shapes transformation activities of the firm. The ambidexterity view was extended by presenting an alternative combination of modes within the hybrid ambidexterity approach.

Practically, this research suggests that an integrated approach should be implemented by state-owned electric utilities to respond to a wave of disruptive innovations.

Publication arising from this study

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Abstract

This study examines the literature on response strategies to disruptive innovations in regulated electricity markets. The relationship between disruptive innovation and the resource-based view is explored through the lenses of ambidexterity and dynamic capabilities to provide possible responses for state-owned electric utilities to threats and opportunities arising from such innovations. This research contributes by presenting various strategic options for managers to operate in evolving electricity markets successfully. These recommendations can assist electric utility managers, national energy regulators and policymakers in better decision making.

(PDF) AMBIDEXTERITY, DYNAMIC CAPABILITIES, AND DISRUPTIVE INNOVATION IN REGULATED ELECTRICITY MARKETS (researchgate.net)

DEDICATION

This thesis is dedicated with all my love and gratitude to my husband, **Pranesh Bhugwandin,** for his undying love, support and encouragement throughout my career,

&

To my children **Kiaan** and **Kimaya**. You are my inspiration and joy.

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LIST OF ACRONYMS AND ABBREVIATIONS

APE: *Agence des* participations *de l'État*

CFE: Comisión Federal de Electricidad

COP: Climate Change Conference of the Parties

CRE: Commission de régulation de l’énergie

EDF *Renouvelables:* Électricité de France Renewables

EDF: Électricité de France

IPP: Independent power producer

MW: MegaWatt

NERSA: National Energy Regulator of South Africa

OECD: Organisation for Economic Co-operation and Development

OCGT: Open Cycle Gas Turbine

RTE: Réseau de Transport d'Électricité

SDG: Sustainable Development Goals

SIIF Énergies: Société Internationale d'Investissements Financiers – Énergies

ULA: United Launch Alliance

US: United States

USD: US dollars

VRIN: valuable, rare, inimitable and non-substitutable

VUCA: volatile, uncertain, complex and ambiguous (business environment)

CHAPTER 1. INTRODUCTION

1.1 1.1 Purpose of the study

This interpretive study explores the market dynamics and strategic options available to electric utilities in regulated electricity markets; theoretical strategic tools were interwoven to recommend a unique strategic approach for state-owned utilities to respond to disruptive innovations. The cases investigated were South Africa and France.

1.1.1 Threat of disruptive innovations

For more than 100 years, the electric utility business was stable, dominated by the use of fossil fuels for power generation until electric utilities began to experience changes due to disruptive innovations mainly on the customer end of the supply chain (Graffy & Kihm, 2014; Hurlbut, 2017; Kind, 2014; Rahimi et al., 2016; Sioshansi, 2016), climate change policy commitments by governments to reduce carbon emissions (Fox-Penner, 2014; Wainstein & Bumpus, 2016) and customer behaviour. The driving force is to adopt low-carbon technologies and reduce excessive or wasteful energy use (International Energy Agency, 2021). Whilst increasing populations and economic growth are amplifying global energy demand, technological advances are simultaneously increasing energy efficiency and driving costs down for renewable energy and energy storage technologies (Baker et al., 2016), resulting in the use of fossil fuels for power generation becoming economically unviable (Newell & Raimi, 2020; Pereira, et al., 2022).

Electric utilities are facing a threat to their current business due to a wave of disruptive innovations co-occurring in several sectors at once: technology and policy development, social and cultural preferences, and scientific investigation and business (Agnew & Dargusch, 2015; Hurlbut, 2017; Kattirtzi et al., 2021). Although Professor Clayton Christensen (1997) coined the phrase “disruptive innovation” more than 20 years ago, the core tenets remain the same. Initially, disruptive innovations were defined as a type of discontinuous innovation that introduces new products, services or business models which at first enter a niche, low-end market but gradually displace market incumbents by successfully moving up-market through performance improvements (Adner, 2002; Bower & Christensen, 1995; Christensen & Raynor, 2003; Christensen, 1997; Christensen & Bower, 1996; Gilbert, 2003). The theory of disruptive innovation is based on the premise that incumbents fail as their internal processes and values force them to focus on their existing customers and ignore innovations targeted at emerging markets where there is a small customer base (Christensen, 1997; Christensen & Bower, 1996; Christensen et al., 2015b). Although Christensen, before his death in January 2020, redefined disruptive innovation as a process that introduces new products, services and business models which are driven by a technology enabler that first becomes established in simple applications at the low end of a market and then successfully moves upmarket, eventually displacing incumbents (Christensen & Dillon, 2020) there seems to be little agreement amongst scholars and innovation practitioners on the definition and boundaries for application (McDowall, 2018; Williamson et al., 2020); this is further discussed in the literature review.

1.1.2 Appropriate response to disruptive innovations

The disruptive innovation phenomenon, particularly in the energy sector, has sparked interest amongst academia and practitioners on how electric utilities could strategically respond to disruptive innovations and which tools may be appropriate.

Whereas the disruptive innovation theory suggests that the most appropriate response to disruptive innovations should be to 1) create autonomous units with new value networks, separate resource allocation and investment decision-making processes for commercialisation (Christensen & Raynor, 2003; Christensen, 1997); 2) launch several new businesses early whilst the firm is still healthy (Christensen & Raynor, 2003) and 3) undertake business model or continuous innovation that creates value for the customer (Denning, 2016), the resource-based theory through the dynamic capability perspective suggests that the best response is to build dynamic capabilities and good strategy anchored by valuable, rare, inimitable and non-substitutable resources (Teece, 2018a, 2018b), whilst the ambidexterity perspective calls upon organisations to respond by simultaneously exploring new markets and exploiting existing opportunities in the current business (Birkinshaw, Zimmermann, & Raisch, 2016). However, several authors have also discussed various pathways to achieve ambidexterity such as structural separation (Tushman & O'Reilly, 1996), temporal separation (Puranam et al., 2006), inter-organisational specialisation (Lin et al., 2007), reciprocal ambidexterity (Rafailidis., 2017) and dynamic capability as a form of ambidexterity (Faridian & Neubaum, 2021) as well as explicated which dynamic capabilities to build to perceive and respond to threats and opportunities for example sensing, seizing and transforming (Helfat & Raubitschek, 2018; Teece, 2014b, 2020; van Lieshout et al., 2021), better cognition and social and human capital (Helfat & Martin, 2015) and strengthening of knowledge sharing, agility and flexibility processes within a firm (Sabahi & Parast, 2020). The evolution of these theories and several other strategic approaches (Gans, 2016; Jin & Shin, 2020; Yeh & Walter, 2017; Zhang et al., 2018) available to managers will be elaborated on in the literature review.

Managers are uncertain as to which strategies to adopt and under which conditions. Extant literature (Birkinshaw et al., 2016; Christensen, 2018; Porter & Heppelmann, 2015; Teece & Leih, 2016) appears primarily focused on private business which is mainly driven by profit maximisation and assumes that all incumbents are in pursuit of long-term survival and maintaining competitive advantages. This may not apply to all businesses, as authors Lazaroiu et al., (2017) indicated that the primary goal of state-owned electric utilities is developmental, i.e. to provide universal access to energy most efficiently and ensure the security of electricity supply to the country. Social welfare and economic growth are primarily the critical drivers for state-owned electric utilities (Mazer, 2007; Power et al., 2016).

This research presents possible ways of looking at these issues from a collection of excellent minds. It highlights various options managers may not have been aware of that can be adapted for use by utilities operating in regulated markets. These recommendations are built on the conceptual findings from this research.

This research makes a fourfold contribution: empirical, conceptual, practical and methodological. Empirically, this study contributes to the underpinnings of the resource-based theory (Barney, 1991; Wernerfelt, 1984) and disruptive innovation theory (Christensen & Raynor, 2003; Christensen & Dillon, 2020) and provides evidence for the assembly and integration of the ambidexterity, dynamic capability and disruptive innovation theories. Conceptually, by using the disruptive innovation theory, dynamic capability, and ambidexterity views as theoretical lenses, this research used a qualitative approach to building a framework on possible strategic approaches and identifying theoretical relationships between concepts. Practically, this research provides implementable guidelines to state-owned electric utilities on possible strategic responses and opportunities to disruptive threats. Methodologically, this research has contributed to an alternative manner of conducting case study research. The integrated analysis used in this study extended the manner of conducting case study research from the standard methods of using within-case and cross-case analysis to a method which also includes the examination of emerging themes, constructs and issues in an unrestricted manner i.e. not confined to each research question or theory during the analysis.

1.2 Context of the study

1.2.1 Nature of the market for state-owned electric utilities

There are many types of state-owned companies with varying degrees of government involvement, such as wholly-owned enterprises by the state, partially privatised enterprises with minority or majority state-ownership and indirect stakes in the form of state-owned banks, sovereign wealth funds and portfolio equity investments that buy equity in listed or unlisted companies on the stock exchange (Cuervo-Cazurra & Li, 2021). This study focused on direct ownership in the form of wholly-owned or where the state has majority ownership of the electric utility. The electric utilities considered for this research were Électricité de France, 83.6% state-owned, and Eskom, 100% state-owned. Wholly-owned and majority state-owned electric entities enjoy monopolistic positions in their industries. As compared to the private sector, state-owned enterprises can easily access resources such as land and capital as banks regularly support state-owned enterprises under pressure from the government regardless of the associated risks and use debt to leverage financial needs (Nguyen & Van Dijk, 2012; Phi et al., 2021).

In contrast, private companies depend on social networks to access finances and business services. For these reasons, they can quickly be crowded out of the market by state-owned enterprises. Traditionally, the electric utility is vertically integrated into four primary electricity supply functions: generation, transmission, distribution and retailing to drive lower costs at scale (Glachant et al., 2021; Megginson & Mueller, 2022) and is established to pursue government's social and development objectives such as to cater to less profitable customer segments, keep prices low, sometimes trading off profitability, minimise unemployment, or invest in geographically remote areas.

National electricity regulators intervene to issue rules and licenses designed to implement the national government's electricity policy frameworks that control access to the electricity networks and entry into the market, ensure that consumers pay reasonable prices, and determine network charges (Pollitt, 2019). Historically, retail customers must purchase electricity from the regulated state monopoly supplier with the legal right to distribute it at their locations. These monopolies have a legal obligation to supply and plan for all retail customers' needs and make electricity available at prices approved by the national regulator (Glachant et al., 2021). Traditionally, electric utilities have met their obligations to supply electricity by owning and operating all the infrastructure and assets required to supply a "bundled" product to retail consumers i.e. vertical integration.

Since 1990, all member countries of the Organisation for Economic Co-operation and Development (OECD) have reformed their electricity markets to varying extents due to pressures from clean energy policy requirements, ageing infrastructure, shortages of state funding, debt burdens and increasing operational inefficiencies and prices of electricity (Blagrave & Furceri, 2021; Eberhard & Catrina Godinho, 2017; Marino et al.,2019). These reforms included ownership changes, restructuring of the generation, transmission, distribution and retail services to free up marketplaces for increased private participation and supplier choice and prices set at marginal cost. Developing countries have slowly embraced reforms (Eberhard, 2019; Foster & Rana, 2019). In non-liberalised markets, the national electricity industry has not undergone structural reforms to create competitive wholesale and retail markets and prices of electricity to customers are set by the national energy regulator containing subsidies (Pollitt, 2012); for example, South Africa (Baker, et al., 2014a; DPE, 2019) and South Korea (Mah et al., 2014).

Although the rationale for liberalisation of electricity markets includes enhanced efficiency, reduced cost of electricity, increased customer choice, mobilisation of private investment, consolidation of public finances, increased competition and introduction of private participation (Müller-Jentsch, 2001; Wang & Mogi, 2017) there is no conclusive evidence that reforms in both developed or developing countries have performed well (Nepal & Jamasb, 2015; Streimikiene et al., 2013). Nakano and Managi (2008) claimed that liberalised electricity markets experienced increased investment uncertainty and power blackouts. Joskow (2006) reported a decline in research and development, which impacted the reliability of the power system. Streimikiene et al. (2013) reviewed studies relating to the impacts of liberalisation on competitiveness in European Union member states. They showed that developing liberalised electricity market models does not reduce electricity prices. Nepal and Jamasb (2015) stated that market reforms in many developing countries have failed to display efficiency improvements with minimal or no effect on poverty and income inequality. Similarly, Blagrave and Furceri (2021) analysed a dataset of 90 developed and developing countries. They found that although privatisation reforms improved outcomes in electricity provision and positively affected the macroeconomy, employment increased on average, but income inequalities widened. These uncertainties cause practitioners to doubt whether liberalisation of the electricity market is an appropriate response to disruptive innovations in the electricity sector.

1.2.2 United Nations Conference of Parties and Sustainable Development Goals

Since 1995, the United Nations Climate Change Conference of the Parties (COP) has brought together countries worldwide to progress toward resolving climate change and sustainable development issues. In Paris at COP 21, almost every nation agreed to a new international treaty to keep global warming at 1.5°C - 2°C through decarbonisation interventions, mainly in the energy and transport sectors (Kelly, 2022). At COP 26 held in Glasgow in 2021, developed countries committed to urgently shifting finances to assist developing countries in moving towards net zero carbon emissions and the creation of markets for innovation technologies (International Energy Agency, 2021).

In addition to the efforts of the COP, all United Nations member states in 2015 adopted 17 sustainable development goals (SDG), a blueprint to achieve peace and prosperity for people and the planet in the current and future generations (United Nations, 2022). Out of the 17 SDGs, goals 7 and 13 require special attention for this study as these goals deal with the attainment of affordable clean energy solutions (SDG 7) and climate action (SDG 13). The premise is that the development of clean energy solutions will lead to the mitigation of climate change.

As a result of the United Nations COP and Sustainable Development Goal policies, more and more countries are adopting and implementing policies in the form of new laws regulating the activities of the energy sector in line with new, green economy standards (Niemczyk et al., 2022) and implemented decarbonisation policy instruments in both the energy and transport industry. Generally, the principal instruments for decarbonisation across countries have been increasing the shares of renewable energy in the country’s electricity supply plans and deploying energy efficiency and green transport strategies.

The global acknowledgement of the need for transition from fossil fuels to renewable energy sources has stimulated discussion about the role of government policy with markets and guiding innovation. A governmental policy can substitute or complement market forces by reinforcing or counteracting the allocative and other effects that existing markets would otherwise bring about. In some instances, a policy can also serve as a market creation and co-creation mechanism, such as creating new carbon-free markets (Pitelis et al., 2019).

The authors Pitelis et al. (2019) explored 34 OECD countries' policies and found that governmental industrial policy instruments positively affect renewable energy technologies, with the demand-pull technologies being more prominent in countries with high policy interventions than technology push and systemic instruments. In addition, the authors found that governmental policy support may induce lower-quality innovations due to actors taking advantage of available funding and market shares (a proxy for market power), which inhibit renewable energy innovation. Hille et al. (2020) performed a cross-country comparison with patent data of 194 countries and territories. The results indicated that solid portfolios of renewable energy support policies increased patenting in solar- and wind-power-related technologies. However, the free-market school of thought counterargues that free markets can focus on commercialised innovations and self-correct when required (Baumol, 2014; Karlson et al., 2021). Therefore, governmental policies promoting or guiding innovations are unnecessary and counterproductive, and states should have a negligible role in designing and implementing support measures for sustainable development (Managi et al., 2021). Conventional neoclassical economic theory recommends public sector intervention only in cases of market failures, for example, when there are externalities, monopolistic restrictions, or public goods, and provided that the public sector intervention does not cause more harm than what it seeks to mitigate (Pitelis et al., 2019).

The work of Vecchi et al. (2015) showed that national institutional context has an impact on the rules of competition, firm strategy, and firm performance since government interventions impose rules for legitimacy, serve as a source of knowledge, and allocate incentives and resources for innovation. Rodríguez-Pose and Di Cataldo (2015) explained that risk-adjusted returns to innovation are likely to look less attractive in countries with weak economic institutions. Typically, poor economic institutions such as developing countries are likely to discourage innovation, while solid economic institutions encourage innovation.

1.2.3 Influence of state-ownership on company strategy

Although the goals of attaining profits and protecting shareholder value apply to both state and privately-owned companies, state-owned companies are not driven by profit maximisation and have additional objectives related to to non-business goals, including politically motivated investments in innovation, employment and social stability (Aguilera et al., 2021). Resource provision functions differ from privately owned firms because government support such as bailouts, subsidies and taxes protect state-owned companies from financial ruin (Lu et al., 2021). Generally, managers of state-owned companies enjoy larger budget limits, subsidies, or tariffs that drive the state's goals, such as broader industrial activities, social welfare and local job creation (Lazzarini et al., 2021).

Empirical evidence shows that state-ownership and political connections influence a wide range of strategic decisions, including capital structure decisions such as financial leverage, research and development intensity, and internationalisation of markets, that impact the financial performance of firms (Musacchio & Lazzarini, 2014; Tihanyi et al., 2019). However, the literature is divided on whether state-ownership has a positive or negative effect on the firm strategy of state companies. On one view authors discussed state-ownership with a range of organisational challenges such as the use of state-owned utilities for political gain and bailout (Musacchio et al., 2015), low powered economic incentives and employee motivation (Eforis, 2018; Landoni, 2018), ineffective management monitoring, poor firm performance (Marson et al., 2021; Szarzec et al., 2021) and negative political influence on strategic goal and functions that restrict managerial intentions and actions (Lazzarini et al., 2021). State-owned companies were also shown to engage and implement risk aversion strategies due to the need to satisfy more stakeholders than privately owned firms, resulting in poor performance (Tihanyi et al., 2019). Authors Gil-López et al. (2020) found that the willingness and capacity of a state-own company to engage in entrepreneurial activities depended on its degree of autonomy from the state and the extent to which its legal and market environments increase its dynamism, complexity, and hostility. State-ownership companies are considered less efficient in productivity and innovation (Asri, 2022).

In the second view, the authors propose state ownership to have a positive influence on the strategy of state-owned companies as the state as a shareholder attracts lower interest on bank loans and enjoys more favourable agreements from banks (Eforis, 2018) which results in the undertaking of more significant developmental projects and enables future growth of the firm. Lazzarini & Musacchio (2018) discussed state ownership as a competitive advantage in terms of “patient capital” for long-term investments, exclusive rights to operate in specific industries or geographical areas and the ability to leverage off networks with foreign governments, typically not available to private companies.

1.2.4 Background to the Cases

This study examined proactive and reactive strategic responses to disruptive innovation opportunities and threats in the regulated electricity industry by examining two state-owned utilities -- Eskom (South Africa) and Électricité de France (France**).** A detailed case profile and reasons for selecting individual cases are given in Chapter 3.

1.2.4.1 French Electricity Industry

France is categorised as a developed country (OECD, 2022) with slow economic growth and rising unemployment rates compared to other European Union countries (Legros & Martin, 2021).

Électricité de France (EDF) is an 83.6% state-owned electric utility (EDF, 2020b). The remaining shares are owned by institutional investors, retail investors and employees, and Électricité de France is listed on the French Stock Exchange (Yanyuan, 2017). Électricité de France owns 82.5% of the electricity market share in France (Wokuri et al., 2019).

The Energy Regulatory Commission regulates the French electricity markets, the Commission de régulation de l'énergie (Kraft, 2017). Électricité de France sells electricity in France, United Kingdom, Italy, Poland, Belgium, Switzerland, Netherlands, Turkey, Greece, Portugal, Israel, Spain, Bulgaria, Germany, China, Laos, Vietnam, India, South Africa, United States, Brazil, Canada and Mexico (EDF, 2016). The vertically integrated company provides generation, transmission, distribution and retail services.

Électricité de France owns 50.1% of Réseau de Transport d'Électricité (Kraft, 2017), which is an independent transmission system operator that maintains and owns the transmission grid and provides real-time balancing between the energy produced and required to meet the needs of the country (Marques et al., 2016). Enedis, a 100% subsidiary of Électricité de France, manages 95% of the distribution electricity network in France (Deloitt, 2015; Karsenti & Daguzan, 2017). In the areas not served by Enedis, the activity is managed by local distribution companies. The distribution system operators communicate with the Réseau de Transport d'Électricité on electricity injected and extracted on the grids they operate, so Réseau de Transport d'Électricité can calculate the supply and demand of electricity (Arnaud et al., 2017).

The French electricity market is structured to conform to the European Union's legal and regulatory framework, which demands a competitive structure (Kraft, 2017). Therefore, the French electricity market permits consumers to choose their power suppliers, freedom of establishment for suppliers and non-discriminatory access to the transmission and distribution networks (Deloitt, 2015). Although France has liberalised its electricity market to some extent by creating wholesale and retail markets, introducing freedom of supplier choice and increasing private participation in the market, it is partially liberalised as there is both a market price and a regulated price/tariff option available in the two-tiered wholesale market and residential customer segment (Bhagwat & Hadush, 2020; Lebrouhi et al., 2022). Electricity retailers have regulated access to the nuclear power produced by Électricité de France through the policy termed Acc`es R´egul´e `a l’Electricit´e Nucl´eaire Historique, which was designed to promote upstream and downstream competition. The Acc`es R´egul´e `a l’Electricit´e Nucl´eaire Historique policy gives access to retailers to buy electricity generated by Électricité de France’s nuclear power plants at a regulated access tariff of 42 € /MWh for up to a total of 100 TWh per year (Benatia, 2022).

France adopted a new energy model on 17 August 2015 by enacting the Energy Transition Act for Green Growth (Ministère de l'Environnement de l'Énergie et de la Mer, 2016). The act set out six medium to long-term goals for national energy production and consumption which included i) decreasing greenhouse gas emissions by 40% by 2030, ii) reducing the use of fossil fuels by 30% in 2030, iii) increasing the share of renewable energy to 32% of final energy consumption by 2030 and 40% of electricity generation, iv) reduction of the share of nuclear energy to 50% by 2025, v) reducing total energy consumption by 50% in 2050, and vi) reducing the amount of landfill waste by 50% in 2025.

The French Ministry for Environment, Energy and the Sea has implemented a national low-carbon strategy, carbon budget and a Multiannual Energy Programme (PPE) to enable the implementation of the Energy Transition Act for Green Growth.

The Multiannual Energy Programme drives a change to achieve carbon neutrality in France by 2050 via increasing shares of renewable energy and energy efficiency and decreasing fossil fuel consumption (Ministère de la Transition écologique, 2019). The French state has committed to the development of new forms of mobility, replacing items that use fossil energy with clean technologies/energy, improving energy efficiency in homes to lower consumption of energy, developing competitive renewable energy technologies and solutions, implementing a tax on petrol and diesel to stimulate the uptake of e-mobility products and services and increasing carbon taxes. Furthermore, the French state will support low-income households with additional grants to achieve energy savings in their homes and dispense energy vouchers to assist poor customers in paying their heating bills.

The Multiannual Energy Programme confirmed the closure of all coal plants in France by 2022 and two nuclear reactors at Fessenheim by 2020, with the remaining reactors planned for closure between 2022 and 2035 (Ministère de la Transition écologique, 2019). These pro-environmental policies were not well accepted in France and led to large-scale protests, primarily by the *Yellow Vest Movement,* due to negative socio-economic consequences associated with the policy measures, such as increased taxes and fuel prices (Xue et al., 2022). This has created economic and environmental policy uncertainties.

1.2.4.2 South African Electricity Industry

South Africa is a developing country with low economic growth, high poverty and unemployment rates (DMRE, 2019). Eskom Holdings SOC Limited is a 100% state-owned power utility in South Africa that is vertically integrated, owning the electricity generation, transmission, distribution, and retail businesses. It owns 88% of the market share in South Africa and generates approximately 45% of Africa's electricity (Eskom, 2022a). Electricity is imported and exported from the Southern African Development Community via the Southern African Power Pool, which is an interconnected power grid comprising South Africa, Botswana, Lesotho, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe (Eskom, 2017). Electricity prices are regulated by the National Energy Regulator of South Africa (NERSA) as mandated mainly by the Electricity Regulation Act (2006) and the National Energy Regulatory Act (2004) (Baker et al., 2014a). The National Energy Regulator of South Africa determines revenue allocation following the Electricity Pricing Policy.

The electricity produced by Eskom is distributed to business and residential customers in areas of supply licensed to either Eskom, metros or municipalities. In 2011, the South African Department of Energy introduced the Renewable Energy Independent Power Producer Programme; however, the Eskom generation, transmission and distribution businesses remained vertically integrated with no creation of an independent system market operator (Baker et al., 2015). Eskom is the single buyer of electricity from the country's generators, whilst the national energy regulator determines the electricity price via annual tariffs (DPE, 2019).

In South Africa, no competitive markets are currently in place; however, a bill for the amendment to the Electricity Regulation Act (2006) has been submitted to parliament. This bill seeks approval to create a National Transmission Company of South Africa and an open market for competitive electricity trading.

In October 2019, the Minister of Public Enterprises, Pravin Gordhan, released the “Roadmap for Eskom in a Reformed Electricity Supply”, which explained the financial, governance, leadership, operational, structural and climate change policy challenges that Eskom faces (DPE, 2019). The roadmap indicated the state’s intention to restructure Eskom into separate transmission, generation and distribution subsidiaries under the Eskom Holdings Group – to manage the entity better, thereby minimising Eskom’s reliance on bailouts from the National Treasury, and to improve transparency and accountability.

The 1998 White Paper on Energy Policy outlined the state’s commitment to promoting renewable energy as an electricity supply option to diversify from coal as a fuel source for electricity generation (DME, 1998). Subsequently, in August 2002, the Department of Minerals and Energy released the White Paper on the Promotion of Renewable Energy and Clean Energy Development, which set a target of 10,000 GWh of renewable energy contribution to the country's energy consumption by 2012. The commitment to transition the country to clean energy sources was echoed in succeeding energy-related policies such as The National Development Plan, The Integrated Energy Plans, The Electricity Pricing Policy, National Environmental Management Air Quality Act 39 (2004), The National Energy Act 34 (2008), and the South African Carbon Tax Act 15 (2019). The 2019 Integrated Resource Plan indicated that 11,017 MW of coal-fired generation from Eskom power stations will be decommissioned by 2030 and replaced by cleaner fuel sources (DMRE, 2019).

The Minister of Forestry, Fisheries and Environment, Barbara Creecy, released a proposal for public comment which sought to revise carbon emission targets to a range of 398 - 614 Mt CO_2 equivalents between 2025 and 2030 (DFFE, 2021). The proposal was to reduce the initially determined national emission contributions committed at COP 15, making the transition to clean energy more ambitious for the energy sector. Due to the operational challenges experienced at Eskom’s coal-fired stations, South Africa has experienced electricity blackouts periodically since 2008, which has adversely impacted the economy's growth. The state has come under pressure to address the lack of electricity in the country and support firms’ use of green energy. Subsequently, the Department of Mineral Resources and Energy had gazetted an amendment to Schedule 2 of the Electricity Regulation Act, 2006 (DMRE, 2021) to enable private entities to self-generate up to 100 MW of electricity and wheel electricity from a generation facility to an end-user without a license from the National Energy Regulator of South Africa.

Over the years, the South African state had simultaneously developed instruments to promote energy efficiency through the Energy Efficiency Target Monitoring System of 2014 (DOE, 2016) and the publication of the Energy Efficiency Tax Credit Act (Section 12 L of the Revenue Tax Act of 1962) in February 2019 (SARS, 2019).

The South African Department of Transport, through its green strategies, is also committed to contributing to the reduction of South Africa's total greenhouse gas emissions by committing to a 5% reduction of emissions in the transport sector by the year 2050 and steps that will be taken include switching to cleaner fuels and adopting new technologies that enable green mobility (Transport, 2018).

1.2.5 Strategy as practice

This study is set within the Strategy as Practice (Jarzabkowski & Spee, 2009; Johnson, 2007), a subset of the strategy discipline. It goes beyond conventional strategy research of economic-based investigations to a domain that investigates what transpires in strategic planning, strategy implementation and activities that are associated with strategy (Jarzabkowski et al., 2007; Jarzabkowski & Spee, 2009; Johnson, 2007). Strategy as Practice emphasises the micro-level social activities, processes and practices that characterise organisational strategy and strategising, which links current strategic management research with practice-oriented organisational studies (Golsorkhi et al., 2010). It is focused on the doing aspects of strategy and relates to questions on who does it, how they do it and investigates what they do and what implications this has for shaping strategy (Jarzabkowski & Spee, 2009; Johnson, 2007).

'Practice' has evolved into a critical concept for understanding pertinent issues about how agency and structure, individual action and institutions are connected in social systems, cultures and organisations (Golsorkhi et al., 2010; Johnson, 2007). The dynamic business environment has driven research to investigate the micro activities of strategising to explore how a firm should adapt, align and reconfigure itself to emerge successfully from the rapidly changing external environment (Golsorkhi et al., 2010).

Jarzabkowski and Spee (2009) classified extant literature on dimensions of either practitioner of strategy or praxis. Micro praxis refers to micro actions of the individual or group's experience of a specific event such as a decision, meeting or workshop. Meso praxis denotes organisational or sub-organisational level actions such as patterns of strategic actions or programme change, and macro praxis refers to strategy praxis at the institutional level, which is generally associated with explaining patterns of action within a specific industry.

Based on these dimensions, the authors developed a typology of nine domains for strategy as practice research, explaining the area of focus for the strategy as practice research. This study is positioned within Domains H, E, and I of the typology matrix (Table 1). Domain H provides the framework in which the relationship between bodies external to the organisations (cases) influences organisational strategic practice. In this study, the external bodies in Domain H are represented by:

- The State as the majority shareholder of the electric utilities i.e. *Agence des* Participations *de l'État* (APE) in France and the Department of Public Enterprises in South Africa.
- The Ministries of Energy (South African Department of Mineral Resources and Energy, Ministère de l’Environnement de l’Énergie in France).
- The Ministries of Environment (South African Department of Forestry, Fisheries and Environment, Ministère de l’Environnement de l’Énergie in France).
- The National energy regulators (National Energy Regulator of South Africa, Commission de régulation de l’énergie in France).
- Innovators in the local, national and global ecosystem.
- Competitors in the market.

Domain E provides the framework in which the relationship between bodies internal to the organisations (cases) influences organisational strategic practice. In this study, the internal bodies in Domain E are represented by executive management and heads of departments. These actors make strategic decisions over time as the praxis of the firm.

Domain I provides the framework in which the relationship between bodies external to the organisations (cases) influences macro-level praxis. In this study, national energy regulators and energy ministries represent the external bodies in the institutional field.

Table 1: Strategy as practice matrix adapted and condensed (Jarzabkowski & Spee, 2009)

	Micro	Meso	Macro
Individual internal	**A** Individual practitioners acting at a micro level within the organisation	**B** Individual practitioners acting reciprocally within and with organisational contexts.	**C** Individual organisational practitioners acting intersubjectively with the macro environment
Aggregate internal	**D** Aggregate practitioners within a job function acting at a micro level within the organisation	**E** Aggregate practitioners (e.g., top management) acting within an organisation using unique strategies per group within the class.	**F** Aggregate organisation-al practitioners acting intersubjectively with the macro environment.
Aggregate external	**G** Aggregate extra-organisational actors' influence on intra-organisational practice	**H** Aggregate extra-organisational actors' influence on organisational practice	**I** Aggregate extra-organisational actors' influence on strategy as practice in the field

1.3 Research problem

The fourth industrial revolution has led to the acceleration of digital electronics, the explosion of automation, communication and robotics applications, rapid access to data and the democratisation of knowledge, which in turn has brought a plethora of technological advancements and disruptive innovations such as blockchain, adaptive and predictive algorithms, energy storage and nano technologies that are transforming all industries and daily activities (Dewulf, 2021; Dogaru, 2020). Historically, the electric utility business model was based on predictable sales growth, and national energy regulators adjusted electricity prices such that customers paid flat or falling cents per kilowatt-hours whilst national regulators ensured that utilities remained reasonably profitable (Pérez-Arriaga et al., 2018). For more than a century, the electric utility business was dominated by centralised fossil fuel power generation and the business was predictable with the utility's critical task to ensure the reliability of the power supply to enable economic growth and development in the country however electric utilities began to experience a change in the early 2000s due to disruptive innovations impacting across the supply chain (Hurlbut, 2017; Kattirtzi et al., 2021; Kind, 2014; Rahimi et al., 2016) and global sustainability and climate change policy commitments by governments (Fox-Penner, 2014; Kattirtzi et al., 2021; Rahimi & Mokhtari, 2018; Wainstein & Bumpus, 2016). These changes include a rapid uptake of distributed energy generation, renewable energy technologies, microgrids, energy storage, zero-net energy buildings and developments on the customer side of the meter (Pérez Arriaga et al. 2017; Sioshansi, 2016). The driving force was to adopt low-carbon technologies and reduce excessive or wasteful energy use and greenhouse gas emissions (International Energy Agency, 2021). Increasing populations and economic growth amplify global energy demand, while technological advances simultaneously increase energy efficiency and drive down costs for renewable energy and energy storage technologies (Baker et al., 2014b). This results in fossil fuel technologies becoming economically unviable for electricity generation (Newell & Raimi, 2020) and forcing higher electricity prices. Consumers have evolved into prosumers by self-generating electricity at prices on par or cheaper than purchasing from state-owned utilities and selling their excess electricity to the power grid (Botelho et al., 2021; Sioshansi, 2016; Tayal, 2016). Due to the rapidly decreasing costs of distributed renewable electricity and energy storage systems, traditional centralised power generation is no longer necessary for universal access to modern energy services (Glachant, 2019; Levin & Thomas, 2016; Wainstein & Bumpus, 2016). The future of state-owned electric utilities is uncertain because self-generated electricity does not contribute to the utility's revenue and may induce a utility death spiral (Schwarz et al., 2020).

New operating models and business models are emerging in the electricity sector: new platforms to coordinate distributed system operations, prosumers, monetisation of power system flexibility through energy storage, demand response technologies, and the creation of energy service companies to provide consumers with behind-the-meter services and products (Botelho et al., 2021; Castaneda et al., 2017; Lombardi & Schwabe, 2017; World Energy Council, 2020). Graffy and Kihm (2014) and Tayal (2016) noted that a surge in rooftop solar photovoltaics installations leads to a wave of disruptive innovations in energy markets that manifests as disruptive competition and challenges (Agnew & Dargusch, 2015; Felder & Athawale, 2014) for electric utilities.

1.3.1 Speed and volume of disruptive innovations

The acceleration of disruptive innovations in development and diffusion is faster than previously experienced and is on the periphery of driving important changes in government economies and society (Schwab, 2017). Currently, the rate of change is so rapid that incumbents cannot respond. New entrants appear overnight with a superior product at unmatchable prices – sometimes free – and gain global market share immediately, as with Google Maps versus hardware navigation devices (Denning, 2016). Kumaraswamy et al. (2018) noted that in this era, firms' ecosystems and industries face accelerated continual disruption due to innovations enhancing the value of existing products and services, rendering business models obsolete and altering value networks. The increased pace of change and technological renewal means that traditional processes of strategy formulation within a power utility will soon be a thing of the past, and new strategies need to be developed to accommodate this changing world (Bergek et al., 2013; Graffy & Kihm, 2014; Kumaraswamy et al., 2018).

Disruptive innovations will positively and negatively impact living standards and welfare (Majumdar et al. 2018; Schwab, 2017), contributing to rising inequalities. Casey (2016) and Green and Newman (2017) emphasised that understanding and responding to the threats and opportunities presented by disruptive innovations in the electricity industry affects price stability, which will impact consumers, economic growth and universal access to energy.

1.3.2 Responding to Disruptive Innovation

Literature on response strategies to disruption is limited (Christensen et al., 2015a; Christensen et al., 2016b; Hurlbut, 2017; Schwab, 2017) and operating in a regulated market creates distinctive constraints on management choices and responses to disruptive innovations (Teece et al., 2016). The extant literature on responses to disruptive threats mainly focuses on the challenges of incumbents and factors that determine the choice of the response strategy. Sandström et al. (2009) explored the challenges of incumbents and how these challenges affected Hasselbad, a leading camera manufacturer's reaction to disruptive threats. This case study found that the firm's limited resources and niche strategy affected how the firm managed its transition to disruptive innovation. Whilst Verspreet (2013) examined factors related to strategic choices using the music industry, Markevičiūtė (2017) examined the response strategies of incumbents to disruptive innovation using the case of the broadcasting industry to determine what factors cause the strategic choices of local incumbent television broadcasters in response to global disruptive innovations. However, these studies do not conclusively answer how to respond to disruptive threats, the opportunities available, and under what conditions these may be applicable.

Although the disruptive innovation theory and resource-based theory are complementary, these theories seem to have different perspectives on responding to fast-changing business environments. The disruptive innovation theory suggested that the most appropriate response to disruptive innovations should be 1) the creation of spin-offs with new value networks, separate resource allocation and investment decision-making processes to commercialise innovation (Christensen & Raynor, 2003; Christensen, 1997); 2) launching of several new businesses early whilst the firm is still healthy (Christensen & Raynor, 2003) and 3) shifting the goal of the firm to continuous innovation that creates value for the customer (Denning, 2016). However, the resource-based theory through the dynamic capability perspective suggested that the best response is to build dynamic capability and good strategy anchored by difficult-to-imitate resources (Teece, 2007), whilst the ambidexterity theory called upon organisations to respond by simultaneously exploring new markets whilst exploiting existing opportunities in their current business (Tushman & O'Reilly, 1996). The above recommendations are based mainly on studies conducted in unregulated markets.

The disruptive innovation theory is clear about how to seize an opportunity, i.e., creating a separate entity to pursue disruptive innovations and building a creation engine to constantly produce new businesses (Christensen & Raynor, 2003; Christensen et al., 2016a). However, it is limited in how an incumbent can sense, shape opportunities and renew itself (Teece et al., 2016; Teece, 2007, 2014b). Although Christensen has argued that companies should build a business creation engine capable of constantly producing innovative new businesses through new business models, he admits that “to date, no company we know of has built an enduring capability like that” (Christensen et al., 2016a, p. 38). Later, Christensen et al. (2018) highlighted that "given the contingent nature of disruption theory, applying a one-size-fits-all solution is a particularly egregious mistake, " implying that different strategic approaches may be required for different industries or markets. Earlier, Porter (1996) argued that operating in the same market with two different or conflicting strategies is impossible because strategic positioning requires trade-offs, and it is impossible to be all things to all customers. Businesses can incur huge straddling costs that may result in losing value in their current business. Charitou and Markides (2002) agreed with Porter (1996) that the existence of trade-offs makes it difficult for incumbents to respond to disruptive innovation effectively. A company that tries to compete in both positions simultaneously risks degrading the value of its existing activities and will experience major inefficiencies. The disruptive innovation theory remains unclear on this issue. This creates uncertainty amongst practitioners on how best to respond to disruptive threats and opportunities.

In rapidly changing business environments, the resource-based theory can be considered complementary to the disruption theory in the debate on how firms respond to threats and opportunities from disruptive innovations. The dynamic capability view is seen as an extension of the resource-based theory as it shares similar assumptions (Barney, 2001), and it assists in understanding how a firm's resource stock evolves in response to competition (Ambrosini & Bowman, 2009). However, it has suffered criticism. Arend and Bromiley (2009) highlighted four problems that limit the potential of the dynamic capability view; 1) lacks clarity on the value-added relative to existing concepts of absorptive capacity, architectural innovation, intrapreneurship, strategic fit, first-mover advantage, organisational learning and change management; 2) unclear theoretical foundation; 3) poor empirical support; and 4) uncertain practical implications. Peteraf et al., (2013) state that coherence in the dynamic capability framework is lacking due to the differing conceptual views presented by the conflicting seminal articles of Eisenhardt and Martin (2000) and Teece et al. (1997). Although the dynamic capability view is widely popularised as one of the best practices to respond to change (Birkinshaw et al., 2016; Peteraf et al., 2013), Pisano (2017) noted that there are numerous definitions of the dynamic capability construct, which creates confusion, and literature on how to identify and select capabilities that lead to success is limited.

The disruptive innovation theory is also vague on how ambidexterity can be achieved i.e. the capacity of an organisation to address mutually conflicting demands (Birkinshaw et al., 2016) whilst simultaneously pursuing exploration and exploitation activities (Johnston et al., 2016; O'Reilly & Tushman, 2013; Raisch et al., 2009). Christensen (1997, p. 167) stated that: "established firms that successfully built a strong market position in a disruptive technology were those that spun off from the mainstream company an independent, autonomously operated organisation", suggesting that an ambidextrous structure is required as a response to disruptive innovation. Later Christensen pointed out that the greater the degree of alignment between the new opportunity and the existing business priorities (Christensen et al., 2016a, p. 37):

> “the better it is to pursue the opportunity through the existing business; conversely, the greater the difference, the more necessary it will be to pursue the opportunity through a separate, dedicated business unit that has the autonomy to develop a unique business model to fulfil those objectives”.

However, Christensen offered limited explanation and guidance on establishing this with minimal organisational inertia. Although Christensen discussed when spin-offs are necessary to exploit change and the nature of the teams required to lead the innovation to commercialisation, there is limited recommendation on effective structures to manage the coexistence of two different cost structures, processes and values networks or which mainstream processes should be retained, shared or leveraged for opportunities (Christensen & Raynor, 2003; Christensen, 1997). Literature on ambidexterity suggests that more research is required to improve understandings on how to achieve organisational ambidexterity (Johnston et al., 2016; Winterhalter et al., 2016).

Literature seems focused on the pros and cons of regulating disruptive innovations (Brummer, 2015; Campbell, 2012; Cortez, 2014; Cramer & Krueger, 2016; Curtis & Schulman, 2006; Munos, 2009) as opposed to responding to disruptive threats (Christensen et al., 2015a; Christensen et al., 2016b) and taking advantage of opportunities whilst operating in a regulated market.

1.4 Research questions

The following research questions were addressed in this study:

RQ1. How are state-owned electric utilities positioned in relation to their respective market forces?

RQ2. What are general strategic approaches among state-owned electric utilities?

RQ3. What assembly of theoretical tools is available to state-owned electrical utilities to strategise effectively?

1.5 Research objectives

The objective of this research was to explore strategic approaches that could be considered by state-owned electric utilities to respond to disruptive innovations in regulated markets, to position state-owned electric utilities in relation to market forces, and to identify and evaluate an assembly of theoretical tools for application to optimise their strategies.

The theoretical lenses of the disruptive innovation theory, dynamic capability and ambidexterity perspectives were used to probe possible solutions to these dilemmas. The conceptual contribution is located at the intersection of the disruptive innovation theory, dynamic capability and ambidexterity views (Figure 1).

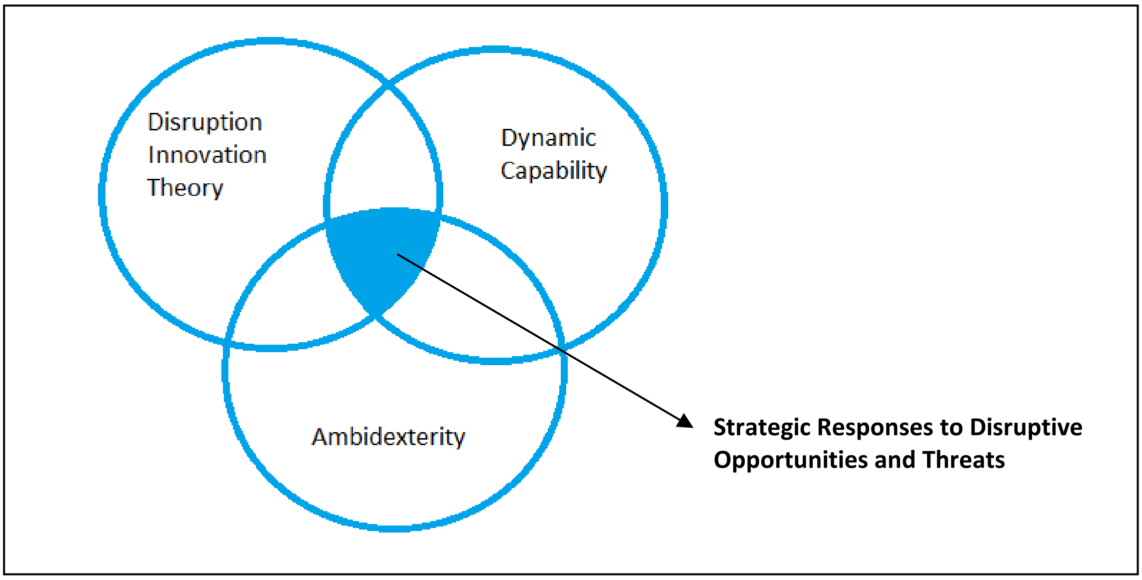

Figure 1: Theoretical positioning

Following the research questions, the objectives were to:

Objective 1: Position electric utilities in relation to their respective market forces

Objective 2: Differentiate general strategic approaches amongst electric utilities

Objective 3: Identify and integrate an assembly of theoretical tools that state-owned electric utilities can use to strategise effectively

1.6 Significance of the study

The electricity industry is undergoing a significant change worldwide: competition, restructuring, privatisation, regulation, and changing attitudes towards utilities are at the core of the current changes, driven by disruptive innovations (Graffy & Kihm, 2014; Kind, 2014; Sioshansi, 2016). The decline in sales of electric utilities is a global challenge (Castaneda et al., 2017; Costello & Hemphill, 2014; Felder & Athawale, 2014; Sioshansi, 2016). Electricity industry changes will impact both consumers and economic growth (Kind, 2014; Tayal, 2016); therefore, understanding and responding to environmental changes is important to the development of society. The view of electricity utilities as natural monopolies is now under scrutiny due to a convergence of several factors across technology, economics and policy (Hurlbut, 2017; Tayal, 2016). Understanding and responding to disruptive threats and opportunities will contribute to designing electricity markets, which is important to developing sustainable, secure and affordable power systems (International Energy Agency, 2016).

The literature on response strategies to disruptive threats and opportunities appears mixed. Some authors (Bergek et al., 2013; Christensen et al., 2015a; Christensen et al., 2016b; Nagy et al., 2016; Si & Chen, 2020) suggested that the theory of disruptive innovation still requires refinement and expansion and more research should be conducted in the areas of effective response strategies to disruption. This study examined the response literature on disruption in the electricity industry. It analysed the relationship between disruptive innovation and resource-based theories to provide possible solutions to this challenge.

There are several articles written about how regulation shapes strategic approaches in unregulated market environments (Cortez, 2014; Huesig et al., 2014; Kaulio et al., 2016; Pinkse et al., 2014), citation literature on how incumbents could respond to disruptive innovations in regulated or monopolistic markets is incomplete (Brummer, 2015; Kind, 2014; Larouche & de Streel, 2021; Uygur, 2019).

This research makes a fourfold contribution: empirical, conceptual, methodological and practical.

Empirically, this study contributes to knowledge by providing empirical underpinnings of the resource-based theory and understanding challenges faced by electric utilities.

Conceptually, by using disruptive innovation theory, dynamic capability and ambidexterity views as theoretical lenses, this study uses a qualitative approach to:

1. Expand the theoretical envelope on response strategies to disruptive innovations by 1) developing a framework for response strategies that include both reactive and proactive responses; 2) examining the relationship between the disruption theory and resource-based theory in a new setting i.e. a regulated market; and 3) examining the relationship between disruption theory and resource-based theory relative to concepts of ambidexterity and dynamic capability.
2. Suggest further theoretical understandings of dynamic capabilities and ambidexterity by investigating which specific capabilities and activities are required to respond to disruptive threats and opportunities in a regulated market and effective ways to manage ambidextrous activities in a firm.
3. Suggest an explanation for long-term survival and competition in state-owned entities in disruption theory.
4. Contribute to the discussion on strategy as a practice by linking micro activities to a macro context of the changing energy landscape and directing research away from the content discussion to the actual activity of strategising.
5. Practically, the research provides insights into incumbents operating in regulated markets on appropriate responses and opportunities to disruptive threats and also long-term energy planners, policy-makers and energy regulators who can influence new market designs, structural reforms and energy models.

Several response strategies are available to managers, elaborated in the literature review. This research will contribute to the conversation on response strategies and clarify issues about responding to and manageing threats from disruptive innovations in regulated markets. This study will assist managers in better decision-making.

1.7 Delimitations of the study

The scope of this study will be limited to the case studies of the national energy regulators and electric utilities in South Africa and France. Implementation factors will not be considered as part of this study.

Although regulated markets are those in which the state typically controls supply and demand, market participation, price of electricity and network access and prices (Lopez, 2016; Mazer, 2007), this study delimits regulated markets to markets in which the national energy regulator controls the price and supply of electricity.

This study focuses only on three main theories i.e. disruption innovation theory, ambidexterity and dynamic capability, to recommend a unique strategic approach for state-owned utilities. Agency and stakeholder theories are commonly discussed in the literature and are not investigated in this study.

Although electric utilities face several challenges, such as cyber security, loss of customers, theft of assets and equipment, non-payment, and compliance with clean energy policies, the scope of this study is limited to strategic responses to disruptive innovations.

The terms organisation, company, firm and utility are interchangeably used in this thesis. The term institution is not used because of its association with institutional theory and logic, which is not within the scope of this study.

1.8 Definitions of terms

Absorptive capacity: It is the firm’s ability to identify new external knowledge, recognise the value of this knowledge, acquire the new knowledge, assimilate the new knowledge, transform the new knowledge to fit the firm's capabilities and use the new knowledge to create competitive advantage (Senivongse et al., 2019).

Affiliates: According to the Comisión Federal de Electricidad Law promulgated in 2014, affiliated entities are those in which the CFE participates, directly or indirectly, with more than fifty percent of their share capital, regardless of whether they are incorporated under Mexican or foreign legislation (CFE, 2018, 2020). The affiliated entities are not state-owned, have a legal nature, and are created by the private law of the place of their incorporation or creation (CFE, 2018).

Ambidexterity: The capacity of an organisation to simultaneously address mutually conflicting demands of balancing today's business whilst being adaptive to changes in the environment (Birkinshaw et al., 2016; Du & Chen, 2018; Raisch & Birkinshaw, 2008).

Business incubators: these are institutes that support the creation and growth of new businesses with tangible and intangible resources for an agreed duration of time and are funded by a sponsor (e.g. government or private corporation) and/or fund themselves by taking rent (or less frequently equity) from incubatees (Hausberg & Korreck, 2020).

Business model: A business model describes the plan for how a firm creates, captures and delivers value to customers, emphasising the relationships between the flows of costs, revenues, profits, the firm's resources, competencies, organizational structure and the value proposition to the market (Demil & Lecocq, 2010; Teece, 2018a).

Business model disruption occurs when a business model disrupts an established model by redefining the value creation, capture or delivery of a traditional model (Cozzolino et al., 2018; Teece, 2010).

Business model innovation: This is a type of innovation that creates value by making changes to an organisation's value propositions and existing operating model to deliver new value propositions that competitors do not offer (Jin & Shin, 2020).

Capability: A capability is a set of activities the firm performs in a repeatable and reliable manner to enable a particular set of tasks to be accomplished in a way that allows products and services to be made and delivered and profits generated (Helfat & Winter, 2011; Teece & Leih, 2016).

Construct: A set of elements the interviewee may represent or recognise as related. These elements are the building blocks that ultimately make up the interviewee's 'constructed' view of strategic responses.

Co-opetition: Co-opetition between two firms is simultaneously walking a thin line between cooperating partners in good faith and maintaining a positive but strong competition with rivals (Ansariet al., 2016).

Disruptive Innovation: The concept refers to a process that introduces new products, services or business models driven by a technology enabler, which generally becomes established in simple applications at the low end of a market — typically cheaper, simpler and more accessible — and then successfully moves upmarket, eventually displacing incumbents (Christensen & Raynor, 2003; Christensen & Dillon, 2020; Christensen et al., 2015b).

Distributed energy resources: The term refers to electric generation units that are connected to power distribution grids and serve on-site or neighbouring energy loads rather than supplying bulk electricity to the transmission system (Barrows et al., 2021; Jaramillo et al., 2021).

Dynamic Capabilities: These are the capabilities that enable a firm to integrate, build and reconfigure internal and external resources to maintain a competitive advantage in a fast-changing business environment (Teece, 2007, 2014b, 2020).

Efficiency Innovations: Efficiency innovations are a type of disruptive innovation in the market that serves the purpose of increasing efficiency by doing more with less. Efficiency innovations create growth from new consumption as these innovations are focused on doing more with less (Denning, 2016).

Green Hydrogen: Green hydrogen refers to the production of hydrogen via renewable energy sources (Abad & Dodds, 2020) and can be used in multiple grid-tied, off-grid and hybridised applications such as storage of renewable power, traded as a fuel to produce electricity and in heating applications (Longoria et al., 2021; Maestreet al., 2021).

Liberalised market: In the electricity supply industry, liberalisation has often involved privatisation (and/or the introduction of new private entrants) and structural reform of national industries in creating competitive wholesale and retail markets with regulated, non-discriminatory third-party access to monopoly transmission and distribution networks (Pollitt, 2012).

Low carbon innovations: Low carbon innovations emit smaller quantities of harmful gases into the atmosphere or remove harmful gases such as sulphur and nitrogen from coal through underground coal gasification and carbon capture and utilisation (Guo et al., 2021; Shi et al., 2019).

Market Creating Innovations: These disruptive innovations transform complicated and expensive products into cheaper and more accessible products so that many more people can buy and use them (Denning, 2016).

Mini-grid: A mini-grid is a decentralised small-scale utility grid comprising multiple conventional or renewable energy sources, such as solar photovoltaics and diesel generators, which are used to serve customers with an electrical load between 10 kW and up to 10 MW and can operate with a connection to the primary utility grid (grid-tied) or as stand-alone (Elkadeem et al., 2021).

Organisational Culture: Behaviour patterns influencing operational performance (Bayramov et al., 2023).

Prosumerism: Prosumerism is characterised by a bidirectional energy process in which actors are both consumers of grid-based electricity as well as producers of renewable energy that can sell excess electricity to the power grid (Botelho et al., 2021; Brown et al., 2020).

Regulatory Disruption: The new product, technology or service may fall within a regulatory agency’s jurisdiction but not entirely in the regulator’s existing regulatory framework (Cortez, 2014)

Regulated markets: Regulated markets are those in which the state typically controls supply and demand, market participation, price of electricity and electricity network access and prices (Lopez, 2016; Mazer, 2007).

Seizing: Mobilisation of resources to address opportunities, make required investments and capture value from doing so (Teece, 2018b, 2020)

Sensing: Refers to organisational and managerial activities that entail continuous environment scanning, detection, identification, development and assessment of opportunities in line with customer needs and unexploited markets, as well as the perception of threats in the business environment (Baden-Fuller & Teece, 2020; Teece, 2018b, 2020).

Service Innovation: Creating and implementing new services that increase customer satisfaction and create more value for customers (Kurtmollaiev & Pedersen, 2022).

Strategic Response: Making changes to the current business to remain relevant. These may include structural changes, new products or service offerings and modifying business practices (Khanagha et al., 2018; Khanagha et al., 2014).

State-owned: An entity where the state has significant control through full or majority ownership (OECD, 2015).

Subsidiary: An entity controlled by another entity (IFRS, 2018). Control is gained if the parent entity acquires more than 50% of the voting rights. The parent company can govern its subsidiaries' financial and operating policies to gain benefits from the subsidiary's operations.

Sustaining Innovations: Sustaining innovations are innovations that improve existing products and do not create new markets (Denning, 2016)

Transforming: Continued renewal and reconfiguration of resources to innovate and respond or bring about changes in the market and business environment, including recombining and modifying existing resources(Teece, 2018b, 2020).

1.9 Assumptions

An assumption from the literature review is that all incumbents pursue long-term survival through growth and maintenance of competitive advantage.

The disruption innovation theory assumes heterogeneity within firms, describing them as internally complex and layered with conflicts about resource allocation. However, it does not assume a similar level of heterogeneity in the external environment. Whilst the disruption theory suggests that their markets control firms, it pays little attention to how firms can influence key actors in their environments.

The resource-based theory also assumes that resources are heterogeneous across organisations and that this heterogeneity can be sustained over time (Barney, 1991; Barney, 1995). Another assumption of the resource-based theory is that resources remain static over time as the theory does not address how future valuable resources can be created or how the existing stock can be renewed in fast-changing environments (Ambrosini & Bowman, 2009; Barney, 2001; Lockett et al., 2009; Priem & Butler, 2001). The dynamic capability framework is an extension of the resource-based theory (Teece et al., 1997) anchored in the assumption that resources that are simultaneously valuable, rare, inimitable and non-substitutable are a source of competitive advantage (Barney, 1991; Barney, 1995).

It is assumed that all interview participants answered questions honestly and openly. Company executives and senior staff are held accountable for the success of strategic approaches. They may be biased or reluctant to divulge truths about the extent of the success of failure achieved by their company.

1.10 Structure of this thesis

This thesis is structured into nine chapters. Chapter One introduced the topic of disruptive innovations in the electricity industry, the research objectives, research questions and the theoretical lenses used to evaluate the research findings. Chapter 2 discusses the literature review of strategic approaches available to electric utilities. The theories of disruptive innovation, dynamic capabilities, ambidexterity, and their respective limitations are also elaborated. Chapter 3 explains the research methods and provides insights into the similarities and differences of the cases chosen for this study.

The within-case analyses of France and South Africa are presented in Chapters Four and Five, respectively. These chapters provide an overview of the company structure of each utility and present the detailed findings concerning each research question.

Chapter Six deals with the integrated analysis and discusses the findings per research question. Chapter Seven presents the conclusions and recommendations from this research and lay outs opportunities for further research.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This literature review addresses each research question and the key concepts relevant to each question. Literature related to the theories of disruptive innovation, dynamic capability and ambidexterity was explored to understand the market dynamics, strategic theoretical tools and options currently available to state-owned electric utilities in regulated electricity markets. A theoretical literature review was conducted to explore and critically analyse theoretical frameworks, concepts and models with the aim to contribute to the development and refinement of the disruptive innovation, ambidexterity and dynamic capability theories. A diverse range of studies was reviewed drawing connections between various research findings to create a comprehensive understanding of the theories.

Section 2.2 discusses the evolution of the theory of disruptive innovations within two leading schools of thought, namely market and competency-based evolutions, and elaborates on the limitations of this theory together with regulations required for the promotion of disruptive innovations.

Section 2.3. explores possible strategic approaches available to electric utilities to respond to threats and opportunities from disruptive innovations and explains the limitations in the literature.

Section 2.4. evaluates both the dynamic capability and ambidexterity theories and explains the limitations of these theories, together with similarities and differences between the theory of dynamic capability and disruptive innovations.

2.2 Positioning of state-owned entities in relation to market forces

RQ1: How are state-owned electric utilities positioned in relation to their respective market forces?

The main drivers of wholly-owned and majority state-owned electric utilities are social welfare, economic development and ensuring access to electricity for all customer segments (Lazaroiu et al., 2017; Megginson & Mueller, 2022). These electric utilities are protected monopolies in their industries, can easily access finance and are protected by regulations that prevent other parties from accessing the market via licencing and grid access barriers (Pollitt, 2019). State-owned electric utilities are allocated generous budgets and are buffered from severe financial challenges via government support packages such as bailouts and increased tariffs (Lu et al., 2021). The monopoly enjoys profits regardless of whether or not it innovates due to guaranteed customers and profits from a regulated rate of return; thus, the utility is not incentivised to seek growth via innovation or respond to competition (Gilbert, 2006). However, globally, traditional electric utilities are now facing challenges due to the volume and speed of disruptive innovations, sustainability and climate change policy requirements, rising debt burdens, increasing electricity prices and operational inefficiencies (Blagrave & Furceri, 2021; Eberhard & Catrina Godinho, 2017; Rahimi et al., 2016). A fundamental feature of the emerging revolution in the electricity industry is the disruption of established energy systems, technologies, markets and business models (Kattirtzi et al., 2021). The electricity industry is undergoing several reforms to address these challenges, as explained in Section 1.2.1 and Section 1.2.4.

In fast-changing business environments, the theory of disruptive innovation can be used to respond to disruptive competition and as a way for incumbents to survive and grow (Denning, 2016; King & Baatartogtokh, 2015). The theory of disruptive innovation is one of the most influential theories in business management that is reshaping the paradigm of innovation-driven growth (King & Baatartogtokh, 2015; Williamson et al., 2020). Although various categories of innovation strategies have been formulated to interrogate and explain innovation-driven growth, none offer the same likelihood of success as the framework developed by Clayton Christensen. The disruptive innovation framework had demonstrated that a disruptive innovation strategy has an increased success rate of improving a firm’s market share than a strategy that builds on and supports the existing ways of conducting business

(Christensen, 2013). Monopolistic electric utilities can look to the disruptive innovation theory as a means to survive and thrive in the turbulent industry.

2.2.1 Evolution of Disruptive Innovation Theory

Joseph Schumpeter was the first to recognise innovation as the process through which industries "incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1942, p. 83). In his seminal work on Capitalism, Socialism and Democracy, he describes this process as creative destruction and debates that this is the core of capitalism. This debate has since compelled scholars to explore why incumbents succeed in certain types of innovation but fail when threatened by others.

In their efforts to explain the mechanisms of the innovation process and its effects, academics developed numerous theoretical frameworks. These focused on various characteristics of the disruptive innovation theory, such as the role of technology development, variations in demand patterns and analytical perspectives of organisational theory. Initially, innovation life cycles were discussed as a radical technology in the market, leading to deep research and testing by all market players until a specific technology or design evolved as the leader (Abernathy & Utterback, 1978). The incumbent then invests in incremental innovations to further improve the dominant technology or technical design, and once another radical technology is launched, the innovation life cycle begins again. This pattern of innovation later became crucial for the disruptive innovation theory as it became one of the fundamental reasons incumbents fail when threatened by disruptive innovations.

The process of creative destruction was also explained via demand patterns, technological paradigms and trajectories (Dosi, 1982). It was theorised that customer needs and preferences were influenced by existing technology and that these needs and preferences arose from socio-economic processes which evolved into specific technological paradigms. New paradigms denoted discontinuities of progress in technological trajectories, redefined the trajectory and created a radically new class of problems. This concept later influenced the construct of value networks, which became central to the disruptive innovation theory. Building on this, the theory of disruptive innovation posits that value networks strongly define and restrict what a firm within this network can and cannot do, influencing how established firms respond to disruptive innovations.

The literature proposes two primary schools of thought about mechanisms influencing innovation processes. The first school focused on explanations around competencies, skills and knowledge, claiming that incumbents fail when competence-destroying innovations render their existing knowledge base obsolete (Tushman & Anderson, 1986). The second school of thought is based on customer and market dynamics, arguing that incumbents feel threatened only when innovations introduce new performance attributes (Christensen, 1997).

This first school of thought is discussed in the next section.

2.2.2 Competency-based Evolution

The competency-based school of thought posits that a business' competitiveness and success depends on the influence of the company's existing resources, skills and knowledge as some innovations refine and advance existing technological competencies and capabilities (Abernathy & Clark, 1985). Initially, innovations were categorised into four types, i.e. regular, niche, revolutionary and architectural, and it was demonstrated that niche, revolutionary and architectural innovations had the potential to disrupt and make existing competence obsolete, whilst regular innovations conserved and entrenched existing competencies. This view of the firm's competencies, skills, knowledge and abilities provide an inward focus on why great firms failed when faced with disruptive innovations.

In the competency-based view, technological discontinuities either enhance or destroyed competence (Tushman & Anderson, 1986). Competency-destroying innovations require a dramatically different knowledge and skills base to develop and produce a product or service from the incumbent's existing knowledge or skills base. Therefore, competence-destroying innovations render the existing knowledge obsolete, making it difficult for incumbents to compete against these innovations. In contrast, competency-enhancing discontinuities build on the know-how embedded in the technology that it replaces and introduces an enhanced performance frontier. Since incumbents build on existing knowledge and skills, they were not threatened when faced with this type of innovation. Building on this sociocultural evolutionary concept, other researchers argue that a dominant design emerged after a technological discontinuity (Anderson & Tushman, 1990). In this view, a breakthrough innovation starts with fierce competition in the market, which produces variations of the original innovation, and this competition eventually results in the selection of a single dominant design in the market. Successful variations in the form of accumulated knowledge are preserved by the incremental evolution of this standard architecture design, and a new discontinuous advancement would start a new cycle of variation, selection and retention.

Similarly, specialists demonstrated that architectural innovations destroyed the existing architectural knowledge of incumbents. Since architectural knowledge is entrenched in the structure and processes of incumbents, this destruction is not easily recognised. It is difficult to fix, leading to the failure of incumbents when confronted with disruptive innovations (Henderson & Clark, 1990).

Whilst authors argued that incumbents seem to be restrained by their previous successes associated with the old technological paradigm as their existing skills, processes and operating procedures restrict their ability to respond effectively to changes in the environment (Abernathy & Clark, 1985; Macher & Richman, 2004; Tushman & Anderson, 1986), some researchers found that competence-enhancing technologies have been introduced by market leaders who are either already exerting a significant presence in the industry (Rothaermel & Hill, 2005; Tripsas, 1997) or have the capability to leverage their existing competencies when entering a new market (Gilbert, 2012a; Mitchell, 1989). In this view, competence-enhancing innovations tend to reinforce the incumbent's competitive market position because they enable the established market leaders to exploit their current competencies and increase barriers to entry (Gilbert, 2012a). This is contrary to Christensen’s theory (Christensen, 1997), which predicts that the failure of incumbents is fundamentally due to their investing in competence-enhancing innovations and overlooking disruptive innovations until it is too late.

Extending the concept of competency-enhancing innovations, some authors found that solid competition as a result of disruptive innovations mainly driven by incumbents could also bring about late shakeouts in mature industries such as electricity, because incumbents were capable of absorbing the disruptive technology, and integrating this innovation with their existing capabilities (Bergek et al., 2013). However, this notion of creative accumulation highlights a dual nature of accumulation and creativity, in that the accumulation aspect creats barriers to entry and offset the attacker's advantage, whilst the creativity aspect presents challenges for incumbents, particularly in industries where products are composed of a multitude of technologies and represent a variety of performance attributes. The creative accumulation school of thought recommends that incumbents respond to turbulence in their industry by simultaneously refining and developing existing technologies at a rapid pace, acquiring and developing new technologies and resources, and integrating novel and existing knowledge into superior products and solutions (Bergek et al., 2013). For example, case studies describing online disruptive innovations showed that the ”Internet of Things” relied on an incremental evolutionary process to upgrade and integrate with information technologies (Kodama, 2018). This incremental process is additive in nature, whereby value creation is progressively added; therefore, the “Internet of Things” is “creative accumulation” rather than “creative destruction” in nature. The creative destruction school of thought is discussed in Section 2.2.3 on the market-based evolution of disruptive innovations.

Later, the creation accumulation concept was merged with the absorptive capacity school of thought because both recognised the value of assimilating new knowledge with existing knowledge to be a competitive advantage. Initially, the absorptive capacity construct was framed by Cohen and Levinthal (1989); however, it was reconceptualised by scholars as the firm’s ability to identify new external knowledge, assimilate the new knowledge, transform the new knowledge to fit the firm’s capabilities and use the new knowledge to create competitive advantage (Senivongse et al., 2019). However, some authors also discussed absorptive capacity as routines, meta routines or processes used to identify, acquire, assimilate, transform, and exploit new knowledge, which enhances competitive advantages in turbulent business environments (Osorio-Londoño et al., 2021; Senivongse et al., 2019). Other authors explain absorptive capacity as a duality concept with characteristics either as resources and asset properties (Rohenkohl et al., 2021; Senivongse et al., 2017) or capabilities (Ávila, 2022). The concept of absorptive capabilities as a dynamic capability has been posited by several researchers (Bhupendra & Sangle, 2022; Pihlajamaa, 2021) and is discussed in Section 2.4.1.

The competency-based school of thought theorises that the strategic renewal of a firm and the retention of its competitive advantage depends on the influence of the company's existing resources, skills, knowledge, competencies, and capabilities. This school posits that building on existing capabilities and knowledge will assist firms in responding to disruptive innovations.

The second school of thought on mechanisms influencing market-based innovation is discussed in the next section.

2.2.3 Market-Based Evolution

The antecedents of the disruptive innovation theory are presented in Table 2 in date order to illustrate the evolution of relevant concepts of time.

Table 2: Antecedents of Disruptive Innovation Theory

Authors	Categorisation	Generalisation of association	Recommendations
Ettlie, Bridges, and O'keefe (1984)	Incremental vs. radical innovations	Incumbents are likely to succeed with incremental innovations but fail when faced with radical innovations.	• Radical innovation and adoption are promoted by centralised decision-making structures and moving away from complexity towards organisational generalists. • Greater support from top managers in the innovation process is

Authors	Categorisation	Generalisation of association	Recommendations
			required to initiate and drive radical innovation.
Dewar and Dutton (1986)	Incremental vs. radical innovations	Incumbents are likely to succeed with incremental innovations but fail when faced with radical innovations.	• Investment in human capital in the form of technical specialists is required to facilitate radical innovation and adoption.
Christensen, (1997)	Sustaining vs. disruptive technologies	Incumbents succeed when faced with sustaining technologies but fail with discontinuous technological innovations.	• Invest in disruptive technologies early by creating a spin-off from the mainstream company. • Consider new markets and develop the new business around new value definitions.
Adner (2002)	Sustaining vs. disruptive technologies	A demand-based view of technological competition – an absolute lower price unit is critical for disruption to occur	• While disruption is enabled by sufficient performance, it is influenced by price. To identify potential disruptors, managers must plot performance-provided and performance-demand curves and price trajectories of the competing products.
Christensen and Raynor (2003)	Sustaining vs. disruptive innovation	Incumbents fail when faced with disruptive inno-vations and succeed with incremental innovations. Christensen and Raynor (2003) refined disruptive technologies into disruptive inno-vations, including services and bus-	• Create autonomous units with new structures, processes and values. • Proactively sense changes in the low-end and non-consumption markets and launch several new growth businesses whilst the firm is still healthy.

Authors	Categorisation	Generalisation of association	Recommendations
		iness model disruptions. They extended the concept of disruptive innovations to include both new markets and low-end segments/markets.	
Danneels (2004)	Disruptive innovation	Danneels (2004) proposed that disruptive technology changes the basis of competition by changing the performance metrics along which firms compete.	• Develop a classification of technologies to enhance the understanding of how the emergence of new technologies shapes the fate of firms and industries. • Predictions need to be developed and tested about which technologies will become disruptive and which firms will fail. • Assess the merits of spin-offs and customer orientation as a response to disruptive technologies.
Markides (2006)	Disruptive innovation	Different innovations create different markets and pose radically different challenges for incumbents.	• Technological, business models and radical product innovations should be treated as separate phenomena.
Govindarajan & Kopalle, (2006a)	Disruptive innovation	Developed a scale to measure disruptiveness and established its predictive validity in an attempt to determine whether incumbents fail or succeed when threatened by disruptive innovation	• According to the authors' measure, disruptive innovation should be inferior to the attributes that mainstream customers value; (ii) offer new value propositions to attract a new customer segment or the more price-sensitive mainstream market; (iii) be sold at a lower price;

Authors	Categorisation	Generalisation of association	Recommendations
			(iv) penetrate the market from niche to main-stream.
Govindarajan and Kopalle (2006b)	Disruptive innovation	Govindarajan and Kopalle (2006b) provided a general measure of disruptiveness, including low-end and high-end disruptions.	• Disruptive innovations can also be initially offered at a high-er price than existing products in the market and still pose a threat to incumbents. • An adhocracy culture promotes the deve-lopment of disruptive innovations in a firm. • The disruptive innovation framework does not help make ex-ante predictions about which firms are likely to develop disruptive innovations, and more research should be conducted.
Schmidt and Druehl (2008)	Disruptive innovation	Schmidt and Druehl (2008) developed a diffusion framework theorising that disruptive innovations diffuse from the low-end upwards towards the high-end and categorised low-end encroachment as fringe-market, detached market and immediate scenarios.	• 3-step process to identify threats and op-portunities for low-end encroachment, which included: i) identifying market segments and primary attributes of the existing product in current mark-ets; ii) evaluating each market segment's willingness to pay for each attribute, and iii) evaluating which segments will buy the new product over time

Authors	Categorisation	Generalisation of association	Recommendations
Sandström (2011)	Disruptive innovation	Disruptive innovation has the potential to flourish in high-end or mainstream markets despite its initial inferior performance, as customers are willing to make trade-offs based on value.	• Literature should consider value creation rather than focusing on price and performance dimensions. • More research is required on the conceptualisation of the term value networks and how firms can renew their business models.
Obal (2013)	Disruptive innovation	Inter-organisational trust can influence a buyer's intent to adopt a disruptive innovation	• Aim to develop a trusting relationship with the buyer • Develop strategic alliances
Christensen (2015)	Disruptive innovation	A disruptive innovation framework can predictive market place disruptions	• The strategy should focus on over-served customers or customers in a new market with products that are cheaper and simpler than existing offerings • To be simpler and cheaper, the product must possess an enabling technology that allows it to fulfil the job of the customer at a lower price than other offerings in the market • The strategy has to be disruptive to all other strategies in the market and not be sustaining to competitors
Ansari et al. (2016)	Disruptive innovation	They posit that disruption affects incumbents and an entire ecosystem.	• The disruptive innovation framework should adopt a systemic view of how disruptive innovations can affect

Authors	Categorisation	Generalisation of association	Recommendations
			several relationships within an ecosystem.
Nagy et al. (2016)	Disruptive innovation	A disruptive innovation is rede-fined to include characteristics of radical functionality, discontinuous tech-nical standards and or new forms of ownership that alter marketplace expectations.	3-step process to predict disruptive innovations:- i) identify the innovation in terms of functionality, technical standards and forms of ownership, ii) identify where in the value chain of the firm the innovation is being used, and iii) compare the potentially disruptive innovation with the technologies currently used in the firm for that value chain segment.
Christensen in Denning (2016)	Market-creating innovations vs sustaining innovations vs efficiency innovations	Christensen recognises multiple market disruption patterns. Disruptive innovation is a theory of com-petitive response adjacent to the growth of a firm.	• Build defensible evolution via business models • Engage in con-tinuous innovation that creates value
Kumaraswamy et al. (2018)	Disruptive innovation – continual disruption	Authors extend the definition of disruptive inno-vations to include new perspectives – evolutionary, rela-tional, temporal and framing that culminate in a performative approach.	• The phenomenon should be handled from a performative ap-proach instead of Christensen's predictive approach.

Authors	Categorisation	Generalisation of association	Recommendations
Christensen and Dillon (2020)	Disruptive innovation powered by a technology enabler	Disruptive innovation is a process that introduces new technologies, services and business models powered by a technology enabler that takes hold in simple applications either at the low end of the market or creates a new market— typically by being cheaper and more accessible — and then moves upmarket, eventually pushing out established competitors from the market place.	• Incumbents should focus on the job that customers are trying to accomplish by making purchases to create the right products for the customer. • Firms should build the capability to manage emergent strategy • Leaders should build systems, processes and cultures to solve in-novation challenges • Firms should build sustainable business models
Si and Chen (2020)	Disruptive innovation	A disruptive in-novation could be broadly classified as i) a process instead of a specific outcome, ii) it first gains a foothold in low-end markets or creates new markets, iii) its products or services are initially inferior to the incumbent in the market but they meet the needs of consumers willing to trade off superior performance for attributes that are simpler, smaller and more convenient, iv) development is not along existing technological paths, v) the attributes of products or services	• Proposed a multilevel theoretical framework of influence factors to improve the predictability of disruptive innovations, including individual, firm, industry, national/ economy and network/ systems levels.

Authors	Categorisation	Generalisation of association	Recommendations
		offered will improve over time to meet the need of mainstream consumers gradually penetrating this market.	

The earlier theories focus on dichotomies between incremental and radical innovations (Dewar & Dutton, 1986; Ettlie et al., 1984), but later this shifts to sustaining versus disruptive innovations (Adner, 2002; Christensen, 1997) and disruptive innovation versus continual disruption (Kumaraswamy et al., 2018). Whilst earlier authors tried to explain the failures of incumbents when threatened by new technologies from an inward perspective of a firm, later authors began to account for failures based on outward perspectives that considered the external environment (Christensen, 1997; Denning, 2016; Gilbert, 2012b; Sandström, 2011). Over time, the term disruptive innovation evolved from a descriptive framework on responses to technology change to a theory of innovation and growth (Christensen et al., 2016a) and later included competitive responses (Christensen & Dillon, 2020; Dogru et al., 2019). The theory moved from a predictive approach to how incumbents respond when threatened by disruptive innovations to a performative approach to account for disruptive innovations' many meanings and perspectives (Kumaraswamy et al., 2018).

While earlier studies recognised that incumbents tend to succeed with incremental innovations but failed when faced with radical innovations, they did not explain why incumbents failed when they encountered discontinuous innovations (Dewar & Dutton, 1986; Ettlie et al., 1984). The seminal work of Clayton Christensen in “The Innovator’s Dilemma” was popularised, as it offered a theory on why incumbents always failed when threatened by disruptive technologies, and argued how new technologies came to outperform superior technologies in a market by rejecting earlier views that primarily looked inside a firm to account for these failures

(Christensen, 1997). Later, the term disruptive technologies was referred to as disruptive innovations (Christensen & Raynor, 2003) to broaden the applicability of the theory to include services and business model innovations such as discount department stores, low-price point-to-point airlines, and online businesses (Danneels, 2004; Markides, 2006; Yu & Hang, 2010) and subsequently efficiency innovations (Denning, 2016). Initially, the disruptive innovation theory posited that whilst sustaining innovations improved the performance of established products that are already valued in major markets, disruptive innovation is a process whereby an entrant company with fewer resources can topple incumbents in a marketplace despite their abundance of resources, existing market share, management experience and brand presence (Christensen, 1997). The shift happens because market leaders focus all their investments on improving their existing products for their most profitable customers. As a result, they overshoot the needs of this segment whilst ignoring the needs of less profitable customer segments. Incumbents decide not to respond to the entrant company's growing market position until a substantial market share is lost.

Despite its popularity, the theory of disruptive innovation has been widely criticised. Christensen was accused of cherry-picking examples to support his theoretical claim, and some studies showed that not all disruptive innovations succeeded, as in the case study of the Iridium global satellite phone system (Cohan, 2000). It was argued that the shift of customer expectations to new performance attributes was loosely explained in the disruption theory. A demand-based view suggested that an absolute lower unit price is critical for the disruption (Adner, 2002). In response to criticisms that the original theory of disruptive innovation was incomplete, the theory was refined to introduce distinctions between low-end and new-market footholds (Christensen & Raynor, 2003). The theory was reframed to explain that low-end disruptive innovations enter the bottom of the market and take hold within an existing value network before moving upmarket. In contrast, new market disruptive innovations took hold in a completely new value network and addressed the needs of previously unserved customers.

However, the theory did not explain what made a technology disruptive, what exact criteria must be used to identify disruptive technologies, at what point a technology is disruptive in the market, and what characteristics a firm must possess to succeed (Danneels, 2004). Researchers argued that whilst the theory could be used for post hoc conditions, it was limited in making ex-ante predictions to assist managers in determining which emerging technologies will become disruptive in the market to formulate response strategies. Some authors also argued that Christensen's findings on the value of being customer-orientated are misstated and narrow, as they suggest that managers should ignore the needs of existing customers. A new definition was proposed, which was broadly in line with Christensen's work but focused more on the performance metrics which determine the impact: "A disruptive technology is a technology that changes the bases of competition by changing the performance metrics which determine the impact" (Danneels, 2004, p. 249).

Further criticism of the theory was that the definition of disruptive innovation was vague in describing what constituted a disruptive innovation, as different kinds of innovations have different competitive effects and produce different types of markets. For example, business models and radical product innovations may share similarities to what Christensen classified as disruptive innovations, but they are different phenomena that create different kinds of markets, pose different challenges, and require managers to formulate different response strategies (Markides, 2006). Expanding on this argument, some authors insisted that the disruptive innovation theory lacked reliable and valid measures for important innovation attributes such as disruptiveness of innovation and proposed a disruptiveness scale based on reliability and validity (Govindarajan & Kopalle, 2006a). According to this measure, disruptive innovation (i) should be inferior to the attributes that mainstream customers value; (ii) offer new value propositions to attract a new customer segment or the more price-sensitive mainstream market; (iii) be sold at a lower price; and (iv) penetrate the market from niche to mainstream. Building on this work to include both high-end and low-end disruptions, a disruptive innovation was conceptualised as an innovation that introduces a different set of features, performance and price attributes relative to the incumbent in the market, which is an unattractive combination to mainstream customers because of the lower performance attributes and they seemed to value the high price. However, a new segment might value the inferior performance (Govindarajan & Kopalle, 2006b). Over time, the performance attributes are improved to satisfy mainstream customers and eventually more of the mainstream market. This more generalised explanation of the disruptive innovation theory became critical as it began to account for higher-priced disruptive innovations that could also threaten incumbents.

To improve the understanding of why some innovations could be more disruptive to incumbents than others, researchers suggested a diffusion framework complementary to the trajectory patterns of the disruptive innovation theory, which was based on the concept that diffusion of disruptive innovations began from the low-end upwards towards the high-end termed low-end encroachment – after first selling only in the new market segment (Schmidt & Druehl, 2008). This view theorised that incumbents were likely to ignore the potential impact of low-end encroachment patterns as the initial impact on the market tended to be low in contrast to high-end encroachment patterns, which had a more immediate and pronounced impact on the market. A three-step process was recommended to assist incumbents in identifying the potential diffusion pattern and impact of an innovation, which could assist in determining threats and opportunities from emerging innovations. This process involved the identification of market segments and primary attributes of the existing product in current markets, evaluation of each market segment's willingness to pay for each attribute, and also determining which segments would buy the new product over time.

Whilst the theory of disruptive innovation (Christensen & Raynor, 2003) proposed that the main challenge for a firm’s existing customer segment seemed to be related to managing the internal resource allocation process, research showed that in high-end segments, the main struggle was the concept of new value proposition and its compatibility with the existing network structures of a firm (Sandström, 2011). Therefore, scholars were advised to conduct further studies in search of a more nuanced conceptualisation of the term ‘value network’, and investigations should be focused on how firms may proactively renew their business models to match the new value propositions that disruptive innovations create.

Some authors found the disruptive innovation theory to be exaggerated and reported that potentially disruptive technologies i) were introduced as often by the incumbent as by entrants, ii) are not cheaper than existing technologies in the market, iii) rarely disrupted firms, iv) the potential for incumbents to disrupt is higher than entrants, and v) lower attack decreases the potential of firm disruption (Sood & Tellis, 2011). They explained that the theory of disruptive innovation needed a more precise definition as the same term was used to describe both the causative agent (disruptive innovation) and the effect (disruption). It was unclear which domains disruption could occur as studies indicated that disruption could occur in the technological (performance evolution), firm (competitive survival) and demand (market acceptance) domains (Sood & Tellis, 2011).

Whilst extant literature (Christensen, 1997; Tushman & Anderson, 1986) found that entrants were likely to have more success with disruptive innovations than incumbents, other authors (Danneels, 2004; Sood & Tellis, 2011) occasionally found that incumbents also enjoy success. These exceptions could arise due to inter-organisational trust between incumbents and suppliers because incumbents seemed to adopt disruptive innovations based on their pre-existing relations with their technology suppliers (Obal, 2013). This view extended the disruptive innovation theory to consider additional elements of the external market as reasons for why incumbents tend to overlook emerging disruptive innovations and fail to respond proactively.

Disruptive innovation theory has been opposed and termed a “competitive strategy for an age seized by terror” (Lepore, 2014, p. 3). In this view, it was argued that Christensen handpicked a set of cases to build a supportive framework for his theory and his original theory was built mainly with the example of the disk drive, which was considered to be a poor choice for an investigation which was designed to create a model to be applied to other industries, especially after Christensen (1997) had remarked that nowhere in the history of business had there been an industry like disk drives. This observation indicated that the disruptive innovation theory was incomplete, and further refinement is required for application in other industries, such as the electricity industry.

Further criticism was that the disruptive innovation theory had limited predictive ability, and studies indicated that integrated steel mill incumbents that mini-mill newcomers that were threatened, recovered over time, and did not exit the market as predicted by the disruptive innovation theory, nor did the disk drive incumbents in the 1980s disappear (Lepore, 2014). Instead, the disk drive incumbents were able to consolidate. They recovered because divisions that are today’s industry leaders led the market in the 1980s, although the company's ownership shifted over time. Gradually, the victory in the disk drive industry was claimed by incumbents good at incremental innovation, which suggests that there are perhaps other pathways for disruption, and these may require strategic considerations.

The disruptive innovation theory was updated to clarify that disruptive innovation refers to a strategy that uses technology, but the technology itself may not be disruptive because often technologies that are applied in disruptive ways are created by incumbents; however, these incumbents' position the technologies as a performance improvement to their existing offerings, which does not become disruptive until an entrant repositions it in line with a disruptive strategy (Christensen, 2015). The view that the disruptive innovation theory had no predictive power has been refuted. Common elements for responding to disruptive innovations were highlighted: i) the strategy should focus on over-served customers or customers in a new market with products that are cheaper and simpler than existing offerings; ii) to be simpler and cheaper, the product must possess an enabling technology that allows it to fulfil the job of the customer at a lower price than other offerings in the market; and iii) the strategy has to be disruptive to all other strategies in the market and not be sustaining (Christensen, 2015).

Even though the theory has been widely discussed and applied for almost 20 years, there seems to be confusion around what disruptive innovation means, what would be displaced and by whom (Christensen et al., 2015b; King & Baatartogtokh, 2015).

Scholars acknowledge that the theory of disruptive innovations had become so widely accepted that its predictive power and what constitutes its core elements are seldom questioned, yet analysis of 77 case histories presented in the framework of the disruptive innovation theory (Christensen & Raynor, 2003; Christensen, 1997) revealed inconsistencies as i) 24 of the cases did not involve a trajectory of sustaining innovation before the emergence of presumably disruptive innovation, ii) in 60 of the cases the incumbent did not overshoot customer needs, iii) in 30 cases incumbents did not have the capabilities to compete with the potential disruption and, iv) approximately one-third of incumbents were not displaced by disruptive innovations (King & Baatartogtokh, 2015). These findings suggest that the disruptive innovation theory is incomplete and requires further improvement, so the definition shifted to "an innovation with radical functionality, discontinuous technical standards and/or new forms of ownership that redefine marketplace expectations" (Nagy et al., 2016, p. 125). These authors explain that if disruptive innovations possess characteristics that a firm already utilises, be it functionality, a technical standard, or a form of ownership, then the innovation is unlikely to disrupt that firm; but if the functionality, technical standards, or form of ownership was not used by the firm then the innovation has the potential to be disruptive to the firm. Prediction of disruptive innovations would assist a firm to respond to disruptive innovations proactively. Therefore, these authors outline a three-step process to facilitate the prediction of disruptive innovations: first, identifying the innovation in terms of functionality, technical standards and forms of ownership, secondly, identifying where in the value chain of the firm the innovation being used, and thirdly, comparing the potentially disruptive innovation with the technologies currently used in the firm for that value chain segment.

Later, Christensen acknowledged that there could be several different pathways to disruption and that firms such as Tesla, Whole Foods and Apple had attained market disruption by introducing luxury products into the market and rapidly advancing these products' performance, whilst Google introduced Google Maps a radically new navigation technology with a trajectory of improvement that was so steep that competitors could not respond (Denning, 2016). Disruptive innovation theory was repositioned as a theory of competitive response in which the construct of disruption did not focus on growth but rather was viewed as adjacent to growth. In earlier versions of the theory (Christensen & Raynor, 2003; Christensen, 1997), the framework only characterised two types of innovations. The first was market-creating innovations, which are disruptive because they replace existing products in the market with simpler, cheaper and more accessible products which enable more customers to buy and use these products. The second are sustaining innovations, whose role is to make existing products better; and missed a third type of innovation, classified as efficiency innovations (Denning, 2016). Efficiency innovations were reflected as having the potential to eliminate incumbents by creating efficiencies to do more with less whilst driving cost savings for consumers. Although efficiency innovations have the same impact as disruptive innovations in destroying incumbents, their purpose in the market is to do more with less, rather than contribute to growth. Incumbents were advised to build a defensive evolution via business models and engage in continuous innovation that created value.

Although the disruptive innovation theory had evolved to recognise that there are multiple patterns for disruption, the theory remains inconsistent, as examples such as the Apple and Google range of products were not necessarily cheaper, simpler and more accessible to consumers. The issue of disruptive innovations being characterised as low-cost models possessing good enough performance attributes has been hotly debated in the literature (Schmidt & Druehl, 2008; Sood & Tellis, 2011). The Apple range of products was considered mainly premium products appealing to the elite in society who are price insensitive, and these premium products are not necessarily cheaper, simpler and more accessible as Christensen theorised. For example, the Apple smartwatch is regarded as sophisticated with digital features measuring heart rates and activity levels, is more expensive than the traditional clock face analogue watches and is relatively inaccessible, as the smartwatches are selectively marketed to stores serving middle to high-end customers. Despite the term’s popularity, the theory of disruptive innovation still requires further refinement and expansion. Christensen et al. (2016b) advised that more investigations should be conducted on effective responses to disruptive threats.

Studies investigating TiVo and the TV industry ecosystem found that a disruptor does three things: first, it confronts co-opetitive challenges that were intertemporal, dyadic and multilateral; secondly, it continually adjustes its strategy to address co-opetitive challenges as they emerged. Thirdly, it reframes the relational positioning within the changing ecosystem such that its innovation is repositioned in alternative ways; for example, as sustaining the operations of members in an ecosystem and uses soft and hard power to gain cooperation from incumbents (Ansari et al., 2016). This reframing of the concept changed the focus from the “disruptive” aspect of the innovation that generally threatens incumbents from focusing on the benefits of the innovation that could enhance the value generated for various incumbents within the ecosystem. The theory was expanded from an inward focus on the incumbent to an external view considering the external ecosystem attributes. The new conceptualisation of the disruptive process also highlighted that the process was not a straightforward trajectory with the central tension arising from resource allocation as previously suggested (Christensen & Raynor, 2003), but rather the journey was experienced as a bumpy road with challenges arising from co-opetitive tensions which required both emergent and divergent strategies.

Building on this concept of ecosystems, academics have noted that the term “disruptive innovations” has multiple meanings and discussed several facets of disruption – evolutionary, relational, temporal and framing and recommended that the phenomenon should be theorised from a performative approach as opposed to Christensen’s predictive approach (Kumaraswamy et al., 2018). These authors argued that a performative approach would release firms from the need to accurately predict and quantify disruptive innovations, and enable them to focus on efforts that enact constituted worlds whilst acknowledging that efforts are part of a broader ecosystem of relationships and interactions amongst heterogenous actors. Other researchers have supported this view and added that performativity is an ongoing journey (Garud et al., 2018). However, Christensen asserted that scholars and managers interpret and apply the theory in whatever manner suits their desires, which caused further confusion in developing and applying the theory (Christensen et al., 2018). Confusion would create doubt amongst managers, which, in turn, would prevent firms from responding promptly to disruptive innovations.

Despite criticisms by workers in the field over several years, the core mechanisms of the original theory remain the same. Before his death, Christensen clarified that disruptive innovation is a process that is powered by a technology enabler that takes hold in simple applications either at the low end of the market or creates a new market— typically by being cheaper and more accessible — and then moves upmarket, eventually pushing out established competitors from the market place (Christensen & Dillon, 2020, p. 22). In this update, disruptive innovation was conceptualised as a relative concept dependent on who or what is being disrupted and discussed as accessible and affordable products and services that initially appear unthreatening to an incumbent but, over time, will transform an industry. Thus, Christensen shifted the disruption framework from an earlier focus only on incumbents to include an industry view in alignment with suggestions from other academics (Ansari et al., 2016; Kumaraswamy et al., 2018). This shift implied that strategic responses to disruptive innovations should include impacts on incumbents as well as consider other ecosystem actors. In addition, the disruptive innovation framework has been positioned as a tool to predict competitor behaviour and what a firm could do in response to a threat or opportunity. The recommended strategic approach for incumbents to survive a disruptive innovation was extended to include the concept of building a sustainable business model, as the dangers of operating with unsustainable business models are more significant than the threat of disruption from faster, cheaper and more convenient alternatives in the market. However, Christensen admitted that there are anomalies in his theory that are still waiting to be discovered, for example, digital transformations and the growth potential of digital firms, and these new insights could shift the boundaries of the theory even further (Christensen & Dillon, 2020).

What constitutes a disruptive innovation remains unclear due to multiple definitions of disruptive innovations being based on several perspectives (Dogru et al., 2019; Kuokkanen et al., 2019; Si & Chen, 2020) such as – i) innovation activities (Snihur et al., 2018), ii) disruptive innovation as an evolving process rather than an outcome

(Guttentag & Smith, 2017), iii) the effects of disruptive innovation (Kumaraswamy et al., 2018) and iv) basic key characteristics generally related to locking customers in a new way (Christensen & Dillon, 2020; Pandit et al., 2018) for example, lowering gross profit; not following the traditional pathways of improving the performance valued by mainstream consumers, introducing a new trajectory of performance and improving performance along with parameters different from the traditional ones.

Si and Chen (2020) reviewed articles in the Social Science Citation Index (SSCI) journals. They concluded that a disruptive innovation could be broadly classified as i) a process instead of a specific outcome, ii) first gaining a foothold in low-end markets or creating new markets, iii) products or services that are initially inferior to the incumbent in the market but meet the needs of consumers willing to trade off superior performance for attributes that are simpler, smaller and more convenient, iv) development is not along existing technological paths, v) attributes of products or services offered will improve over time to meet the need of mainstream consumers, gradually penetrating this market. These classifications shifted the original theory by suggesting that the innovation is not disruptive, but it is the gradual process of change that occurs when mainstream consumers begin to accept the innovation, whilst at the same time valuing new attributes, and that for disruption to occur, the innovation must be launched with a flexible and dynamic business model. Researchers proposed a multilevel theoretical framework of influence factors to improve the predictability of disruptive innovations, which included individual, firm, industry, national/economy and network/systems levels and found that industry-level factors had not been fully explored but are critical for improving the understanding of disruptive innovations at a meso level (Si & Chen, 2020). These improved understandings will in turn assist in formulating better response strategies.

Some authors have highlighted that most of the research on disruptive innovations has been limited to investigations in developed countries and argued that disruptive innovations in emerging economies such as China exhibit different characteristics than those in developed countries (Williamson et al., 2020). These authors pointed out inconsistencies with Christensen's theory as i) disruptive innovations in China focused on offering different value propositions to customers as opposed to being launched as products with inferior performance, ii) the rate at which disruptive innovations are improved and extended is generally faster than in developed markets and iii) disruptive innovations in China are typically launched directly into the mass market rather than a niche. Therefore, case study comparisons from different countries could further enrich disruptive innovation theory.

From the literature, the definition of disruptive innovations can be consolidated into:

A discontinuous process in which new products, services, business models or technologies attack the mainstream by offering new value propositions that make it more attractive for consumers and creates significant changes in the market demand.

Although a Google Scholar search returned 170,000 articles on "strategic responses to disruptive innovation" on 25 July 2021, most of the literature focused on refining the concept or definition, disruptive business models, the theory's predictive ability, and identifying disruptive innovations. Articles on how an incumbent should respond to disruptive threats and opportunities were limited.

This study on strategic approaches to disruptive innovations in regulated markets contributes to expanding and refining the term disruptive innovation. The following section discusses the influence of regulations on disruptive innovations, which in turn influence strategic approaches.

2.2.4 Regulations for disruptive innovations

Disruptive innovations are not asymmetrical with conventional business processes and models traditionally set up for the existing market. They have characteristics of new markets (Christensen & Raynor, 2003), cross-markets and cross-industries, which leads to the diversification of existing markets (Bu, Li, & Wu, 2021) and pose new challenges for regulators because regulators are users, promoters, and regulators of innovation. The “permissionless innovation” school of thought argued that the success of the internet and its myriad of disruptive products and services, which drove growth and innovation, was due to the lack of regulation concerning who created, connected or distributed information (Cerf, 2012) thereby suggesting that disruptive innovations should not be regulated. However, the downside to the lack of regulation resulted in the rise of the dark web, which has enabled gun sales, human trafficking and the sale of child pornography.

Scholars discussed that regulations could influence how a firm perceives and responds to disruptive innovation e.g. the U.S. Food and Drug Administration controlled the implementation of new medical software and devices and acted as a gatekeeper for diffusion into the market, influencing incumbents to overlook these innovations (Cortez, 2014). Whilst the literature generally agrees that some form of regulation is required to regulate disruptive innovations to protect consumers and firms (Biber et al., 2017; Walker-Munro, 2019), there is little agreement on the type of regulation that is best suited for disruptive innovations. Some researchers argue that disruptive innovations should be allowed to develop in society without restrictions from state regulators unless a compelling case can be made that the innovation will bring harm to society (Thierer & Camp, 2017); other authors (Fajar, 2020; Wahyuningtyas, 2019) advocate for self-regulation i.e. a shift from the state as a regulatory authority to business people by giving them the right to self-regulation. Self-regulation is posited as a regulatory process whereby an industry-level organisation, such as a trade association or a professional society organisation, sets rules and standards for how companies operate in the industry. However, self-regulation has limitations; for example, balancing individual party interests and aligning self-regulation with public policy would be difficult.

Authors argued that disruptive innovations cannot be regulated by traditional regulatory frameworks, which are generally sector-specific due to their convergence in several sectors at once, sometimes causing disorder in society (Cui & Davis, 2022; Fajar, 2020) as witnessed by global protest demonstrations mainly from incumbents against disruptive sharing services such as Uber, Lyft and Airb&b. Incumbents in the taxi and hotel industry have claimed that while their prices are regulated and requirements for operating licenses and safety are stacked upon them to ensure consumer protection, the same restrictions were not placed on platform-sharing innovations. Challenges to regulating disruptive innovation include violation of intellectual property rights, avoidance of taxation, the issue of responsible usage and violations of competition law (Fajar, 2020). Financial innovation start-ups have emerged in domains such as asset management, risk control, peer-to-peer lending and insurance service, which have rendered the traditional regulatory frameworks for banking and insurance industries inefficient. In the financial services industry, disruptive innovations such as blockchain and cloud computing are supplementing existing infrastructure in the traditional financial services industry and posing new challenges for regulators, such as excessive cash and campus loan borrowings, violent collection methods, extremely high-interest rates, Ponzi schemes and infringement of personal privacy (Bu et al., 2021). Thus, new regulatory frameworks are required for implementing disruptive innovations.

Studies showed that different regulation measures (liberal, moderate, moderate-collaborative and protective) in the cities of San Francisco, New York, Amsterdam, London, Berlin, Paris, Barcelona, Reykjavik, Vienna, Tokyo and Hobart produced different outcomes for the sales and acceptance of disruptive peer to peer accommodation in residential areas (von Briel & Dolnicar, 2021). Regulations have a moderating effect on the uptake of disruptive innovations and should be considered in strategic approaches.

Each utility is positioned in its market as follows:

- Électricité de France (France) is 83,6 % state-owned, meaning it has less autonomy, and electricity prices are only controlled in the residential customer segments of the market. However, the state fully controls access to distribution and transmission networks. Private investment entities and employees own 16,4% of Électricité de France, driving commercial expectations of profits, allocations and operational efficiencies. New market entrants own 17.5 % of the electricity market share.

- Eskom (South Africa) is 100% state-owned. The market is monopolistic as the national energy regulator controls electricity prices and market entrance. New market entrants own 11,9% of the market share via the South African Renewable Energy Independent Power Producer Programme.

Proposition 1a:

In all markets included in this study, new entrants are allowed under tightly controlled circumstances, providing the disruptive innovations that the electric utilities need to respond to.

Proposition 1b:

A monopolistic market influences the nature of disruptive innovations in the regulated electricity market in the following ways:

- Fewer pathways to market.
- Disruptive innovations face strong brand differentiation and brand loyalty.

2.3 Strategic approaches for state-owned electric utilities

RQ2: What are the general strategic approaches among state-owned electric utilities?

The absence of competition characterises monopolistic electricity markets, and the state owns a majority of the market power in the industry by owning the power utility, controlling prices and quantities, and entrance to the market via regulation. While monopolistic electric utilities are protected via regulation and generally do not face competition, this is now changing as disruptive innovations such as solar photovoltaics, micro wind turbines, batteries, and electric vehicles have enabled the distribution and self-generation of electricity. In addition, these innovations can be scaled to provide large-scale electricity generation, which is cleaner than fossil fuel technologies currently used by monopolistic state-owned electric utilities. Global climate change policies, consumer preference for using renewable energy sources for electricity generation, and new energy-efficient innovations have created new markets with new suppliers in the industry. The state-owned electric utility now has to compete in new markets and with new suppliers in the industry. Therefore, monopolistic electric utilities require new strategic approaches to respond to the changes in their business environment. At the heart of these changes are disruptive innovations.

Thus far, the strategic approaches for state-owned electric utilities experiencing threats from disruptive innovations in monopolistic markets have been to i) remain in the electricity business and adapt to the new ways of generating electricity, which is supported by government policies and incentives such as early retirement of coal plants and replacement of ageing plants with cleaner energy sources such as renewable energy and gas (Nedopil et al., 2022), ii). Engage in domestic and international mergers and acquisitions to grow, iii) diversify into new energy technology businesses such as renewable energy (Niemczyk et al., 2022) and iv). block the diffusion of disruptive innovations in renewable energy (Darudi & Weigt, 2020). However, all these approaches appear reactive, and state-owned utilities would need to find new approaches to remain relevant in the evolving energy sector. Organisations become leaders or retain leadership by commercialising disruptive innovations and developing plans for learning and discovering emerging or new markets rather than focusing on existing customers (Millar, Lockett, & Ladd, 2018). Like other industry transformations, for example, the cellphone and computer industries, the transformation in the electricity industry will gain pace, and growth will become more innovation-dependent, with success coming to those firms that use innovative products, services, processes and business models to gain competitive advantages (Sarasini & Langeland, 2021).

Table 3 presents several definitions of disruptive innovations over time due to the different views researchers explored and recommended response strategies. The perspective that disruptive innovation is a process is commonly held among authors. While some researchers discussed disruptive innovations as a demand construct from the perspective of the customer (Agarwal et al., 2016; Christensen & Raynor, 2003; Christensen & Dillon, 2020; Markides, 2006; Yeh & Walter, 2017), some defined the term as an outcome having an effect such as the impact on the industry (dos Santos Paulino & Le Hir, 2016) or organisational systems (Millar et al., 2018) and later others framed the term as both an outcome and demand (Martínez-Vergara & Valls-Pasola, 2021; Nagy et al., 2016; Rambe & Moeti, 2017; Si & Chen, 2020). Although the concept had transitioned from disruptive technologies to disruptive innovations to include other types of disruptions, such as services, products and business models (Christensen & Raynor, 2003; Markides, 2006), the variations in the definitions still followed the original connotation that disruption is enabled by technology (Christensen & Dillon, 2020; Danneels, 2004; Parry & Kawakami, 2017; Rambe & Moeti, 2017; Yeh & Walter, 2017).

Table 3: Evolution of disruptive innovation definitions and response strategies 1997 to 2021

<table>
<tr><th>Author</th><th>Response Strategy</th><th>Disruptive Innovation Definition</th><th>Definition Perspectives</th></tr>
<tr><td>Christensen (1997)</td><td>• Create an autonomous unit with a new business model
• Grow the profit requirements of the new unit as the emerging market size increases</td><td rowspan="2">“When performance and oversupply occur, and a disruptive technology attacks a mainstream market, the technology often succeeds because of improved functionality, simplicity, price, reliability, and convenience."

Christensen (1997, p. 192)</td><td rowspan="2">Technology, competition</td></tr>
<tr><td>Gulati & Garino, (2000)</td><td>• Joint ventures and partnerships
• Integration based on brand, management, operations and equity</td></tr>
</table>

Author	Response Strategy	Disruptive Innovation Definition	Definition Perspectives
Christensen and Raynor (2003)	• Create autonomous units with new structures, processes and values • Proactively sense changes in the low-end and non-consumption markets. • Launch several new growth businesses whilst the firm is still healthy.	“Disruptive innovations do not attempt to bring better products to established customers in existing markets. Instead, they disrupt and redefine that trajectory by introducing products and services that are not as "good" as those currently available. However, these technologies are more straightforward, more convenient, and less expensive, appealing to new or less-demanding customers. The improvement cycle begins once the disruptive product gains a foothold in new or low-end markets." Christensen and Raynor (2003, p. 34)	Process, low end or creates new markets, includes trade-offs, demand-based
Charitou and Markides (2003)	• Focus and invest in the traditional business. • Ignore the innovation. • Attack back (disrupt the disruptor). • Embrace the innovation and abandon the traditional business.		
Campbell & Park, (2004)	• Deliberate strategies that evaluate opportunities and wait until a good project emerges	“A disruptive technology is a technology that changes the bases of competition by changing the performance metrics which determine the impact”. Danneels (2004, p. 249)	Technology, competitive strategy, outcome-based
Markides (2006)	• Leave the development of disruptive innovations to entrants. • Incumbents should buy minority equity stakes or create strategic alliances with the disruptors. • There is no need to respond to all disruptive innovations.	“A disruptive innovation introduces a different set of features, performance and price attributes relative to the existing product, an unattractive combination for mainstream customers at the point of product introduction because of inferior performance on the attributes these customers value and/or a high price-although a different customer segment may value the attributes. Subsequent developments over time, however, raise the new product’s attributes to a level sufficient to satisfy the mainstream customers, thus attracting more of the mainstream market”. Govindarajan and Kopalle (2006b, p. 15)	Process, low-cost model, trade-offs, demand-based
Schmidt and Druehl (2008)	• Managers should develop low-end encroachment and high-end strategies for pursuit. • The firm must make projections for the future based on reservation price curves and costs. • Managers should identify situations where the preference of various customer segments is negatively correlated		

Author	Response Strategy	Disruptive Innovation Definition	Definition Perspectives
	across attributes and offer incrementally different and radically divergent products. • Managers should seek situations where customers are willing to trade convenience for quality. • When customer preferences are positively correlated across key performance dimensions or when there is only one dimension, managers should identify low-cost opportunities or further high-end improvements if customer performance needs have not reached saturation. • Managers should realistically ascertain the expected level of encroachment and the speed at which this would happen. • Firms should not box specific customer segments as "innovators" or "laggards". The marketing approach should match the encroachment strategy.		
Gilbert (2012b)	• Develop a strategy for each disruptive innovation. • Develop a technology roadmap to address adoption in an informed manner. • Utilising proven innovation adoption processes.		
King and Baatartogtokh (2015)	• Calculate the value of winning. • Leverage existing capabilities. • Collaborate with other companies.	"Disruptive innovations are initially considered inferior by most of an incumbent's customers, and they are not willing to switch merely because it is less expensive. Instead, they wait until its	Process, low-cost model, trade-offs

Author	Response Strategy	Disruptive Innovation Definition	Definition Perspectives
		quality rises, then adopt the new product and happily accept its lower price." Christensen et al. (2015b, p. 6)	
Denning (2016)	• Undertake a business model or continuous innovation that creates value for the customer.	"Disruptive innovation is a specific type of radical innovation that has a particular dynamic influence on the industry structure and may induce the replacement of existing firms by new entrants". dos Santos Paulino and Le Hir (2016, p. 41)	Outcome-based, competitive strategy
Gans (2016)	• Beat them by investing in new technology. • Join them by acquiring their business and products. • Wait them out and react when it is certain that the emerging technology will be disruptive.	"Disruptive innovation is a theory of competitive response. It tells how incumbents will likely respond to such innovations and how disruptors react to the incumbent's response. For example, introducing a sustaining innovation will result in an increased attack; a counter-disruptive response may result in being ignored or fleeing". Denning (2016, p. 11). Disruptive Innovation is "an innovation that changes a market's performance metrics or consumer expectations by providing radically new functionality, discontinuous technical standards and or new forms of ownership that redefine marketplace expectations". Nagy et al. (2016, p. 122) Disruptive innovation is described as "simple, cheap, small, and easy-to-use products or services that cater to the need of the unserved or underserved market and has the potential to increase revenue by developing an altogether new market". Agarwal et al. (2016)	Competitive strategy, outcome-based Creator of new markets, demand and outcome-based Demand-based creates new markets.
Yeh and Walter (2017)	• Accelerate service innovations	"Disruptive innovation is a product based on disruptive technology and delivers superior performance on attributes valued by mainstream markets". Parry and Kawakami (2017, p. 143) "Disruptive innovations usually commence with complex business models involving sophisticated products and dominant technologies, but with incremental per-fection of the product/service and technological improvements to suit di-	Technology, demand-based Process, low-cost model, demand-based, outcome-based

<table>
<tr><th>Author</th><th>Response Strategy</th><th>Disruptive Innovation Definition</th><th>Definition Perspectives</th></tr>
<tr><td></td><td></td><td>verse tastes, the less dominant, inexpensive product expands its market share and ultimately takes over the market”. Rambe and Moeti (2017, p. 634)</td><td></td></tr>
<tr><td>Zhang et al., (2018)</td><td>• Strengthen the existing business model
• Invest in the disruptor, learn and modify the existing business.
• Partner with a disruptor from another platform industry to attract more customers.
• Incorporate different levels of a platform model into traditional business.
Expand the current business model and directly compete with disruptors.</td><td rowspan="2">Disruptive innovation is a “commercial introduction of a product, service, process and/or organisational change that disrupts the activities of existing players in an industry or similar organisational system”. Millar et al., (2018, p. 3)</td><td rowspan="2">Process, competitive strategy, outcome-based</td></tr>
<tr><td>Urbinati, et al., (2019)</td><td>• Evolve approaches of open innovation and ambidexterity via dedicated business units to exploit internal assets and capabilities. over time to respond to cycles of disruptive changes.</td></tr>
<tr><td>Muema (2020)</td><td>• Create dynamic business models that trigger self-reinforcing cycles of growth.
• Optimise dynamic capabilities through collaborations and alliances with experienced partners
• View disruptive innovations as opportunities rather than threats.</td><td rowspan="2">"Disruptive innovation describes a process by which a technology enabler takes root in simple applications at the low end of a market- typically by being less expensive and more accessible- and then relentlessly moves upmarket, eventually displacing established competitors. The technology then displaces established competitors” Christensen & Dillon, (2020, p. 22)

Disruptive innovation is “An innovation process in which technologies, products or services are initially inferior to those provided by incumbents in the attributes that mainstream consumers value, but these technologies, products or services can attract and satisfy the consumers in low-end or new markets with advantages in performance attributes (such as being cheap, simple, or convenient) that these</td><td rowspan="2">Process, technology, competitive strategy, low-cost model, demand-based

Process, low end and creates new markets, low-cost model, demand-based (satisfy needs of consumers) and outcome-based</td></tr>
<tr><td>Jin and Shin (2020)</td><td>• if the innovation is not reducing the incumbent's customer base, then the incumbent should not adopt the</td></tr>
</table>

Author	Response Strategy	Disruptive Innovation Definition	Definition Perspectives
	innovation but continue to invest in its existing business. • if the disruptor is reducing the existing customer base of the incumbent and the incumbent has the motivation, assets and competencies to compete, then the incumbent should abandon its existing business practices and adopt the innovation to scale up. • incumbents should adopt the innovation whilst keeping their existing business and decide to what degree they will adopt the innovative business models and how they will structure them within their organisation.	consumers value but which at the same time are neglected by mainstream markets. Over time, through the incremental improvement of technology or process, a disruptive innovation gradually satisfies the needs of mainstream consumers to attain certain market share from or even replace incumbents in mainstream markets". Si and Chen (2020, p. 6) "Disruptive innovation can be seen as a process that takes place over time, which starts in the low-end market or creates a new market to move up toward the mainstream and high-end market. A disruptive innovation does not initially compete with incumbents. However, over time, competition intensifies, often resulting in the displacement of the traditional incumbents or the sharing of the market. However, the disruptive innovation typically enjoys a larger market share, offering products or services with unique characteristics that make it a better choice for consumers." Martínez-Vergara and Valls-Pasola (2021, p. 16)	Process, competition, low end, or creates a new market, outcome-based and demand-based
Rosenbach (2021)	• imitating the disruptive business model. • defending the current business model. • creating new business models.		
Högberg and Willermark (2022)	• incumbents need to relate to a changing business environment and build long-lasting relationships with customers. • translate strategy to everyday practices. • reframe and renegotiate value with customers.		

The original framework for the disruptive innovation theory was considered too restrictive because it referred to an innovation's specific mechanism and evolution path. In contrast, disruptive innovations can be manifested on several levels, such as industry structure, industry segment and social system and are driven by factors such as regulation, cost, customers, quality and resources (Millar et al., 2018). Therefore, a broader perspective was proposed that described a disruptive innovation as a "commercial introduction of a product, service, process or organisational change that disrupts the activities of existing players in an industry or similar organisational system" (Millar et al., 2018, p. 254). This perspective shifted the disruptive innovation theory from a process and posited that disruption is an outcome that both results and processes can measure. However, this definition appeared too wide-ranging and seemed like a "catch-all container" as the definition did not differentiate between other types of innovations such as sustaining or efficiency innovations and emerging technologies which also have the potential to cause changes. A systematic review and analysis of extant literature in the Social Science Citation Index Journals found that the perspectives related to disruptive innovation being a process rather than an outcome were the most popular, and with less controversy (Si & Chen, 2020). To better explain the fundamental characteristics of disruptive innovations, a new definition was proposed that a disruptive innovation is:

> "a process in which technologies, products or services are initially inferior to those provided by incumbents in the attributes that mainstream consumers value, but these technologies, products or services can attract and satisfy the consumers in low-end or new markets with advantages in performance attributes (such as being cheap, simple, or convenient) that these consumers value but which at the same time are neglected by mainstream markets. Over time, through the incremental improvement of technology or process, a disruptive innovation gradually satisfies the needs of mainstream consumers to attain certain market share from or even replace incumbents in mainstream markets" (Si & Chen, 2020, p. 6).

However, this definition appeared similar to that of Christensen and Raynor (2003), that disruptive innovation is a process in which technologies, products or services initially arise from an inferior performance and over time, the performance attributes increase, appeals to customers at the bottom end of the market or creates new markets and eventually displaces the incumbent. This definition does not account for various pathways of disruption such as entrance at the high end of a market or efficiency innovations and maintained the connotation that disruptive innovations are technological products. However, the recommendations from the study by Si & Chen, (2020) were that more new conditions and contexts should be explored to present a novel approach to the theory to bring a new and more prominent role in achieving sustainable development and growth. This recommendation suggested that there is still room to broaden the definition of disruptive innovation to include specific industry characteristics.

Some scholars summarised perspectives found in the literature from 1964 to 2017 and elaborated on the widespread disagreements in the manner Christensen had made generalisations on how disruptive innovations altered the bases of competition, transformed the market, created new businesses or markets, arose from low-cost models and considered technology (Martínez-Vergara & Valls-Pasola, 2021). They discussed perspectives of seventeen definitions and finally agreed on three main characteristics that defined the theory:

i) disruptive innovation is a process that can transform or stimulate market changes,

ii) disruptive innovation is a low-cost model, and

iii) the use of technology to increase the value of a product is pertinent.

However, these three approaches are similar to the five characteristics of disruptive innovations discussed by Si and Chen (2020) and would have similar limitations (explained in Section 2.2.3). Over time, the disruptive innovation theory (Christensen & Raynor, 2003) was posited as a multifaceted concept through several criticisms. Authors discussed that the theory was not reflective of reality because it did account for top-end disruption, had not catered for managerial discretion such as decisions taken not to follow product development strategies to meet the needs of the most demanding customers, and did not explain the decline in market share and rebirth of some incumbents such as Apple (Nicholas, 2021). Although there are benefits of using history to construct theories to explain how and why specific industries changed, “The Innovator’s Dilemma” was criticised for generalising beyond what the historical evidence could reveal (Nicholas, 2021). These criticisms suggest that there is still room for expansion of the theory and its definition to account for specific industry conditions.

Disruptive innovations are reshaping the power industry, bringing new challenges and opportunities for incumbents. The disruptive innovation theory presents the best possible solutions for incumbents to thrive and remain relevant under these conditions. The disruptive innovation framework has proven that a disruptive strategy can increase a firm's market share more than a strategy that simply builds on sustaining innovations to keep existing customers happy.

The responses to disruptive innovations and their limitations are discussed in the next section.

2.3.1 Responses to disruptive innovations and limitations

Christensen (1997) initially recommended that the best response to disruptive innovations was to create an autonomous commercial organisation with a new business model. The entity's profit requirements should increase relative to the size of the emerging market. Studies have shown (Table 3) that several possible strategic approaches are available to an incumbent, and the issue of how to respond to disruptive innovations is more complex than suggested by the theory of disruptive innovation. Initially, there was a debate in the literature as to whether an incumbent should make an effort to respond to threats and opportunities from disruptive innovations (Charitou & Markides, 2003; Markides, 2006; Tellis, 2006), but over time, authors seemed to agree that there should be a response as indicated by the various approaches presented in Table 3. Recently, business model innovation has appeared to be the most popular approach recommended by several authors (Denning, 2016; Jin & Shin, 2020; Zhang et al., 2018).

However, the literature indicated several dissenting views. Some authors had debated that managers did not have to make an either-or choice on whether to create spin-offs from the traditional business when faced with disruptive internet innovations, as the key to success was integrating the traditional physical operations with new business activities because the benefits of integration were too significant to abandon entirely (Gulati & Garino, 2000). For example, an incumbent could respond to disruptive internet innovations efficiently by leverageing partnerships and joint ventures, and the level of integration could be determined by examining the dimensions of brand, management, operations and equity. Other authors urged senior executives to act proactively by sensing market changes at the low end of existing and non-consumption markets, then establishing autonomous units with independent cost structures, processes and values and launching several new businesses, including acquisitions in high-growth markets while the firm was still healthy, rather than later defending against threats (Christensen & Raynor, 2003).

Charitou & Markides (2003) expanded on the work of Christensen and Raynor (2003), presenting five alternative strategic approaches viz.: i) focus on and invest in the traditional business, ii) ignore the innovation, iii) attack by disrupting the disruptor, iv) adopt the innovation and v) embrace the innovation abandoning the old business. Researchers claimed that how a company responded to disruptive innovation depended on its motivation and ability to do so (Charitou & Markides, 2003). If the incumbent's motivation is low, a response should be to ignore the disruption and focus on the main business. However, if the motivation is high, the appropriate response is dictated by ability and circumstances (Figure 2).

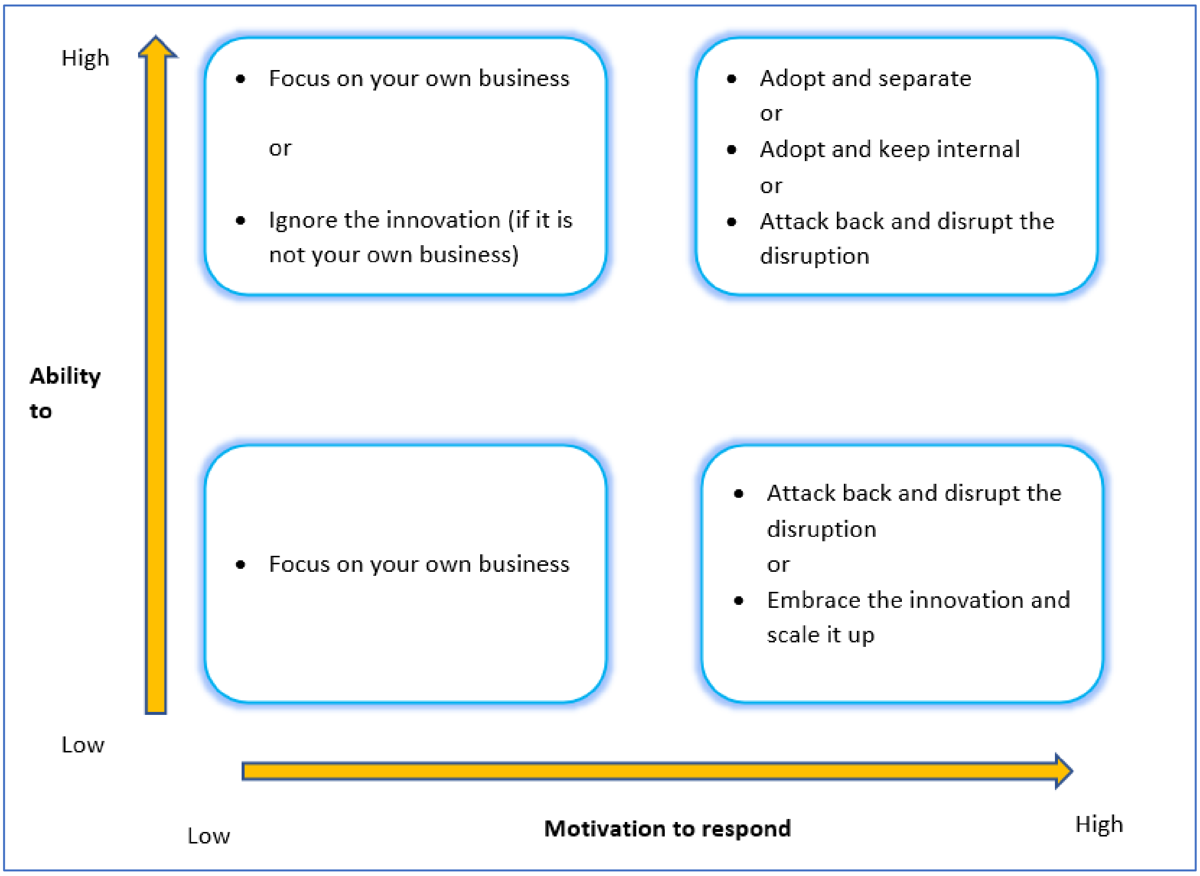

Figure 2: Response to disruptive innovations, adapted from Charitou and Markides (2003)

Some studies indicated that the creation of separate structural configurations, such as corporate venturing units, did not solve the growth problems of incumbents and recommended the action of more deliberate strategies to evaluate opportunities in fast-changing business environments by careful selection and a willingness to reject all projects until a good one emerges (Campbell & Park, 2004). Other studies suggested leaving the development of disruptive innovations to entrants and advised that incumbents should buy minority equity stakes or form strategic alliances with disruptors to create and maintain a network of start-ups instead of attacking back (Markides, 2006).

A framework to help recognise threats and opportunities from disruptive innovations was suggested by Schmidt and Druehl, (2008) - the framework recommended that managers simultaneously develop low-end encroachment and high-end strategies for pursuit if customer performance needs have not reached saturation; ii) make projections into the future based on reservation price curves and costs; iii) identify situations where the preference of various customer segments are negatively correlated across attributes and offer products that are incrementally different and radically divergent; iv) seek situations where customers are willing to trade convenience for quality; v) realistically ascertain the expected level of encroachment and the speed at which this would happen; and vii) not box specific customer segments as “innovators” or “laggards”. In addition to these suggestions, some researchers advised that firms could reduce disruption threats by developing a strategy and technology roadmap for each disruptive innovation (Gilbert, 2012b). The strategy could range from “all in” to “wait and see” scenarios, including organisational change management and training to avoid compromising the established business. However, other authors cautioned that the value of winning should be calculated before developing a response strategy, recommending that existing capabilities should be leveraged for profitability and collaborations with new entrants should be established (King & Baatartogtokh, 2015). Others cautioned that incumbents should only respond when it is certain that the emerging technology is disruptive to their business, when they should consider the costs entailed for responding before acquiring entrants’ businesses or products (Gans, 2016).

Later, Christensen in an interview with Denning (2016) affirmed that continuous innovation, which creates value for the customer or a defensive evolution strategy via business model developments, could be effective response strategies to threats and opportunities against disruptive innovations. He recommended that an organisation create and close down different business units or spin-offs when profits decline rather than be allowed to adapt or evolve when such units had been created solely to serve a particular customer and had a different business model or way of making money. As in the case of IBM, the company survived the disruption from mainframe computers to minicomputers to personal computers by creating business units under the corporate parent and shutting them down when disruption occurred. Apple, Amazon, and Zara made experimentation and innovation the core of their business. This type of mental mode enabled continuous disruption of others and their products without the creation of spin-offs. However, Christensen et al. (2016b) pointed out that the literature is weak on proposing solutions as to what incumbents could do about disruption or how firms should respond to disruption and which strategies are effective, suggesting that recommendations to incumbents on how to respond to disruptive innovations have not been exhausted.

Some researchers (e.g Bughin, 2017) supported Christensen et al. (2016b)'s recommendations of introducing business model innovations as a strategic response to disruptive innovations and elaborated that incumbents should develop new customer segments and utilise new business models to compete with entrants. Other scholars viewed disruption as an opportunity rather than a threat. They advised that strategic responses should include accelerating service innovation by reskilling high-level administrators to become innovation leaders, fostering an innovation-supportive culture, bundling performance evaluations and rewards to innovation outcomes, and creating dedicated innovation teams with high levels of decision-making autonomy (Yeh & Walter, 2017). This school of thought supported the view that partnerships with customers and commercial entities should be developed, and strategic choices depend on the nature of the disruption and the characteristics of the business. This implies that the nature of disruption in the electricity industry could be experienced differently from other industries, and recommendations for the characteristics of state-owned electric companies could also be different.

In addition, Zhang et al., (2018) also recommended that incumbents threatened by disruptive innovations in the sharing economy should i) strengthen their existing business model while modifying existing assets to better meet the needs of current customers and to attract new customers in market segments with less competition, ii) invest in the disruptor to learn about its business model, successes and customers behaviour which could improve or modify the incumbent's existing offerings, iii) partner with the disruptor from another industry to attract the disruptor's customers and offer new products or services to existing customers and access the disruptor's platform ecosystem, iv) incorporate several platform-based models into its traditional business as mixed strategies enable an incumbent to maintain its competitive position, and v) directly compete with disruptors when a large portion of the incubements' business model and/or operating philosophy already resembles a platform model. However, Christensen et al. (2018) affirmed that his framework does not explain everything about innovation or business success as many forces and interrelationships are at play, suggesting that more research is required to understand these forces to build a more comprehensive theory with associated recommendations to incumbents.

The historical analysis of the global music industry showed that incumbents evolved their strategic approaches of open innovation and ambidexterity i.e. dedicated business units to exploit internal assets and capabilities over time to respond to cycles of disruptive changes brought about by digital music distribution, permanent digital download and music streaming (Urbinati et al., 2019). This finding suggests that different disruptive innovations may require different strategic approaches.

Similar to other studies, Yeh and Walter, (2017), who recommend that incumbents view disruptive innovations as opportunities rather than threats, researchers have built on this perspective and advised incumbents to view customer discontent with existing operating models together with firm inertia as inflexion points to focus on the opportunities rather than the threats presented by disruptive innovations (Muema, 2020). Researchers investigated the failure of incumbents in the travel industry and encouraged incumbents to optimise their dynamic capabilities via collaborations and alliances with experienced partners for developing technologies, products and processes and create dynamic business models that activate self-reinforcing growth cycles (Muema, 2020). In addition, incumbents should maintain their existing businesses whilst adapting elements of their existing business models to respond to the changing business environment and customer expectations.

Supporting the view that incumbents should respond to disruptive innovations by making business model changes, analysis conducted on disruptive business models in the fashion industry by Jin and Shin, (2020) revealed three types of responses with conditions: i) if the new innovation is not reducing the incumbents existing customer base, then the incumbent should not adopt the innovation but continue to invest in the existing business strengthening existing competitive advantages, ii) if the disruptor is reducing the existing customer base of the incumbent and the incumbent has the motivation, assets and competencies to compete then the incumbent should abandon its existing business practices and adopt the innovation with the intention to scale up to capture the growing market, and iii) incumbents should adopt the innovation whilst keeping their existing business and decide to what degree they will adopt the innovative business models and how they will structure them within their organisation. These recommendations are similar to earlier suggestions from Charitou and Markides (2003). Although incumbents were advised to compare innovative business models with their own to determine ways to differentiate themselves further or to imitate or adopt the new practices to the extent allowed by their assets and motivations, researchers were urged to conduct more research in other industries to build a more robust model based on insights into similarities and differences from approaches adopted by other incumbents, in other industries. This call implies that the body of knowledge on strategic responses to disruptive innovations is incomplete, and investigations into state-owned entities in monopolistic electricity markets would add to this body of knowledge.

Rosenbach (2021) also proposed that incumbents could achieve success by responding to disruptive innovations with a threefold strategy of (i) simultaneously imitating the disruptive business model, (ii) defending the current business model, and (iii) creating new business models. Rosenbach (2021) demonstrated that while adaptation strategies happen simultaneously, they are interlinked and dependent on the resource complementarity from the incumbent's existing business model, suggesting that knowledge, skills, and competencies are required for successful strategic approaches to disruptive innovations. In contradiction, other studies (e.g. Högberg & Willermark, 2022) on disruptive innovations in the hotel industry recommended that: i) incumbents need to relate to a changing business environment and build long-lasting relationships with customers, ii) translate strategy to everyday practices by creating new structures to integrate the new ways of doing business into the organisation and, iii) reframe and renegotiate value with customers by creating loyalty programmes and developing online applications. The focus for the strategic approach has shifted from business models to customer relationships.

The multiple perspectives on strategic approaches to disruptive innovations in the literature may confuse practitioners on what actions to take and how electric utilities could respond to changes in their business environment. Several disruptive innovations have been unleashed into the energy industry, simultaneously impacting state-owned entities. The theory of disruptive innovation is unclear on how to effectively respond under these circumstances as the framework (Christensen & Dillon, 2020) only accounts for one emerging disruptive innovation at a time. The theory postulated the creation of a separate commercial entity as a response but did not suggest what the optimal structural configuration should be for multiple disruptive innovations co-occurring at the same time.

Proposition 2: Of all the strategic options available in monopolistic markets, the disruptive innovation responses offer incumbents a range of possible solutions to compete, viz:

1. **No action**
   - Ignore the innovation
   - Wait and see
2. **Focus on existing business**
   - Invest in the existing business and strengthen competitive advantage
3. **Focus on new business**
   - Abandon existing businesses and adopt the disruptive innovation
   - Play two games simultaneously by keeping the existing business and adopting the disruptive innovation
   - Attack back by disrupting the disruptor
4. **Holistic approach**
   - Undertake business model innovation
   - Continuously innovate, creating value for customers
   - Service innovations

2.4 Theoretical tools for effective strategising

RQ3: What assembly of theoretical tools is available to state-owned electrical utilities to strategise effectively?

Strategising refers to activities undertaken by entities to align their aspirations and capabilities deliberately and emergently in response to a change, thus exploring how aspirations can be achieved, aspirations need to be changed, capabilities need to be realigned or developed, and the context can be changed (Bryson, 2021). Strategic tools are frameworks or techniques that assist organisations in formulating their strategy. The following sections discuss literature on dynamic capability (Section 2.4.1) and ambidexterity (Section 2.4.2) as tools for strategising in monopolistic electricity markets.

2.4.1 Dynamic Capability Theory as a Tool for State-owned Electric Utilities to Strategise in Monopolistic Markets

In turbulent business environments, the resource-based view can complement the disruptive innovation theory in the debate on how firms strategically respond to threats and opportunities from disruptive innovations. Whilst the disruptive innovation theory focused on external forces to achieve competitive advantage, for example, market positioning and structure, the resource-based view focused on the internal strengths of the firm that could be shifted or adapted to achieve and sustain competitive advantages such as capabilities, resources and knowledge. While several fields addressed issues associated with change, such as innovation, organisational learning, and cognition, none other than the dynamic capability perspective explicitly focused on how firms can persistently change their resources over time (Ambrosini & Bowman, 2009; Warner & Wäger, 2019) thus making it a valuable tool for strategising against disruptive innovations.

The dynamic capability framework is an extension of the resource-based view (Teece et al., 1997) anchored in the assumption that a good strategy together with resources that are simultaneously valuable, rare, inimitable and non-substitutable (VRIN) is a source of competitive advantage (Barney 1991, 1995). The term 'capabilities' refers to the critical role of strategic management in adapting, integrating, and reconfiguring resources and competencies to respond to changes in the business environment.

Literature on dynamic capability is divided between two leading schools of thought emanating from the seminal papers of Teece et al., (1997) and Eisenhardt and Martin, (2000). The primary debate appeared to be over the fundamental nature of dynamic capability. Teece et al., (1997, p. 516) described dynamic capability as “the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments”. However, Eisenhardt and Martin (2000, p. 1107) debated dynamic capability in terms of a firm’s processes:

> “We define dynamic capabilities as the firm’s processes that use resources specifically the processes to integrate, reconfigure, gain and release resources-to match and even create market change. Dynamic capabilities thus are the organisational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die”.

Although there are limitations to both schools of thought, this study seeks to offer possible solutions to incumbents experiencing disruption in regulated monopolistic electricity markets via the “ability/capability” knowledge school.

Zahra et al., (2006) criticised the dynamic capability theory (Teece et al., 1997) that it did not differentiate between substantive capabilities, for example, new routines to develop new products versus changing the capability of the firm to develop new products. Later, the dynamic capability framework was extended to explicate its foundational elements. The micro-foundations were identified as the capacity to i) sense and shape opportunities and threats, ii) seize opportunities, and iii) reconfigure the firm’s intangible and tangible assets and resources (Teece, 2007). In this framework, sensing and shaping activities included identifying opportunities and threats via constant scanning, searching, and exploring technologies and markets locally and afar, probing customer needs, understanding latent demand and structural evolution of industries and markets and anticipating supplier and competitor responses. Seizing opportunities refers to investing in commercialising new products or services, identifying and determining how to meet capability gaps and developing and implementing business models for new products and services. Reconfiguration activities comprised the transformation of organisational structures and processes such as creating spin-offs, augmenting knowledge assets, asset and resource realignment and redeployment, mergers, acquisitions and divestments. The framework (Teece, 2007) theorised that excellence in orchestrating these micro-foundation capacities underpinned a firm’s capability to innovate and capture sufficient value to maintain competitive advantages successfully.

Some scholars (e.g. Arend & Bromiley, 2009) argued that: i) the value add of the dynamic capability theory was unclear and its framework not novel relative to other established concepts such as absorptive capacity, architectural innovation, and intrapreneurship, ii) the theory lacked a coherent theoretical framework because there is casual mixing of assumptions such as rationality and market efficiencies across journal articles explaining the same view, iii) the theory did not explain when organisations do not change although it focuses on organisational change, iv) weak empirical support and v) unclear practical implications. In addition, researchers highlighted that the theory definition and associated structural components were blurry because there was no clear differentiation between ordinary capabilities and dynamic capabilities (Helfat & Winter, 2011). Dynamic capabilities, together with their inputs, can include not only the higher-level routines, such as the building blocks of their execution, but also the skills and competencies that support their functioning (Felin et al., 2012).

Furthermore, other researchers have refuted previous claims that the dynamic capability theory was based on limited empirical support and instead, found 142 examples of empirical studies (Eriksson, 2013). The dynamic capabilities framework was widened to distinguish between ordinary and dynamic capabilities. While ordinary capabilities are the ability to attain technical efficiency and do things right in the core business functions of operations, administration, and governance, dynamic capabilities have been theorised as higher-level activities that govern and direct ordinary activities towards market leadership (Teece, 2014b). The theory proposed that incumbents should respond to environmental changes by building dynamic capabilities to adapt, orchestrate and innovate (Teece, 2014b).

Others expanded the dynamic capability framework to include constructs of firm agility, proposing that agile managers could respond better to changes in turbulent business environments through higher cognition and social and human capital (Helfat & Martin, 2015). However, the dynamic capability framework was criticised for not considering factors such as alignment with corporate strategies and the external business environment, including distribution channels, customers and competitors impacting VRIN resources, organisational capabilities and competitive advantage (Yassien & Jordan, 2015). Initially, the Teecian (2014b) view indicated that the strength of a firm's dynamic capabilities influenced the speed and extent to which a firm's resources could be aligned and re-aligned to maintain profitability in dynamic business environments; however, this concept was later refined to suggest that uncertainty may be more relevant than the speed of change in face-paced business environments (Teece et al., 2016; Teece, 2018b).

Several authors agreed that the concept remains open to an array of conceptualisations and interpretations even over the most simple terms, including how dynamic capabilities are defined, and attempts to introduce finer levels of details had led to multiple definitions (Di Stefano et al., 2014; Pisano, 2017). Researchers have rebuked each other for the fact that no comprehensive framework exists for understanding the antecedents, dimensions, mechanisms, moderators, and outcomes of dynamic capabilities (Schilke et al., 2018).

Later, the dynamic capability framework was broadened to include not only a good strategy built on VRIN resources as a requirement to maintain competitive advantage (Teece, 2007) but also a sound business model because business models could be imitated by competitors. However, a robust business model combined with VRIN assets could sustain and achieve market leadership (Teece, 2018a). This framework discusses dynamic capabilities as higher-order organisational processes that sense opportunities for the future, develop business models to seize new or changed opportunities and reconfigure the organisation based on the existing state and desired plans. The framework recommends that management focus on these higher-order capabilities, as they are the most appropriate for innovation and the selection of business models that address the threats and opportunities from disruptive innovations.

Other authors proposed that dynamic capabilities such as innovation, scanning, sensing, and integration for orchestration within the business ecosystem are essential for retaining market leadership in rapidly changing environments, and there should be a focus on integration capabilities as they play a vital part in improving the ability of incumbents to capture value (Helfat & Raubitschek, 2018). It was also suggested that innovation is a dynamic capability that drives organisational resilience to disruptive innovations and enhances knowledge sharing, agility and flexibility (Sabahi & Parast, 2020). Therefore, firms should increase capabilities and resources in innovation as a response to disruptive innovations. Again, the dynamic capability framework was expanded to suggest that the dynamic capabilities of an organisation could be enhanced through open innovation, as these processes can increase the firm's ability to sense and seize new opportunities and leverage external resources (Teece, 2020). Additionally, the activities for developing dynamic capabilities were conceptualised as - i) searching for opportunities; ii) knowledge management and learning; iii) coordination; iv) configuration and reconfiguration; and v) organisational adaptation (Cyfertal et al., 2021). Whilst this framework indicates that individual activities in the process are interlinked through mutual interactions, the framework also highlights that probing for opportunities is the precursor and the primary factor driving the other activities in the process; therefore, the framework recommends that managers should respond to disruptive innovations by improving activities associated with probing for opportunities.

However, there have been criticisms about dynamic capabilities being substitutable because firstly, such capabilities are not drawn from competitive factors but instead are created internally by each firm; there may be no limit to the number of firms that can have similar dynamic capabilities as they engage in competition, and secondly, since it does not rely on an asset or resource that is scarce (Cyfert et al., 2021). Therefore, an endless supply of such dynamic capabilities can exist, all mutually substitutable, and could be exposed to the same trade-offs as traditional product strategies. Further criticism of the dynamic capability theory (Teece, 2014b) was that every strategic choice limits what a firm can and cannot do. Therefore, pursuing a dynamic capability cannot produce an organisation capable of doing everything simultaneously (Cyfert et al., 2021).

Practitioners had looked to the dynamic capability framework to guide incumbents on how to respond and compete in turbulent environments. It can be used as a tool for state-owned electric utilities to strategise in monopolistic markets.

The following section discusses the ambidexterity framework as a tool for strategising.

Proposition 3a: Dynamic capabilities can be used as a strategic tool to address disruptive innovations in monopolistic electricity markets as it focuses on continuously renewing capabilities, resources and knowledge to maintain competitive advantages.

2.4.2 Ambidexterity theory as a tool for state-owned electric utilities to strategise in monopolistic markets

The ambidexterity theory is an extension of the dynamic capability framework, which posits that in turbulent business environments, firms need to exploit existing internal competencies and assets simultaneously with exploring new external opportunities (Du & Chen, 2018; O'Reilly & Tushman, 2013; Sollosy, 2013). It follows that firms in dynamic electricity markets can compete by exploiting existing resources to meet today's needs and proactively explore new opportunities to respond quickly to market changes emanating from disruptive innovations. Empirical evidence generally confirms that organisational ambidexterity leads to enhanced short-term performance and increases long-term survival rates in fast-changing business environments (Junni, et al., 2013; Luger, et al., 2018). This is because ambidextrous firms are better than others at responding to disruptive business models and innovations (Birkinshaw et al., 2016; Du & Chen, 2018). Therefore, ambidexterity theory can be used as a tool for state-owned electric utilities to strategise in monopolistic markets.

Initially, it was proposed that firms should change their structures sequentially to explore new opportunities via innovation (Duncan, 1976), whilst others claimed that the most important adaptive challenge confronting organisations was the need to exploit existing assets and capabilities simultaneously to avoid market share losses arising from shifting technologies (March, 1991). In this case, adaptation was seen as a response strategy in rapidly changing business environments. Other scholars suggested that incumbents could retain long-term success by improving the alignment of strategy, structure, people and culture through incremental change punctuated by discontinuous innovation or revolutionary change, which can be achieved by creating autonomous groups or divisions within the traditional company (Tushman & O'Reilly, 1996). Creating autonomous entities as an excellent response to disruptive innovations was supported (Christensen, 1997), and managers were advised to launch several new businesses whilst the firm was still healthy. This suggested that a firm should be ambidextrous, simultaneously developing innovation streams to explore new markets whilst exploiting current capabilities to succeed and thrive in turbulent business environments.

Limitations of the ambidexterity theory included, for example, the challenges experienced by Barnesandnobel.com, a separate commercial entity of Barnes & Noble books, where synergies were lost in purchasing, information sharing, branding, cross-promotion and customer service. These losses suggested the pros and cons of creating parallel autonomous entities with their own processes, structures and resources (Gulati & Garino, 1999). The theory of ambidexterity was criticised for lacking explanations on the appropriate degree of separation required to attain success. The case studies of Hewlett-Packard (HP) in developing inkjet printers and Schwab for online trading indicated that incumbents could succeed with disruptive innovations without creating spin-offs (Cohan, 2000). Both incumbents initially created separate commercial entities to pursue disruptive innovations; however, they merged these separated entities back into the mainstream business, suggesting that the theory is limited to how and when to create structural ambidexterity in the organisation**.** Additionally, some researchers (e.g. Iansiti et al., 2003) found that retailers who embraced disruptive innovations and integrated these innovations with their operations in their existing business were more efficient at generating revenues than those retailers that kept them as separate commercial units, thereby suggesting that there may be several pathways to achieve ambidexterity. The eternal challenge behind the ambidexterity concept was that exploration and exploitation are contradictory forces, and firms need to reconcile their paradoxical organisational demands to enjoy superior long-term performance (Raisch & Birkinshaw, 2008).

The ambidexterity theory appeared unclear on the function between differentiation, i.e. creating autonomous units for exploration and exploitation; and integration, which is the approach to address both exploration and exploitation activities within the same organisational unit. However, the theory considers these two concepts mutually exclusive solutions (Raisch et al., 2009). Furthermore, the theory was criticised as vague because there was no clarity on whether ambidexterity occurs at an individual or organisational level, and this implies that perhaps other levels of ambidexterity may also exist. Some researchers pointed out that the ambidexterity theory did not explain both static and dynamic perspectives on ambidexterity (Raisch et al., 2009) because firms become ambidextrous by adapting specific configurations; however, markets and organisations are dynamic, and the theory is limited in accounting for dynamic elements. Further debate pointed out that whilst research in the field of innovation and knowledge processes discussed the importance of the external acquisition of new knowledge for exploration, the ambidexterity theory did not explain the relationship between internal and external processes in creating and preserving ambidexterity.

It has also been highlighted that simultaneously exploring and exploiting made conflicting demands on firms, resulting in internal conflicts and organisational inertia, such as competition for scarce resources, different capability requirements, structures, processes and culture (O'Reilly & Tushman, 2013). Although the literature discussed tensions arising from the paradox of trying to achieve organisational ambidexterity, the theory broadly expanded to explain how organisational ambidexterity can be managed by merging both mechanistic and organic structures. Organisational ambidexterity has been conceptualised as a multilevel phenomenon in context, structure, planning and reward systems and decision-making processes to lower levels, i.e., managers, teams and individuals.

Varying claims also existed on how ambidexterity could be effectively managed. Although the structural separation approach has remained popular, involving the creation of parallel autonomous units with their own people, structure, processes and cultures (Donada et al., 2021; Tushman & O'Reilly, 1996) other approaches have included:

i) temporal separation, which allows a firm to switch between exploration and exploitation (Puranam et al., 2006; Siggelkow & Levinthal, 2003),

ii) inter-organisational specialisation which allows a firm to participate in joint ventures, alliances, and acquisitions to complement the dual activities (Lavie & Rosenkopf, 2006; Lin et al., 2007),

iii) contextual ambidexterity which permits choices about dividing time between exploitation and exploration, simultaneously allowing for sensing of opportunities and threats and seizing opportunities (Adler et al., 1999; Gibson & Birkinshaw, 2004; Gulati & Puranam, 2009),

iv) reciprocal ambidexterity which is a combination of temporal, structural and contextual forms of ambidexterity combined with assessing capabilities within individual units to simultaneously exploit, explore or harness individuals from separate interdependent units (Rafailidis et al., 2017), and

v) dynamic capability as a form of ambidexterity based on a complex set of capabilities and decisions that enables a firm to sense opportunities and threats, seize opportunities and reconfigure the firm's resources (Faridian & Neubaum, 2021).

Even though the role of structural, temporal and contextual ambidexterity in business model innovation has been recognised, the ambidexterity framework has been chastised for providing limited explains on the circumstances under which structural, temporal and contextual strategies are likely to be superior compared to the other and the differences in performance within each strategy chosen (Markides, 2013a).

The ambidexterity view has appeared to be unclear on the temporal separation concept as it appears to not explain when firms should reintegrate the separate unit with the parent company and what factors influenced the optimal point of reintegration. Additionally, within the spatial separation strategy, it was unclear which elements should be separated, what should be kept the same, and what determines the choice. Furthermore, the contextual ambidexterity concept has not described the organisational context that promotes ambidextrous behaviours in employees and suggested that the framework considers firm-specific solutions to assist in building a more comprehensive theory (Markides, 2013a).

The theory of ambidexterity has been used to address dualities in business, such as efficiency and flexibility, adaptability and alignment, and exploration and exploitation; it is thus in danger of losing its meaning as it is being used to answer all research questions about organisational management (Birkinshaw & Gupta, 2013). The diversity in approaches to conceptualisation and operationalisation was considered to be very large in the literature, and this was reflected as the leading factor in the fragmented body of knowledge around the ambidexterity theory. Although the ambidexterity research seemed to have converged around exploration and exploitation, these terms were considered too broadly defined. Building on this criticism, other authors added that the “exploit and explore” terminology did not explain organisational survival, although these constructs deal with threats to firm survival (O'Reilly & Tushman, 2013). Researchers also debated that the idea of sequential ambidexterity did not provide insights into how it occurs, what the transitions look like at ground level or the role of senior teams and leadership in attending to the paradoxical demands of ambidexterity (O'Reilly & Tushman, 2013). These criticisms suggested that there could be more units of analysis beyond organisational and individual levels. They highlighted that the theory could be extended further to consider the firm's larger ecosystem.

The Boston Consulting Group (Reeves et al., 2013) presented a model for successfully strategising in fast-changing business environments where firms choose an ambidexterity approach based on the diversity of strategic styles required to compete in diverse environments. The model recommended:

i. separation for firms facing different contexts but which are generally stable
ii. the switching approach is when a firm changes its strategic style as its environment changed
iii. a self-organising approach when a company needs to use multiple strategies concurrently while techniques are evolving and
iv. the ecosystem approach when a firm needs to orchestrate a diverse ecosystem of external parties to source the styles it requires to compete.

However, the model's limitations were that the separation and switching approaches created restrictions for information flow and resources, whilst the self-organising and external ecosystem approaches could suffer from cost duplication.

Several authors claimed that the role of individuals in organisational ambidexterity was underdeveloped (Caniëls, Neghina, & Schaetsaert, 2017) and without a clear understanding of the structures, processes and behaviours that enable and support ambidexterity, it cannot be systematically managed (Asif, 2017). Although various measures of ambidexterity had been proposed, it remains unclear how ambidexterity could be best operationalised (Rosing & Zacher, 2017). Whilst there was some consensus in the literature that organisational ambidexterity is required for responding to disruptive innovations, criticism has been that it is challenging to implement (Lis et al., 2018).

Later, the ambidexterity theory was reconceptualised from earlier static perspectives (O'Reilly & Tushman, 2013) to a dynamic ability to balance exploration and exploitation (Luger et al., 2018). The dynamic ambidexterity framework posits that the more firms reach a balanced exploration and exploitation state, the less likely they are to adapt their exploration-exploitation abilities in the subsequent periods of disruption. It follows that firms align their vision, strategies and structures to enable ambidexterity. However, these actions could stimulate defensive managerial behaviours and organisational inertia, resulting in complementary outcomes that cause self-reinforcing effects or path dependencies. Therefore, managers are advised to simultaneously combine capability-building processes to balance exploration and exploitation with capability-shifting processes to adapt the exploration

- exploitation balance as a response to turbulence in their business environments. It was theorised that this dual capability could provide firms with the complete collection of strategies required to survive episodes of discontinuous change. These firms would benefit from exploration and exploitation mutually enabling forces and gain from the returns of dynamic alignment with their shifting contexts. However, the limitation of this framework is that it could be challenging to resolve multiple tensions that arise simultaneously.

Drawing on a comparative case study of four electric utilities in Germany, researchers expand on the range of ambidexterity approaches that firms could use to survive and achieve competitive advantage (Ossenbrink et al., 2019). They argue that, in rapidly changing markets characterised by numerous and uncertain opportunities requiring novel culture and capabilities, organisations could invest in initiatives combining structural and contextual ambidexterity—an approach termed hybrid ambidexterity. The hybrid ambidexterity approach theorises that the choice of strategic approach is influenced by managers' perceptions of capabilities and opportunities, which are shaped by differences in the environment, such as the geographic location of firms' operations, markets, and headquarters (Ossenbrink et al., 2019).

Furthermore, the analysis showed that there are unique market dynamics in the public sector, such as strong ties with the government through traditional contracting strategies, contracts for services with start-up companies, agreements granting private rights to facility use and knowledge sharing that created opportunities for incumbents to use ambidexterity to innovate and survive when new entrants emerge (Joseph & Wood, 2020). For example, an incumbent in the space industry, United Launch Alliance (ULA), developed the Vulcan launch system in response to a disruptor SpaceX by pursuing innovation and using ambidexterity. ULA changed some of its policies to enable the exploration of new opportunities while maintaining its core values of reliability and high quality. It integrated this into its product line launch systems. United Launch Alliance used contextual ambidexterity by developing its Vulcan product line. It sought to maintain culture, policies and processes that have enabled the firm to cement a reputation of high quality and reliability across the organisation and, in parallel, explored how to position itself to gain a greater share in the commercial and civil launch market (Joseph & Wood, 2020).

It has been suggested that ambidexterity be used to overcome business model transformation paradoxes, which simultaneously requires exploring market shaping and stabilising strategies in incumbent firms (Carlborg, Hasche, & Kask, 2021). When market structures are disturbed, incumbents may experience situations where their existing business model do not fit well with the new market structures. Business model transformations can be proactively executed to induce structural market change and reactive as a response to stabilise the existing market structure; therefore, managers are advised to allocate resources to both activities. Since business model transformations take place in networks of actors, strategies would require the actor's continuous involvement to succeed with both shaping and stabilising strategies. Therefore, a better understanding of an actor's interplay between shaping and stabilising strategies could assist firms in overcoming the business model transformation dilemma. However, discussions on how this ambidexterity could be achieved have been limited.

The various approaches to ambidexterity should not be seen as alternatives (Hill & Birkinshaw, 2014; Kassotaki, 2022), but instead, firms should use combinations of approaches whilst seeking to optimise ambidexterity in their organisational context. A review of organisational ambidexterity research has shown that most studies have focused on structural factors and the effect of ambidexterity on firm performance. However, references to complex interfaces addressing additional variables, such as the upscaling of disruptive innovations and the efficiency of high-technology firms (Kassotaki, 2022), have been limited. Furthermore, the ambidexterity concept is becoming increasingly important because it influences organisational agility and assists organisations in coping with the growing levels of tensions in response to threats and opportunities from the dynamic business environment (Kaneko & Sanchez, 2022). Avoiding tension through temporal or structural tensions or emphasising one side of the paradox will likely lead to sub-optimal solutions. Other constructs, such as *project* agility (the ability of firms to manage the interdependent exploitation and exploration elements of persistent contradictions in projects), can be used to drive *organisational* agility, thereby influencing firm performance. Further research into the applications of ambidexterity is likely to be fruitful.

Proposition 3b: Ambidexterity can be a strategic tool to address disruptive innovations in monopolistic electricity markets. It could enable the utility to exploit existing internal competencies, assets and capabilities while simultaneously exploring external opportunities.

The following section concludes the literature review and discusses the conceptual framework.

2.4.3 Conclusion of literature review

The conceptual framework (Figure 3) summarises the literature review by illustrating the forces acting on the electric utility, the strategy as practice agents, and the strategic alternatives and tools available to electric utilities in regulated markets to respond to disruptive innovations.

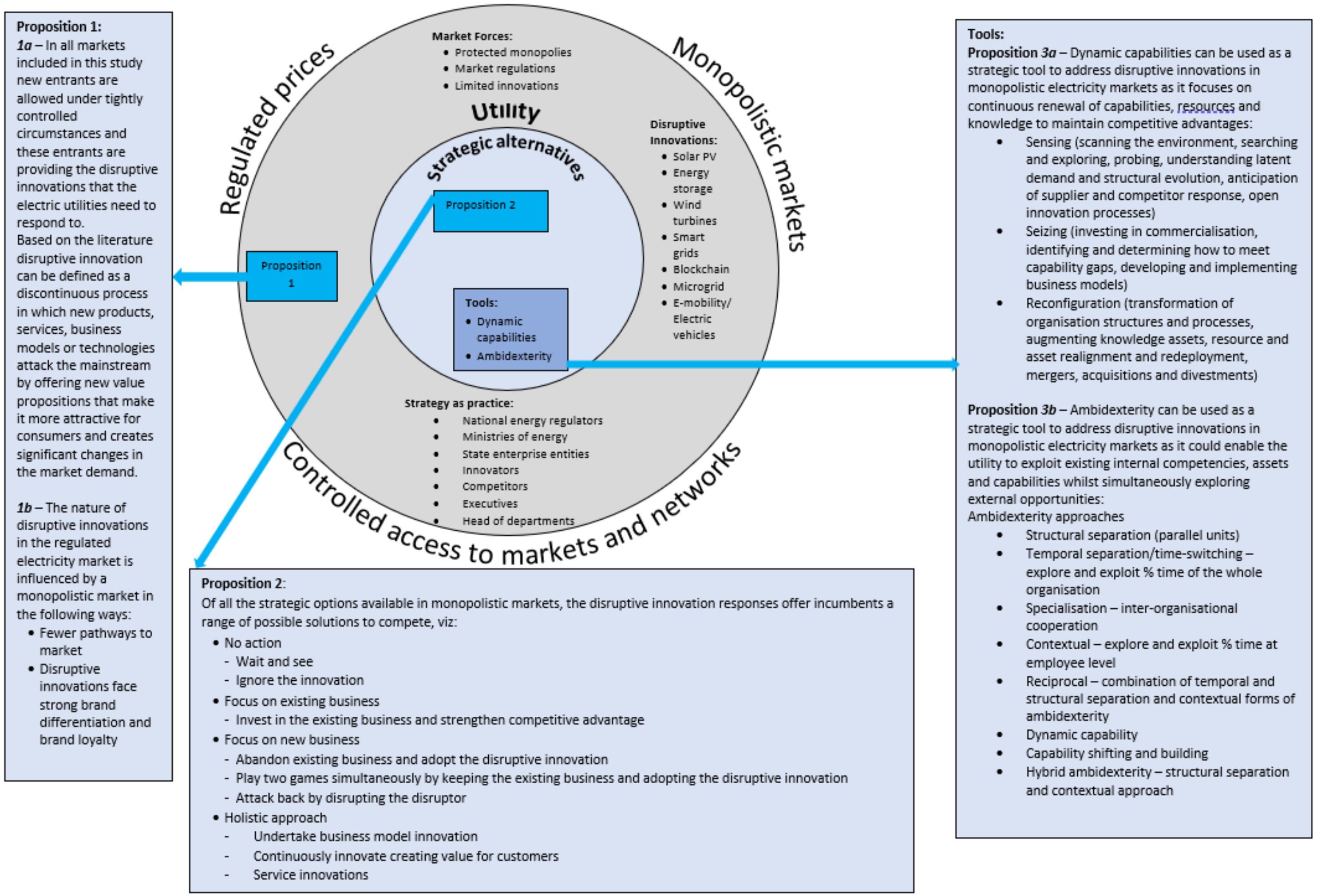

Figure 3: Conceptual framework forces acting on the electric utility, the strategy as practice agents, and the strategic alternatives and tools available.

In summary, the nature of the traditional electricity industry is monopolistic; electricity prices are regulated, and the state controls access to the market and networks. The electric utilities are primarily state-owned and form monopolies protected through regulations. These characteristics act as market forces, and together with strategy as practice agents such as national energy regulators, ministries of energy and state enterprise entities, they influence the strategic options of a utility. At the same time, disruptive innovations such as solar photovoltaics, wind turbines, energy storage technologies and electric vehicles act as a force to which the electric utility needs to respond. Out of all available options for the electric utility, the disruptive innovation responses offer a range of possible strategic choices, i.e. no action, focusing on existing business, focusing on new business or an holistic approach. In addition, a utility can also use dynamic capabilities and ambidexterity approaches as tools to strategise in monopolistic markets.

Dynamic capability entails sensing and shaping opportunities and threats, seizing opportunities and reconfiguring the firms' tangible and intangible assets and resources to maintain competitive advantages. Sensing and shaping activities include scanning, searching, and exploring the business environment, probing customer needs, understanding latent demand and industry and market structural changes, anticipating supplier and competitor responses, and participating in open innovation processes. Seizing activities entail making investments to commercialise new products and services, identifying and determining how to meet capability gaps, and developing and implementing business models to capture and deliver value from new products and services. Reconfiguration activities entail transforming current organisation structures and processes, augmenting knowledge assets, realigning and redeploying resources and assets, mergers, acquisitions, and divestments.

Generally, there are eight ambidexterity approaches available to electric utilities. These include (i) structural separation, (ii) temporal separation, (iii) specialisation and inter-organisational cooperation, (iv) contextual, (v) reciprocal, (vi) dynamic capability, (vii) simultaneously building and shifting capabilities, and (viii) hybrid ambidexterity.

The propositions for this study are:

Proposition 1a: In all markets included in this study, new entrants are allowed under tightly controlled circumstances, and these entrants are providing the disruptive innovations that electric utilities need to respond to (Page 59).

A summarised definition of disruptive innovation drawn from the current literature is a "discontinuous process in which new products, services, business models or technologies attack the mainstream by offering new value propositions that make it more attractive for consumers and create significant changes in the market demand".

Proposition 1b:

A monopolistic market influences the nature of disruptive innovations in the regulated electricity market in the following ways (Page 59):

- Fewer pathways to market
- Disruptive innovations face strong brand differentiation and brand loyalty

Proposition 2: Of all the strategic options available in monopolistic markets, the disruptive innovation responses offer incumbents a range of possible solutions to compete (Page 75), viz:

1. No action
    - Ignore the innovation
    - Wait and see
2. Focus on existing business
    - Invest in the existing business and strengthen competitive advantage
3. Focus on new business
    - Abandon existing businesses and adopt the disruptive innovation
    - Play two games simultaneously by keeping the existing business and adopting the disruptive innovation
    - Attack back by disrupting the disruptor
4. Holistic approach

- Undertake business model innovation
- Continuously innovate, creating value for customers
- Service innovations

Proposition 3a: Dynamic capabilities can be used as a strategic tool to address disruptive innovations in monopolistic electricity markets as it focuses on continuously renewing capabilities, resources and knowledge to maintain competitive advantages (page 81).

Proposition 3b: Ambidexterity can be a strategic tool to address disruptive innovations in monopolistic electricity markets. It could enable the utility to exploit existing internal competencies, assets and capabilities while simultaneously exploring external opportunities (Page 89).

The following section discusses the method that was used to conduct this research.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This section describes the methodology followed to respond to the propositions that arose from the literature review and were suggested as possible solutions to the research questions. The section explores the paradigm in which the research is located, and details of sampling, data collection procedures, the data used in the study and the analysis process are also discussed. The limitations of this study, together with the ethical considerations and validity and reliability, are explained.

A qualitative multi-case study was chosen to investigate possible strategic responses to threats and opportunities from disruptive innovations in regulated markets.

3.2 Research Paradigm

This research was guided by the interpretivist paradigm, a philosophy that affirms multiple realities of a phenomenon (Krauss, 2005; Mackenzie & Knipe, 2006). Epistemologically, the view of the interpretivist paradigm is that the knowledge of reality is a social construction by human actors (Carson et al., 2001). As the objective of this study was to provide an exploratory case analysis of how state-owned electric utilities are responding to disruptive threats and opportunities in regulated markets, the interpretivist paradigm provided a unique opportunity to gain deeper insights by exploring different social realities through experiences and perceptions of interviewees located in different social contexts in three different countries (Alharahsheh & Pius, 2020; Charmaz, 2017).

Further, the interpretivism paradigm was suitable for this study because it is primarily concerned with explaining how phenomena are experienced by respondents (Volmar & Eisenhardt, 2020).

3.3 Research Design

This study used a case study approach to provide in-depth insights on how state-owned electric utilities are positioned in relation to their respective market forces, what the general strategic approaches among state-owned electric utilities are, and what assembly of theoretical tools is available to state-owned electrical utilities to respond to disruptive innovations in regulated markets. The case study approach permitted a deeper understanding of the forces at work within single settings (Gehman et al., 2018) and across settings (Krehl & Weck, 2020), providing valuable insights for problem-solving. A case study design was well suited for this research as the theoretical interrelationships between constructs of the disruptive innovation theory, dynamic capability and ambidexterity perspectives was holistically explored and new concepts and propositions were discovered within the context of a regulated market.

The cross-sectional exploratory case study design facilitated the collection of different kinds of data through interviews and documents about each case, giving an in-depth view of electricity utilities in different industry settings through the inner workings of the utility and interactions with respondents. Respondents' views and experiences generated thick descriptions, which were analysed thematically to articulate triangulated responses to each research question (Rashid et al., 2019; Tomaszewski et al., 2020).

Two cases, Eskom and Électricité de France, were used in this study to raise the trustworthiness of the study and to gain a deeper understanding of the topic being investigated: multiple cases allow for investigation of similarities and differences between the cases, giving deeper exploration of research questions and theoretical implications (Eisenhardt & Graebner, 2007). The cases provided data in different country contexts, revealing patterns and relationships as the same issues were explored in each case, enriching the understanding of the theoretical propositions (Nilmanat & Kurniawan, 2021). In addition, using two cases of state-owned electric utilities raises confidence in the robustness of the study's findings (Priya, 2021).

Although case studies have been criticised as being weak in comparison to quantitative statistical methods (Denscombe, 2014; Yin, 2013) due to lack of generalisability, scholars have also explained that the aim of case study research is not to derive statistical outcomes or generalise to a population (Takahashi & Araujo, 2020), but rather to provide a basis for the development of theoretical propositions that could be tested in a further study. These criticisms imply a lack of rigour, impacting the study's credibility (Denscombe, 2014; Yin, 2013). However, other authors have highlighted that developing a robust framework and displaying methodological transparency improves rigour and trustworthiness (Massaro et al., 2019). This study embraced these recommendations, as demonstrated in the relevant sections of this chapter.

3.4 Strategy of Enquiry

This study used an enquiry process compounded from several authors for building theories from case study research (Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021; Rashid et al., 2019; Saldaña, 2021). Table 4 indicates the plan of action and alignment to the research journey from problem definition to reaching closure.

Table 4: Strategy of enquiry for study, combined from Ebneyamini & Sadeghi Moghadam (2018); Priya (2021); Rashid et al. (2019); Saldaña (2021)

Research Journey	Activity	References
Purpose of the study	Formulated the conceptual statement to act as a guide to this study and affirmed that case study research can meet the goals of this study.	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021; Rashid et al., 2019)
Type of Research	It was determined that exploratory case study research would be best suited to answer the research questions.	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021)
Problem Definition	Research questions to meet the goal of the study were formulated. The research questions were: 1. How are state-owned electric utilities positioned in relation to their respective market forces? 2. What are general strategic approaches among state-owned electric utilities?	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021)

Research Journey	Activity	References
	3. What assembly of theoretical tools is available to state-owned electrical utilities to strategise effectively?	
Case Selection	The population was identified by focusing on theoretically sound information-rich cases. For this study, two state-owned electric utilities operating in a regulated market were purposively selected, namely Eskom and Électricité de France.	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021)
Literature review	A critical review of scholarly articles about the concepts identified for this research was undertaken. The literature review was carried out to find out possible answers to the research questions and resulted in developing propositions for this study.	(Priya, 2021)
Data collection methods and instruments	Determined the data gathering methods, identified the multiple data sources and formulated the instruments. This study used documents, in-depth interviews, and documentary sources. The interview guide was the instrument, and interview guides for the electric utility and national energy regulators were formulated.	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021; Rashid et al., 2019)
Case study database	A case study database was constructed. Raw data was recorded and analysed in the AtlasTi software.	(Priya, 2021)
Data Analysis	The data was analysed using coding techniques. Raw data was coded and categorised, which led to themes. Each case was analysed as a stand-alone entity to allow unique themes to emerge. The emerging themes from the individual case evidence informed the themes in the integrated analysis, leading to the formulation of theoretical propositions.	(Ebneyamini & Sadeghi Moghadam, 2018; Priya, 2021; Rashid et al., 2019; Saldaña, 2021)
Discussion	The findings were compared and contrasted with the literature. The emergent theoretical propositions were integrated with the extant literature to formulate the contributions to knowledge.	(Rashid et al., 2019)
Conclusion	Possible responses to each research question were given. This included findings from combining all the data gathered relative to theoretical propositions.	(Rashid et al., 2019)

How this research was conducted can be described in 3 phases (Figure 4).

- Phase 1 documentary analysis
- Phase 2 interviews with electric utilities
- Phase 3 interviews with national energy regulators

Each phase is discussed in turn. The findings from Phase 1 informed the interviews conducted in Phases 2 and 3. Figure 4 shows the process flow in which data was captured for the study. Firstly, the documentary analysis took place, and then those findings, plus the literature review, were used to construct the two interview guides for the electric utilities and the national energy regulators.

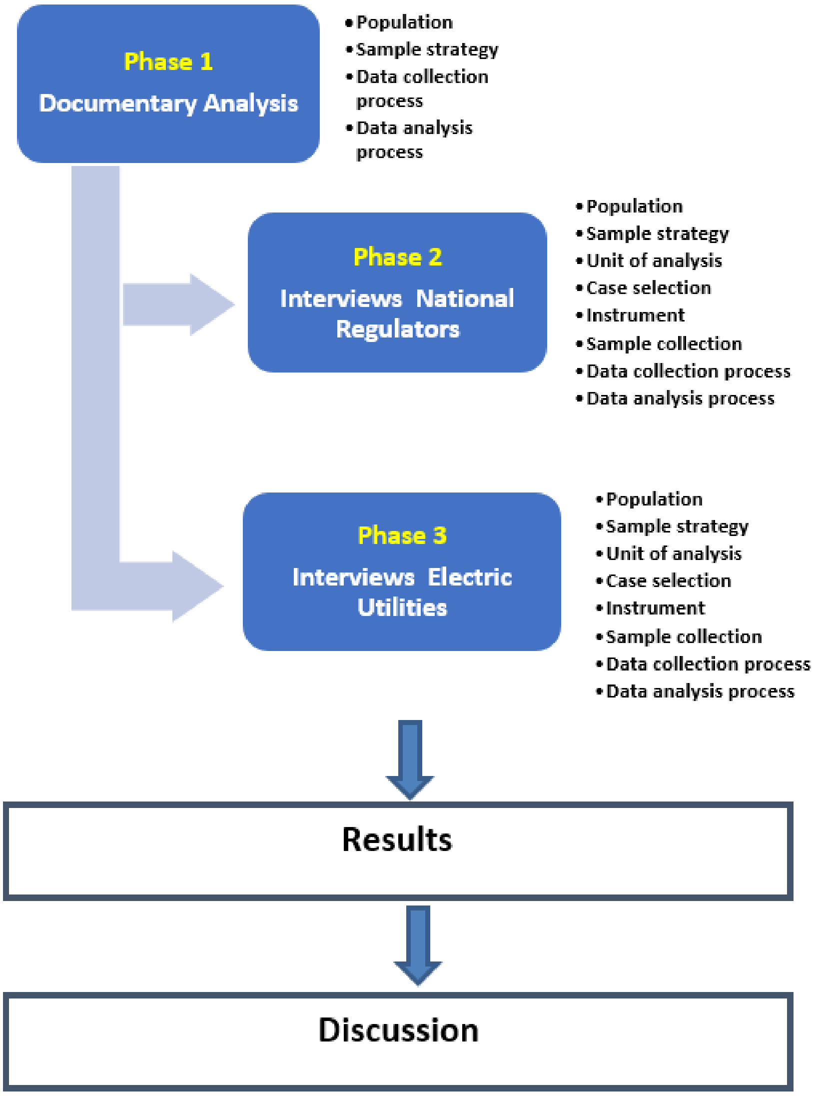

Figure 4: Illustration of research phases

3.5 Unit of Analysis

The unit of analysis for this study comprised the strategic responses to disruptive innovations in regulated markets. It might at first appear that the units of analysis were the electric utilities, but in this study, the utilities were the population. The strategic responses are what was being investigated. A case, as described by Yin (2009), is a “rich, empirical instance of some phenomenon, typically using multiple data sources”, which makes it clear that the unit of analysis is not restricted to an organisation, country or group. The unit of analysis limited against the researcher drawing erroneous conclusions from using several units of analysis within this study (Birks & Mills, 2011; Rule & John, 2011).

3.6 Triangulation

Triangulation using multiple data collection methods allowed for a more robust substantiation of findings and conclusions, which increased the study's credibility. Figure 5 illustrates the flow of the data collection process and reflects the triangulation process for this research.

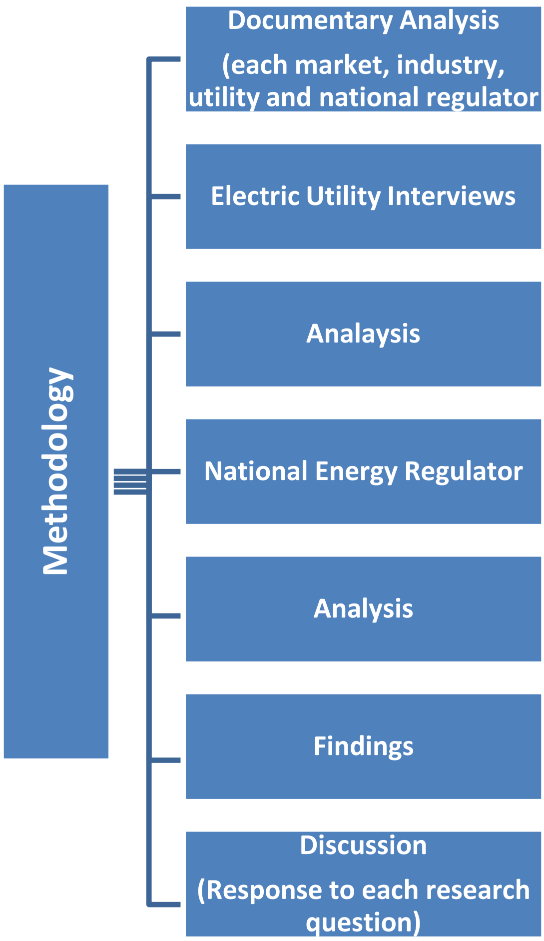

Figure 5: Triangulation process and data collection of the research

This study used triangulated data collection techniques, analysis procedures, data types and interviewees within each case because data triangulation supports findings with different underpinnings and makes the dataset rich and more comprehensible (Farquhar, Michels, & Robson, 2020). This study used both primary and secondary data sources. The primary data source was the interviews with the utility and national energy regulators; the secondary was documents.

3.7 Phase 1- Documentary analysis

3.7.1 Population

The population of documents consisted of company documents, national policies, regulations and website information.

3.7.2 Sampling strategy

Documents were purposively selected (Boddy, 2016) to provide information for answering the research questions (Carmichael & Cunningham, 2017). The documents selected for this study are elaborated on in the relevant sub-sections.

3.7.3 Data collection process

The secondary data included documentary sources used to inform and complement the primary data and assisted in better understanding the cases, their markets, policies, regulations and response strategies to disruptive innovations. The documentary sources were also used for context setting before the interviews were held. All documentary sources were used to interpret the context of each case and inform the interview sessions and analysis.

A summary of the documentary sources used in this study is described in Table 5.

Table 5: Documentary sources of information

Country	Case	Documentary sources
South Africa	Eskom	Annual reports, financial statements, company strategy, business plans, organisation structure, website information, company brochures and reports
	South African National Energy Regulator (NERSA)	Website information, country regulation and policy on energy planning, electricity pricing and market structure
France	Électricité de France (EDF)	Annual reports, financial statements, company strategy, Business plans, organisation structure, website information, company brochures and reports
	Commission de régulation de l'énergie (CRE)	Website information, country regulation and policy on energy planning, electricity pricing and market structure. European Union policy on energy and electricity markets

3.7.4 Document analysis process

The document analysis process entailed finding, selecting, making sense of and synthesising the data contained in the documents (Morgan, 2022). The content analysis was done by skimming, reading and interpreting the various document sources (Bowen, 2009) to appraise and understand the external and internal business environments under which the utilities operated; only information relevant to the research questions was gathered. In selecting the documents, authenticity, credibility, representativeness and meaning were considered (Morgan, 2022). Documents were verified for authenticity by checking that only those from official websites, with logos, dates and no inconsistencies were included. In addition, documents were scrutinised for idiosyncratic content by evaluating whether the content reflected information from other documents about the same topic.

3.8 Phase 2 – Electric Utilities

This section describes how the research was carried out for the electric utilities.

3.8.1 Population

The population for this study was the electric utilities in twenty-five countries that belonged to a 21st Century Power Partnership Programme. The 21st Century Power Partnership is a global collaborative programme focused on advancing clean energy efforts in electric utilities. The electric utilities were selected for investigating strategic responses to disruptive innovations in regulated markets because national energy regulators control electricity prices (Lopez, 2016; Mazer, 2007).

3.8.2 Sampling strategy

Cases were purposively selected based on ‘fit for the purpose’ of answering the research questions and providing solutions to the research problem (Carmichael & Cunningham, 2017; Staller, 2021). Two electric utilities, viz., Eskom and Électricité de France, were selected via a stratified purposeful sampling technique as it permitted the selection of cases from a specific population of interest, enabling a more straightforward comparison of the variation across cases as well as exploration of any cross-cutting themes/issues (Farrugia, 2019). Other state-owned electric utilities in Australia, Canada, Denmark, Finland, Germany, India, Italy, Netherlands, New Zealand, Norway, Saudi Arabia and Sweden would have also met the study purpose, but access to data was limited.

Further details on the criteria for case selection, sample selection and how each utility meets the case criteria are elaborated on in the subsections below.

3.8.3 Case selection

In this study, two state-owned electric utilities had been purposively selected from a class of potential cases that met the selection criteria. The study purpose guided the selection criteria (Table 6), the relationship between case and class of cases, the number of cases, data availability and accessibility. Cases that addressed the purpose of the study were selected i.e., to build a framework of response strategies to disruptive innovations and identify theoretical relationships between the constructs of the disruptive innovation theory, ambidexterity and dynamic capability frameworks. In addition, cases that supported the study’s objectives (Priya, 2021; Yin, 2017) were selected, i.e. state-owned electrical utilities that generate electricity in countries where electricity price is regulated in one or more customer segments. The cases were selected to enrich theory-building through varied data (Eisenhardt, 2021; Yin, 2017). The Eskom and Électricité de France cases are exemplary as their failure to respond to disruptive innovations led to the loss of revenues and profitability, which would be of national interest since electricity growth is coupled with economic growth. Électricité de France is the state-owned electric utility of France, which is a developed country, whilst Eskom is from a developing country i.e. South Africa. The comparison between a developed and developing country enriched the data as it permitted the phenomenon of disruptive innovations to be studied in different contexts and increased the credibility of the study.

Whilst scholars (Sadeghi Moghadam et al., 2021) suggested that two to eight cases are likely to replicate or extend theory and propositions, other authors (Ebneyamini & Sadeghi Moghadam, 2018) had also explained that the ideal number is dependent on what is being studied and recommended that researchers select cases that are information-rich so that the most can be learned. Hence the selection of two state-owned electric utilities added to the rigour and big picture understanding of this research (Eisenhardt, 2021). Furthermore, Électricité de France and Eskom were willing to share information and documentation, enabling data access (Priya, 2021).

Table 6: Case selection criteria

Factors	Criterion	Comments
Purpose of the study	Électricité de France and Eskom are state-owned utilities operating in regulated electricity markets, and these cases supported the purpose of the study, which was to provide possible strategic options for disruptive	Build a framework of response strategies and identify theoretical relationships between the constructs of disruption

Factors	Criterion	Comments
	innovations in regulated markets (Priya, 2021; Yin, 2017).	theory, ambidexterity and dynamic capability.
Class of cases to which the case belongs	Électricité de France and Eskom are state-owned utilities that operate in regulated markets; therefore, these cases supported the objective of the study, which was to explore strategic approaches that could be considered by state-owned electric utilities to respond to disruptive innovations in regulated markets to position state-owned electric utilities in relation to market forces and to identify and evaluate an assembly of theoretical tools for application to optimise their strategies (Priya, 2021; Yin, 2017)	Select state-owned electrical utilities and operate in countries where electricity price is regulated in one or more customer segments.
Relationship of the case and class of cases	Exemplary and contrasting cases will likely improve theory building (Eisenhardt, 2021; Yin, 2017). Électricité de France and Eskom are exemplary cases, as failure to respond to disruptive innovations would be of national interest. Électricité de France is owned by the state of France, a developed country, while Eskom is owned by the state of South Africa, a developing country. The contrast between developed and developing countries permitted thick descriptions.	Select state-owned electric utilities that operate in a developed and developing country.
Number of cases to be studied	Based on the criteria of the ability of interviewees to speak fluent English, electric utility with majority state ownership and willingness of the utility to share data, two cases were selected from the 21st Century Power Partnership Programme (Ebneyamini & Sadeghi Moghadam, 2018).	Selection of information-rich cases where the phenomenon occurs (Eisenhardt, 2021).
Practical aspects to be considered	The willingness of utilities to share information, access to interviewees, geographical distance, time difference, and Ability of interviewees to speak English.	Access to rich, detailed, reliable data will enrich the study evidence (Priya, 2021)

An initial screening process was conducted based on Eskom's international research collaboration and partnership agreements with international research institutions. Eskom is part of the 21st Century Power Partnership programme with 25 member countries (Table 7). France is a member country, and their state-owned electric utilities were contacted via this partnership/platform for participation in this research as the findings from this study may be transferable to other utilities or potentially valuable to other power utilities. The researcher was employed at Eskom, which increased her accessibility to data.

Table 7: Members of the 21ST Century Power Partnership Programme (Clean Energy Ministerial, 2022)

Members	Ability to speak English	Electric utility with majority state-ownership	Access to information and documents for analysis
1. Australia	Yes	Yes	No
2. Brazil	No	Yes	No
3. Canada	Yes	Yes	No
4. Chile	No	No	No
5. China	No	Yes	No
6. Denmark	Yes	Yes	No
7. Finland	Yes	Yes	No
8. France	Yes	Yes	Yes
9. Germany	Yes	Yes	No
10. India	Yes	Yes	No
11. Indonesia	No	Yes	No
12. Italy	Yes	Yes	No
13. Japan	Yes	No	No

Members	Ability to speak English	Electric utility with majority state-ownership	Access to information and documents for analysis
14. Mexico	Yes, but not fluently	Yes	Yes
15. Netherlands	Yes	Yes	No
16. New Zealand	Yes	Yes	No
17. Norway	Yes	Yes	No
18. Poland	No	Yes	No
19. Portugal	No	No	No
20. Russia	No	Yes	No
21. Saudi Arabia	Yes	Yes	No
22. South Africa	Yes	Yes	Yes
23. South Korea	No	Yes	No
24. Spain	No	No	No
25. Sweden	Yes	Yes	No

Twenty-five case institutions were analysed according to the criteria stipulated in Table 6. Two cases were selected, namely Eskom and Électricité de France, which is in line with the recommended guidelines for the number of cases that should be studied (Ebneyamini & Sadeghi Moghadam, 2018; Eisenhardt, 2021). Preliminary interviews were held with senior representatives at Eskom to request contact details to set up the initial interviews with Électricité de France. The annual reports of the selected case institutions and the electricity market regulations for each case were further interrogated to ensure that the selected cases fit the study's design (Yin, 2017) and met the case selection criteria. The selected cases described in Table 7 were chosen due to their suitability in advancing the study purpose (Ebneyamini & Sadeghi

Moghadam, 2018; Rule & John, 2011) and obtaining variation to achieve a wide range of rich, thick data (Glaser & Strauss, 2017). In addition, the two cases were chosen to represent different contexts and to provide a level of variation so findings can be integrated and consolidated to provide theoretical variation.

The sections below describe how the utilities meet the selection criteria. Further details on each utility have been elaborated on in Section 1.2.4.

3.8.3.1 Eskom

Eskom meets the case selection criteria (Table 6) of this study as it is an electric utility which is 100% owned by the South African state (Eskom, 2020a) and the country's electricity prices in all customer segments and grid charges are regulated by the National Energy Regulator of South Africa (NERSA) which is mandated mainly via the National Energy Regulatory Act (2004), the Electricity Regulation Act (2006) and the Electricity Pricing Policy. Eskom is the country's leading electricity producer responsible for the transmission and bulk distribution of electricity to metros and municipalities (Eskom, 2022a). Depending on the area of supply licence, business and residential customers are supplied with electricity by Eskom, metros or municipalities. Eskom also directly supplies industrial, mining, commercial, agricultural and international customers and imports and exports electricity regionally via the Southern African Pool. The electricity sector is structured as a combination of a natural monopoly and a single buyer model – the latter means that independent power producers are allowed to generate electricity, which is sold to Eskom's grid and distributed as Eskom's supply.

3.8.3.2 Électricité de France

Électricité de France (EDF) fits the case selection criteria (Table 6) as it is 83.6% owned by the French State (EDF, 2020b), and residential electricity prices are regulated in France by the Commission de régulation de l'énergie (Kraft, 2017). France has both a whole and retail electricity market, allowing the market to set the price, consumers to choose their suppliers, and freedom of establishment for suppliers. The Acc`es R´egul´e `a l'Electricit´e Nucl´eaire Historique policy gives access to retailers to buy electricity generated by Électricité de France’s nuclear power plants at a regulated access tariff of 42 /MWh for up to a total of 100 /TWh per year (Benatia, 2022).

Électricité de France is a vertically integrated electric utility providing generation, transmission and distribution services (Deloitt, 2015). Whilst Électricité de France is a monopoly in France, the company also supplies electricity in 23 countries (EDF, 2018a). The French Energy Regulatory Commission established an independent transmission system operator, Réseau de Transport d'Électricité (RTE), to operate the grid and ensure non-discriminatory access to the grids. Électricité de France owns 51% of Réseau de Transport d'Électricité (Marques et al., 2016) and manages 95% of the distribution electricity network in France via its subsidiary Enedis (Deloitte, 2015; Karsenti & Daguzan, 2017). In the areas not served by Enedis, the activity is managed by local distribution companies (Deloitte, 2015).

Table 8: Selected cases

Name of Electric Utility	**Country**	**Percentage State-owned**	**State Regulator for Electricity**	**Areas of electricity supply**	**Electricity Market Structure**	**Dominant Fuel Source**	**Total Installed Capacity**
Eskom	South Africa	100%	National Energy Regulator of South Africa	South Africa, Lesotho, Uganda, Botswana, Zambia, Zimbabwe, Mozambique, Swaziland and Namibia	Vertically Integrated – No competitive wholesale and retail markets exist	Coal	46 466 MW (Eskom, 2021)
Électricité de France **(EDF)**	France	83.6%	Commission de régulation de l'énergie	France, United Kingdom, Italy, Poland, Belgium, Switzerland, Netherlands, Turkey, Greece, Portugal, Israel, Spain, Bulgaria, Germany, United States,	Liberalised-competitive wholesale and retail markets established	Nuclear	120 500 MW (EDF, 2021a)

Name of Electric Utility	Country	Percentage State-owned	State Regulator for Electricity	Areas of electricity supply	Electricity Market Structure	Dominant Fuel Source	Total Installed Capacity
				Brazil, Canada, Mexico, China, Laos, Vietnam, India, South Africa			

3.8.4 Instrument

This study used the interview guide (Annexure A) to collect data from the interviews.

3.8.5 Sample selection

A total of 18 candidates from the two electric utilities (Table 9) were purposively selected (Conlon et al., 2020) and interviewed for this study as saturation of the dataset was reached at this point i.e. after this point the interview process no longer offered any new data (Kumar et al., 2020). Respondents were selected based on their experience and knowledge of energy policy and regulation, company strategies, business plans and responses to disruptive innovations by electric utilities. Key participants included department heads from the corporate strategy, sustainability, electricity generation, renewable energy, new business, human resources and research and development units because of their role in establishing strategy and influencing strategic plans and organisational growth (Gartner et al., 2010; Mintzberg, 2013). The snowballing method was used at the end of an interview; participants were requested to recommend other professionals (Bhardwaj, 2019) whom they believed could contribute to this study through their knowledge and experience with disruptive innovations and responses to such innovations.

Table 9: Number of interviews at the electric utilities

Country	Case	Number of interviews
South Africa	Eskom	8
France	Électricité de France (EDF)	10
Total		**18**

Code names were not used to conceal the electric utilities' identity as they are monopolies in their country, and each utility had given permission for the research to be conducted. The country's name was prefixed to the respondents' pseudonym codes as a code, followed by the interview number, to maintain the confidentiality of each interviewee. This is illustrated in Table 10.

Table 10: Electric utilities pseudonym codes

Respondent	Illustration
Interview 1 Electric Utility in South Africa	South Africa_Eskom_1
Interview 1 Electric Utility in France	France_EDF_1

3.8.6 Data collection process

In-depth semi-structured interviews were used as primary data for this study. The details of these interviews are discussed in the next section.

3.8.6.1 Semi-structured interviews

Semi-structured interviews were used to collect data as they permitted participants to openly converse on questions raised by the research and allowed for flexibility to probe deeper insights (Chauhan, 2022). An interview guide had been formulated

(Annexure A) to ensure that issues relevant to the research questions of this study were discussed at all interviews (Saldaña, 2021). The literature guided the questions following the initial open-ended questions and constructs underpinning the disruptive innovation, ambidexterity and dynamic capability theories. Several authors (Coy, 2019; Gehman et al., 2018) supported beginning with expectations based on existing literature. Interviews were scheduled in advance for 60 minutes. Consent for participation in a subsequent interview was also requested at some interview sessions as more time was required for further clarification and explanations.

Participants were interviewed in person at their offices or through information and communication technologies such as Skype. Consent was obtained from all participants (Annexures A and C) for audio recordings, and a case study database was kept as part of the audit trail. There was a time delay of approximately four months between interviews for each selected case, which allowed for initial analysis and understanding of the emergent data before moving to the next case. It also enabled reflection on the issues under investigation, emerging arguments and directions suggested by the data. The in-depth, in-person interviews also provided an opportunity to gather additional company and country-specific documents (Seidman, 2013).

3.8.7 Data analysis process

The raw data collected in this study was recorded in ATLAS.ti for analysis and then coded and interpreted to provide insights into the response phenomena (Linneberg & Korsgaard, 2019). The purpose of the analysis was to condense data into an intelligible and interpretable format; this began early in the research process when the research problem was formulated to determine whether the data and its analysis would answer the research questions (Saldaña, 2021).

This study followed the recommendations of several authors who advised a high-quality data analytical strategy to include sound theoretical propositions and case descriptions (Creswell & Poth, 2017; Gehman et al., 2018; Priya, 2021; Yin, 2017). The data analysis in this study comprised data preparation, coding, memo writing, integrated case analyses, and theoretical proposition development (Gehman et al., 2018; Saldaña, 2021). Details of each step are provided in the following section.

3.8.7.1 Data preparation

Data was transcribed verbatim prior to analysis. These transcribed documents were stored in ATLAS.ti for analysis. Data management included backup and preservation of data integrity (Denscombe, 2014). Data was backed up via an external hard drive, and backed-up copies were used during the analysis to protect the original data from unintentional damage and corruption (Denscombe, 2014). In addition, the Dropbox cloud application was used as a storage tool. All electronic mail exchanges on the research project were maintained online as a contingency strategy for unexpected problems.

3.8.7.2 Coding and categorisation process

Raw data was inductively analysed (Linneberg & Korsgaard, 2019) using the coding procedure recommended by Elliott (2018) and Saldaña (2021). Saldaña (2021) described coding as allocating interpretive tags or names to concepts, ideas, constructs or themes that emerge from the data. The initial coding process began with the *in vivo* method of assigning codes using the interviewee's own words (Strauss, 1987). This was followed by converting the codes to gerunds where appropriate (Charmaz & Keller, 2016). A reflection model (Carmichael, 2009) was used to add depth to the analysis. The reflection model consisted of ‘What?’, ‘So what?’ and ‘Now what?’ (Carmichael & Cunningham, 2017) to foster thinking about the meaning and implications of the codes. In the first step of the reflection modelling process (what?), a descriptive code was used to identify ‘what’ is in the data. In the second stage, the researcher queried ‘So what?’ in order to code the meaning of the data and in the last stage, the researcher sought to answer the ‘Now what?’ considering the implications of the meaning of the data (Carmichael, 2009; Carmichael & Cunningham, 2017). The reflection modelling process resulted in several levels of coding, providing further analytical depth to the initial descriptive codes. The process proceeded with comparison, focused and theoretical coding (Saldaña, 2021). This process involved constantly comparing, reorganising, or “focusing” the codes into categories, prioritising the codes to develop categories around which other codes revolved, and synthesising them to formulate a key category which became the constructs for the theory. These stages are iterative and are repeated when new theoretical propositions emerged.

The analytical rigour of this study was increased through the use of ATLAS.ti software package, Version 8, is a sophisticated program that enables the analysis and management of qualitative data from multiple sources (Elliott, 2018).

3.8.7.3 Memo writing

Memo writing was used in this study when codes, concepts and constructs were identified and examined in the dataset (Charmaz, 2014; Corbin & Strauss, 1990). The memos were used to build and revise theory during the research process (Charmaz, 2014; Corbin & Strauss, 1990). This process began with the first coding session and continued until the conclusion of the research.

The ATLAS.ti software was used to record the memos, which contributed to the rigour of the data analysis process. Memo-writing also facilitated researcher reflexivity by developing awareness of the researcher’s prejudices and openness to data, which prevented conflicts with the researcher’s biases (McGhee, Marland, & Atkinson, 2007).

3.8.7.4 Integrated Case Analysis

Each case was coded and analysed separately to investigate emerging issues thoroughly and constructs relevant to responding to each research question in turn. A pattern-matching technique was used for further analysis of the generated themes (Saldaña, 2021). Quotations from the raw data were used to illustrate the themes as they emerged in response to each research question of the study. Integrated analysis assisted in a robust and well-rounded interpretation of the cases under investigation. The emerging themes from the individual case evidence were used to inform the themes in the cross-case analysis (Takahashi & Araujo, 2020). The examination of emerging themes, constructs and issues was conducted in an unrestricted manner i.e. not confined to each research question or theory during the analysis. This allowed for themes and constructs to be holistically analysed and integrated to answer the study's research questions.

The cases were analysed using themes from the literature and emergent themes from the data, which permitted creative thinking whilst establishing similarities and differences across cases (Takahashi & Araujo, 2020). Propositions about relationships among categories were developed during the research process.

3.8.7.5 *Theory Development Process*

The theory development for this study came from the coding and categorisation of the raw data, which led to themes and were ultimately formulated into theoretical propositions (Eisenhardt, 2021; Saldaña, 2021).

3.9 Phase 3 – National Energy Regulators

This section describes how research was carried out for the national energy regulators.

3.9.1 Population

The population for this study was 25 member countries that were part of the 21ST Century Power Partnership Programme.

3.9.2 Sampling strategy

National energy regulators from France and South Africa were purposively selected (Staller, 2021) as the sample cases because the monopolistic electric utilities that were chosen as these entities regulate cases; this relationship provided additional insights to the research.

3.9.3 *Case selection*

In this research, two national energy regulators from South Africa and France were purposively selected based on selection criteria (Table 5) that were guided by the study purpose, relation between case and class of cases, the number of cases, data availability and accessibility (Eisenhardt, 2021; Priya, 2021). The national energy regulators chosen were: i) National Energy Regulator of South Africa and Commission de régulation de l'énergie.

The perspectives from the national energy regulators in different countries contributed to the thick, rich descriptions of strategic responses to disruptive innovations in regulated markets by providing contrasting perspectives to the electric utilities. There is a regulatory relationship between the national energy regulators (case) and the electric utilities (cases) as the regulator sets the price for electricity and network charges and evaluates the utility's performance as part of the price determinations. Although two cases were selected, the focus should not be on the ideal number of cases but on obtaining rich information to answer the research questions (Ebneyamini & Sadeghi Moghadam, 2018). The data was accessed via the relationships established with Eskom and Électricité de France.

Further details on each national energy regulator were discussed in Section 1.2.4

3.9.4 *Instrument*

The interview guide (Annexure B) was the instrument used to collect interview data.

3.9.5 *Sample selection*

Five candidates (Table 11) from the national energy regulators were selected and interviewed via purposive and snowball sampling (Conlon et al., 2020). These candidates were subject matter specialists and were chosen based on their knowledge and experience related to electricity regulations and the technical performance and efficiencies of the state-owned electric utility in their country. Interviewees from the electric utilities were requested to recommend professionals from the national energy regulator whom they believed could contribute to the objectives of this study.

Table 11: Number of interviews conducted with national energy regulators

Country	**Case**	**Number of interviews**
South Africa	South African National Energy Regulator (NERSA)	2
France	Commission de régulation de l'énergie (CRE)	3
	Total	**5**

Code names were not used to conceal the name of the national energy regulator, as there is only one energy regulator per country. However, the interviewees' identities were kept confidential, and pseudonym codes were prefixed with the name of the national energy regulator as a code, followed by the interview number, to maintain the confidentiality of each interviewee. This is illustrated in Table 12.

Table 12: National energy regulator pseudonym codes

Respondent	**Illustration**
Interview 1 National Energy Regulator in South Africa	South Africa_NERSA_1
Interview 1 National Energy Regulator in France	France_CRE_1

3.9.6 Data collection process

In-depth semi-structured interviews were used as primary data for this study. Further details on semi-structured interviews are elaborated on in the next section.

3.9.6.1 Semi-structured interviews

An interview guide had been formulated for the national energy regulators (Annexure B) to keep the researcher focused on the research questions and ensure that by the end of the interview, the issues about the research had been discussed (Saldaña, 2021). The interview process with the national energy regulators was the same as that conducted with the electric utilities.

3.9.7 Data analysis process

The data analysis process was the same as for the electric utilities.

3.9.8 Theory development process

The theory development for this research came from the coding and categorising the raw data, which led to themes and, finally, to theoretical propositions.

3.10 Limitations of the Research

Although the case study method has received criticism for its lack of robustness as a research tool, it has been argued (Zainal, 2017) that this can be overcome by crafting a multi-case design that shows multiple sources of evidence through maximum diversity rather than quantitative sampling logic. In addition, case study conclusions are generalisable to theoretical propositions rather than populations (Yin, 2013).

3.11 Validity and Reliability Qualitative Equivalents

In quantitative studies, the term reliability refers to the replicability or consistency of measurements, and validity elaborates on the credibility and generalisability of data, but this is not the same for qualitative research. The reason is that socially constructed realities cannot be studied as individual factors but only holistically since the constructs or factors are interrelated, influence each other, and are influenced by the context's nature (Lincoln & Guba, 1986). Credibility, transferability, dependability, and confirmability were suggested as equivalents to quantitative studies to build trustworthiness in a qualitative study (Lincoln & Guba, 1986). Each of these is described in the following sub-sections 3.11.1 to 3.11.4.

3.11.1 Transferability

This study used thick descriptions (Anderson, 2017) as described in the research design and data collection process. The use of 34 responses from interviewees, semi-structured interviews, and memos generated thick descriptions for this study, which resulted in the development of codes to categories to themes and then to theoretical propositions. This study's rigour was strengthened by the presentation of rich, direct quotations and descriptive phrases in the analysis chapters of this study to illustrate how the concepts and constructs were developed.

The research was conducted methodically to achieve rigour. This included avoiding bias and misrepresentations when conducting the research by cross-checking the study’s procedures and data and incorporating reflective memos. Data was collected and analysed fairly, and the study’s conclusions were based on the data collected.

As data was gathered, the researcher took detailed notes and used reflectivity by developing awareness of the researcher’s prejudices and openness to data, which may conflict with the researcher’s biases. The researcher included direct quotes as part of the evidence of data collected from the research participants where suitable.

Yin (2017) recommended transferability by developing a comprehensive data collection protocol so that a qualitative study's procedure may be replicated in another setting. Hence, the data collection and analysis in this study followed the procedure described in this chapter's data collection and analysis sections.

Atlas.ti was used to ascertain the level of consistency of the coding. The Atlas.ti qualitative analysis software was used to enhance the quality of the research by assisting in the coding and categorisation of the data and limiting human error in the qualitative analysis process.

The research is not generalisable because qualitative research assumptions and processes are oriented towards theory building, not theory testing.

3.11.2 Credibility

This study used triangulation techniques as described in this chapter's data collection, data analysis, types and case study design sections to enhance the study's credibility. All research procedures were described and documented in detail to indicate a transparent process and build trustworthiness and credibility (Yin, 2017).

Prolonged engagements (Anderson, 2017) were held via in-depth interview sessions, which lasted 60 minutes, and follow-up sessions were also held with some interviewees to further clarify issues. This allowed the researcher to determine possible sources of distortions and ascertain important factors about the phenomenon of disruptive innovations.

3.11.3 Dependability

Consistency or dependability of the results was attained by the researcher acquiring data with maximum variation (Morse, 2015) in how disruptive innovations were experienced and how electric utilities responded to the phenomenon. This was achieved by utilising multiple cases from developed and developing countries and multiple interviewees from different entities i.e. electric utilities and national energy regulators. Snowballing techniques were used until data saturation was achieved.

3.11.4 Confirmability

Confirmability was achieved by keeping an audit trail of all transcribed documents and analysis files in the ATLAS ti. Software. All steps taken and decisions made in the research process have been clearly explained, from establishing the research question in Chapter 1 to the design criteria and data analysis (Morse, 2015). In addition, this study used triangulation of different data sources, data collection techniques, analysis procedures and interviewees as described in this chapter.

3.12 Ethical Considerations

Several ethical challenges could arise in this study. Yin (2013) and Denscombe's, (2014) guidelines on qualitative studies were followed throughout this study, and an ethics clearance certificate from the University of Witwatersrand was obtained. All interviews were conducted at the office or business premises and were scheduled in advance. To protect the participants' anonymity, video recordings were not made, and consent was obtained for voice recordings (Yin, 2013). The participants' responses and identities were protected via pseudonyms (Denscombe, 2014). The data was anonymised and consolidated when published in scholarly articles and conference publications.

The purpose of the study and how the information will be used was explained to all participants, and all participation was voluntary.

3.13 Conclusions

This method chapter described the research design and processes executed in the fieldwork. This discussion was framed regarding the interpretivist paradigm and qualitative research methods. This chapter provided an overview of the aspects that guided the research strategies and described the data collection and analysis process.

The following two chapters discuss the findings from the data collected for France and South Africa.

CHAPTER 4. WITHIN CASE ANALYSIS FRANCE

This chapter presents the findings from the qualitative analysis conducted on the Électricité de France and Commission de régulation de l'énergie datasets. The data was analysed within the context of strategy as practice, which focused on the doing aspects of strategy. The key findings are presented in a thematic manner per research question to provide detailed evidence on the themes and sub-themes that emerged from the coding process.

Verbatim quotes from the interviews illustrate the interviewees' understanding and experiences. Themes emerged through continuous examination of the constructs that occur in the data. The study did not proceed with a concern for frequency (Elliott, 2018) as the objective was to comprehensively represent the different experiences and understandings of the disruption phenomenon in different countries. Interpretation of the findings follows Saldaña (2021). By design, quotes used in this chapter were not ascribed to specific individual interviewees to circumvent reader bias in interpreting the data. In addition, this will also prevent pseudonyms from being traced back to the actual interviewees.

4.1 Document Findings

The documents included memos, company documents, national policies, regulations and website information. The document analysis pertains to research questions one, two and three.

Électricité de France reports to the *Agence des* Participations *de l'État* (APE), an agency manageing state-owned entities reporting to the Ministry of Economics and Finance (APE, 2017). The function of *Agence des Participations de l'État* is to exercise oversight on the state-owned company to ensure a return on the equity invested by the government and optimise the long-term value of assets owned by the state (APE, 2019). This oversight function is administered via shareholder compacts, strategic intent statements and corporate plans, which influence the utility's company strategy, financial sustainability and Électricité de France's role in the changing business environment. Thus, the shareholder oversight function directs how the electric utility will respond to disruptive innovations.

4.1.1 Company Strategy

The Électricité de France strategy termed CAP 2030 underpins the company's ambition to build a net zero energy future with electricity, innovative solutions and services to help save the planet and drive well-being and economic development (EDF, 2021b). The company has three strategic focus areas in order to decarbonise its operations and grow:

i. Creating services and solutions to support customers in the shift towards carbon neutrality;

ii. Globally leading in the generation of carbon dioxide-neutral electricity;

iii. An international key player in the energy transition

The company's commitments to transformation support these strategic priorities, corporate social responsibility and the implementation of four plans. These plans included the launching of i) an electric mobility plan to secure 30% of market share by 2023 in the supply of electricity for electric vehicles in France, United Kingdom, Belgium and Italy; ii) a storage plan to develop 10 GW of new storage facilities in the world by 2035; iii) a solar plan to lead in solar photovoltaics capturing 30 % market share in France and; iv) the plan to be a global leader in the nuclear industry by providing the highest standards of quality and excellence in the performance of plants and building of new superior plants.

Électricité de France's innovation activities included the i) commissioning of 50 MW of batteries to decarbonise Oxford, ii) inauguration of the first hydrogen production and distribution plant in France, and iii) development of a 240 MW hybrid floating solar project in Lago.

Overall, Électricité de France's company strategy indicates that their strategic approach to disruptive innovations includes (i) continued investment into the existing nuclear business whilst simultaneously (ii) adopting disruptive innovations such as e-mobility, solar photovoltaics and energy storage solutions and (iii) investing in continuous innovation. The strategy also indicates a business model change and expansion into international markets.

4.1.2 Company Structure

The Électricité de France group is structured into 21 subsidiaries with businesses in France and international countries. These entities enable the utility to respond to threats and opportunities from disruptive innovations. For example, the subsidiaries EDF Renouvelables, Citelum, Dalkia, Sowee, IZI Solutions and EDF ENRS sell products and services related to disruptive innovations such as solar photovoltaic systems, battery technologies, energy efficiency devices, electric vehicle charging and wind turbines. This company structure highlights that the utility is ambidextrous, i.e. simultaneously exploiting the current business whilst exploring new opportunities by creating parallel structures. The percentages in Figure 6 indicate the ownership of Électricité de France in each subsidiary, illustrating partnerships or alliances with other entities.

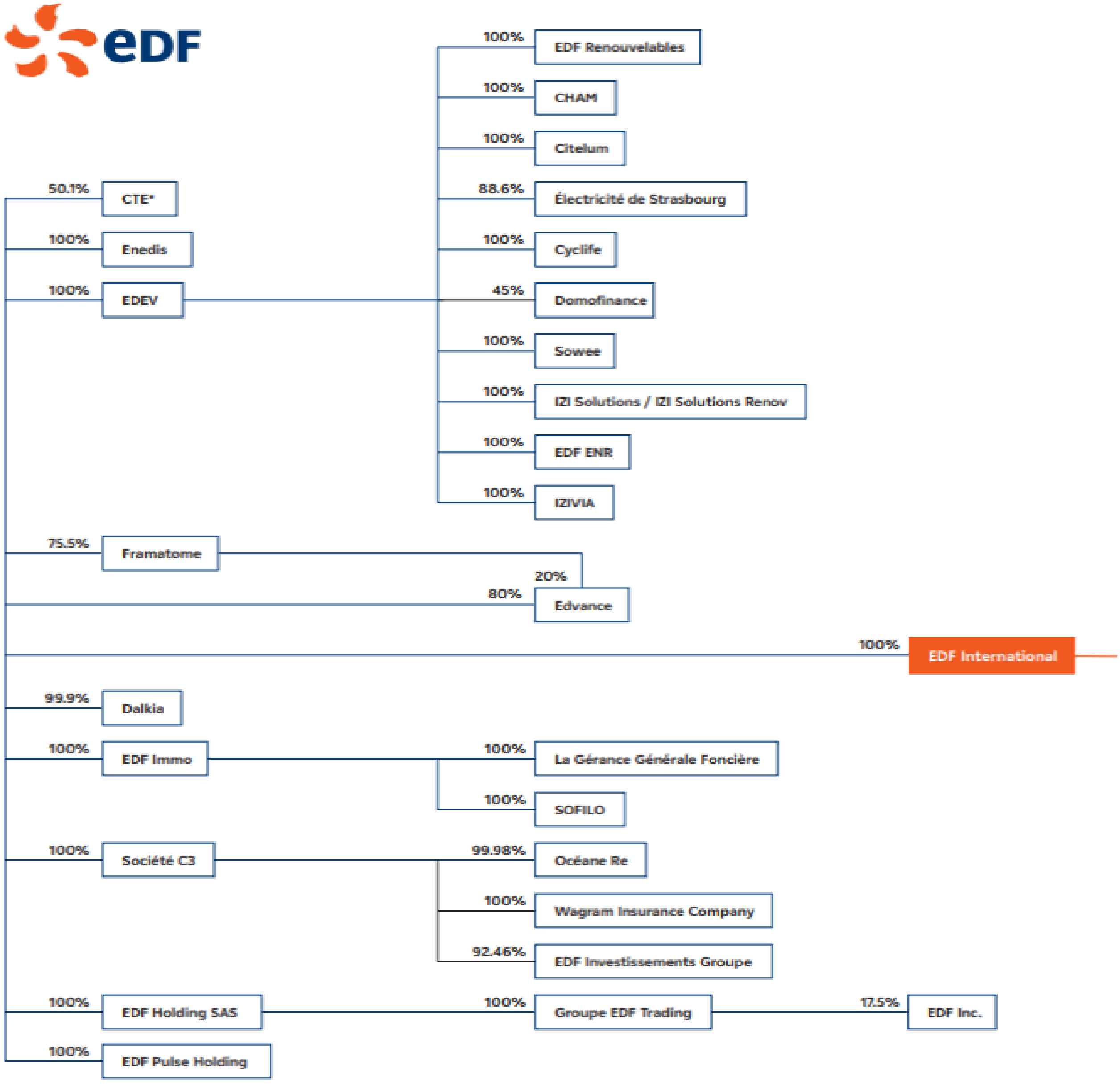

Figure 6: Subsidiaries of the Électricité de France group

Électricité de France, in the year 2000, acquired 35% of Société Internationale d'Investissements Financiers – Énergies (SIIF Énergies), which was founded by Pâris Mouratoglou, to produce wind and solar energy solutions (Pialot, 2016). In 2002, Électricité de France acquired 50% of SIIF Énergies, renaming the company EDF Energies Nouvelles, and in 2011, it acquired 100% of EDF Energies Nouvelles. In

2018, the company name was changed to EDF *Renouvelables* (Renewables in English), emphasising a repositioning and differentiation of the subsidiary within its current market (EDF, 2018b). This timeline of investment into disruptive innovations related to renewable energy showed that mergers and acquisitions had occurred over time in the industry.

The executive committee centrally manages the Électricité de France Group through divisions of the parent company reporting to the executive committee or via subsidiaries that an executive committee member directly manages. This central executive management approach, with executives having dual management roles, allows for organisational ambidexterity as the executive team can manage existing business operations and activities related to exploration via subsidiaries. For example, the Renewable Energy Division in the parent company and the subsidiary, EDF Renouvelables, report to Mr Bruno Bensasson, who is the group senior executive vice-president for renewable energy in the organisation as well as the chairman and chief executive officer of EDF Renouvelables (EDF, 2020a). The Renewable Energy Division is, amongst others, responsible for the operations related to existing hydro plants, whilst EDF Renouvelables explores renewable energy solutions in new geographic locations.

In June 2017, Électricité de France created a new department within the Innovation and Strategy Division called EDF New Business to act as a start-up incubator. Later, in October 2018, the EDF New Business department was structured as a division and renamed EDF Pulse Croissance to create new growth drivers for the Group by providing innovative and competitive products and services to households, businesses and local authorities (EDF, 2019). EDF Pulse Croissance is a corporate venture entity and an intrapreneurial project incubator that works closely with Électricité de France's Research and Development team, divisions, and subsidiaries that engage in open innovation activities and partnerships with start-ups (EDF, 2019).

The analysis of the company structure revealed that Électricité de France is an ambidextrous organisation and responds to disruptive innovations by creating subsidiaries, joint ventures, partnerships, and specialised units within the parent company for exploration. Executive committee members have dual roles, i.e., they manage both functions related to the existing business and activities related to exploration.

4.1.3 *Regulation Challenges and Profitability*

To force competition in the market, the Commission de régulation de l'énergie (CRE) regulated access to "historic nuclear energy (ARENH)", allowing alternative or independent energy suppliers to have access to almost a quarter of Électricité de France's nuclear production at a fixed price (EDF, 2021b). This regulated price was mainly below market price, which gave independent suppliers the advantage of buying nuclear power cheaply at regulated prices and reselling it to consumers. Électricité de France was exposed to a loss risk as it cost more to produce the power.

Electricity sales amounted to €84,461 million in 2021, up by €15,430 million from 2020. The financial result 2021 was a financial income of €360 million, an improvement of €2,942 million compared to 2020 (EDF, 2021b). However, net indebtedness grew from €42,920 million in 2020 to €42,988 million in 2021, suggesting that profitability may be eroding.

Because disruptive innovations are restricted from entering a monopolistic market, the regulator enables competition by controlling the price at which the utility sells electricity to independent power producers. While the utility remains profitable now, its financial sustainability may be eroding due to growing debt.

4.2 RQ1: How are state-owned electric utilities positioned in relation to their respective market forces?

4.2.1 Électricité de France

The data for Électricité de France was analysed separately to examine emerging themes thoroughly. These findings are categorised and presented as evidence from interviews conducted.

4.2.1.1 Business Factors

(i) Shareholding

The data indicates that Électricité de France is a listed company on the stock exchange with 15% private ownership i.e. retail investor institutions and employees. Respondents elaborated that private investors are financially driven and are motivated by share prices and long-term dividends. Although the state's interest is represented by multiple ministries such as the Treasury, Ecological Transition, Finance and the Agence des Participations de l'État (APE), the Agence des Participations de l'État (APE) is the shareholder representative. Agence des Participations de l'État are asset managers responsible for setting dividend-related policies. The shareholders engage the management team of Électricité de France in a dialogue to set goals and review performance. However, interviewees reported that there seem to be tensions between the shareholders' financial interest, alignment with the government's energy strategies, and the role of Électricité de France in supporting the changing industry.

> Executive 6: *"They don't care about the industrial aspects: shall we support the nuclear industry? If it's not good for EDF, the guy from Agence des Participations de l'État would say: "No, as a shareholder, I don't want that." In reality, that's a bit more complicated, because the nuclear industry is also a part of that".*

While Électricité de France is involved in the management of the Enerdis subsidiary (Distribution business), it is not involved in the management of Réseau de Transport d'Électricité and acts as a passive shareholder. Réseau de Transport d'Électricité is an independent network operator facilitating non-discriminatory access to the electric grid.

(ii) Profitability

The company's debt is growing due to the renewal of ageing nuclear plants, resulting in financial difficulties. Électricité de France is struggling to access investment capital. For example,

> Executive 10: *"…because the truth is EDF is short of cash. The company has a big debt, and our debt is growing. So, it is not a cash cow that funds us. We all struggle to access investment capacity, and the corporate debt is increasing".*

(iii) Strategic Direction

A minority of the interviewees believed that the role of the utility was changed to become an enabler for the changing energy system rather than monopolising the market. Most interviewees believed that the utility's role was to continue providing public or social tariffs for customers who could not afford electricity and energy services.

> Executive 5: *"We need to be the enabler of it. We know that it cannot work without a platform system, which has to be supporting all that, but will not be the centre of it anymore".*

Interviewees also indicated that the points for changing the strategic direction of the utility are related to political changes.

> Executive 6: *"I can identify what the switching point is, what I can say I will take that path, I know that path. A lot of the switching points are political switching points".*

The data indicates that the electric utility follows instructions from the state concerning electricity plans for the country and policy changes. The state's mandate influences the company's strategy and the state's direction is driven by election mandates.

> Executive 4: *"The state is driven by the elections, you know, so it depends on who is running the state and its mandate".*

Respondents also communicated that although the state focused on driving financial gains in the electric utility, it does not favour the retrenchment of employees.

> Executive 6: *"There's never been any layoff, dry layoff. The older ones you can offer pre-retirement schemes, you stop hiring young ones when you see a bit ahead and for the other ones, you offer them jobs somewhere else".*

The decommissioning of nuclear and coal plants to enable more integration of renewable energy is viewed as a political problem by executives because the loss of jobs would become a national problem for the ruling party.

The data revealed uncertainty in the strategic direction that the utility needs to take as decommissioning dates for the nuclear and coal fleet have not been confirmed by the state.

> Executive 5: *“we don’t know exactly when we are shutting down our coal plants in France, because it depends on how we are negotiating with the French government on coal, which is not done”.*

In conclusion, the multiple shareholding model and the state utility's dual commercial and developmental role cause tensions. This conflict seems to cause confusion about the company's strategic direction, i.e., how the state-owned utility should respond to disruptive innovations and when the state-owned utility should respond.

Disruptive innovations have resulted in business model changes as the monopolistic utility no longer controls its transmission business, and the transmission business processes have evolved to facilitate the entry of independent power producers. Disruptive innovations have also stimulated the separation of the vertically integrated utility model, resulting in new subsidiaries for generation, transmission and distribution businesses. Hence, disruptive innovations have caused structural changes in the electricity industry.

The utility's debt is growing, which affects the company's financial sustainability and the company's ability to raise capital for its business growth.

4.2.1.2 State factors

(i) Ownership

Électricité de France owns 51% share of the electricity transmission subsidary Réseau de Transport d’Électricité and 100% of Enerdis the distribution company.

Some interviewees indicated that competitors perceive monopolistic ownership as dangerous and raise suspicion that the state-owned company may influence prices that favour them.

(ii) Industry Role

The data indicated that the state is responsible for providing public services and ensuring universal access to electricity and energy services. Interviewees expressed that it is the state's responsibility to find a solution for poor customers who cannot afford electricity. The data showed that the French state had established instruments such as issuing cheques for poor customers to pay for their electricity and heating requirements.

> Executive 10: *"I would say independently from EDF established a cheque mechanism, so it is checked that you can ask them to pay your electricity bills if your revenues are lower than x…And they send cheques by post to the poorest people that have been identified by the welfare civil servants among our customer base".*

(iii) Preferential treatment

Six out of the ten executives confirmed that Électricité de France is a monopolised national asset, thus having the ability to raise capital easily due to this ownership.

> Executive 5*: "We are one of the biggest. We are able to go to the banks and get money at any time".*

In addition, two interviewees communicated that due to the utility's superior technical abilities and engineering reputation, Électricité de France is afforded contractual privileges.

> Executive 2*: "Sometimes it's the government which can come to us. The government of the [country], came to see us five years ago and said: "We need technical assistance… they call us to answer to a project, but sometimes they don't' call us, but we are aware of the tenders. We are privileged on some websites".*

The data also revealed that the utility has some ability to influence regulation as it is a state-owned entity.

> Executive 6: *"So the main problem is to monitor the regulatory framework, because you can have an influence on the regulatory framework. It's not a fully controllable matter, but it's a partially controllable matter".*

To sum up, disruptive innovations have changed the role of the state utility in the industry and this in turn changed the utility's business model. The role of the state utility is transforming only to serve the needs of indigent households as other customer segments begin to self-generate electricity. The state-owned utility receives preferential treatment in the market as it has easy access to capital because it is a state monopoly, and the utility can influence regulation to some extent to protect its interests.

4.2.1.3 Market factors

(i) Monopolistic market

Électricité de France retains 80% of the market. The utility has a strong brand presence and enjoys exclusivity rights, making it difficult for competitors. Électricité de France has exclusive rights to sell electricity to customers at both the public tariff and market price, whilst competitors can only offer the market price to customers.

> Executive 9: "…*if you want to go to the public tariff, you have to go with EDF. So, we have maybe 20 million customers with the public tariff and with those customers we have the monopoly".*

Électricité de France, via its subsidiary Enerdis, has also monopolised the distribution system operator services as there are no other regional distribution system operators.

> Executive 10: "…*this is the old business, but old business is also DSO and retail. And DSO is very huge, because it's national. There are no regional distribution companies, it's a national monopoly that is owned by Enedis".*

In summary, the current competitive market in France is unfair to new entrants. The monopolistic utility has built a strong brand presence over the years and is allocated exclusivity rights by the regulator to sell electricity at public tariffs, which are cheaper than market prices.

(ii) Competition

Competition was forced into the French electricity market by allowing independent power producers to buy from the market and resell as described by Executive 3:

> *"And the sellers of energy: if they don't generate energy they buy electricity on the market and then they sell the electricity to customers and to force the competition, as EDF had the monopoly".*

Four out of ten interviewees reported that the utility will not be allowed to retain 90% of the market as it goes against the European Energy Policy, which requires the establishment of a competitive market. The dataset indicates fierce competition in all market customer segments, and most interviewees stated that the utility is losing 100,000 customers each month due to competition. Executives conveyed that there are more than 20 competitors in the market for electricity generation and 40 companies for selling electricity. The biggest competitor was perceived to be Energie, which is 30% state-owned. The data revealed rivalry between Engie and Électricité de France for electricity products and heating solutions. Other significant competitors were Exxon, Iberdrola, Total Direct Energy, Enel, Gazxprom, Leclerc Supermarket, Europoen Utilities, and the minor competitors included consumers with rooftop pv.

> Executive 3: "*So, for generation there is EDF and Engie and there are minor actors, which are some customers with PV on their roofs and there are a lot of customers with PV on their roofs: I think there are more than 300 000 customers with that in France".*

However, some respondents indicated that competition is increasing due to consumers becoming electricity producers and a large number of electricity suppliers because renewable energy plants are cheaper to build than coal plants. For example,

> Executive 4: *"Competition is also increasing, because many people can be producers, IPPs, … you are able to build a coal station or a gas station, it's a 500 million investment. Which is now close to 5 million euros. So this is something that many, many people can do".*

The dataset indicated that there is also competition between nuclear and renewable energy technologies as the cost of renewable technologies is decreasing.

Électricité de France perceived that the competition being imposed on the utility is unfair as competitors are allowed to buy electricity on the market cheaper than the regulated tariffs and believed this to be non-commercial. The utility reported that this is resulting in the loss of its market share.

> Executive 5: "…*we are selling electricity to our customers, to our competitors, if they cannot find electricity cheaper than 42. We are losing any time. This is unfair. We know it. The regulation is unfair. So end-users are leaving EDF because of the prices of our competitors that was on the market two years ago".*

Most executives expressed that whilst there is a competitive market, Électricité de France still has a public service responsibility and, due to being a monopoly, has more poor customers than competitors. Competitors avoid poor consumers as they consume small volumes of electricity and are likely to default on payment.

> *Executive 6 explained* "*We are the bigger, so we have more poor customers. And our competitors, they try to avoid having poor customers, because with poor customers you usually have small consumptions and the other one is, you are more likely to have a payment problem*".

Some interviewees expressed that previously, the utility believed that government was their key customer, but since competition was introduced into the market, this has changed to the end consumer, who is ultimately the one paying for electricity.

> Executive 1*: "In fact our real customer was the state, and now we have to keep a very tight connection with the market and with the different kind of expectations*".

In summary, the state-owned electric utility is losing market share and facing fierce competition from disruptive innovations. A competitive environment has refocused the utility to value the end customer paying for services. The utility will face revenue challenges due to its public service responsibility to provide services to poor customers. Indigent households do not consume large volumes of electricity and are likely to default in payment.

(iii) Customers

The data indicated that consumers are becoming more aware of what they are buying and want green energy or products with low emissions such as renewable energy.

> Executive 1 explained: *"many users will switch from oil and gas to electricity just to be able to lower carbon emission".*

Interviewees elaborated that customer behaviour is changing as customers want to be more energy efficient, be informed about their consumption and source of electricity, self-produce electricity, and trade directly with their neighbours.

The data showed that the utility's relationships with the customer is likely to changein the future due to the deployment of smart meters. The smart meters have enabled the grid to become smarter and more dynamic.

> Executive 8: "*Customer relationships going to change, grid is changing- smart meters have been implemented. Everything is going to change".*

The data also showed that consumers expect the utility to care for its customers, pay cheap electricity prices, and be served with reliable electricity.

In summary, disruptive innovations change customer behaviour by providing more information such as energy consumption patterns. This information, in turn, has caused consumers to become more energy efficient. Disruptive innovations have the ability to change trading behaviours which could cause customers to reduce their dependence on supply from the utility.

The utility is also utilising disruptive innovations such as smart meters to improve the efficiencies of its existing wires business.

(iv) Business model innovation

The dataset showed that the market is changing quickly with new ways of producing, distributing and trading electricity and has evolved from centralised to decentralised electricity generation. There are alternative products in the market, such as batteries, solar photovoltaics, and wind farms. Customers are now prosumers and want to trade directly with entities.

There are new business models from retailers to create more value for consumers, such as supermarkets promising low electricity prices by combining grocery discounts with electricity purchases.

> Executive 3 explained*: “Leclerc is a supermarket, a big one. So, they entered into the market two months ago. I think that they promised a 20% discount and Leclerc’s sector is to have the lowest price every time on every product”.*

The data also indicated that beyond selling electricity, Électricité de France has extended its offerings to energy efficiency services, natural gas and products for energy storage.

> Executive 1 said that*: “We are also purchasing energy efficiency services. It is one of our business line. So we are assuming that our business should evolve from (sending) selling energy to sparing energy”.*

Overall, disruptive innovations provide alternatives in the market, resulting in new ways of producing, distributing and trading electricity. Customers have transitioned to become prosumers. Retailers have established new business models to create more value for consumers. The utility’s business model has transformed from only providing grid electricity to offering new services and products such as energy efficiency, natural gas and energy storage.

(v) Mergers and acquisitions

Mergers and acquisitions have occurred in the energy industry, such as creating the 23% state-owned entity Engie, formerly known as GFD Suez. Engie is also a major competitor in the electricity market, providing electricity generation and distribution, natural gas, nuclear energy, and renewable energy. Engie had acquired subsidiaries for wind energy and solar photovoltaics. Électricité de France initially started investing in wind energy as a joint venture with SIIF Energies but later bought out all shares owned by SIIF Energies. For example,

> Executive 4: “*It started more than 15 years ago, a joint venture between EDF and the founder of EDF Renewables. It was a joint venture. EDF was willing to explore renewables at a time when the market was very tiny and the founder of EDF Renewables was keen to find a strong partner to have the means to grow and develop the business or the joint venture between the two. EDF initially acquired a 35% stake in EDF Renewable and then up to 50%; today, it’s 100%*.

Thus, disruptive innovations are causing mergers and acquisitions in the market, resulting in the industry's transformation.

(vi) Policy and Regulation

The data finds a dispute in the market due to using the historical customer database that Électricité de France has acquired through its monopoly. The contention is that the data would allow electricity sellers to make new offers to consumers and cherry-pick the best customers, enhancing their competitiveness. The regulations allow Électricité de France to use this data only for consumers purchasing electricity under regulated tariffs and not for businesses developing outside of regulated tariffs. However, the market still suspects the utility of using the dataset's advantage or old monopoly to develop new businesses.

> Executive 6: *"We cannot use the means of the old monopoly to develop a business, because the competitors don't have the same means, they don't have the history"*.

Another contentious issue is cost-reflective tariffs. Interviewees reported that the Minister of Energy in the interest of poor consumers, reduced the regulated price of electricity i.e., tariffs, to make electricity prices more affordable. Whilst competitors are disgruntled as these regulated prices are too low and they cannot compete, the utility is resentful because it cannot recover the cost of producing electricity, resulting in financial losses.

> Executive 10: "*Very often what happens is that the Energy Minster doesn't apply the law. The way they choose to cater for the poor people, is that they ask EDF to help save on their electricity bills by dropping the tariff.*

Consumers were incentivised to install rooftop solar PV to drive the country's clean energy policy targets. However, the utility was forced to buy electricity produced from prosumers at four times the price that Électricité de France sells to them. The utility perceived this unfair and reported that this regulation resulted in financial losses.

The data shows that a clean energy tax had been established in the industry as a funding instrument to subsidise poor customers. Cheques are given to poor people; however, interviewees viewed this as a complicated management system.

Some interviewees expressed that the unbundling of the utility into separate subsidiaries for the generation, transmission and distribution of electricity had resulted in silos and a fragmented way of viewing the customer i.e. the customer is viewed from a supply perspective or a seen as a buyer of electricity. Opportunities for retaining customers are lost in this market design.

> Executive 3: **"***You create silo. And so people work for transmission, go work for distribution, but you forget that you work for the network in general".*

In general, disruptive innovations are causing a reregulation of the electricity industry. The new regulations create artificial competition to allow independent power producers to participate in the market by forcing the utility to sell electricity to these new entrants at lower costs than market prices. New regulations are causing tensions in the market. The utility is losing market share to new entrants and money by selling electricity below the cost of production, which is not financially sustainable. Independent power producers perceive the new regulations as unfair, as the utility can retain historical customer data, which could be used for business development. Tariffs issued by the regulator are not cost-reflective to protect customers who cannot afford market prices. However, if the utility cannot recover the costs to produce electricity, then this results in financial losses and new entrants cannot compete when the regulated prices are lower than the market price. A new tax levy had been introduced to fund indigent consumers.

Disruptive innovations such as rooftop solar photovoltaics are being incentivised for increased diffusion into the market, leading to financial losses for the utility.

4.2.1.4 Disruptive Innovations

The categories below present the innovations that the interviewees perceived to be disruptive.

(i) Digital technologies

The data revealed that the evolution of information technologies, blockchain, artificial intelligence, cloud computing, smartphones, digitalisation, the Internet of Things, smart grid and cyber security were disruptive innovations. For example,

> Executive 6: ***"****If you go to the IT, there's the devilish triad, I call it. That's AI, plus block chain, plus IOT".*

(ii) Renewable energy technologies

Renewable energy technologies such as solar photovoltaics, wind farms, green hydrogen and electric vehicles were seen as disruptive innovations.

> Executive 5 **"***PV is certainly the most interesting, because PV cost is disruptive".*

(iii) Business model innovation

Interviewees highlighted that new business models, such as prosumerism, were disruptive to the utility.

> *Executive 4* **"***…And this also opens new ways of producing electicity, that is centralised and decentralised. Customers are consumers now. That's something that is also a big new theme."*

(iv) Interconnected power generation technologies

Two out of ten interviewees highlighted that microgrids could be disruptive to the utility. Interviews believed that smaller grids, either independent of the national power grid or connected to the national grid only for backup supply, would cause a revenue reduction to the power utility.

> Executive 3: ***"****For Distribution I would say microgrid. For Transmission, microgrid as well".*

(v) Energy storage applications

Interviewees indicated that energy storage innovations such as batteries for large-scale and small-scale uses beyond the meter solutions and vehicle-to-grid applications are disruptive to the utility business.

> Executive 9: *"When storage at a large scale will come it will be maybe the disruption of the century for the electricity market. But we don't know when it is going to come, but we know that it's coming".*

(vi) E-mobility services

Interviewees reported that e-mobility services, such as the charging of electric vehicles and electric vehicle fleet management, were disruptive.

Executive 1: ***“**We are to develop mobility services, which means smart charging and also electric vehicle fleet management”.*

To sum up, interviewees from the electric utility perceived (i) digital technologies, (ii) renewable energy technologies, (iii) business model innovations, (iv) interconnected power generation technologies, (v) energy storage applications and (vi) e-mobility services to be disruptive to the utility. The utility appeared more aware of the potential threats from disruptive innovations but, to a lesser degree, about the opportunities.

4.2.2 National Energy Regulator of France

The findings from the interviewees conducted with Commission de régulation de l’énergie (CRE) are categorised and presented as evidence in this section.

4.2.2.1 *Business Factors*

(i) Shareholding

These are the same as the findings from interviews with Électricité de France (Section 4.2.1.1).

4.2.2.2 *State Factors*

(i) Ownership

These are the same as the findings from interviews with Électricité de France (Section 4.2.1.2).

(ii) Industry Role

The National Energy Regulator reported that it is not the responsibility of the state utility to ensure access to modern electricity and energy services to people and to protect customers who cannot afford electricity. For example;

France_CRE1: *“But regarding customer protection and ensuring that everybody has access to the grid, it’s definitely not a mission of the utility”.*

Overall, state-owned electric utilities should primarily be positioned for competition and commercial viability, not for the achievement of the state's developmental goals.

4.2.2.3 Market Factors

(i) Policy and Regulation

The data confirms that the Commission de régulation de l'énergie (CRE) is responsible for setting tariffs related to network charges and electricity prices, ensuring non-discriminatory access to the grid and fair treatment of producers and retailers in the market.

In addition, the dataset indicates that there are parallel markets whereby consumers can choose either a regulated price/tariff for electricity or a competitive price from retailers.

> France_CRE2: *"…people who did not change their energy supplier, they still pay this, they are still using these tariffs. But they can go and see another, and sign an agreement with any other energy supplier and sometimes get a discount on price".*

The interviewees also reported that renewable energy is more expensive than nuclear and coal energy, and incentives are required to drive these technologies into the market to achieve the country's energy targets.

The interviewees did not discuss challenges pertaining to regulation and forced competition in the market.

In addition, the data confirmed that government support is available for customers who cannot afford electricity.

To sum up, the emergence of disruptive innovations has created parallel markets in the electricity industry (unregulated and regulated) to enable consumer choice. Disruptive innovations require incentives to allow market penetration in monopolistic markets.

(ii) Competition

The data confirms that there is fierce competition in the market, with more than 40 suppliers of electricity, 148 distribution system operators and many retailers.

> France_CRE1: *"So you have EDF, but you also have 40 French suppliers in the retail market".*

(iii) Structural reforms

Although the French electricity market had been liberalised to allow independent participants into the supply and retail markets, the market is still monopolised by Électricité de France. While there are 148 distribution system operators in France, Enerdis, which Électricité de France owns, is the leading distribution system operator, manageing 95% of the distribution network. In addition, Électricité de France owns 51% of Réseau de Transport d'Électricité which manages and operates the transmission network.

> *France_CRE1: "Enedis, because it's the main DSO in France. But we have 148 DSOs, so Enedis is the main DSO and you have what we call local power suppliers, which were created after the Second World War. But some of our local and public services like Enedis covers French territory at 95%".*

Therefore, disruptive innovations in the energy industry have resulted in structural reforms of the electricity sector. This is evidenced by the introduction of independent power suppliers and retailers, which changes the market structure and the legal separation of Électricité de France into subsidiaries for generation, transmission and distribution of electricity. Enerdis and Réseau de Transport d'Électricité were created as new subsidiaries for distribution and transmission of electricity. The state-ownership of the transmission business has also changed to 51%, allowing for private participation in the transmission sector, thereby indicating a structural transformation.

4.2.2.4 Technology Factors

(i) Renewable energy technologies

Interviewees discussed alternative products in the market such as solar rooftop photovoltaics and electric vehicles; however, the uptake for solar photovoltaics is not high as grid electricity prices are still cheaper and consumers are not going entirely off the grid due to the cheape prices. There is a high uptake for electric vehicles as the government has implemented taxes for diesel and petrol vehicles.

> France_CRE3: *"I would say in France its pretty cheap to be connected to the grid and therefore they have no economic interest to be disconnected".*

In conclusion, there are new disruptive innovations in the electricity market, which is providing alternative forms of energy generation and reducing the customer's reliance on the state utility for the provision of electricity. The government implements taxes for fossil-based products, stimulating the uptake of disruptive innovations such as electric vehicles and solar photovoltaics.

(ii) Energy storage technologies

Although the interviewees acknowledged that batteries could be disruptive to the industry as some consumers are installing batteries together with solar photovoltaics, they believed that this technology is currently expensive and may only have an impact on the utility business model in the long term.

> France_CRE3: "*For the moment we don't see any short-term or mid-term change in the… I would say, people who are putting PV on their roofs and some batteries, they are staying connected to the grid".*

As more consumers adopt this technology, disruptive innovations such as energy storage technologies will impact the business model and operating model of electric utilities. Disruptive innovations such as solar photovoltaics and battery energy storage combine to create further customer value. This becomes a bigger threat for the utility as it allows the customer to go completely off-grid, reducing the customer's dependency on the state utility for the electricity supply.

(iii) Adaptation of technology

Electrical networks are changing as they need to be adapted to integrate innovations such as renewable energy into the grid. Networks need to be more flexible to enable the integration of new forms of energy generation technologies onto the grid.

France_CRE1 *“you have very big powerlines between conception zone area and nuclear powerplants, but there is some challenge to adapt the networks in order to store renewable capacity”.*

Thus, disruptive innovations are changing the role of the state utility as the electric utility needs to adapt its current operating models and assets, such as network infrastructure, to facilitate the diffusion of disruptive innovations into the market. The regulator perceived the following innovations to be disruptive to the industry, firstly, renewable energy technologies and secondly, energy storage technologies.

4.2.3 Conclusion to the Responses to Research Question 1

Disruptive innovations are restricted in a monopolistic electricity market and allowed under tight conditions to control competition. Disruptive innovations are being incentivised to stimulate uptake in the market; hence, the utility faces fierce competition, resulting in market share and financial losses. These innovations are causing changes in customer and trading behaviour, resulting in customers using less grid electricity. The monopolistic utility needs to simultaneously adapt its current business to facilitate the diffusion of disruptive innovations into the market and compete to stay financially sustainable and relevant to the customer.

The dual commercial and development role of the state-owned utility and the public-state shareholding model causes tensions for the company's strategic direction.

The electricity market appears to lack fairness and transparency. The state-owned electric utility enjoys preferential treatment as it has easy access to capital due its status as a state monopoly and the ability to influence regulation. Electric utilities have been given exclusive rights to sell electricity at public tariffs lower than market prices. The regulation permits exclusive access to the historic customer database.

The utility identified the following innovations to be disruptive in the electricity market viz. i) Digital technologies; ii) Renewable energy technologies; iii) business model innovations; iv) interconnected power generation;(v) energy storage applications; and (vi) e-mobility services. The regulator perceived renewable energy technologies and energy storage technologies to be disruptive. Disruptive innovations, such as solar photovoltaics and energy storage technologies, combine to create more significant threats to the incumbent, which could enable the consumer to go off grid and no longer require electricity from the state utility.

Disruptive innovations have caused **business model changes** in the electricity sector by providing new ways to produce, trade and distribute electricity. Consumers have evolved to prosumers. Retailers and electricity utilities have changed their product offerings to create more value for consumers.

Disruptive innovations have caused **industry changes** via mergers and acquisitions, fierce competition, regulatory reforms on trading, pricing of electricity, and introduced parallel markets (regulated and unregulated prices) and structural reforms in the market.

The utility needs to adapt its current business model, operating model and assets to facilitate the diffusion of disruptive innovations into the industry.

A monopolistic utility influences the nature of disruptive innovations in a regulated electricity market in the following ways:

i. Strong brand presence of the incumbent.
ii. Controlled competition.
iii. Incentives and taxes are required to drive uptake in the market.
iv. The ability of the incumbent to influence regulation.

4.3 RQ2: What are the general strategic approaches among state-owned electric utilities?

The dataset for Électricité de France was analysed to investigate how the utility responds to disruptive innovations.

4.3.1 Strategic approaches by state utility

The categories and subcategories for the strategic approaches are described in this section.

4.3.1.1 No action

(i) Wait and see

Generally, the utility was reactive, responding to disruptive innovations that can emerge. The utility first conducts research and builds pilots and demonstrations to understand the innovation before adopting the technology such as battery energy storage plants and a wind farm for power generation.

> Executive 4: *"We are reactive on what we see coming and we are proactive on what we don’t see coming. Both. I mean, I think you have to be, unless you are super clever, you see everything coming then you can only be proactive. But nobody is like that, so I think you have to be both".*

Thus, the utility is reactive and will wait for disruptive innovations to reach a certain level of maturity before responding to them.

4.3.1.2 Focus on existing business

(i) Invest in existing business with sustaining innovations.

The evidence shows that Électricité de France is investing in its traditional business by developing new nuclear reactors that are safer, more efficient, powerful, and longer lasting than predecessors to strengthen its existing business. These new nuclear reactors are used to extend the plant life of existing nuclear stations by ten years as well as replace its ageing fleet for example the Flamanville 3 project, which has been in development since 2007 and is scheduled to bring 1 650 MW of new capacity to the national grid by 2024.

> Executive 3: “*We have a big project concerning fusion and we think that it could change the generation of electricity, because it’s totally more efficient to have fusion. And I think we want to have some reactors ready in 2040 or 2050”.*

The utility is also converting some coal-fired plants to utilise biomass to generate electricity, which will enable a continued use of coal plants with lower harmful pollutants such as the 1 200 MW Cordemais power plant. In addition, Électricité de France is deploying 15 million smart meters to improve network operations and billing of customers which assists in strengthening the existing business.

Therefore, electric utilities are reactive and invest in sustaining innovations to intensify competition.

4.3.1.3 Focus on new business

(i) Adopting disruptive innovations

Besides selling grid electricity generated via traditional methods, Électricité de France is adopting mature disruptive innovations and offering them as new products and services to customers such as wind energy, solar energy systems, battery energy storage, energy efficiency devices, heating and electric vehicle charging.

> Executive 1:*" We have launched battery technology company which is called Zinnium, with a new chemical solution".*

Thus, Électricité de France responds to disruptive innovations by playing two games simultaneously.

(ii) Hybrid approach

Électricité de France is adopting a hybrid approach to the wave of disruptive innovations it faces. In addition to taking no action, focusing on existing and new business, the utility is also engaging in continuous innovation activities to "attack the attacker" such as developing floating wind turbines, which could be cheaper and more efficient than onshore wind farms and solar photovoltaics panels that use lighter, cheaper, more efficient materials and cells that absorb a broader spectrum of sunlight wavelengths thus capturing more energy.

> Executive 1: *"…We provide new solution to develop renewables, in the field of wind farms. We are working on a specific research concerning a new PV technology".*

Therefore, the utility is responding to disruptive innovations using a hybrid approach. Électricité de France is investing in sustaining innovations to strengthen its traditional business by extending the life of nuclear and coal plants, adopting mature disruptive innovations and offering these as new products to the customer such as renewable energy and energy efficient devices as well as engaging in continuous innovation to fight back and retain market leadership.

4.3.1.4 Holistic approach

(i) Service innovation

The data revealed that the utility is not engaging in service innovation. Although the utility is offering new services such as energy efficiency, energy storage, finance for solar photovoltaic systems, smart charging of electric vehicles and electric vehicle fleet management in countries such as Brazil, United Kingdom, France and Belgium France, it is not new to the world and other competitors may be offering the same services.

> Executive 5 *" We intend to be the first provider of mobility services by 2030 in four countries Brazil, United Kingdom, France and Belgium".*

Hence, the electric utility is not engaging in service innovations and not adopting a more holistic approach to responding to disruptive innovations.

4.3.2 Conclusion to the Responses to Research Question 2

Overall Électricité de France is responding to disruptive innovations in the following manner: - no action i.e. will wait and see until the innovation has reached a level of maturity before responding; focusing on exiting business by investing in sustaining innovations; focusing on new business by playing two games at once, and finally, adopting an integrated approach by engaging in continuous innovation to attack back. Generally, the utility is reactive and has adopted the wait-and-see approach. The utility conducts innovations and builds pilots and demonstration projects to test and understand the maturity of the innovation before adopting the innovation for example battery energy storage, green hydrogen and wind plants.

The dataset revealed that the utility is focusing on improving its existing business to sustain competitive advantages by investing in sustaining innovations such as smart meters, developing more advanced nuclear reactors and co-firing coal stations with biomass to extend the operation of coal plants.

The electric utility is focusing on new business by playing two games at once, i.e., adopting disruptive innovation as a new product offering and simultaneously investing in its existing traditional business. Furthermore, the data showed that Électricité de France is engaging in continuous innovation such as the research and development of floating wind turbines and more efficient solar photovoltaic panels to attack back. Thus, the utility is using an integrated approach to respond to disruptive innovations, which entails simultaneously investing in its existing business, focusing on new business by playing two games at once i.e. adopting disruptive innovations as new product offerings and attacking back by engaging in continuous innovation.

However, the utility is not utilising a holistic approach to respond to disruptive innovation as it does not engage in service or business model innovation.

4.4 RQ3: What assembly of theoretical tools is available to state-owned electric utilities to strategise effectively?

4.4.1 Dynamic Capabilities

Categories and themes related to dynamic capabilities are presented in this section.

4.4.1.1 Sensing

The dataset showed that all utility divisions are monitoring the external environment to understand and anticipate changes in the market, customer behaviour, societal trends and emerging technologies. The research and innovation department continuously seeks innovations by connecting to a global innovation system and collaborating with competitors and startups to identify opportunities, threats and explore innovations. The interviewees expressed that early technologies must be screened because the potential opportunity should be understood.

> Executive 7: "*So these guys or these ladies, they're in charge to identify, look, you know, watch very deeply what is happening in the country where they are. We have one in Korea, also, for example, and in Japan. They are in charge to watch new technologies appearing and new ideas, start-ups, you know".*

To summarise, dynamic capabilities such as continuous sensing, screening, monitoring and detecting threats and opportunities in the market, changing customer behaviour and emerging technologies are essential for retaining market leadership. Exploring innovation is another important dynamic capability required to maintain competitive advantage. This entails connecting to global innovation ecosystems, collaborating with competitors and startups to develop and discover innovations.

4.4.1.2 Shaping and Seizing

The data indicates that ideas, concepts, and opportunities are shaped to maximise utility benefits and reduce risk before the utility seizes opportunities.

(i) Investing

Buying equity in several startups and investing in joint ventures, consortiums, business incubators, innovation hubs, and internal projects related to new products and services are seized opportunities. Électricité de France set up EDF Pulse Growth a department that invests in intrapreneurial projects to develop ideas into commercial products. For example, Électricité de France had invested in the i2R laboratory, a Fabrication Laboratory piloted by in-house designers. It seeks to establish a new means of research within the R&D think tank at Électricité de France to generate and materialise hypotheses anticipating future behavioural, technological, environmental and societal breakthroughs in the energy sector.

> Executive 10: *"Our investment directors and looking for many, many new opportunities and new projects and new start-ups to invest in. And to do*

that we have to find solutions also find the projects and the business that we want to invest in".

Therefore, the ability to seize opportunities by making investments is a dynamic capability. Investments can be made through buying equity in several startups, joint ventures, consortiums, business incubators, innovation hubs and internal projects pertaining to new products and services.

(ii) Innovation

The data showed that the utility is engaged in exploration, experimentation, research and development activities resulting in patents. The utility has more than 2 000 patents and some of which are protected and commercialised.

> Executive 7: "We *have patents for this because it's strategic for our assets and business".*

Hence innovation capabilities such as the exploitation of patents by developing, protecting and commercialising them is a dynamic capability.

(iii) Risk-taking

Thirty percent of the interviewees expressed that part of winning is the ability to take risk through investment in early stages of technology development or early adoption of new technologies which later prevents expensive buy out of companies and allows for early detection of opportunities. Interviewees also expressed that risk-taking could be shared via consortiums and partnerships.

> Executive 10 *" What we are trying to do is to detect these opportunities earlier and to have EDF accept to take more risk, going into these businesses at very early stages, but with small ticket"*

Électricité de France partnered with Idinvest a private equity and asset management firm and launched a dedicated venture capital entity called Electronova Capital, which funds start-ups specialising in innovative technologies.

Overall, the dataset indicated that risk-taking is a dynamic capability required to sustain competitive advatage. Risk taking could be done by adopting emerging technologies early or investing in early stages of technology development. Risk-taking can be shared via partnership structures such as consortiums and joint ventures.

(iv) *Agility*

Although some executives recognised that it was important for the company to be agile to respond to changes in the business environment, no evidence was adduced that the utility was agile.

> *Executive 1 "So we are trying to look very far and we are also trying to be more agile… But that is a big question, how to become more agile, when you are a large company with large divisions, and a galaxy of small companies".*

Hence, agility is an important dynamic capability required to respond in rapidly changing environments.

4.4.1.3 Transforming

(i) Human resources

The utility is adapting and transitioning by enhancing the skills of existing staff as well as building new capabilities and skills via training and development for example in data analytics, entrepreneurism, renewable energy and battery energy storage. New skills are being acquired via buy out and partnering with startups such as Pivot Power a start up for battery energy and electric vehicle infrastructure. Investing in new subsidiaries such as IZIVIA also requires new skills. IZIVIA specialises in applications for charging stations of electric vehicles e.g. charging cards, supply and installation of charging stations, maintenance and management of fleet charging stations.

The utility is reconfiguring the business by redeploying staff to new projects and new growth areas of the business as well as hiring new people with different skills sets to the existing business such as renewable energy, e-mobility services and data analytics. Early retirement packages have been offered to staff to reduce head count and enable external recruitment of different skill sets.

> Executive 5: "*we are spending more than 6% to 7% to our former turnover in internships and we are helping our people to move. We already shut down coal plants, gas plants, oil plants. We withdrew from the one river".*

In summary, reconfiguration and replenishment of skills are dynamic capabilities required to adapt to turbulent business environments. New skills and capability need to be built within the organisation whilst existing skills can be enhanced to transform the business to a desired state. Investment in subsidiaries offering new products and services can also be a way to acquire new skills. In addition, people with new skill sets can be hired or staff can be redeployed to new business growth areas. Processes such as early retirement packages can be used to replenish the business with new skills as old skills become obsolete.

(ii) Organisation structure

The organisation structure is being transformed as subsidiaries are being established to offer new products and services such as IZI Solutions that offer home installations for electric vehicle charging, heat pumps and insulation applications, Sowee for energy management services and Electronova Capital a venture fund.

> Executive 3: "*So, in France we have EDF Renouvelables which is a subsidiary of EDF and they work in France and they work internationally".*

The organisation structure is also being transformed by creating specialised units within the parent company for growth and exploration. A new growth department EDF Pulse Croissance was created within the Innovation and Strategy Division for the creation of new growth opportunities (discussed in Section 4.1.2) and a new energy storage unit was set up to investigate new product offerings.

Therefore, reconfiguring organisational structure is a dynamic capability essential to maintaining leadership in rapidly changing environments. New structures need to be created for growth and exploration such as subsidiaries or specialised units within the parent company to offer new products and services.

(iii) Assets

Existing assets are being modified to support the country's transition to cleaner energy usage. For example, nuclear reactor designs are being modified to increase the flexibility of the nuclear plant to be able to ramp down during periods of high renewable energy penetration on the grid and quickly ramp up when there is limited renewable energy available. This advancement in nuclear reactors will enable greater shares of renewable energy to be connected to the country's power system. Coal fired plants are being modified to cofire with biomass to reduce the use of fossil fuels thereby decreasing green-house gas emissions. Électricité de France as per its "CAP 2030" strategy is changing the asset base from 70% nuclear energy to 50% by 2030 to increase its investment in renewable energy technologies and large scale energy storage such as solar photovoltaics, wind and batteries.

Thus, the ability to reconfigure assets to respond to environmental threats and opportunities is a dynamic capability. The existing assets should be modified to offer new products and services, adapt to the state utility's changing role and strengthen competitive advantage. Assets can be retired earlier to make new investments into other assets.

(iv) Organisational processes

Électricité de France is changing internal processes such as funding allocation and innovation to enable partnerships with competitors, start-ups, manufacturers, customers and research institutes. The research and development processes have been amended to combine startup knowledge and skills with in-house expertise to accelerate innovation and growth.

> Executive 7: *"This is new for us…With Total we are a competitor,...because we are all interested in having quick progress on the PV technology so as to reduce the cost, but we cooperate together because this is research".*

The ability to quickly change internal processes to allow for transformation of the business is a dynamic capability. Processes such as funding allocation, fostering of innovation and creation of partnerships with competitors, start-ups, manufacturers, research institutes and customers transform knowledge and skills of the firm and accelerate innovation and growth.

(v) Organisational culture

The data indicates that the utility is beginning to change its organisational culture to be more entrepreneurial. This is being done through the promotion of intrapreneurship and the identification of new business opportunities. Every year the Pulse Awards, a recognition for achievement in innovation, is held to encourage cross-functional teams to compete for funds to accelerate ideas to proof of concept projects. The Innovation Department then transfers winner's concepts to the EDF Pulse Growth department for commercialisation.

> Executive 1: *"It is like an exploring lab and you are asking the people just to explore. You give them money to explore, just to say you will try to explore what should be our next business with no income expected, nothing expected but learning and exploring".*

The ability to transform organisational culture is a dynamic capability key to responding to change in the business environment. Processes promoting entrepreneurship and commercialising new products and services for the firm should be encouraged.

4.4.2 Ambidexterity

This section presents themes, categories and evidence for ambidexterity strategies from the data.

4.4.2.1 Structural separation -parallel structures

(i) Subsidiaries and joint ventures

Électricité de France is exploring new opportunities as a response to disruptive innovations via the establishment of separate parallel structures such as subsidiaries (Section 4.4.1.3) and joint venture businesses in alignment with the objectives of the company strategy.

> Executive 7: *"EDF, we have also another venture capital fund called Electranova. So Electranova is a capital venture fund that we have built in association with some financial institution …Idinvest, is the name of it".*

Électricité de France created a separate joint venture company with Masdar an energy company in Abu Dhabi to explore and collaborate on opportunities in non-utility scale renewable energy and energy efficiency applications.

Therefore, the formation of autonomous structures such as subsidiaries and joint venture companies with separate strategies, cultures and processes can be an option to explore new markets whilst exploiting current capabilities, assets and resources.

(ii) Innovation hubs

The utility has established separate to the existing business innovation hubs, business incubators and laboratories globally to explore, experiment and identify opportunities and threats from innovations. Several experts within the innovation hubs and business incubators are tasked to develop ideas and proof of concepts and establish startups or new business lines within Électricité de France to commercialise new products.

> Executive 7 *"… in addition we have approximately 20 people which are based in France or in our labs in Silicon Valley, in China, in Singapore, and so on. We have, also, even in some part of the world, even if we don't have a lab, we have one innovation guy. For example, in Russia, in Moscow, we have a company there, and we put one person there. We have also in Brazil and Japan".*

Hence creating innovation hubs, business incubators and laboratories as separate structures from the existing operational business permits exploration of new markets, new products and services and the ability to sense and shape opportunities and threats to disruptive innovations.

(iii) Specialised internal exploration business units

Électricité de France has created specialist business units for exploration and experimentation within the parent company such as the Research & Development business unit based in Sarclay which has approximately 2 000 employees. Two hundred and twenty-five employees are based outside of France to explore new markets and identify and shape threats and opportunities that may arise globally. The Research & Development teams are also focused on research and testing to improve operational performance of the existing business by investigating breakthrough technologies in hydraulics, nuclear power and the environment.

> Executive 1: *"There are more than 400 projects each year within R & D, with half of them concerning generation and half of them are concerning new services for the new businesses".*

A new business unit within the parent company, EFD Pulse Croissance, was also established to explore and commercialise new solutions (Section 4.1.2).

So, the creation of internal specialised units can also be used as a structure to strengthen competition from the current products and services whilst simultaneously discovering and shaping threats and opportunities from innovations.

4.4.2.2 Formations

(i) Intra organisational alliances

Électricité de France is exploring new opportunities via cross-collaborative teams to create new energy solutions. The skills in these teams are pooled together from different parts of the existing business to explore opportunities. For example, skills available in pumped and chemical storage are being integrated from the hydro-power plant and research business units to develop new energy storage solutions.

> Executive 7: "*We have teams from, a nuclear plant or a hydro plant or, wind farms or the commercial division and so on. They come together and prepare their innovation together*".

Thus the intra-organisational pooling of skills and resources from different business units to explore and develop innovations is a form of ambidextrous approach to switch from exploitation mode to exploration.

(ii) Inter-organisational alliances

The data indicates that the utility is able to explore via collaborations, partnerships, horizontal joint ventures and consortiums with startups, research institutions, competitors and specialised businesses. For example, Électricité de France collaborates with its competitor Total Energies on research initiatives to reduce the cost of solar photovoltaic technologies; Mcphy, a specialist business in hydrogen production, storage and distribution equipment for the generation of carbon-free hydrogen; and startups such as Masteos and Zenpark for decarbonisation energy solutions and services.

> Executive 3: *"So we partnered with companies who are manufacturing PV panels and who have designed a technical solution for customers to have a PV panel, four or five lamps, a TV and we tend to gradually bring more products to the customers".*

Therefore, inter-organisational specialisation is an ambidextrous approach that can be used to conduct activities to explore new products, services and markets.

4.4.2.3 Dynamic capabilities

Themes, categories and evidence for dynamic capability processes that enable ambidexterity in the utility is the same as the findings discussed in Section 4.4.1. Figure 7 illustrates this link. Whilst the organisation is exploiting its existing assets and capabilities the following dynamic capabilities are simultaneously being built to enable the exploration of new opportunities:

- Sensing - facilitates exploration by screening or discovering innovations, opportunities and threats to disruptive innovations
- Seizing - permits exploration through the processes of making investments and risk-taking with innovations, organisational agility and exploitation of patents that result in the creation of new products and exploration of new markets;
- Transformation activities – strategic renewal for seeking new opportunities, thereby promoting exploration through modifying organisational strategies, processes and culture.

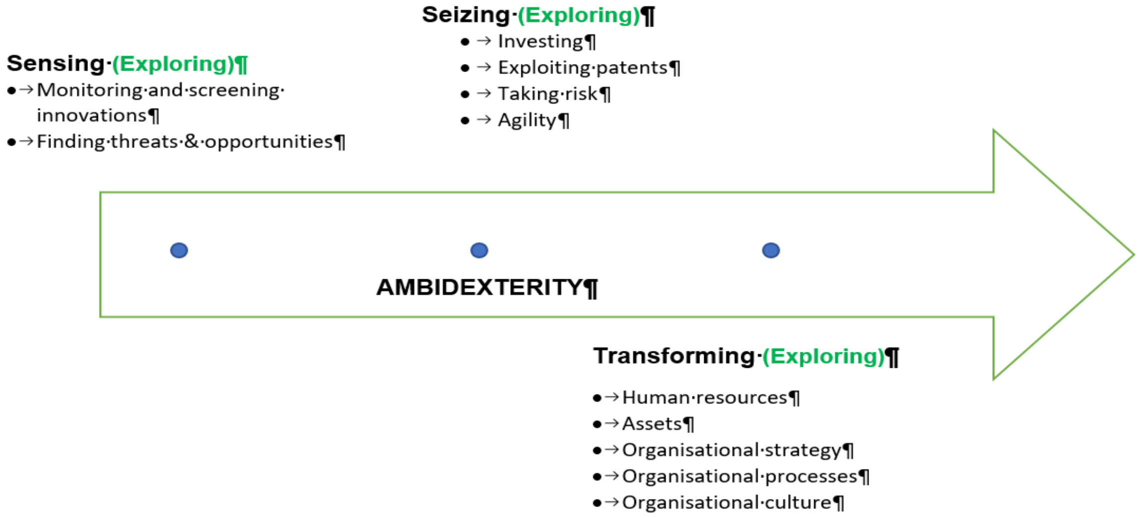

Figure 7: Dynamic capability processes that enable ambidexterity

4.4.2.4 Dual Management Roles

Électricité de France manages existing business operations and explores new opportunities by establishing dual executive management roles. For example,

> Executive 7 stated: *" the director of R&D has also been nominated to directly report to the CEO as Chief Technology Officer. So my boss has two hats – in charge of innovation, research, and development functions and also for the whole group in charge, as the CTO".*

Therefore, the Research and Development executive manages the exploration activities of the organisation as well as exploits the existing business by managing operations of the information technology business.

Hence, establishing dual management roles for executives is an ambidextrous approach.

4.4.3 Conclusion to the Responses to Research Question 3

Whilst Électricité de France is exploiting its existing business by extending the operation of coal plants, extending the life of nuclear plants (Section 4.43.1.2) and advancing nuclear reactor technologies to become more competitive, the utility is also adapting and transitioning to the turbulent business environment. Électricité de France has built the following dynamic capabilities to respond to disruptive innovations:

- Exploring - screening and monitoring emerging innovations, detecting opportunities and threats to disruptive innovations and changing customer behaviour by connecting to global innovation ecosystems and collaborating with competitors and startups.
- Shaping and seizing opportunities - investing in startups, joint ventures, consortiums, business incubators, innovation hubs and internal projects related to new products and services, and exploiting patents by developing, protecting and commercialisation of innovations and taking risk by adopting and making investment in emerging innovations.
- Transforming – reconfiguration of (i) human resources by acquiring new skills through subsidiaries, building or hiring of new people and manageing headcount levels for example offering early retirement packages, (ii) existing assets via modification to offer new products and services or early retirement of assets to make new investments into disruptive innovations, (iii) organisational structure to create new entities for growth and expansion such as subsidiaries or specialised internal units, (iv) organisational processes that change the knowledge and skillset of the firm and accelerate innovation and growth, and (v) culture to promote entrepreneurship and commercialisation of innovation.

The data indicated that the utility was not building organisational agility as a response to disruptive innovation.

In response to the fast-changing business environment, the utility is using the following ambidexterity approaches:

- Structural separation – creation of subsidiaries, joint ventures, innovation hubs and specialised business units within the parent company for exploration activities.

- Formations – intra and inter-organisational alliances to explore new products, services and markets and pooling of skills and resources to explore and develop new innovations.
- Dynamic capabilities through the building of sensing, seizing and transforming capabilities for exploration.
- Dual executive management roles whereby an executive simultaneously manages functions of the existing business as well as functions related to exploration activities.

The next chapter presents the findings from the South African case study.

CHAPTER 5. WITHIN CASE ANALYSIS: SOUTH AFRICA

This chapter discusses the findings from the qualitative analysis conducted on the Eskom and South African National Energy Regulator datasets. The data was derived from interviews and memos and analysed through the strategy as practice perspective. Through rigorous examination of the constructs in the data, themes emerged. The main findings are presented in a thematic manner per research question to provide detailed evidence on the themes and sub-themes that emerged from the coding process.

Verbatim quotes from the interviews are used to present evidence of the findings and demonstrate the interviewees' understanding. The study did not proceed with a concern for frequency (Elliott, 2018) as the focus was on understanding the phenomenon of disruptive innovations in different country settings. Interpretation of the findings follows Saldaña (2021). Pseudonyms were used when quotes were presented to protect the anonymity of the interviewees.

5.1. Document Findings

The documents included memos, company documents, national policies, regulations and website information. The document analysis pertains to all three research questions.

Eskom reports to the Department of Public Enterprises who is the shareholder representative for the South African government mandated to: i) drive socio-economic impact to enable a sustainable economy through the re-industrialisation of the South African economy, ii) provide oversight to state-owned companies, and 3) ensure sustainability of state-owned companies (DPE, 2021). The Department of Public Enterprises has mandated Eskom to lower business costs in South Africa, enable economic growth and provide stable electricity supply.

5.1.1 Company Strategy

Eskom's current financial and corruption challenges as well as poor operational performance of the generation business and frequent load shedding is no secret, so Eskom has embarked on a turnaround strategy to stabilise, optimise and grow the company over the short, medium and long-term respectively (Eskom, 2020b). The turnaround plan compromises of activities to restructure debt, move towards electricity tariffs that reflect true cost, improve revenue collection, reduce costs across the value chain, improve energy availability from coal fired stations and restructure the generation, transmission and distribution businesses into subsidiaries (Eskom, 2020a). Therefore, the utility is responding to operational and financial challenges and not to disruptive innovations or changes in the business environment.

The strategic intent objectives as set by the shareholder for the period 2020 to 2023 required Eskom to: i) provide reliable, predictable and affordable electricity; ii) ensure and maintain a financially viable and sustainable company; iii) align its socio-economic contributions to national transformation imperatives; iv) reduce the impact on the environment through the application of low carbon technologies; v) ensure the company is responsive to the demands of a dynamic energy landscape and pricing scenarios; and vi) continue to strengthen governance processes (Eskom, 2020a). This strategic intent does not explicitly focus the company to respond to disruptive innovations but rather to strengthen the existing business activities. The company's corporate strategies are then aligned to the strategic intent and does not place explicit focus on responding to disruptive innovations.

5.1.2 Company Structure

The Eskom Holdings SOC Ltd is the parent company (Figure 8) wholly owning four subsidiaries viz: 1) Eskom Enterprises SOC Ltd which comprises a collection of non-regulated businesses mandated to provide life cycle services to Eskom power stations and the electricity industry in Africa as well as operate two hydroelectric stations in Uganda, 2) Escap SOC Ltd a captive short-term insurance subsidiary, 3) Eskom Finance Company SOC Ltd established to provide home loan finance and optimise home ownership costs to Eskom and its employees, and 4) Eskom Development Foundation a non-profit company which serves as the corporate social investment arm of Eskom. Thus Eskom's structure is not ambidexterous as these subsidiaries strengthen the existing business.

Figure 8: Subsidiaries of the Eskom Holdings Group (Eskom, 2020b)

Currently Eskom is implementing a business project to legally separate the electricity generation, transmission and distribution line functions (Figure 9) into subsidiaries. This had resulted in the registration of two new subsidiaries called the National Transmission Company of South Africa SOC Ltd and the Electricity Distribution Company of Sout Africa. The National Transmission Cmpany of South Africa began trading on 1 July 2024.

The creation of new subsidiaries enables greater efficiency of the Eskom transmission, generation and distribution businesses, improves transparency of costs and operations and supports accountability of the management teams. Hence Eskom has created new subsidiaries to strengthen its current grid electricity business rather than new structures for ambidextrous activities.

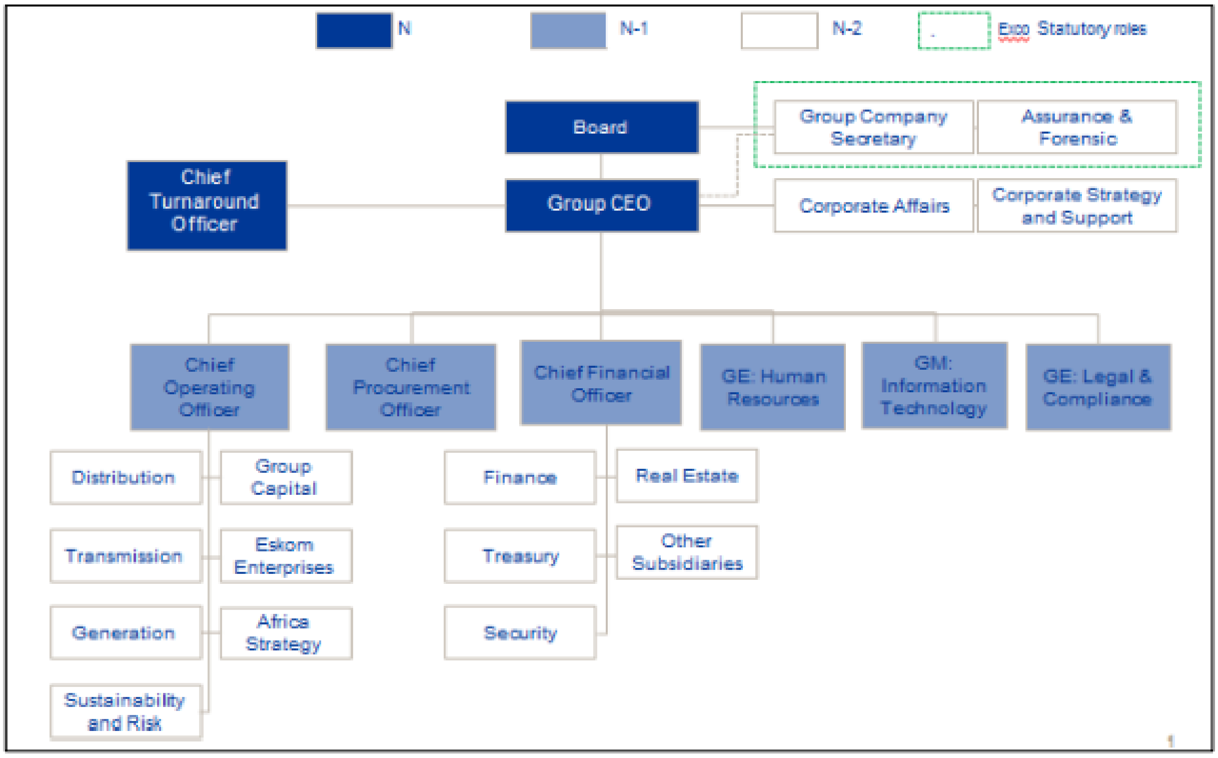

Figure 9: Organogram of Eskom Holdings SOC Ltd (Eskom, 2020a)

The Eskom Group chief executive officer manages the Eskom Holdings company via an executive committee depicted in Figure 10 as N-1. The Eskom Enterprises subsidiary reports to the Chief Operating Officer as the subsidiaries strengthen the exiting business operations. The Eskom Research, Testing & Development business unit within the Sustainability and Risk line division and the Africa Strategy business are functions that explore new opportunities for Eskom.

Thus this organogram showed that the utility engages in ambidextrous activities via specialised internal business units. A chief operations officer centrally manages all operational functions as well as the exploration activities. Therefore the executive has a dual role of managing the existing business and functions related to exploration.

5.1.3 Profitability Challenges

Over the years Eskom has been plagued by mismanagement, corruption, rapidly rising inputs costs such as coal and chemicals, cost overruns on the building of new infrastructure projects i.e., Medupi and Kusile power stations. In addition, Eskom is facing financial challenges driven by a weak balance sheet due to a high debt burden, tariff allocations that are lower-than the cost to produce and deliver electricity, declining revenues and escalating municipal debt. These factors contributed to Eskom's debt reaching R400bn in 2023 (Eskom, 2023).

In February 2023 the Minister of Finance announced a total debt relief of R254 billion to Eskom over the next three years enabling the utility to manage its liquidity position (Eskom, 2023). Thus, the utility's current business model is unsustainable.

5.2. RQ1: How are state-owned electric utilities positioned in relation to their respective market forces

5.2.1 Eskom

The data for Eskom was analysed separately to examine emerging themes thoroughly. The findings are categorised and presented as evidence from interviews concluded.

5.2.1.1 Business Factors

(i) Shareholding

The dataset confirms that the Department of Public Enterprises is the shareholder representative of government. Any dividends paid by Eskom is transferred to the National Treasury and these funds are used to develop the state.

(ii) Profitability

The data reveals that Eskom is experiencing financial and operational difficulties. The company's focus is to survive in the short term by recovering the operations from poorly performing coal-fired power stations to eliminate load shedding in the country, cutting costs, spending prudently and reducing head count. A transformation management office was created to implement and monitor cost saving and revenue generation initiatives however, interviewees expressed that little effort is put into growth from new opportunities.

Interviewees also highlighted that the shareholder over the past 10-15 years did not address financial sustainability of the company as the focus was only on the short term. It was perceived that the shareholders drove black economic empowerment policies that aimed to facilitate inclusive economic participation however this was to the detriment of the company. For example, a programme was launched by government to introduce junior black coal miners into the market however because these small mines did not have economies of scale the coal prices were higher than the incumbents in the market such as Anglo and Exarro. Eskom was forced to buy from small black-owned mines to drive government's development goals.

> Executive 7 explained: *"I don't think junior miners will work, because mining is a thing you have to do at scale and the way in which you want to do junior mining means you're going to put additional costs in the business and the business will be unsustainable as a result of it".*

In addition, executives believe that the company has entered into a death spiral as load shedding is accelerating the installation of solar photovoltaic technology for self-generation and revenues of the utility which begin to decline. The utility will then increase prices to compensate for the loss of revenue, resulting in more customers installing alternative energy solutions.

> Executive 6: *"Although you have a vision that talks about an aspiration to grow, but if you look at the short- to medium-term it really is a "just survive the death spiral".*

(iii) Strategic Direction

The data affirms that the strategic intent of Eskom is to produce low-cost electricity for economic growth, create jobs, and improve the welfare of citizens of the country. However, 60 percent of the interviewees reported that it was unclear whether Eskom should pursue opportunities outside of South Africa i.e. sale of new products and services which is beyond just import and export of electricity.

> Executive 5: *"So the issues that we're grappling with at the moment are whether we just stay in South Africa, or whether we expand out into other parts of Africa".*

Due to the company's poor financial situation, there is no long-term vision on growth, and new opportunities and resources are not allocated to pursue growth. Interviewees discussed that new government administration teams are appointed every five years after elections whilst power plant investments are made over a 50-year period. Therefore, there could be misalignment with strategic objectives.

(iv) Culture

Most interviewees reported that it is not part of the Eskom culture to embrace change and the utility's business model has not changed despite the shifts in the industry such as the arrival of alternative energy technologies and new policies permitting the procurement of energy from independent power producers.

> Executive 1: *“The organisation’s indoctrinated culture was that everything in the electricity industry belonged to Eskom, and Eskom would drive anything that belonged to the energy industry. That role has shifted from a stakeholder government stance, and from a policy stance. However, the culture within Eskom hasn’t shifted”.*

To sum up, the business factors theme indicates that state utility's dual commercial and developmental role is problematic as the shareholder had sacrificed the company's financial sustainability in pursuit of the country’s developmental goals. Therefore the trade-off between commercial and developmental goals is a balancing act. Getting it wrong can have severe repercussions for the company and country, such as load shedding. Under conditions of financial and operational challenges, the company's strategic direction is unclear on how the utility should grow or respond to threats and opportunities from disruptive innovations. A long-term strategic intent is difficult to achieve under state-ownership as a new government is elected every five years and there may be changes in the strategic direction from the new administration of the country.

The culture of a state utility is slow to adapt and lacks agility to respond to disruptive innovations.

5.2.1.2 State Factors

(i) Ownership

The data confirms that Eskom is solely owned by the state.

> Executive 2 *"Our strategic intent is sent by the government who is the shareholder and on an annual basis they give us the strategic intent statement".*

(ii) Industry Role

All interviewees stated that the main role of the utility is to provide electricity to lower income households and that Eskom applies social thinking to delivery of a service regardless of profitability for example in rural areas, where households are sparsely distributed and grid electrification is expensive due to construction of long powerlines that need to supply power to a few houses. However, due to government's developmental goals, Eskom is forced to electrify such households.

> Executive 8: *"When a utility comes with the more social thinking they will connect and will drive for a 100% electrification, regardless of the fact that they might lose money on some of it".*

Interviewees highlighted that Eskom focuses on resolving socio-economic challenges in the country rather than finances or protecting the company's balance sheet. The Eskom strategy aligns with government objectives and not triple bottom line benefits, encompassing people, planet and profit.

The majority of executives also believed that the future of the utility is uncertain due to changes in policy related to environment and climate change as well as new technologies concerning the generation of electricity. The belief is that the Generation and Transmission line divisions will eventually become private entities and Eskom will only play a role in the Distribution business as it focuses on delivering electricity to indigent households.

(iii) Preferential Treatment

All interviewees discussed that because Eskom is a state monopoly, the utility is protected by policy and regulations against competition from independent power producers and barriers of entry are high such that new entrants would require licences from the National Energy Regulator of South Africa to either generate, transmit or distribute electricity.

> Executive 2 :*"It's the cloud that we have around us that, as a monopoly we are big, government owned and protected. There is nothing that gives us an advantage above that".*

Interviewees believed that due to the monopoly Eskom would automatically be given centre of control for any activity in the energy industry, for example, if there was a national demand side management programme it would be Eskom that would be given the role to implement smart meters and not private entities.

In summary, the state factors indicate that whilst disruptive innovations are changing the energy landscape the utility appears stuck with an old business model and employees do not have a commercial mindset as they believe that the role of the company is to serve indigent households.

The state-owned utility receives preferential treatment and has the ability to influence regulation and policy so as to protect itself from competition in the market. The state controls entry into the market to limit competition and threats to the utility.

5.2.1.3 Market factors

(i) Monopolistic market

The data confirms that Eskom is a monopoly and, therefore, no market exists. Eskom acts as the single buyer entity in the market and signs purchase power agreements with independent power producers.

> Executive 5: *"I guess there's competition in the generation space, but it's competition for the market, rather than competition in the market, in other words, through PPAs".*

This results in a strong brand presence for the utility.

(ii) Competition

Since there is no market in the electricity industry, there is no competition. However, there is rivalry between Eskom and municipalities as Eskom also distributes electricity directly to key customers within the municipality areas of supply. Beyond the meter, there is competition in the private sector to supply new devices for alternative forms of energy such as solar photovoltaics and batteries and energy efficiency technologies such as heat pumps.

> Executive 5: *"I guess there's competition in the beyond-the-meter space for customers that want to go off the grid".*

Eskom is also beginning to face a new form of competition as private generators are producing electricity and "wheeling" this electricity via the distribution network irrespective of regulation which does not permit the concept of wheeling at this time.

All interviewees highlighted that customers are beginning to self-generate electricity and viewed this trend as a threat.

Hence, a monopolistic market creates tensions between the local spheres of government and the state utility as there is competition for areas related to the distribution of electricity. Because the electricity market is regulated from the generation of electricity until the meter of the customer, disruptive innovations have created alternative unregulated pathways or solutions to reach the customer such as wheeling energy between customers and beyond the meter applications.

(iii) Customers

The dataset indicates that customer behaviour is changing as customers are now self-generating electricity and becoming more energy efficient. Customers are also wanting to directly trade electricity between themselves by wheeling electricity across the network.

> Executive 1: *"And then also self-generators. Self-generators with the end-state of being generators that wheel on the local level.*

Thus, disruptive innovations create a change in customer and trading behaviours. They also create new value for customers as they now have the ability to self-generate electricity and become more energy efficient.

(iv) Business model

The dataset reveals that the market has changed due to new ways of producing, distributing and trading electricity and the market is moving away from large centralised electricity generation to self-generation, prosumerism and wheeling of energy from private generators to consumers using utility and municipality networks.

Despite this change in the market all interviewees remarked that the utility's business model has not changed.

> Executive 8: *"The thing is, there is a huge rate of change, at the moment, in the electricity space. You look just on the generation side – we have gone from ten years ago, where big generation was pretty much all there was, to now, where your micro-grids, mini-grids and all the rest rarely are your most feasible option a lot of the time. Now, we, as a utility, cannot respond to that, cannot see that, cannot change our business mode".*

Overall, disruptive innovations have triggered changes to the market environment and given rise to new business models such as prosumerism and wheeling of energy. The utility's prevailing business model has not changed and is becoming irrelevant.

(v) Policy and Regulation

The majority of interviewees expressed that although the energy landscape is changing, the policy and regulation is lagging. New frameworks and regulations are required to encourage the dissemination of disruptive innovations such as solar photovoltaics, off grid solutions and new services. Nevertheless, the market is moving in the absence of regulation as consumers install their own electricity generating systems and become prosumers as well as trade via wheeling of energy across Eskom and municipality networks.

The dataset shows that although the shareholder had indicated that Eskom should unbundle into three separate subsidiaries for generating, transmitting and distributing electricity, the policy has not changed to support a competitive market.

> Executive 5: *"Market rules around if people want to go off-grid, do they still have to pay a grid connection fee – that kind of thing – is not currently in our regulatory framework".*

Therefore, regulations are lagging in the electricity industry and do not support the uptake of disruptive innovations.

5.2.1.4 Disruptive Innovations

The categories below discuss the innovations that the interviewees perceived to be disruptive to the utility.

(i) Digital technologies

The data indicated that information communication technologies such as devices that enable smart grids and smart metering technologies are disruptive; for example,

> Executive 6: *"It's also the sort of smart metering that is also starting to change the way the industry is going".*

(ii) Renewable energy technologies

Interviewees reported that renewable energy solutions such as biomass, solar photovoltaics, wind turbines and electric vehicles were disruptive for example,

> Executive 3: *"I saw an article that was showing that the Mall of Africa is strictly powered by photovoltaics".*

(iii) Energy storage

Energy storage solutions such as batteries for small and large scale uses and vehicle to grid applications were viewed as being disruptive to the electricity industry.

> Executive 1: *"Obviously renewables, both large scale and distributed and I think the one that's coming, which we haven't really seen the impact of yet, is batteries, and that includes electric vehicle batteries and electric vehicles on their own, just in terms of how they're going to impact time of use of electricity and demand".*

(iv) Business model innovations

Interviewees recognised that disruptive innovations have created were new ways of generating, distributing and trading electricity such as the decentralised use of solar photovoltaics for electricity generation and these disruptive innovations has resulted in the emergence of new business models in the industry for example customers becoming prosumers as well as wheeling electricity across networks. Interviewees highlighted that Eskom should probably respond by changing its traditional business model.

> Executive 1: *"They need to respond to disruptive innovations that would have a significant impact on their business or their business model".*

(v) Interconnected power generation

The majority of interviewees highlighted that distributed energy resources such as off grid and mini or microgrids could be disruptive to the utility business as customers will begin to use less grid electricity supplied by the utility.

> Executive 7: *"Reduction in costs of previously expensive off grid, mini grid solution are going to be disruptive".*

To sum up, interviewees from the electric utility perceived the following to be disruptive to the utility: (i) digital technologies, (ii) renewable energy technologies, (iii) energy storage applications, (iv) business model innovations as a result of disruptive innovations and (v) interconnected power generation technologies.

5.2.2. National Energy Regulator of South Africa

The findings from the interviews conducted on the National Energy Regulator of South Africa are categorised and presented as evidence in this section.

5.2.2.1 Business Factors

(i) Shareholding

Same as the findings from Eskom interviews (Section 5.2.1.1). The Department of Public Enterprises is the shareholder representative for government.

(ii) Inefficient operations

Interviewees view Eskom as an inefficient business. Poor management and performance of power stations across Eskom's fleet has resulted in load shedding. Furthermore, there have been long delays and cost overruns at new build projects such as the Medupi and Kusile power stations. The unavailability of energy from these new build stations has increased loadshedding levels.

The data revealed that loadshedding has caused damage to the economy as businesses cannot operate resulting in closure of some businesses as well as loss of employment. Interviewees believed that Eskom did not care about the economy and its customers and is losing its social licence to operate.

> NERSA_1 *"Nowadays, we load shed, and we don't care, and people are fed up. Eskom have lost their social licence".*

A specialist also discussed that there may be malfeasance in the company as someone maybe benefitting from diesel contracts because more diesel would need to be burnt during load shedding to meet demand for electricity.

(iii) Debt burden

The dataset indicated that Eskom is burdened with debt of almost R400bn largely due to cost overruns of the Medupi and Kusile projects and is unable to service its debt without equity injection from government. In addition, Eskom is operating open cycle gas turbine plants for long periods and destroying its cash flows i.e. operating at higher load factors to mitigate load shedding which is more expensive than burning coal to generate electricity.

> NERSA_1: "*And the problem is that… they running the open cycle gas turbines (OCGTs), and the OCGTs is destroying their cash flow, and it's creating huge financial burden on the end customer and a huge financial debt, if you like, for the end customer*".

Interviewees indicated that Eskom has entered a death spiral. Due to Eskom's inability to meet the country's energy requirements, sales of new technologies such as solar photovoltaics have started to increase, impacting on Eskom's revenue. Eskom will require further bailouts from government to service its debt and remain solvent.

In summary, the business factors indicated that, under 100 percent shareholding of the state, the utility business is inefficient, burdened with high levels of debt and is experiencing malfeasance. The inability of the utility to provide electricity to the customer has accelerated the uptake of disruptive innovations. The utility has entered a death spiral and requires equity injections for its survival.

5.2.2.2 State Factors

(i) Ownership

Same as finding from interviews with Eskom (Section 5.2.1.2).

(ii) Preferential treatment

Interviewees indicated that Eskom receives preferential treatment in the industry and indicated that as per the Electricity Regulation Act, 2006 Eskom must be given a reasonable profit margin or return. Because Eskom is a state-owned company these margins are allocated despite its poor performance.

> NERSA 2: *"So, as much as when they apply for adjustment of revenue we always try to say: 'But you're not as efficient as you are supposed to be, but it's the Act that says: Yes, but we must give them a margin to run the business, so we cannot go contrary to what the Act is saying, because they are not running the business, as I said, as they should be".*

Eskom can build power plants more cheaply than the market can, as it can obtain lower cost of capital rates due to being state-owned and also can operate at lower rates of return. The data also indicated that independent renewable energy power producers also received preferential treatment in the market. Renewable energy is not dispatchable, therefore Eskom incurs additional costs to operate the power system to cater for this intermittency such as operating coal stations in flexible modes and procuring new systems for forecasting demand and supply. The independent power producers do not pay for these additional costs.

To sum up, there are tensions in the market as Eskom and renewable energy independent power producers are both perceived to receive preferential treatment. Despite the company's poor operational performance, the national energy regulator is obliged to give the utility a reasonable profit margin/return which is included in the price that the customer pays. Therefore, the utility is not incentivised to respond to disruptive innovations or stay relevant in the industry.

Owing to the fact that the utility is state-owned, it has the ability to attract lower cost of capital rates from financial institutions. Disruptive innovations require special dispensations such as incentives to penetrate the market.

(iii) Role in industry

The interviewees reported that the role of Eskom in the market is not to make profits but rather to provide cheap, abundant and reliable power to drive economic growth. The interviewees also discussed the role of the state utility not being to perform social development directly, but to drive economic growth, which will in turn drive social development and create jobs. The National Energy Regulator of South Africa via the tariff allocates a margin or return to Eskom therefore Eskom is not allowed to maximise return on investment.

> NERSA_1: *"Social development is adding to the cost of electricity. Electricity's an input cost to the economy, so they should be producing electricity as cheap as they possibly can, and using that to drive the economy, otherwise what is the point, you know? These other things: the job creation, all those sorts of things, come further downstream in the economy. It's not Eskom's job to do that".*

Hence, the state-owned utility does not have a strong commercial mindset as the regulator allocates profit margins/returns.

5.2.2.3 Market Factors

(i) Regulation and Policy

The data confirms that the National Energy Regulator of South Africa is responsible for setting tariffs related to network charges and electricity prices, protecting consumers from harm such as equipment damages due to harmonics on the grid from new innovations, deriving maximum benefit for society by driving economies of scale with respect to new innovations, monitoring Eskom's technical performance, ensuring orderly development of innovations, grid code compliance and fair treatment to all parties pertaining to grid usage.

The data also confirms that there is no competitive market in South Africa and a single buyer model is in place where Eskom buys power from independent power producers. National Treasury allocates subsidies to enable affordability in the country therefore prices for electricity are regulated. Interviewees also deliberated that Eskom cannot respond to disruptive innovation because the regulation does not permit the company to use regulated funds or profit margins derived from electricity sales to invest in new businesses. It would be difficult for Eskom to respond without a policy change.

> NERSA_2: *"The policy is not naturally allowing Eskom, regulations are not. But again, in terms of the regulation, that Eskom finds itself, in terms of the regulator looking at that, will they allow Eskom to now start venturing into the space?"*

(ii) Competition

The data confirms that there is no competition in the market. However renewable energy independent power producers compete against each other when bidding in the independent power producer programme which awards 20-year purchase power agreements with Eskom.

The interviewees indicated that there is rivalry in the distribution industry between Eskom and municipalities. The contention is that municipalities believe that they have a constitutional right as per Schedule 4B of the South African Constitution to solely distribute electricity in the country, which Eskom undermines. Eskom has a distribution license awarded by the National Regulator of South Africa and distributes electricity directly to key customers within municipalities jurisdiction.

> NERSA 1: " *And then Eskom is supplying at 132 and above, they supply key customers which are in the municipal areas, and the municipalities are getting very jealous about the revenue which these customers could generate for them. The secondary competitors, I suppose, would be the IPPS: renewable energy generators which are coming in*".

(iii) Monopolistic Market

The data confirms that South Africa has a monopolistic market.

> NERSA 2 "*Here, in South Africa, Eskom is still a monopoly. I wouldn't say there's a competitor, for one reason: there's no market for other people who can compete with Eskom in terms of prices*".

To sum up, as per the regulation, South Africa does not have a competitive electricity market, and the state controls entry into the market. The penetration of disruptive innovations into the market are restricted. Under these conditions the utility does not need to respond to threats and opportunities from disruptive innovations. The policy and regulation i.e., monopolistic single buyer market model, does not encourage a commercial or entrepreneurial mindset in the utility.

Although policy and regulations restrict disruptive innovations in a market it still has the ability to introduce competition into a monopolistic market via different pathways. For example, renewable energy technologies compete against themselves, thereby reducing the price of electricity, which in turn competes against the utility's prices.

5.2.2.4 Technology Factors

(i) Renewable energy technology

Interviewees discussed that there are new innovations in the market such as solar photovoltaics and electric vehicles but there is not a large uptake of solar photovoltaics as grid electricity is still cheaper.

> NERSA 2: *"Look, innovations that are disruptive are like PV, you're also talking about electric vehicles".*

Some interviewees believed that solar photovoltaics would not be able to meet the needs of energy intensive industries due to their variable nature i.e., energy is produced only during sunshine and the country would still require stable energy from coal fired plants as its base load.

(ii) Energy storage technology

Interviewees perceived energy storage technologies to be potentially disruptive.

> NERSA 1 *“We’re moving into a space when there’s going to be storage. And then when there’s storage, that operational disruption from intermittency will probably fall away because, you know, a plant will be able to be on tap and be dispatchable”.*

Some interviewees reported that it is difficult to classify and formulate new regulations for battery energy storage devices because these devices can be used to generate electricity and as well as they can act as a consumer (load) during times when it requires charging. Thus it creates an unusual combination of cost and revenue streams and makes direct comparisons to other electricity generation technologies challenging. Interviewees reported that energy storage applications are still expensive but would in the future be able to compete with the utility as they enable renewable energy to be stored and made available on demand.

Overall, the dataset indicated that disruptive innovations are bringing about changes in the industry and operations of the power system but the utility is not adapting quickly. The regulator perceived both renewable energy technologies and energy storage technologies to be disruptive innovations.

5.2.3 Conclusion to the responses to Research Question 1

Disruptive innovations are restricted in a monopolistic market and are permitted entry into the market under strictly controlled conditions to control competition. These conditions do not motivate the utility to respond to threats and opportunities from disruptive innovations. The policy and regulation i.e., monopolistic single buyer market model does not encourage a commercial or entrepreneurial minset in the utility.

The state utility's dual commercial and development role is problematic as there are trade-offs between commercial and development goals. The shareholder is the state and can sacrifice the financial sustainability of the company to drive the state’s development goals and strategy. A long-term strategic intent is difficult to achieve for a state-owned company as a new government is elected every five years and there may be changes to the strategic direction.

Disruptive innovations in a regulated electricity market have changed how energy is produced, distributed and traded. Customer behaviour has changed as they can now self-generate, trade and become more energy efficient. Consumers are becoming prosumers through self-generation which has caused **changes in business models** as new forms of trading have emerged such as private entities wheeling energy across municipal and utility networks. Disruptive innovations impact the utility business model, resulting in the model becoming irrelevant and may reduced to only providing services to indigent households. Disruptive innovations also impact **the industry** as they have changed the role of the utility.

The electricity market lacks fairness and transparency as the state utility can influence regulation and policy to protect itself from competition and threats from disruptive innovation. The utility prefers to disseminate new innovations into the market, thereby marginalising new entrants. Although the utility has financial and operational challenges resulting in load shedding, the regulation still requires the regulator to allocate profit margins to the utility.

Regulations are lagging in the industry and do not support the uptake of disruptive innovations. Although the electricity market is fully regulated from generation to distribution of electricity, this regulation stops at the point of the customer's meter. Disruptive innovations find new pathways which are unregulated to reach the customer. Thus disruptive innovation result in parallel markets.

A monopolistic utility influences the nature of disruptive innovations in a regulated electricity market in the following way:

i) Stifled growth due to slow market penetration as the state utility is protected by policies that restrict competition

ii) High business risk due to lagging policy and regulatory frameworks to support new innovations

iii) Strictly controlled competition

iv) Incentives are required to drive dissemination into the market

v) Ability of incumbent to influence regulation

vi) Strong brand presence of the incumbent

vii) Ability of incumbent to attract lower cost of capital rates from financial institutes

Whilst the utility perceived the following innovations to be disruptive in the industry (i) digital technologies (ii) renewable energy technologies (iii) energy storage technologies, (iv) business models; and (v) interconnected power generation; the regulator identified only (ii) renewable energy technologies and (iii) energy storage technologies to be disruptive.

5.3. RQ2: What are general strategic approaches among state-owned electric utilities?

The Eskom data was interrogated to provide answers to how the utility is responding to disruptive innovations.

5.3.1. Strategic approaches by state utility

The categories and subcategories for the strategic approaches are described in this section.

5.3.1.1 No action

(i) Wait and see

The data indicated that the utility's response is reactive to disruptive innovations. Because Eskom will wait and see how emerging innovations technically perform or how fast consumers are adopting the innovation before responding. For example, Eskom commissioned a 3,2 MW wind demonstration facility in 2003 at Klipheuwel in the Western Cape to research and test different wind technologies under South African conditions. But the utility only commissioned its first wind farm for commercial operation in 2015. Although Eskom is producing 100 MW of wind energy at the Sere site in the Western Cape it is not offered as a new product to customers i.e., green or renewable energy product. This wind energy forms part of the total grid energy supplied to customers from all Eskom sources such as coal-fired stations.

Interviewees highlighted that Eskom was forced into building the Sere wind plant as it was part of a World Bank loan condition to build the Medupi and Kusile coal fired power stations. Therefore, the utility is not strategically responding to disruptive innovations or changing its business model.

Similarly, the data also indicated that Eskom has built several small-scale roof top solar photovoltaic plants for own consumption and research purposes since 2012 such as at Kendal and Lethabo power stations and office buildings. However, the utility has not invested in large scale commercial operations nor is the utility offering new services connected to solar photovoltaics and wind energy to customers.

> Executive 2: *"No, nothing has been built except some small solar PVs for own consumption, and predominantly for testing".*

Although the utility had put together strategies for developing wind and solar photo voltaic capacities, the Eskom board did not approve implementation due to the company's financial challenges. All interviewees reported that the utility is not responding or adapting to disruptive innovations for example,

> Executive 8 stated: *"I think we're very good at identifying what is happening in the market. Where we fall flat is figuring out how to adopt it. You look at battery storage – we went to Exco two years ago with advice about how battery storage can help and how it can actually make us more financially secure – none of that has been adopted into the business".*

The majority of the interviewees also shared that Eskom has not changed it's business model to offer new products and services although they have clearly recognised that there are new ways of producing electricity.

To sum up, the utility is reactive, not strategically responding to threats and opportunities from disruptive innovations. Although there are several plans in place to adopt disruptive innovations, these are not being implemented due to the company's financial challenges. The utility is not adapting its business model.

5.3.1.2 Focus on existing business

(i) Invest in sustaining innovation

All interviewees discussed that Eskom is focusing on their existing business and investing in innovations that improve efficiencies of current operations such as the online sampling of coal quality to improve energy availability from coal fired stations and meeting new stringent minimum emission legislation such as the installation of high frequency transformers at Tutuka power station which enhances the efficiency of electrostatic precipitators that trap dust and particulates from flue gas. Interviewees also noted that majority of the coal fired stations are old and plant breakdowns are unpredictable therefore there is a focus on improving existing plant efficiencies.

> Executive 3: *"Our general processes involve, maintaining what we have currently. Maintaining the existing plants and looking at ways of, you know, improving it – retrofitting more efficient ways. Run the plant more efficiently in terms of emissions and felxibility".*

Hence the utility is not responding to disruptive innovations but rather to an operational and financial crisis. The utility focuses on improving operational efficiencies in the current business and adopting sustaining innovations to recover the existing business.

5.3.2 Conclusion to the Responses to Research Question 2

Eskom is reactively responding to disruptive innovations by taking a wait-and-see approach and focusing on existing business operations by investing in sustaining innovations. Although the utility builds pilot and demonstration facilities such as wind and solar photovoltaics to test and better understand the innovations, the utility does not adopt the disruptive innovations as a new product or service offering. The utility has not changed its business model nor is it adapting to the changes in the business environment.

The dataset also indicated that the focus of Eskom is on improving the efficiencies of its current operations due to its inability to meet the country's electricity demands and returning the company to profitability.

5.4 RQ3: What assembly of theoretical tools is available to state-owned electric utilities to strategise effectively?

5.4.1 Dynamic Capabilities

Categories and themes related to dynamic capabilities are presented in this section.

5.4.1.1 Sensing

(i) Scanning and monitoring

The majority of the interviewees highlighted that Eskom is monitoring and tracking trends, technologies, opportunities and threats in the market via the Research, Testing and Development, Corporate Strategy and Planning, Enterprise Risk Management, the Growth Office and Africa Strategy departments. These sensing activities are carried out by attending conferences, undertaking trend, market, and risk analysis, searching and tracking the development of technologies via the internet and site visits, and undertaking a yearly corporate strategy review. Through these processes disruptive innovations are identified and impact to the business is quantified.

> Executive 3: "*In our space we've got people that are looking at what are the changes that are existing out therein the market. We also now and then have sessions with leading consulting firms that are tracking changes globally".*

Hence, the utility is engaged in sensing activities by monitoring, tracking, searching and scanning the environment to detect threats and opportunities from disruptive innovations.

5.4.1.2 Seizing

(i) Risk-taking

The dataset revealed that Eskom is not investing in new opportunities such as innovations, products, and service offerings. Although two departments i.e. the Growth Office and Africa Strategy have mandates to seize opportunities for Eskom in the unregulated market, this is not used. There is limited commercialisation of innovations.

> Executive 2: *"Not so much has been done, except the development of the renewables unit that is really coming about to try and, you know, to get Eskom to adapt to this renewable industry that is mushrooming in our country without us being in the play".*

A minority of interviewees also discussed that the National Energy Regulator of South Africa is unlikely to permit the use of profit margins made from the sales of electricity in a traditional regulated business to be used to fund growth in an unregulated business. The Electricity Regulation Act, the licence agreements from the regulator to the utility and the principles of the multi-year price determination method for the allocation of tariffs do not permit the state-owned utility to take risks as it would be the customer paying for this risk.

The majority of interviewees reported that the company was pursuing a turnaround strategy. In the short term, the company will focus on improving current business operations to return to profitability.

All things considered; the utility is risk averse and does not make investment into new opportunities such as innovations, products or services. Regulation and the current operational and financial challenges are contributing factors to the risk averseness. Risk needs to be taken via unregulated structures through different investment mechanisms, as regulated electricity pricing methodologies do not make provision for risk-taking.

(ii) Innovation

The data showed that Eskom does not have defined processes for the commercialisation of new products and services, and subsequently no appetite for growth in new products or markets. Although the Research, Testing and Development business unit occasionally identifies developments that are new to the world as an outcome of indirect research, these products are not commercialised and, in most cases, if intellectual property is protected, it is not exploited. The Research, Testing and Development business unit does not have processes to deliberately develop new innovations and take them to market for example, dry cooling in coal-fired power plants. Due to South Africa being a semi-arid country, Eskom had to design coal-fired stations that used little water in its production cycle. Dry cooling systems use air instead of water to cool the steam exiting a turbine, thereby saving water**.** Eskom engineers designed the largest dry cooling stations in the world; however this innovation was not patented.

> Executive 5: "*We never protected any intellectual property on any of them. I think we could have made a huge amount of money out of dry-cooling. Actually, the design engineers that did it for us made all the money out of it. Even the Utility Load Monitoring (ULM) device was an innovation in its time".*

Therefore, the utility is not an entrepreneurial organisation and does not have effective processes to commercialise patents and exploit intellectual property.

(iii) Agility

Although the minority of executives articulated that the company should become more agile to respond to competition from disruptive innovations in the market, there was no evidence that the company was agile.

> Executive 4: *"I mean, there's lots of fantastic ideas in the organisation and we don't seem to have this hub that takes these ideas and says: 'Okay, let's incubate it. Let's take it to the next stage. Let's partner. Let's do this.' We're not agile enough".*

Executives recognised that agility is a dynamic capability that is required for the firm to quickly adapt and compete.

5.4.1.3 Transforming

(i) Human Resources

Eskom has undertaken limited activities to transform its resources. The dataset showed no evidence of the utility of modifying, reconfiguring, or renewing skills and capabilities to compete with disruptive innovations as the company's strategy focused on improving the efficiencies of the existing business operations. However, there has been some skill enhancement to technical staff that are required to operate the new Sere 100 MW wind farm and solar photovoltaic plants located at power stations and office buildings. Skills of engineers in the Transmission and Distribution divisions had been enhanced to enable the integration of disruptive innovations such as renewable energy technologies onto the power system to support the Renewable Energy Independent Power Producer Programme.

> Eskom interviewee 2: *"I know that some people have been sent to go and study renewables institutions all over the world, that people have been going there, but for only some few select people will go for three weeks and they're back and things like that and conferences to reskill them and make them understand, but not really sending them to courses".*

But the majority of the interviewees noted that the utility is not adapting to the changes in the business environment nor modifying the workforce to compete with disruptive innovations. Interviewees believed the company was reactive and forced to connect renewable energy technologies to the grid via pressure from state departments.

Hence, the utility is making limited modifications to the skills of its workforce; only limited enhancement of existing skills is evident. There is no evidence of reconfiguration and renewal of skills to adapt to the changing business environment.

(ii) Organisation structure

The dataset showed no evidence that new structures such as subsidiaries had been formed to explore new opportunities such as disruptive innovations.

(iii) Assets

The majority of the interviewees believed that the assets of the company are not changing from the traditional ways of generating electricity to include disruptive innovations such as renewable energy because the Sere wind farm was built due to a World bank loan condition to the funding of the Medupi power station and the solar photovoltaic roof top plants are less than 500 kW which are built for own consumption. The company strategy in the short term is not to invest in growing the business but maintaining and improving the existing business. There is a small change in the assets related to the Eskom Distribution and Transmission businesses. Digitally smarter equipment is being deployed to strengthen the wire's businesses and modernise the grid to support disruptive innovation such as renewable energy technologies.

> Executive 1: *"From the transmission and distribution side, there's physically new lines, new sub-stations, power electronics, flexible technologies, flexible AC technologies and HVDC technologies that's starting to be specified and deployed and commissioned to respond to accommodate the technology innovators or disruptors".*

In sum, the electricity generation assets are slowly being modified under pressure from outside funding agencies. However, the grid assets are being modified to include intelligent digital devices to strengthen the existing wire's businesses.

(iv) Processes

The dataset showed that processes had been changed to support the entry of renewable energy into the power system. Operating procedures at the power stations were changed to ramp electricity output up or down, based on the power system's variable supply of renewable energy. Power system operations were also modified to integrate renewable energy onto the power system.

> Executive 1: *"Not new assets, but there's changes to the operating regime of the assets, the operating life of the assets, the operating procedures. That's changing significantly".*

Therefore, processes in the organisation were changed only to support the integration of renewable energy onto the grid. Processes were not changed to take advantage of disruptive innovations or respond to threats.

(v) Organisational culture

Most interviewees reported that the Eskom culture had not changed to compete with disruptive innovations. The belief is that Eskom should support disruptive innovations as per the state policy rather than compete.

> Executive 2: "*The organisation's indoctrinated culture was that everything in the electricity industry belonged to Eskom, and Eskom would drive anything that belonged to the energy industry. That role has shifted from a stakeholder government stance, and from a policy stance. However, the culture within Eskom hasn't shifted.*

Therefore, the utility does not have an entrepreneurial culture.

5.4.2 Ambidexterity

This section presents themes, categories and evidence from the data for the ambidexterity strategies used by Eskom

5.4.2.1 Structural separation - parallel

(i) Specialised internal exporation business units

The data showed that Eskom had created seperate units within the exisitng business for exploration activities such as the Research, Testing and Development business unit and the Africa Strategy unit.

5.4.2.2 Formations

The interviewees noted that Eskom has no partnerships, or alliances related to offerings of disruptive innovations.

> Executive 6: *"We had the* a *new Growth Office also as a business unit within the subsidiray; Eskom Rotek idea of going into partnerships to grow, but that died".*

Thus the utility attempts to achieve ambidexerity only via structural separation i.e., via the creation of internal business units for exploration. Although there is recognition that ambidexterous strategies could be achieved via other routes like partnerships with external entities, this is not implemented.

5.4.3 Summary of responses to Research Question 3

The data showed that Eskom is building limited dynamic capabilities and ambidexterity strategies to respond to threats and opportunities from disruptive innovations. The utility is experiencing financial and operational challenges that have constrained its response.

Although the utility has built dynamic capabilities for sensing disruptive innovations by scanning, monioring, identifying and tracking threats and opportunities, the company had not built capabilities for seizing opportunities and has limited capabilities for transforming the business to maintain competive advantages. The data highlighted that the utility is not an entrepreneurial organisation and is risk averse. This is due to regulation that does not consider factors of risk in the electricity pricing methodologies. In addition, the utility has no commercialisiation processes for innovation, and is not building capabilities for agility which is required for adaptation.

Human resources are being enhanced in a slow and limited manner to mainly support the implementation of some disruptive innovations such as the entry of renewable energy into the industry. Existing skillsets are also being enhanced to operate and maintain renewable energy plant owned by the utility.

Organisational structure is not being transformed to explore disruptive innovations. Assets related to the generation of elctricity are slowly being modified to include mature disruptive innovations such as wind and solar photovoltaics. Grid-related assets are being modified to support the entry of disruptive innovations into the market. For example, intelligent digital devices to modernise the grid. Overall, processes are not being changed to take advantage of disruptive innovations or respond to threats. The utility is not building entrepreniual capabilities or capabilities that transform culture.

The dataset also revealed that Eskom has implemented limited ambidexterity strategies to respond to opportunities and threats from disruptive opportunities. The utility had created specialised internal business units for discovering threats and opportunities within its parent company and subsidiary Eskom Rotek Industry such as the Research, Testing and Development, and Growth Office, respectively.

Overall, customers can circumvent monopolies to adopt disruptive innovations that do not require infrastructure and regulated monopolies can only succeed if they are pre-emptively responding to what regulators are going to prioritise.

The next chapter presents the integrated analysis and discussion with literature.

CHAPTER 6: INTEGRATED ANALYSIS AND DISCUSSION OF FINDINGS

The overarching goal of this research was to explore the market dynamics and strategic options available to power utilities in regulated electricity markets. This chapter discusses the integrated analysis of the findings obtained from the research as described in chapters 4 and 5. The integrated analysis highlights the main themes in the research findings for the cases of France and South Africa in the context of the reviewed literature. The analysis also aims to provide evidence from the research as findings to either support, build on or reject established theories and propositions detailed in the literature review. The findings are presented linking the themes and sub-themes to the research questions. Additionally, issues, concepts and findings relating to themes and subthemes are discussed in relation to similar studies undertaken by other researchers. Similarities and points of divergence are also explained.

6.1 RQ1: How are state-owned electric utilities positioned in relation to their respective market forces?

The following sections describes the strategy as practice context from this research, nature of disruptive innovations in the electricity industry and theoretical implications for the disruptive innovation theory.

6.1.1. Strategy as practice

The analysis showed that extra- and intra-organisational actors shaped the industry, macro and meso praxis. The extra-organisational actors i.e., state as a shareholder, ministries of energy, ministries of environment, national energy regulators, competitors and innovators in local, national and global ecosystem influenced the utility’s practices. The shareholder issues an annual strategic intent statement to the power utility that describes the shareholder's expectations in the form of the mandate of the utility, aspirations, and key priority areas for implementation. The strategic intent statement shaped the strategy of the utility through the mandate which defined what the utility can and cannot do. In addition, it influenced the company's aspirations and strategic direction via the company's mission and vision statements. The key priority areas in the strategic intent statement also set the company's direction as these priorities are implemented into the organisation and measured via a shareholders' compact. This has implications for organisational strategising as there must be alignment with the shareholders, such as on long-term goals, risk tolerances, and growth strategies. The strategic intent statement is a forward-looking document which in turn encourages a forward-looking mindset in the utility, prompting the organisation to reach ambitious goals and position itself in the industry.

The Ministries of Energy and Ministries of Environment via policies and regulation shape the utility's strategy as it set the guiding principles and rules for decision-making within a power utility and introduce constraints. For example, policies related to energy planning, energy sustainability and climate influence strategic decisions that force the utility to adopt renewable energy technologies and retire coal plants earlier than scheduled. Policies shape the utility's strategic choices to operate within boundaries defined by the legal and regulatory environment, for example, utilities cannot not readily adopt disruptive innovation such as renewable energy and offer it as a new product to customers as the utilities are not given approval from the respective ministries to build renewable energy plants. This policy influences the organisational strategy to focus on existing business instead of quickly responding to disruptive innovations such as renewable energy.

National energy regulators influence organisational strategy through their regulatory frameworks, incentive mechanisms, decision-making and regulation. Regulators define the market structure, competition policies, and controlled access to grids within the electricity industry e.g., whether the market operates as a monopoly. In essence the national energy regulators define the rules of the game and mould the market. This in turn shapes the strategic choices of electric utilities, influencing their market positioning, competitive strategies and response to disruptive innovations. As in South Africa, there are no regulations that promote the use of solar photovoltaics which caused the utility to delay actions to respond to this type of disruptive innovation. Furthermore, national energy regulators set and adjust the price of electricity in the market to ensure that it is affordable for customers. These pricing structures change the strategy of the utility as revenue models influence profitability and resource allocations of the utility. The power utilities aligne their strategies with the approved tariff structures and make strategic choices not to abandon their existing business based on this.

Competitors actions also shape organisational strategy. The power utilities engage in continuous monitoring and analysis of competitor behaviour, influencing strategic choices on market positioning and how to respond to threats and opportunities. For example, Électricité de France shifted its strategy to adopt disruptive innovations and increase the production of wind and solar energy similar to competitors such as Enel and Iberdrola.

Innovators influence organisational strategy as the utility recognises that disruptive innovations are new inventions in the market and this influences strategies on partnering and collaborating with start ups and innovators. The innovators influence the utility to adjust their strategies to adopt similar innovations or develop counter strategies to maintain competitiveness. For example, Électricité de France partnered with Plentify a start up to launch a new device in South Africa to convert water heaters connected to the national power grid into thermal batteries. These batteries recharge during off peak periods thus assisting the utility to reduce electricity demand during peak periods and better balance supply and demand during peak periods.

The intra organisational actors i.e., executive managers and department heads influence the firm' strategy through direct strategic choices and actions taken on the responses to disruptive innovations. Strategic decisions are implemented as micro level activites throughout the organisation.

Aggregate extra-organisation actors i.e. ministries of energy, ministries of environment and national energy regulators represent an institutional field in this study and via new policies and regulations amend existing practices which influence the macro level praxis, for example, the national energy regulator introduced new regulations to establish wholesale and retail electricity markets thereby introducing competition. This research investigated market forces and strategic positioning at the macro praxis.

6.1.2 Nature of disruptive innovations in the industry and market

The analysis showed that disruptive innovations in regulated electricity markets have an impact at the industry, macro and meso levels. Industry level is an economic category that includes all economic activities by organisations and people involved in the production and sale of similar goods and services which is grouped into a specific field such as electricity or banking or construction, etc., and dominate country factors (Becattini, 2002). The macro level includes broader contextual factors that are external to the organisation and determines the ability of the company to compete such as political, legal, social, environmental, economic and technological (Bai, Zhang, Lu, Ren, & Zhou, 2023) whilst meso refers to the internal organisational level that links various business units such as structures and processes and it mediates between macro and micro levels (Ballard & Seibold, 2003).

Disruptive innovations have transformed the vertically integrated structure of the industry over time via mergers and acquisitions and at a macro level have resulted in the introduction of new types of markets, competitors and customers i.e. prosumers. At the meso scale disruptive innovations have resulted in the establishment of new subsidiaries with new ownership regimes. Therefore, disruptive innovations have an impact at industry, macro and meso levels reshaping the ecosystem whereby incumbents loose competitiveness (see Figure 10 overleaf). This finding also supports the work of other authors (Kumaraswamy et al., 2018) who posited that disruptive innovations are multidimensional and multi organisational in nature, affecting various domains. This has implications for power utilities as they need to respond to changes that are occurring at the industry, macro and meso levels.

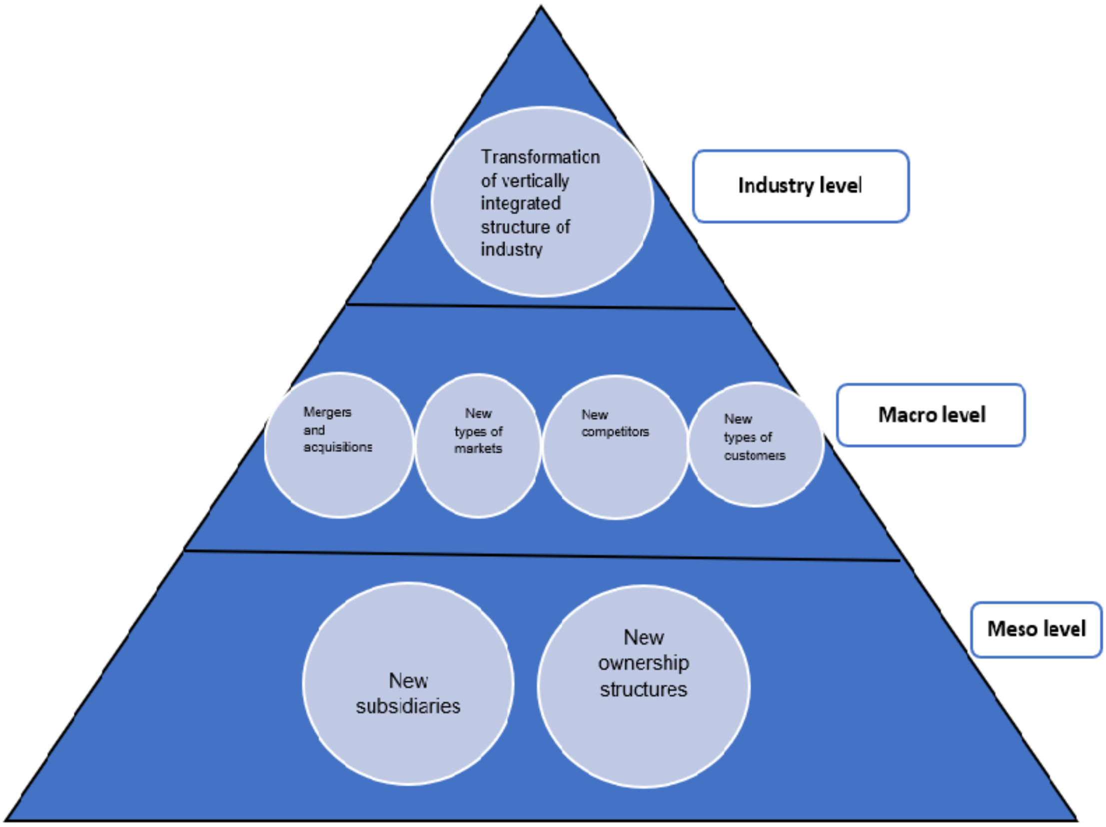

Figure 10: Impact of disruptive innovations in regulated electricity markets

However, this is contrary to the disruptive innovation theory (Christensen & Dillon, 2020) which suggested that the effect of disruption is a linear process impacting only at a meso level when incumbents do not respond vigorously to new entrants in the market. This research showed that multiple disruptive innovations in the market are disrupting the mature electricity industry simultaneously (section 6.1.3) and this impact does not occur in a linear process. The analysis indicated that the process of disruption in the electricity industry occurs in an interconnected and simultaneous manner impacting multiple domains across the ecosystem. For example, whilst power utilities partnered with startups for the development and launch of disruptive innovations such as energy efficiency devices, at the same time new starts up emerged offering similar devices as well as at the same time additional disruptive innovations emerged in the industry from other startups such as battery systems, hydrogen fuel cells and electric vehicles and the new entrants simultaneously increased their market penetration thereby transforming the industry whilst the electric utility is faced with disruption.

The process for disruption seems to be experienced differently in other industries because Palmié, Wincent, Parida, and Caglar (2020a) found that in the financial and banking industry the process was linear but disruption impacted the entire ecosystem. Financial technologies (Fin tech) such as block chain, artificial intelligence and crypto currencies had disrupted the mature financial and banking industry creating a Fintech ecosystem. At the first stage incumbents dominated and sought support from new ventures to enhance their ability to exploit the emerging disruptive innovations e.g., banks cooperated with technology companies to offer new functions such as online payment and mobile banking. At the second stage additional disruptive innovations arose in the ecosystem due to adaptation and exploitation of the new practices by new venture firms. At the third stage, new entrants increased their influence, reshaping the industry whilst incumbents faced the threat of replacement.

Similarly, Turienzo et al. (2023) found that disruptive innovations such as connected and autonomous vehicles are transforming the mobility industry via new business models in the macro environment. These emerged as new alliances were forged between incumbents and companies competing in different areas viz, (ii) digital platforms to improve customer experience and (iii) the advancement from business to customer (B2C) to business to business (B2B) markets associated with growing servitisation offerings.

Furthermore, the analysis showed that in the electricity industry disruptive innovations are not necessarily cheaper and more accessible than main stream products as suggested by the disruptive innovation theory (Christensen & Dillon, 2020; Si & Chen, 2020). Energy produced from nuclear and coal sources were cheaper than renewable energy because renewable energy producers are not charged system costs to transport their energy across the network to reach the end consumer and ancillary services to maintain the integrity of the network. The independent power producers of renewable energy were only charged for their energy on the grid, giving the impression that renewable energy was cheaper than the incumbent. Furthermore, renewable energy due to being expensive is more accessible to top end consumers who are not price sensitive. Hence, many pathways to disruption and electric utilities will need to reposition themselves in the market and respond with holistic approaches.

In addition, disruptive innovations have re-regulated the electricity market by creating parallel markets despite strict existing regulation pertaining to electricity prices and market entry (Figure 11). New unregulated trading pathways emerged such as the concept of wheeling whereby new entrants generate electricity and transport this to customers utilising the utility’s network as in the case. Also, both regulated prices and unregulated market prices coexist in the electricity industry to give customers freedom of choice. Therefore, competition in the electricity market is fierce creating a turbulent business environment. Disruptive innovations ignore existing regulations and grow to create unregulated markets destabilising incumbents' established positions.

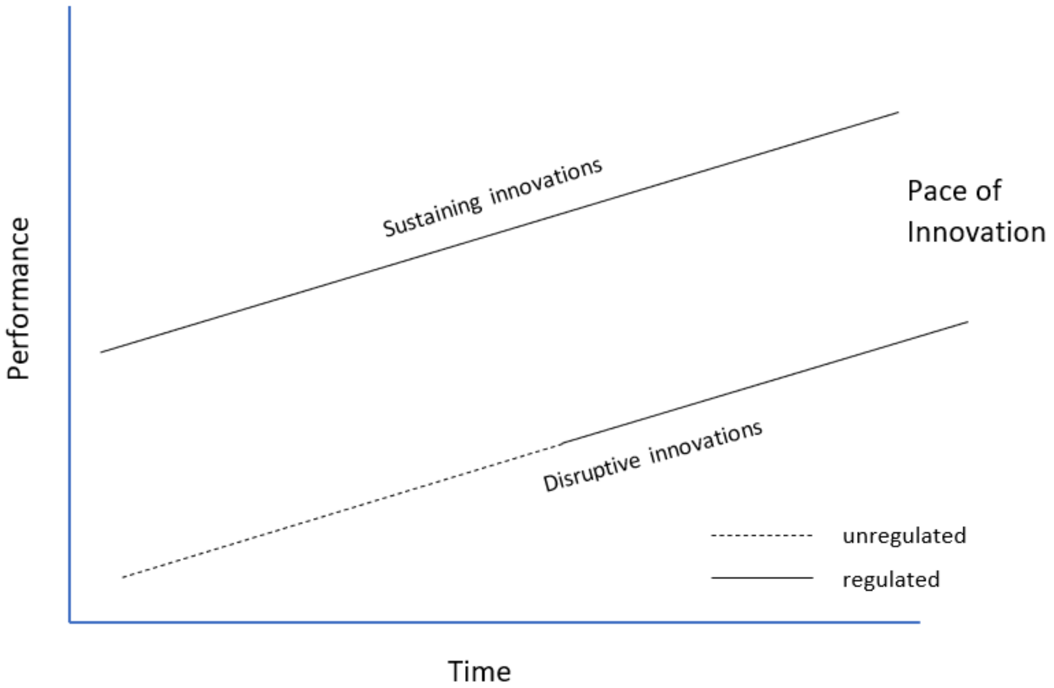

Figure 11: Pace of innovation in regulated electricity markets adapted and improved from Christensen & Raynor (2003).

This finding supported the work of Occhiuto (2022) who reported that although regulators initially used blocking strategies such as issuing court orders and increasing ticketing against Uber, a platform disruptive innovation in the tightly controlled taxi industry, the disruptor ignored these actions and continued to operate. This created a parallel market of regulated and unregulated consumer prices. Uber deployed a market strategy of “growing too big to be banned” to force regulators to incorporate their practices and eventually draft new laws to align with Uber’s practices.

Fajar (2020) has highlighted that many governments find it difficult to keep up with the speed of innovation and generally regulations lag behind as governments set up regulation to control disruptive innovations, whilst balancing the relationship of risk, benefits to consumers, and promotion of innovation. This problem is exacerbated as disruptive innovations converge into several sectors. Huang and Zhu (2022) suggested that regulators can overcome this challenge by adopting an inclusive approach to balance risk and innovation. For example, China enhanced the financial regulation of technological innovation to support and promote the transformation of the traditional financial industry into digital finance or smart finance. This can be applied to the electricity industry as digital and smart finance solutions emerge in the power markets.

6.1.3 What are the disruptive innovations in the market?

Based on the integrated analysis the summarised definition of disruptive innovations as outlined in Chapter 2 can be refined to: - **A discontinuous process in which new products, services, business models or technologies attack the mainstream by offering new value propositions to customers, which in turn, creates significant changes in market demand by establishing parallel markets that reshape the ecosystem as incumbents loose competitiveness.**

Table 13 depicts the innovations that interviewees perceived to be disruptive versus actual disruptive innovations.

Table 13: Comparison of perceived versus actual disruptive innovations

Name of Country	Perceived Disruptive Innovations	Actual Disruptive Innovations
France	Digital technologies, renewable energy technologies, new business models, energy storage applications, interconnected power gener-ation technologies, cloud com-puting, smart phones, smarter meters, cyber security, e-mobility services	Digital technologies, renew-able energy tech-nologies, new business modes, ener-gy storage applications, interconnected power generation technologies
South Africa	Digital technologies, renewable energy technologies, energy storage systems, business model innovations, inter-connected power generation, smart meters, smart grids	Digital technologies, renewable energy tech-nologies, energy storage systems, business model innovations, interconnected power generation
Common Disruptive Innovations	• Renewable energy • Energy storage systems • Digital technologies • Interconnected power generation • Business model innovations	

The common disruptive innovations identified by interviewees were renewable energy technologies, energy storage systems, digital technologies, interconnected power generation and new business model innovations i.e., prosumerism. These are the disruptive innovations in the market that the utility must respond to in order to survive and thrive.

Further analysis was conducted to determine a more comprehensive view on disruptive innovations in the market. A Google Scholar search using the search string “disruptive innovations and energy” was conducted on 25 October 2023 and returned 279 000 hits. Table 14 below indicates the first 20 items as per the Google search.

Table 14: Internet results for disruptive innovations

Disruptive Innovations	
1. Decentralised renewable energy systems	11. Cloud computing
2. Internet of things	12. Solar photovoltaic
3. Big data analytics	13. Cyber security
4. Low carbon innovations	14. Battery storage
5. Sustainable urban retrofitting	15. Wind technologies
6. Digitilisation	16. Electric vehicles
7. Artificial intelligence	17. Peer to peer business models
8. Advanced robotics	18. Wearable computers
9. 3D printing	19. Driverless cars
10. Utility scale renewable energy technologies	20. Ultra-light materials

The analysis showed that there are additional disruptive innovations in the market i.e. low carbon emitting technologies and 3D printing innovations which has not been recognised by the utility and will have repercussions for financial sustainability of the company if not responded to. Low carbon emitting innovations are likely to attack the traditional business model of the electric utility by offering a new value proposition to consumers that prefer the use of environmentally friendly products compared to the mainstream grid electricity generated from fossil fuels. This change in consumer behaviour can modify demand in the market as countries adopt new energy policies to implement ambitious climate actions.

Similarly, not responding to 3D printing has implications for the utility as this printing technique can be used to cheaply manufacture products for various applications in the energy sector e.g. the production of solar cells or solar photovoltaic structures which use different types of materials or the creation of electrolysers in fuel cells that can be used to generate electricity (Kostretsova et al., 2021). The 3D printed energy products can attack the traditional electric utility business model by reducing the demand for grid tied electricity consumption as end users can deploy these products for self-generation of electricity or to save energy.

This wave of disruptive innovations being experienced by electric utilities creates a business environment that is volatile, uncertain, complex and ambiguous (VUCA) (Sinha & Sinha, 2020). Electric utilities need to devise concrete strategies to overcome the threats and take advantage of opportunities to remain relevant.

The Google Scholar search also indicated that disruptive innovations are still largely misunderstood as 9 (highlighted in blue) out of the 20 items indicated in Table 14 are sustaining innovations and not disruptive ones. Therefore, there is room for improvement on the clarity of the phenomenon of disruptive innovations and refinement of the definition.

6.1.4 Theoretical implications for disruptive innovation theory

6.1.4.1 Supporting and competing against disruptive innovations

In regulated electricity markets, the dual commercial and developmental mandate for state-owned utilities is problematic as tensions arise due to the need to achieve profitability, high share prices and pay dividends to shareholders as well as drive government's developmental goals such as provision of affordable electricity to all citizens of the country including indigent households. Rigidities arise due to the trade-off between achieving profitability for the utility, providing cheap, sometimes free electricity, and supporting the electricity industry's transition from fossil fuels to more environmentally friendly solutions to meet global climate policy targets. Governments request electric utilities to retire coal plants earlier than scheduled although the plants still have economic life, in order to increase the share of low carbon technologies in the country's energy system. Another tension that arises is that the power utility is expected to support the market penetration of disruptive innovations, and at the same time, compete against them. For example, the utilities support the market penetration of renewable energy technologies such as solar photovoltaics and wind turbines by modifying existing grid infrastructure and operations to balance variability in the power system, and utilities are expected to enable an electricity market by selling electricity to independent power producers at prices cheaper than their cost of production. However, supporting disruptive innovations such as renewable energy technologies has led to profitability challenges, and due to their dual mandate, utilities are unsure about how to support and compete against disruptive innovations simultaneously.

Christensen's original concepts (Christensen & Raynor, 2003) and subsequent revisions on the disruptive innovation theory (Christensen & Dillon, 2020; Christensen et al., 2018) did not account for companies with dual mandates therefore the theory can be expanded to incorporate dual purpose companies by including the constructs of organisational mission and stakeholder engagement. Companies with dual mandates should focus on social missions instead of market performances that favour profit seeking activities which compete with the firm's commitment to their social mission as this causes mission drift due to internal tensions and creates lack of support from critical stakeholders which eventually endangers the company's survival (Ramus & Vaccaro, 2017). Hence, state-owned electric utilities should maintain a balance of dual goals and prevent mission drift by undertaking stakeholder engagement combined with social accounting i.e., measuring and disclosing social outcomes such as results from environmental campaigns. This can be done firstly by strategically selecting stakeholders based on strong institutionalised social content and socially oriented skills and capacities to bolster the success of social projects, and secondly by integrating stakeholder identification and engagement within an organisation's overall strategy.

Researchers (e.g. Battilana et al., 2022) recommended that dual purpose companies could mitigate the financial and social trade-off's by doing four things. First, by setting explicit financial and developmental goals that clearly explain the organisations value commitments to all stakeholders. Second, by appointing top executives who have prior experience and training in both financial and social logic as they would be more capable of dealing with the multiple external demands that dual purpose companies face as opposed to those managers who have only been exposed to one type of logic, Third, by board members holding the company accountable for both financial and social goals and finally, by rewarding employees for the attainment of both financial and developmental goals.

Although, the disruptive innovation theory did not discuss how an entity can support and compete against disruptive innovations at the same time, other authors (Nalebuff & Brandenburger, 1996) had proposed coopetition strategies to strengthen competitive advantage and to survive competition in fast changing business environments. Therefore, the disruptive innovation theory can be expanded to include this phenomenon. Coopetition is the simultaneous pursuit of cooperation and competition between firms where the cooperative aspects pool collective interests to create greater value and coexists with the competitive part to accentuate private gains from the value created (Seepana et al., 2020). Coopetition facilitates the acquisition and exchange of knowledge between partners (Bouncken et al., 2018), enables the joint research and development of technologies, and offers companies the opportunity to share the risks and costs associated with innovation (Park & Kim, 2021). There are numerous examples of successful coopetition relationships that state-owned electric utilities can draw upon to increase competitive advantages such as several pharmaceutical giants joined forces with smaller pharma firms, retailers and technology giants to develop vaccines during the COVID 19 pandemic (Crick & Crick, 2020) and also American vehicle manufacturer Ford and the German Group Volkswagen Group collaborated to begin development and distribution of electric and autonomous driving cars. Stock market index revisions indicated that fundamentally strong companies can survive a turbulent market of multiple disruptive innovations by proactively acknowledging and investing in disruptive innovations with unicorns i.e., start ups having a rarity of occurrence but have reached a valuation of more than USD 1 billion (Agrawal et al., 2020). Incumbents should see unicorns not as challengers but as collaborators in their quest for revenue growth and cost efficiency.

The disruptive innovation theory can be extended to embrace coopetition strategies by manageing trade-offs between joint value creation and firm value creation via alignment of both for overall value creation (Gnyawali & Ryan Charleton, 2018). Partnerships are influenced by multiple trade-offs such as between fairness and opportunism, sharing and control, and engagement versus rivalry (Corbo et al., 2023).

Other ways could be via building of strong partner interdependence, formed via joint activities or investments to facilitate the exchange of resources and capabilities, building trust and generosity and encourageing coopetition through integration (Jakobsen, 2020). In addition, electric utilities should maintain and support close and lasting collaborations which will enable them to leverage their shared history (a collaboration resource) to curb competitive concerns and enhance novelty and meaningfulness (Dean et al., 2023). Collaborators need to trade-off investments in novelty with investments in meaningfulness. Therefore, electric utility managers need to understand the intricacies and carefully monitor its collaboration environment.

Notwithstanding its benefits, the paradoxical and risky decisions of coopetition adoption can pose challenges for electric utilities. Tensions could arise from the opposing forces of simultaneous competition and cooperation which are interrelated but difficult to balance (Raza-Ullah, 2021). Due to the contradictory logic of sharing and protecting, tensions could result at multiple levels (Czakon et al., 2020) – between managers (Czakon et al., 2020), teams and organizations (Bahar et al., 2022) and individuals (Raza-Ullah et al., 2023). In addition, engaging in coopetition triggers opportunistic behaviour and knowledge leakage which may lead to vulnerable relationships (Woolley, 2023). Open-minded discussions and mutually beneficial relationships are critical to resolving conflicts and this can be established through effective intercultural communication and collaborations harnessing individual and group potential to move into new and unanticipated directions (Liu et al., 2018).

Whilst it is generally difficult to establish common ground on how to achieve mutual benefits from coopetitive relationships, state-owned electric utilities could balance coopetitive relationships and yield enhanced firm performance by simultaneously building trust and distrust mindsets at moderate levels (Raza-Ullah, 2021) and building integration capabilities to emphasise resource coordination and creation between external and internal resources, as well as form coopetitive alliances with competitors and suppliers or customers (Huo et al., 2022). Companies should not only acquire new resources from the outside but also manage and exploit them constantly by converting them into developing new innovations. Furthermore tensions can be overcome by electric utilities not being too restrictive while sharing knowledge, as a transparent and open-access culture is a foundation for value creation (Krammer & Kafouros, 2022).

Researchers have suggested that firms can foster trans-national and global alliances by incorporating cross-cultural issues into their agreements in order for them to be successful, and when the value elements of culture between organisations are incompatible, coopetitive alliances can be formed via developing common practices rather than common values such as motivation, interaction, vision and learning drivers (Rijamampianina & Carmichael, 2005). Meena and Dhir (2023) report that factors such as organisational culture and competitive intensity play a crucial role in driving joint innovation in organisations because organisational culture facilitates internal knowledge-sharing mechanisms, encourages partners to develop mutual understanding, respect, trust, and commitment to coopetitors whilst increasing competitive intensity in the market attracts partners willing to engage in joint innovation to increase firm performance.

In addition, Meena et al. (2023) analysed 144 papers between 1999 to 2021 and made recommendations for successful coopetition strategies that can be applied to state-owned electric utilities such as: first firms should create robust knowledge protection mechanisms as the chances for opportunism is high; secondly, while sharing knowledge with rivals, managerial efforts should align joint processes related to trust building practices to support a seamless flow of knowledge between the strategic partners; thirdly, top management should develop formal control mechanisms to resolve issues about paradoxes and conflicting interests of both parties; fourthly, managers should analyse market uncertainties and maintain a balance between dependence and over dependence on competitors for example the impacts of the war in Ukraine resulted in souring electricity prices and energy security challenges; and lastly, strategists should map the factors of coopetition and formulate strategies for driving business growth, surviving market instabilities, avoiding risks and failures, enhancing customer value and leverageing coopetitive relationships

Electrical utilities can also leverage regional-level coopetition strategies (Crick & Crick, 2023) to increase company performance by (i) joining forces with trustworthy and complementary rivals in rural communities to acquire new assets and opportunities that they would find difficult to access if they were to compete through their own resources and capabilities, for example, collaborations on off grid electricity and fibre programs, and (ii) in situations where there is a high-degree of regional-level rivalry, establish boundaries with partners prior to entering networks, for example, agree on which areas they will collaborate on and which they will compete on, to prevent failures from injecting more competition into the markets.

6.1.4.2 Contextual factors

The analysis showed that organisational culture in state-owned electric utilities is generally slow to adapt to changes in the environment and lacks agility in responding to opportunities and threats from disruptive innovations.

Whilst the disruptive innovation theory (Christensen et al., 2018) described disruptive innovations from a market perspective, it did not focus on debate on market influence and contextual factors such as organisational culture, industry structure, market design and regulations. Contextual factors could contribute to the ex-ante predictability of the disruptive innovation theory, the pace at which disruptive innovations are adopted and type of managerial responses required. For example contextual factors such as market and organisational maturity can give early warning signs for disruptive susceptibility of incumbents (Klenner et al., 2013), local culture, business environments and social interactions influences where disruptive innovation will thrive (Corsi & Di Minin, 2014), understanding the regulatory environment can predict how successful a disruptive innovation would be (Urbinati et al., 2018).

This finding is in agreement with the studies of Antonio and Kanbach (2023) who reported that disruptive innovation literature lacked an integrated understanding of contextual factors such as demand, market structure, culture and regulation due to fragmentation and lack of integrated understanding across disciplines. The authors proposed a three-phase framework for disruption i.e. (i) disruptive susceptibility, (ii) emergence and diffusion and (iii) endgame and outcome, and they posited that each phase is influenced by conceptual factors such as threat size, speed and direct competition, which in turn, influence the likelihood, ease and extent of disruption. The three-phase framework showed that environmental factors play a decisive role in the trajectory of disruptive innovations and incumbents can explore disruptive opportunities and exploit current business. Hence, contextual factors become increasing important when responding to disruptive innovations in the electricity industry.

Furthermore, Bayramov et al. (2023), discuss that the heart of the problem of business transformation in turbulent business environments is organisational culture and recommended the development of innovative business models to ensure sustainability of enterprises as business models are characterised as a new business culture that provides business opportunities through corporate culture management, contributing to operational effectiveness and building new relationships with consumers. The study of Carvalho et al. (2023) reinforces the importance of organisational culture as an inseparable aspect of operational management in fast changing business environments. An assessment of 10 cases indicated that organizational culture is crucial in assisting the workforce cope with the change and supports the development of practices which in turn supports the development of operational excellence and organisational agility capabilities. When culture is disregarded, both excellence and agility will stagnate and the full potential of change and improvement programmes will not be realised. Thus, the disruptive innovation theory can be extended to include contextual factors such as organisational culture.

6.1.5 Conclusion of responses to Research Question 1

This study indicated that extra- and intra-organisational actors shaped the industry, macro and meso praxis. The extra-organisational actors i.e. the state as a shareholder, ministries of energy, national energy regulators, competitors, innovators all influence the utility’s practices. The shareholder issues a strategic intent statement that influences the utility's aspirations and strategic direction, such as long-term goals, risk tolerance, and growth strategies. The ministries of energy and ministries of environment via polices and regulation related to energy planning, energy sustainability and climate shapes the strategic choices of the utility to operate within the confines of the legal and regulatory environment. National energy regulators through various regulatory frameworks also shape the strategic choices of the electric utilities influencing their market positioning, competitive strategies and response to disruptive innovations. Pricing structures influences organisational strategy as utility revenue models influence profitability and resource allocations. Competitors mould organisational strategy as they influence the utility's strategic choices on responses to threats and opportunities of disruptive innovations and market. Innovators influence strategy by offering strategic options to partner and collaborate with start-ups and innovators, adopt similar innovations and shift actions to develop counter strategies to maintain competitiveness.

The intra-organisational actors in this study were the executive managers, heads of departments and specialists who directly influenced strategy through their strategic choices and actions on responding to disruptive innovations. These choices were implemented as micro level activities into the organisation.

Disruptive innovations in regulated electricity markets are mutiorganisational and multidimensional in nature impacting at the industry, macro- and meso-levels thereby transforming the ecosystem through, modifying the vertically integrated structure of the industry, via mergers and acquisitions and creation of new types of markets, competitors and customers at a macro-level, and by creating new subsidiaries with new ownership structures at a meso-level.

This study showed that multiple innovations in the market are simultaneously disrupting the ecosystem at various levels through simultaneous interconnected actions throughout the ecosystem. And contrary to the disruptive innovation theory the process of disruption is not linear only impacting at a meso level as a result of incumbents not responding to disruptive innovations (Christensen & Dillon, 2020). Literature highlighted that the process of disruption is experienced differently in each industry (e.g Palmié et al., 2020b; Turienzo et al., 2023). Furthermore, in the electricity industry disruptive innovations are not necessarily cheaper and more accessible than main stream products as suggested by the disruptive innovation theory (Si & Chen, 2020), because energy produced from nuclear and coal sources were cheaper than large scale renewable energy; this is due to independent power producers not being charged by the utility for transmission and distribution system costs and ancillary services to transport the energy to the end customers. Hence there are many pathways to disruption, and electric utilities will need to reposition themselves in the market and respond with multifacted approaches.

Moreover, disruptive innovations have reregulated the electricity market by creating parallel markets such as unregulated prices for electricity and new unregulated concepts such as wheeling of electricity have emerged. The study found that disruptive innovations ignore existing regulations and grow to create unregulated markets, eventually reducing incumbents' market share.

For the electricity industry, disruptive innovations can be defined as **a discontinuous process in which new products, services, business models or technologies attack the mainstream by offering new value propositions to customers which in turn creates significant changes in market demand by establishing new parallel markets that reshape the ecosystem as incumbents lose competitiveness.**

The disruptive innovations that utilities need to respond to include renewable energy, energy storage, digital technologies, interconnected power generation systems, new business models such as prosumerism, 3D printing and low carbon emission solutions. The Google Scholar analysis to investigate the disruptive innovations in the electricity market also indicated that the phenomenon of disruptive innovations is still largely misunderstood in practice as 9 out of the 20 items listed as disruptive innovations were sustaining innovations.

State-owned electric utilities should be positioned to both support and compete against disruptive innovations. However, the dual mandate of both commercial and developmental objectives is problematic as conflicts arise due to the need to achieve profitability, high share prices, pay dividends to shareholders, and drive governments developmental goals. The disruptive innovation theory did not account for companies with dual mandates therefore the theory can be expanded to include this aspect by incorporating the constructs of organisational mission and stakeholder engagements.

Companies with dual mandates should focus on social mission instead of market performances that favour profit-seeking, competing with social mission commitments (Ramus & Vaccaro, 2017). A balance of dual goals can be achieved by preventing mission drift and undertaking continuous stakeholder engagements combined with social accounting. Some scholars (Battilana et al., 2022) suggested that financial and social trade-offs can be mitigated by setting explicit financial and developmental goals that explicitly explain the organisations value to all stakeholders; appointing top executives that have prior experience and training in both financial and social logic to manage multiple external demands; board members holding executives accountable for attaining both types of goals; and, rewarding employees that attain both financial and development goals.

Furthermore, the disruptive innovation theory is silent on how companies can support and compete against disruptive innovations at the same time. Therefore it can be extended to include the concept of coopetition which was originally coined by Nalebuff and Brandenburger (1996) as a strategic approach to survive competition in turbulent business environments. Coopetition is the simultaneous pursuit of cooperation and competition between firms where the cooperative aspects pool collective interests to create greater value and coexists with the competitive part to accentuate private gains from the value created (Seepana et al., 2020). The disruptive innovation theory can be widened to incorporate coopetition strategies by manageing the trade-off between joint value and firm value creation through the alignment of both for overall value creation in the organisation. Partnerships are influenced by several trade-offs such as between fairness and opportunism, sharing and control and engagement versus rivalry. Mitigation measures include building of strong partner interdependencies such as joint activities or investments to facilitate exchange of resources and capabilities, building trust and generosity and encourageing coopetition through integration across companies.

Tensions could arise from the paradoxical forces of simultaneous competition and cooperation which are difficult to balance due to the contradictory logic of sharing and protecting at multiple levels e.g., between managers, teams and organisations and individuals. Engaging in coopetition could trigger opportunistic behaviour and knowledge leakage which might lead to vulnerable relationships. Open-minded discussions and mutually beneficial relationships are vital to resolving conflicts and could be established through effective intercultural communication and collaborations.

State-owned electric utilities could balance coopetition relationships by building trust and distrust mindsets at moderate levels (Raza-Ullah, 2021) and building integration capabilities to emphasise resource coordination and creation between external and internal resources (Huo et al., 2022). Tensions can also be overcome by electric utilities not being too restrictive while sharing knowledge as a transparent and open access culture as a foundation for value creation (Krammer & Kafouros, 2022). Researchers suggest that firms can foster trans-national and global alliances by incorporating cross-cultural issues into their agreements to improve success and when the value elements of culture between organisations are incompatible (Rijamampianina & Carmichael, 2005). The authors also discussed that coopetitive alliances can be formed by developing common practices rather than common values such as motivation, interaction, vision and learning drivers.

The analysis reinforced the importance of organisational culture as a key aspect of responding to disruptive innovations. However, over the years the disruptive innovation theory did not focus debate on market influence and contextual factors such as organisational culture, industry structure, market design and regulations (Christensen et al., 2018; Si & Chen, 2020). Contextual factors could contribute to the ex-ante predictability of the disruptive innovation theory, the pace at which disruptive innovations are adopted and type of managerial responses required. Environmental factors play a decisive role in the trajectory of disruptive innovations, and incumbents can explore disruptive opportunities and exploit current business (Antonio & Kanbach, 2023). Thus, the disruptive innovation theory should be expanded to include contextual factors such as organisational culture, industry structure, market designs and regulations.

The conceptual framework (Figure 12) highlights the conclusions from Research Question 1.

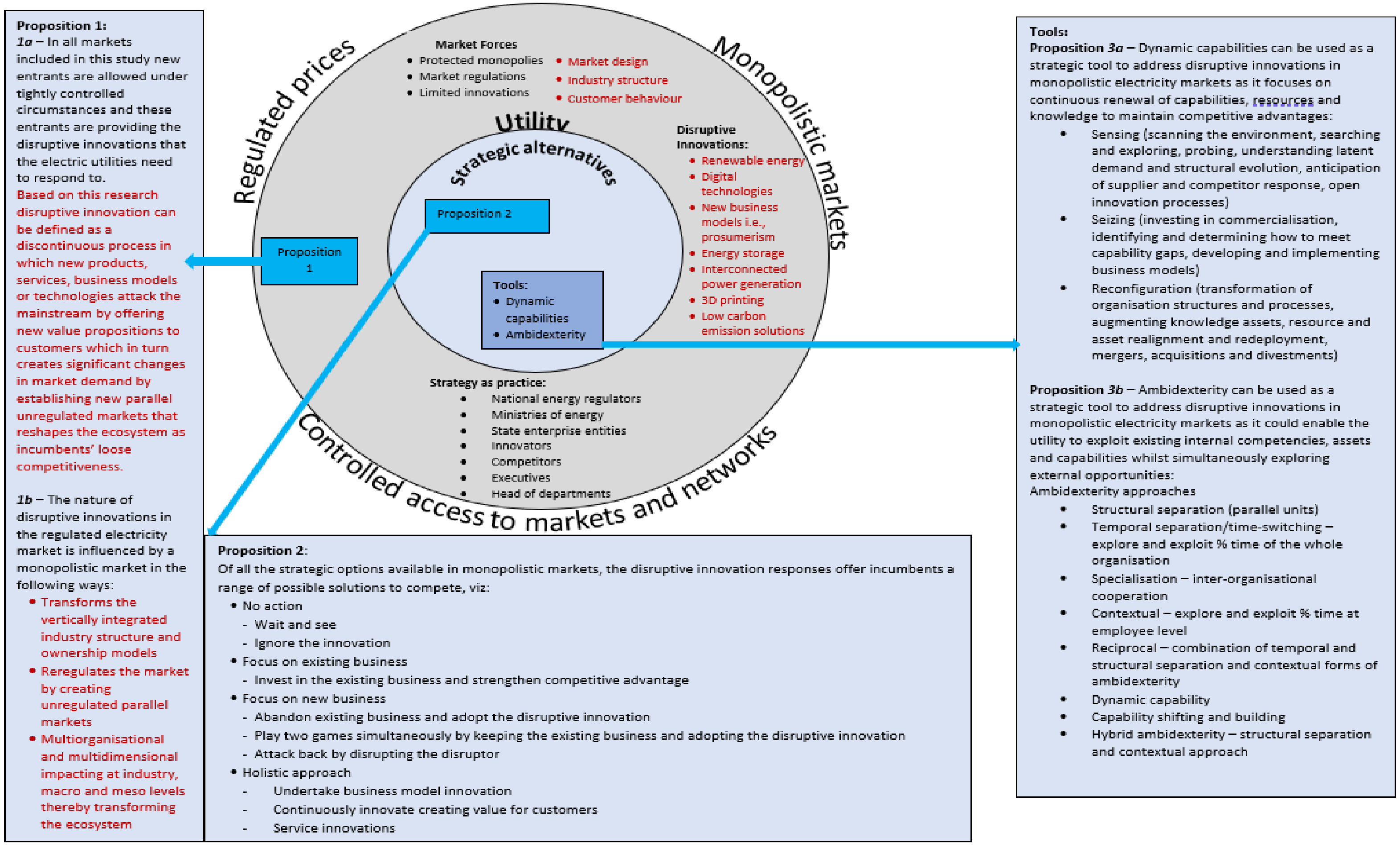

Figure 12: Conceptual framework from Research Question 1

6.2. RQ 2: What are general strategic approaches among state-owned electric utilities?

The following section discusses how the strategy as practice framework can be expanded as a result of the findings of this research, the strategic approaches to disruptive innovations that have emerged from this study and how the disruptive innovation theory can be widened to take these findings into account.

6.2.1. Strategy as practice – Theoretical extension

The research showed (Section 6.1.2) that disruptive innovations have an impact at industry, macro and meso levels reshaping the ecosystem whereby incumbent's lose competitiveness. Hence these findings suggest that the level of praxis as proposed by Jarzabkowski and Spee (2009) can be extended from micro, meso and macro to include industry level praxis (Table 15). The authors broadly categorised the macro level to include strategy praxis of the external business environment and patterns of action within an industry. However, this research showed that the macro level can be further separated into an industry category for deeper understanding as explained in Section 6.1.2.

This extension increases the topology of nine possible domains for strategy as practice research as discussed by the authors to eleven. Thus, based on this research two new domains can be created i.e. Domain J and K. Domain J focuses on research where individual organisational practitioners act intersubjectively with the industry environment and Domain K encompasses aggregate organisational practitioners acting intersubjectively with the industry environment. The cell borders are in red in Table 15.

This extension is important for strategy as practice because industry level praxis can contribute to the multiple levels of action and interaction that needs to be considered by practitioners during strategising and moves strategising activities beyond the firm level to incorporate wider practices of society.

Table 15: Strategy as practice matrix adapted and improved (Jarzabkowski & Spee, 2009)

	Micro	Meso	Macro	Industry
Individual internal	**A** Individual practitioners acting at a micro level within the organisation	**B** Individual practitioners acting reciprocally within and with organisational contexts	**C** Individual organisational practitioners acting intersubjectively with the macro environment	**J** Individual organisational practitioners acting intersubjectively with the industry environment
Aggregate internal	**D** Aggregate practitioners within a job function acting at a micro level within the organisation	**E** Aggregate practitioners (e.g., top management) acting within an organisation using unique strategies per group within the class	**F** Aggregate organisational practitioners acting intersubjectively with the macro environment	**K** Aggregate organisational practitioners acting intersubjectively with the industry environment
Aggregate external	**G** Aggregate extra-organisational actors' influence on intra-organisational practice	**H** Aggregate extra-organisational actors' influence on organisational practice	**I** Aggregate extra-organisational actors' influence on strategy as practice in the field	

Furthermore Figure 11 describes how disruptive innovations have resulted in changes in the industry, macro and meso level and Section 6.3 on dynamic capabilities and ambidexterity as strategic tools for disruptive innovations, elaborate on meso and micro level actions. This is important for the contribution of praxis stream research (Kohtamäki et al., 2022) as it shows a linkage between the industry, macro, meso and micro praxis and reiterates that strategising is inherently a multifaceted phenomenon (Vaara, 2010). Also, the analysis from this research highlighted the interactions between context (praxis), the involved actors and strategic approaches to disruptive innovations as organisational activities and practices by electric utilities.

Whittington (2006) pointed out that an important characteristic of strategy practices is that they are multilevel and embodied in routines such as decision-making processes, operating procedures, and organisational cultures. But, at the same time, other authors have reported that they can also be extra-organisational (Jarzabkowski, Seidl, & Balogun, 2022). For example, the use of SWOT analysis, strategy projects or strategy retreats represent extra-organisational practices adopted by multiple firms as part of their own strategy practices (Burgelman et al., 2018). Thus, although strategy practices can be observed as micro-level activities in strategy processes, they can also be viewed as broader society-level practices that are adopted by many organisations in the ecosystem.

6.2.2 Strategic approaches

Generally, two types of strategic approaches have emerged from this research i.e., a delayed response and an integrated approach. Both electric utilities have head offices where decisions are made by group executives and passed down to lower level business units and subsidiaries.

6.2.2.1 Strategic approach 1 - Delayed response

The analysis indicated that overall, state-owned electric utilities are reactive and slow to respond to the multiple disruptive innovations that they face. The surge of disruptive innovations has created a business environment that is volatile, uncertain, complex and ambiguous (VUCA). Section 6.1.3 describes what the utilities are responding and not responding to but generally, the utilities appeared to wait for the disruptive innovation to reach a certain level of maturity before taking a decision to respond i.e., the utilities are risk averse and respond only to what they can see emerging or definitely will be implemented via regulation. For example, solar photovoltaics, wind turbines and energy storage solutions such as utility scale batteries. This result agrees with literature which reported that incumbents have little desire to allocate resources to disruptive innovations as initially the markets appear niche, small and unprofitable (Yang, Kim, & Choi, 2022).

However, the data also showed that Électricité de France is proactive in responding to green hydrogen innovations. Both the data and literature confirmed that green hydrogen is not a mature technology and regulation has not been developed (Rasul et al., 2022). Électricité de France had established a subsidiary called Hynamics which is located in Auxerre, France to produce 1 MW of electricity and up to 400 kg of green hydrogen per day using water electrolysis. This is the result of an intrapreneurial project led by approximately ten employees and nurtured within the EDF Pulse Croissance, the utility's start-up incubator.

This shows that a response type is not, either/ or, as suggested in literature (Jin & Shin, 2020; Kumaraswamy et al., 2018) but can be both reactive to some disruptive innovations and proactive to others, as indicated in Figure 13.

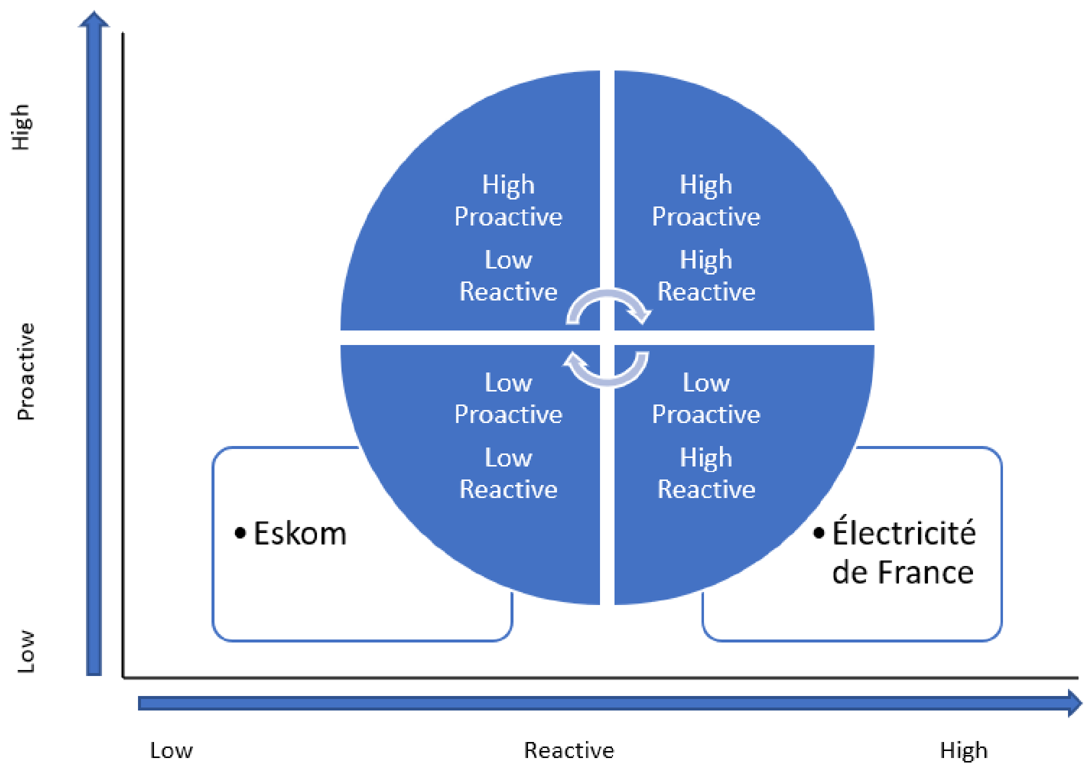

Figure 13: Responsiveness of electric utilities

Research asserts that the benchmark for securing continued success is not to stand still or wait (Kretschmer & Khashabi, 2020). Failing to move fast enough can lead to loss in competitiveness and profitability. Although the disruption innovation theory acknowledged that incumbents do not respond to disruptive innovations until it is too late and implied that they are risk averse, the theory offered limited guidance on when to invest and how to manage risk and uncertainties (Christensen & Dillon, 2020; Ho, 2022). Therefore, the theory can be expanded to include the risk and uncertainty constructs to give managers more direction. The construct of risk will be elaborated in Section 6.3.1.3.

6.2.2.2 Strategic approach 2: Integrated response

Both electric utilities can be viewed as hierarchical organisations where decisions and strategies move from the top down to the business units and subsidiaries, and employees interpret and execute them in their daily practices.

The analysis showed that utilities have adopted an integrated approach to respond to the multiple disruptive innovations in the energy sector i.e. (i) investing in the existing business via sustaining innovations, (ii) adopting the disruptive innovation and offering new products and services, (iii) as well as investing in continuous research and innovation activities to offer new products and to disrupt the disruptor. This is contrary to the disruptive innovation theory (Jin & Shin, 2020) which claimed that incumbents are not motivated to make investments in their own disruptive innovations as they promise lower margins, target smaller markets and introduce inferior products and services. And when threatened by disruptive innovations, incumbents flee upmarket by introducing sustaining innovations to make existing products better. Generally, literature (Table 3) presented recommendations to incumbents when they are faced with one type of disruptive innovation in the market. Therefore, the disruptive innovation theory can be expanded to account for conditions when there are multiple disruptive innovations in the markets as multiple disruptive innovations penetrating the market at the same time creates a VUCA business environment and under these conditions this research suggests that state-owned electric utilities should respond with a three pronged integrated approach. There should be a combination of first, investing in the existing business with sustaining innovations to improve efficiencies and retain existing customers for example extending the life of coal and nuclear plants and converting coal fired power plants to biomass technology, whilst at the same time adopting disruptive innovations which have emerged in the market to offer new products and services such as e-mobility, energy efficiency, solar photovoltaic and energy storage services and finally, investing in continuous research and innovation to compete with disruptors and remain relevant e.g. investing in floating wind turbines and light weight solar photovoltaic structures. Whilst competitors make improvements on onshore and offshore wind turbines that are anchored to the seabed, Electricité de France is piloting floating wind turbines which could be cheaper to build and increases accessibility to better wind resources in deeper seas. Also, light weight solar PV structures would create new markets for customers with structural limitations and could be cheaper than conventional solar PV systems in the market due to then use of cheaper materials. An integrated approach would allow the utilities to both defend against threats and take advantage of opportunities to create new products, services, and markets.

These recommendations are similar to Gans (2016), who suggested that incumbents should respond to disruptive innovations by either beating disruptors through investment in new technology, or joining them by acquiring their business and products or waiting them out and responding when it is certain that the emerging technology will be disruptive. However, this research findings suggest that under conditions of VUCA, incumbents should respond with an integrated approach which incorporates a combination of actions rather than a choice of only one action.

On the one hand, integrated approaches offer the advantages of promoting synergy and coordination across different business units fostering a unified perspective (Lentjušenkova & Lapiņa, 2020) that is more cohesive and effective to dealing with threats and opportunities from disruptive innovations. This approach provides a framework for adapting to changes in the environment and encourages collaboration such as cross functional innovation which fosters the development of creative solutions that draw on diverse perspectives and result in better products for the customer (Acar et al., 2019).

On the other hand, it could be costly, inefficient due to competition for resources (Benazzouz, 2019) and challenging due to the complexity of aligning diverse components as well as implementation may experience resistance from existing structures and practices (Korsunova & Korhonen-Kurki, 2022). But success can be achieved through increased communication and collaboration amongst business units and functions (Kretschmer & Khashabi, 2020).

This integrated approach of simultaneously investing in the existing business with sustaining innovations whilst adopting disruptive innovations and engaging in continuous research and innovation is contrary to the disruptive innovation theory (Christensen & Dillon, 2020) which advised against incumbents investing in sustaining innovations. An integrated approach suggests an ambidextrous solution as a response to threats and opportunities from disruptive innovations. Other authors have also suggested an ambidextrous approach to balance a trade-off between exploration and exploitative activities (Schindler et al., 2023; Yang et al., 2022). For example, Schindler et al. (2023) explored how traditional incumbents i.e. Shinsegae and its subsidiary SSG.COM responded to disruptive innovation in the South Korean retail industry. Shinsegae is one of the top three retail conglomerates in South Korea, owning various subsidiaries. SSG.COM was extended into an online market place aimed at responding to platform disruption in the retail industry. The authors proposed that SSG.COM should innovate its business model to respond to online market domination by integrating its online and offline businesses.

Ambidexterity as a tool for responding to disruptive innovations will be elaborated on in Section 6.3.

Furthermore, the analysis of the case studies of state-owned electric utilities showed that these utilities are not engaging in service innovation. Although Électricité de France is offering new services such as maintenance of photovoltaic systems and energy management, which are different from their traditional business, it is not novel and the same that other competitors are offering in the market. Several scholars discussed the importance of service innovation to respond to competitors in VUCA environments (Kurtmollaiev & Pedersen, 2022; Nwachukwu & Vu, 2022) i.e. the creation and implementation of new ways that service systems can increase customer satisfaction and create more value for the customer. De Ramos (2020) advised that electric utilities need to innovate upon industry standards and integrate themselves into the community because community involvement allows building relationships that form the basis of political capital as numerous government administrations come and go out of office. Service innovation would extend the utilities role in the modern customer-centric activities, making the electric utility an essential partner in future community initiatives. This recommendation was supported by Park and Lee (2021). The authors investigated new electricity business models of 38 electric utilities and suggested that electric utilities collaborate with information and communication technology (ICT) as well as oil and gas companies to make greater efforts to maintain existing consumers and secure new customers through service innovation. Their study also highlighted that service innovation can be used to expand consumer choices, customize services, improve convenience for service use and enhance electricity consumption control. In addition, Lamperti et al. (2023) recommended the development of digital service innovations as a way to respond to disruptive innovations i.e. digital enabled services relying on digital components embedded in physical products that create new digital business models and proposed a six-phase cyclic digital servitization model that firms could implement. This entailed viz. (i) a motivation phase to sense the market, (ii) capabilities phase to assess and search for capabilities internal and external to the company, (iii) development of a solution, (iv) sales phase, (v) delivery phase and (vi) evaluating the effects of the digital servitization processes which may trigger further adjustments in the organisation. Hence, state-owned electric utilities should consider a more holistic approach to responding to disruptive innovations and include service innovation as a possible response. In addition, this finding further extends the disruptive innovation theory as it suggests additional ways to respond to disruptive innovations instead of only creating separating structures and provides insights into types of continuous innovation activities that electric utilities should engage in.

The next section provides a conclusion to research question 2 on what the general approaches are to responding to disruptive innovations amongst state-owned electric utilities.

6.2.3 Conclusion of responses to Research Question 2

The research suggests that the level of praxis as proposed by Jarzabkowski and Spee (2009) can be extended from micro, meso and macro to also include industry level praxis. This extension increases the topology of nine possible domains for strategy as practice research to eleven. Two new domains can be created to focus on research where individual organisational practitioners act intersubjectively with the industry environment and aggregate organisational practitioners act intersubjectively with the industry environment. This is important as industry level praxis can contribute to the multiple levels of action and interaction that needs to be considered by practitioners during strategising and moves strategising actions beyond the firm to incorporate wider practices of society.

The analysis also showed that state-owned electric utilities are responding to disruptive innovations via two strategic approaches i.e., a delayed response and an integrated response. Overall state-owned electric utilities are reactive and slow to respond to the multiple disruptive innovations that are emerging in the sector. The surge of disruptive innovations has created a business environment that is VUCA but electric utilities tend to wait for the disruptive innovations to reach a mature state before responding such as solar photovoltaics, offshore wind turbines and energy storage solutions. The utilities are risk averse and only respond to what they see emerging or will definitely be implemented via regulation. But the data also showed that utilities can respond proactively to disruptive innovations such as green hydrogen technology. This suggests that a response type is not either/or as suggested in literature but can be both reactive to some disruptive innovations and proactive to others (Jin & Shin, 2020; Kumaraswamy et al., 2018). Although the disruption innovation theory acknowledged that incumbents do not respond to disruptive innovations until it is too late and implied that they are risk averse, the theory offered limited guidance on how to manage risk and uncertainties when faced with multiple disruptive innovations (Christensen & Dillon, 2020; Ho, 2022). Therefore, this research contributes to the extension of the theory by providing clarity on response types which will guide incumbents on how to respond to multiple disruptive innovations.

The analysis showed that state-owned electric utilities have adopted an integrated approach to responding to multiple threats and opportunities from disruptive innovations in the electricity sector under VUCA conditions i.e. (i) investing in the existing business with sustaining innovations to improve efficiencies and retain existing customers for example extending the life of coal and nuclear plants and converting coal fired power plants to biomass technology, whilst at the same time (ii) adopting disruptive innovations which have emerged in the market to offer new products and services such as e-mobility, energy efficiency, solar photovoltaic and energy storage services and (iii) investing in continuous research and innovation to compete with disruptors such as floating wind turbines and light weight solar photovoltaic structures.

An integrated approach would allow the utilities to both defend against threats and take advantage of opportunities to create new products, services, and markets. While this approach may appear similar to proposals from other authors (e.g. Gans, 2016) it differs as the approach suggests a combination of actions rather than a choice of only one action at a time. This integrated approach of simultaneously investing in the existing business with sustaining innovations whilst adopting disruptive innovations and engaging in continuous research and innovation is contrary to the disruptive innovation theory (Christensen & Dillon, 2020) which advises against incumbents investing in sustaining innovations. An integrated approach suggests an ambidextrous solution as a response to threats and opportunities from disruptive innovations. Other authors have also suggested an ambidextrous approach to balance a trade-off between exploration and exploitative activities (Schindler et al., 2023; Yang et al., 2022). Thus, the disruptive innovation theory can be extended to account for multiple disruptive innovations by using an integrated response that includes ambidextrous approaches.

But the analysis also revealed that state-owned electric utilities should consider a more holistic approach to responding to disruptive innovations and include service innovation as a possible response. In addition, this finding extends the disruptive innovation theory as it suggests additional ways to respond to disruptive innovations instead of only creating separating structures and provides insights into types of continuous innovation activities that electric utilities should engage in.

The conceptual framework (Figure 14) illustrates the conclusions for Research Question 2.

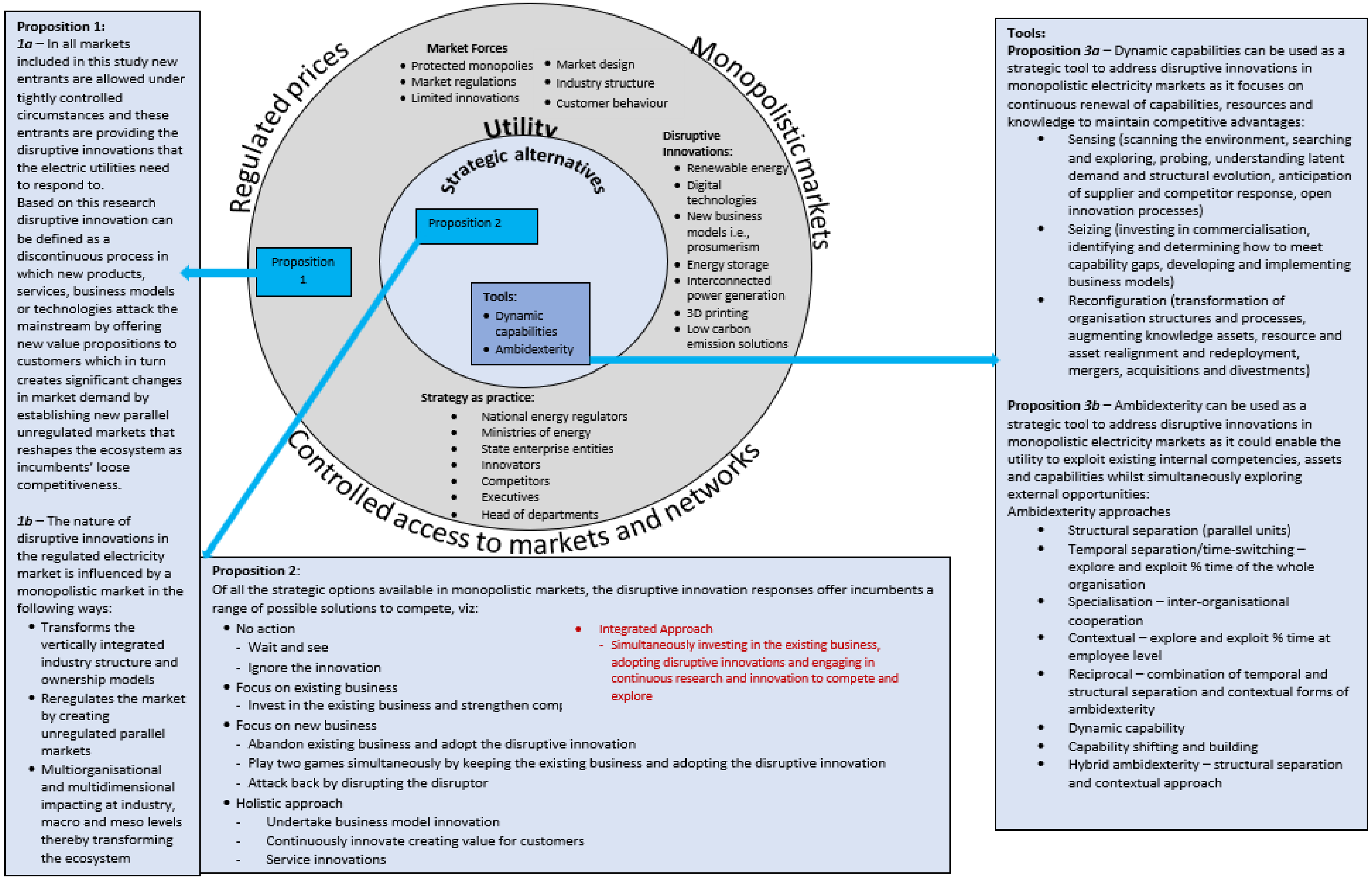

Figure 14: Conceptual Framework for Research Question 2

6.3. RQ 3: What assembly of theoretical tools is available to state-owned electric utilities to strategise effectively?

This section discusses ambidexterity and dynamic capabilities as tools for responding to threats and opportunities from disruptive innovations in regulated electricity markets. Each tool is analysed and discussed in turn together with implications for the dynamic capability, resource-based and ambidexterity theories.

6.3.1 Dynamic Capabilities as a Response Tool

Overall, the analysis showed that state-owned electric utilities are using dynamic capabilities of sensing, sensemaking, shaping, seizing and transforming to respond to disruptive innovations.

6.3.1.1. Sensing and sensemaking capabilities

The analysis revealed that although there are specific functions in the organisation to carry out the sensing activities such as the Strategy and Research and Development departments, generally all specialists in departments and divisions across the organisation continuously scan, search, track and monitor threats and opportunities in the marketplace. Building capabilities can conduct these sensing capabilities (i) in networking, connect to the global innovation systems and gather information e.g. creating networks with research institutions, innovation hubs and business incubators, (ii) for collaboration e.g. with competitors, (iii) that support an intrapreneurial and entrepreneurial culture, (iv) in research and development for experimenting, monitoring, tracking and exploring innovations, and (v) detecting and assessing changes in the environment via market and risk analysis and conducting strategic reviews. Although this research suggests that sensing is outward looking i.e. external business environment, other scholars (Babelytė-Labanauskė & Nedzinskas, 2017) have found that sensing also includes inward looking activities like the identification of emerging internal opportunities. Hence electric utilities should widen their sensing capabilities to include both forward and inward looking activities to respond to the VUCA environment.

The dynamic capability theory (Teece, 2014a, 2018b, 2020) proposed that sensing activities are carried out at an organisational level generally by top management, but this research finds that sensing activities can also be carried out at an individual level or at a micro level i.e. specialists within departments who represent individuals in the organisation. This finding is similar to researchers Felin et al. (2012) who reported that individual level factors such as choices, abilities or cognition are key building blocks for understanding collective phenomena such as capabilities and routines of an organisation. Individuals make generally informed and rational choices and bring different human capital, such as skills, knowledge, experience, cognitive capacities and characteristics to an organisation. Variation in these dimensions may influence routines and capabilities that arise from organisational members and their interactions. Other researchers (Park et al., 2023) also found that low-level mechanisms such as learning by an individual employee can aggregate to firm level dynamic capabilities indicating a link between micro and meso activities in the strategising of an organisation. But meso level activities, for example, activities carried out by top management to respond to changes in the external environment such as influencing policies is also a link between meso and the macro level. Hence the dynamic capability theory can be broadened to account for capabilities that reside at micro, meso and macro levels.

Furthermore, the analysis revealed that managers and employees (who represent individuals in an organisation) mainly in the Strategy, Research and Development and Business Development functions utilise sensemaking capabilities to identify and assess threats and opportunities such as new innovations, business ventures and markets. The managers and individuals appear to use decision logic to identify and assess threats and opportunities for the electric utility. Electric utilities use decision logic in approaches such as market research, trend, competition, customer behaviour and SWOT analysis, technology monitoring and environmental scanning. After threats and opportunities are identified and assessed, sensemaking capabilities are used to make decisions to shape the opportunities or respond to threats and transform the organisation to adapt to environmental changes.

Whilst the dynamic capability theory (Teece, 2018b, 2020) appears silent on sensemaking as a micro foundation, other studies (Harvey, 2023; Mero & Haapio, 2022; Sakellariou & Vecchiato, 2022) affirmed these findings. For example, Mero and Haapio (2022) investigated how business to business firms steer through situations of uncertainty and elaborated that effectual decision-making logic is manifested in the activities that business to business entities use to sense and seize opportunities and threats and modify existing business. Effectuation reasoning can be classified into five categorises viz. (i) decision makers concern themselves with shaping the future by directing their efforts to factors that are within their control (Maine, Soh, & Dos Santos, 2015; Sarasvathy, 2001), (ii) the basis for taking action starts with a set of available means such as knowledge, skills and resources rather than business goals; the business goals arise when imagining courses of action with available means (Engel et al., 2017; Read et al., 2009), (iii) effectuation is focused on available loss rather than expected returns by avoiding investments that risk more than stakeholders can afford (Read et al., 2009; Sarasvathy, 2001), (iv) collaboration and knowledge sharing with partners plays a key role in shaping the trajectory of opportunities and reduces uncertainty (Sarasvathy, 2001) and (v) effectuation thrives on unexpected events as this gives rise to new opportunities (Read et al., 2009). But researchers (Jun et al., 2023; Zhang et al., 2023) also discussed the utilisation of causation decision-making logic in sensemaking which involves predicting and planning for specific outcomes in less dynamic environments and focuses on given goals and established plans. Causation is typically an ends driven decision-making logic. Some writers propose that the two logics i.e., causation and effectuation can coexist as they overlap and intertwine in different contexts of decisions and actions (Agogué et al., 2015; Zhang et al., 2023). They are positively correlated with each other, are not mutually exclusive, and the application of both decision-making logics can result in better firm performance rather than the application of a single logic.

Hence the dynamic capability theory can be expanded to include sensemaking as a dynamic capability and state-owned electric utilities should use both causation and effectuation decision logic for sensemaking. State-owned electric utilities can accomplish this via three modes of interaction (Galkina et al., 2022) i.e., (i) parallel use during alternative periods where one logic dominates the other and this results in switching from one logic to the other, (ii) hybrid synergy which emphasises simultaneous or ambidextrous use of causation and effectuation logic and (iii) resolving tensions because tensions can exist due to the use of different logics to achieve conflicting demands at the individual, organisational and interorganisational level. Tensions can be resolved by employing mechanisms of beforehand cushioning or reconciling the known with the unknown. For example, preparing in advance for a situation such as simultaneously calculating the expected returns, and estimating an acceptable loss for a situation where the expected returns were not realised.

Andries et al. (2013) elaborated on how the application of both decision-making logics can result in better firm performance and showed that, instead of committing to one business model as a response to turbulence in the business environment, entrepreneurs may look to various options, and develop many divergent search paths refining their choices as certainty unfolds. The researchers termed this learning strategy "simultaneous experimentation," an activity combining effectual experimentation with means such as causal planning and selecting business model experiments, thus balancing action with planning. Furthermore, Arvidsson and Coudounaris (2020) conducted a case study of a firm operating as a recruiter in the fast changing information technology sector and concluded that the reason that the firm survived was due to its ability to shift and re-shift its decision-making logic between causation and effectuation reasoning modes, therefore making it more adaptable to an uncertain future. These studies support the recommendation that sensemaking is a dynamic capability and state-owned electric utilities should use both causation and effectuation decision logic for sensemaking.

The analysis on state-owned utilities reinforces the findings of the coexistence of effectuation and causation decision logic as the electric utilities employed an integrated approach to respond to disruptive innovations (Section 6.2.2.2). This integrated approach entails making investment decisions for the existing business which is guided by causal logic and decisions for exploration such as adopting disruptive innovations and investing in research and innovation is guided by effectuation logic. Therefore, both types of decision logics coexist and may be used for responding to disruptive innovations.

The dynamic capability theory can be extended to include sensemaking as a micro foundation element. This advances the understanding of which firms require capabilities to respond to threats and opportunities in VUCA environments. This research also contributes to the resource based theory (Barney, 1991; Barney, 1995) by providing a source to heterogeneity. The resource based theory was criticised for its limited explanation on why and how firms gain a competitive advantage in rapidly changing business environments (Adner & Helfat, 2003; Lockett et al., 2009). The heterogeneity of resources assumes that a firm possesses unique resources, creating a competitive advantage. This research suggests that the simultaneous use of casual and effectuation decision-making logic can be a source of heterogeneity for firms as individuals make decisions, bringing different human capital to the organisation. Variation in these intangible resources influences the capabilities of a firm.

6.3.1.2 Shaping capabilities

The analysis indicated that employees (individuals) and managers in specific functions of the business carried out the activities of shaping the threats and opportunities for example the Regulation, Strategy, Business Development and Research and Development units. State-owned electric utilities can shape threats such as influencing policy and regulation decisions because the shareholder is the state and the state can create policies and regulations that protect the utility's monopoly. For example, Eskom can directly request for allocation of new power generation capacities such as renewable energy generation or large-scale battery projects, thereby shaping the threat of loss of market share and does not have to compete with independent power producers for market access. In addition, opportunities are shaped according to the ability of the utility to raise debt to fund the investment, skills, competencies, knowledge both internal and external to the organisation and shareholders and funders agreement and expectations. Although the analysis shows that the utility shapes opportunities and threats, it also indicates that shaping capabilities were used in seizing and transforming activities. For example, managing risks, investments and patents shaped the strategic direction of the utility. Shaping capabilities are used to transform or reconfigure the company which influenced the adaptation of the utility to the changing business environment. Shaping for transformation and reconfiguration of the business is influenced by all managers in all divisions and departments. For example, by modifying human resources such as upskilling and redeployment of employees, the utility could shape its competencies.

The dynamic capability theory explicates that dynamic capabilities are higher level activities and assessments that direct other capabilities and resources to maintain external fitness of the firm and summarises dynamic capabilities into three categories of activities that take place simultaneously in the organisation i.e. sensing, seizing and transforming or reconfiguration of the organisation (Teece, 2007, 2018b). Although Teece (2007) suggested that a firm senses and shapes opportunities and threats before undertaking activities to seize opportunities, over the years the author did not explicitly recognise shaping as a micro foundational element of dynamic capabilities (Teece, 2014b, 2018a, 2018b, 2020). This is contrary to the research analysis, which indicated that shaping is a dynamic capability that orchestrates strategic direction which drives competitive advantage of a firm. In addition, this research finds that shaping capabilities are not limited to only sensing activities as suggested by the theory (Teece, 2007) but is also used in the activities of seizing and transforming the business (Figure 15). Hence the dynamic capability theory can be broadened to include shaping as a dynamic capability.

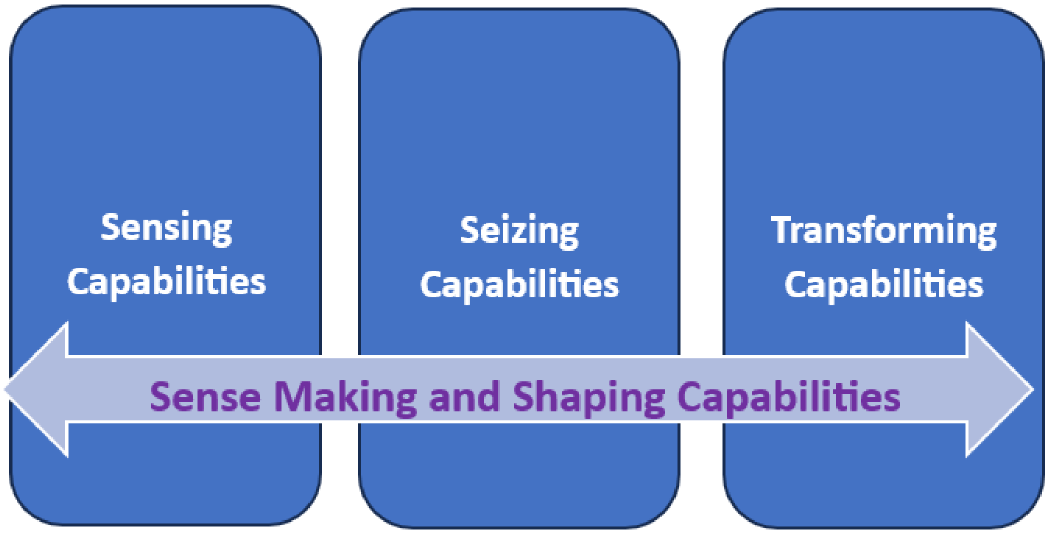

Figure 15: Dynamic capabilities from analysis

Literature suggested that shaping capabilities can be driven by a range of efforts and processes such as effectuation (Matlay, 2008), niche construction (Luksha, 2008), market formation (Lee et al., 2018) and shaping strategies (Nakapreecha et al., 2020). The findings of this research study reinforces the work of Felin and Powell (2016), who conducted a case study of Valve Corporation and recommended that managers build dynamic capabilities for sensing, shaping, and seizing new opportunities as well as creating new structures to respond to threats and opportunities in turbulent business environments. They discussed that sensing, shaping and seizing processes do not stop at the boundaries of the organization because discovering opportunities requires the firm to expand its capabilities beyond the firm in order to facilitate the free flow of information to and from the marketplace for example engagements with external stakeholders through open innovation.

In addition, the scholars recognised shaping as a dynamic capability and discussed that social proofs like self-selection and the “rule of three” served as valuable filtering and enabling devices that redefine and transform new ideas which in turn shapes market opportunities in the important period before the company makes strategic commitments. According to the authors, social proof is any mechanism of social influence that tends to produce coordinated behaviour among individuals and the primary mechanism of social proofs is self-selection. The “rule of three” is a novel solution that harnesses individuals’ capacities to sense and seize opportunities while providing behavioural incentives to coordinate activity and minimise inefficiency. According to this rule, one or two people acting alone could not move a project forward, but a group of three could receive the approval from management. However, the authors discussed shaping only in the context of opportunity shaping, contrary to this research's findings. This research finds that shaping capabilities are used during sensing, seizing and transforming activities to facilitate strategic direction.

This research also supports the study of Nenonen et al. (2019), who discussed shaping capabilities as being dynamic. The authors highlighted shaping capabilities in the context of firms possessing the ability to shape markets. Triggering and facilitating capabilities were identified as two distinct types of repeatable processes that together comprise the market shaping process. Thus, the dynamic capability theory can be extended to include shaping capabilities as a core element.

6.3.1.3 Seizing capabilities

The analysis indicated that state-owned electric utilities modified the organisation in order to seize opportunities for example a new Growth Office was created. This office consisted of a specialised team to undertake business development and commercial activities related to both intrapreneurial and entrepreneurial activities. The team connected with all departments, divisions and subsidiaries within the organisation via workshops, meetings, briefing sessions and conferences. Seizing opportunities comprised making investment in innovation and commercialisation activities for new products and services. For example, developing and exploiting patents and investing in new partnerships, joint ventures such as capital funds, startups, business incubators, consortiums, innovation hubs and intrapreneurial projects. When threats are sensed then seizing capabilities are used to respond. Generally, specialists and managers raised challenges that they believed the utility would likely face with executive management, who discussed these matters with the Board of the utility, Shareholder and respective government departments. Through the ability to negotiate, the utility was able to influence policy and regulation to protect the company. For example, when state-owned electric utilities were threatened by independent power producers entering the market, utilities were able to negotiate with the National Energy Regulators to have costs incurred fully recoverable from the tariffs. In the case of Eskom, executives and specialists were able to negotiate with National Treasury to receive bailouts for financial losses incurred. Hence, the ability to negotiate is a dynamic capability required to seize opportunities or defend against threats. Negotiations link the micro to meso and macro level as threats and opportunities are sensed at a micro level by specialist/ individual who raises these concerns to executives at meso level whom in turn negotiate at macro level i.e., national energy regulators and other governmental departments.

This research findings are similar to the work of Paavola (2021) who analysed transformational events between 1970 to 2012 of Itis shopping centre and found that firms responded to the changes that were being made by other firms within their network and broader business environment by transforming their operating procedures and creating a network of interactive influences through the ability to negotiate within their particular contexts. The Itis Shopping Centre housed a number of Finnish departmental stores such as Stockmann, Sokos, and Anttila. The scholars found that negotiations resulted in modifications to the terms of the contract, allowing the rent to be adjusted according to the store's sales. The idea for the profit-dependent price levels for the rents originated from the negotiations between Itis and Stockmann, as the latter was unwilling to enter the shopping centre with a fixed rent agreement. Anttila doubted its ability to expand and negotiated for a similar contract. Hence the ability to negotiate were found to be a dynamic capability as this skill enabled entities at the shopping centre to seize opportunities such as more suitable rental terms. Thus, the dynamic capability theory can be extended to include the ability to negotiate favourable terms for a firm as a seizing activity.

Furthermore, this research supports literature that described seizing capabilities as a dynamic capability which determines how quickly the organisation can respond to opportunities and threats once these have been sensed (Kump et al., 2019; Mero & Haapio, 2022; Teece, 2007, 2014b, 2020). Teece (2018a) pointed out that the activities involved in seizing opportunities include investing to commercialise new technologies, identifying and addressing capability gaps and designing, updating and implementing business models for new products and services. Similar to findings of this research on state-owned electric utilities, other authors (de Aro & Perez, 2021; Teece, 2020) also identified innovation capabilities as a separate dynamic capability to commercialise products and services. Hence, this research supports this literature by confirming that commercial and innovation activities are dynamic capabilities to seize opportunities.

Leemann and Kanbach (2022) used a systematic literature review method and categorised dynamic capabilities into three levels viz., level 1 dynamic capabilities included sensing, seizing and transforming, level 2 are dynamic sub-capabilities that categorize and organize all idiosyncratic dynamic capabilities found in the study, and level 3 refered to 240 identified idiosyncratic dynamic capabilities. The authors outlined seven dynamic sub-capabilities of seizing i.e. (i) building and adapting business models to reconsider value proposition and profit formulae, (ii) defining strategies and tactics to determine the strategic path of the firm and the strategic moves along that path, (iii) structuring evaluation and decision-making, (iv) acquiring and leveraging of resources, (v) entering new markets and technologies, (vi) joint venturing and partnering, and (vii) shaping ecosystems and markets. However, the findings of this research is contrary to the study of Leemann and Kanbach (2022). The authors categorisation into levels suggested that there is an order of superiority amongst elements of dynamic capabilities, but this research found no evidence of one type or single elements of dynamic capability having greater ability to achieve competitive advantage.

The present analysis indicated that for electric utilities to seize opportunities, they also require risk-taking abilities and abilities to quickly effect changes to the organisation. Hence risk-taking and agility are dynamic capabilities that are required to seize opportunities and this finding supports the literature (Barlette & Baillette, 2022) which reported that transformation of the organisation occurs simultaneously with seizing activities. Furthermore, the analysis showed that the ability to take risk is a dynamic capability that facilitates investment, allowing opportunities to be seized. The analysis indicated that state-owned utilities with higher percentages of state-ownership were more risk averse and had less entrepreneurial and innovation capabilities. For example, Eskom that is 100% state-owned, had no processes to commercialise innovations, no business or innovation incubators and was not offering new services or products related to disruptive innovations such as renewable energy, electric vehicle charging and energy storage. On the other hand, Électricité de France that is 83.6% state-owned possessed a commercialisation strategy, offered new products and services related to disruptive innovations such as offerings of solar rooftop photovoltaic systems, solar photovoltaic maintenance services, energy efficiency products and electric vehicle charging systems. In addition, Électricité de France had established business incubators and innovation hubs globally.

Varma et al. (2020) sampled 165 managers in the highly competitive Indian information technology industry and found that the forces of risk-taking and management control over everyday operations sometimes counterbalance and at other times magnify each other's impact. Similar to this research on state-owned electric utilities, Varma et al. found that in a fast-changing environment with high competition, dynamic capabilities such as innovation are supported by managers' risk-taking abilities, thereby assisting a firm in responding to change more effectively. Furthermore, Sen et al. (2020) found that the ability of management to have a broader perception of risk such as engaging in outsourcing activities and the ability to develop mature risk management mechanisms that would maximise the firm's opportunities whilst addressing the risk is a dynamic capability that enables the firm to act strategically and brings agility and adaptability in order to innovatively grab new opportunities by graduating from an ordinary capabilities mindset to a dynamic capabilities mindset. Hence electric utilities should build risk-taking capabilities as well as risk management mechanisms to respond in turbulent environments.

6.3.1.3 Transforming capabilities

The analysis showed that state-owned electric utilities are continuously transforming the organisation through five main areas to address changes in the business environment i.e., human resources, organisational structures, assets, processes and culture. Overall, the ability to collaborate across functions of the organisation is a dynamic capability required to implement changes that, in turn, result in the renewal of the organisation.

State-owned electric utilities are enhancing existing staff's skills and building new skills and competencies via training and development programmes, for example in data analytics, entrepreneurism, renewable energy grid integration and battery energy storage. New skills are also being acquired via the hiring of people with different skills sets to the existing business such as data analytics, energy storage, renewable energy and commercialisation of products. Whilst all departmental managers are responsible for the renewal of skills and competencies of their staff, the Corporate Human Resources Department is accountable for the overall headcount of the work force and renewal of skills and competencies of the organisation. All departments work in a collaborate manner with the Corporate Human Resources Department to coordinate and effect changes. New skills can also be acquired via buy out and partnering with startups as well as investments into new subsidiaries. For example, Électricité de France acquired Pivot a British start up in battery energy and electric vehicle infrastructure and established a new subsidiary called IZIVIA which specialises in applications for electric vehicle charging cards, installations, maintenance and management of fleet charging stations.

The electric utilities are reconfiguring the business by redeploying staff to new areas of growth, from coal stations that have shut down to new wind and solar plants. Early retirement packages were offered to staff to reduce headcount and renew with external staff possessing different skills and competencies.

Assets of the utility were modified to support the country’s transition to clean energy sources. For example, new nuclear reactors were designed to increase the ramping capabilities of reactors to quickly ramp down during periods of high availability of renewable energy on the grid and coal fired plants were modified to cofire with biomass to reduce the use of fossil fuels thereby decreasing air pollution and greenhouse gasses which mitigate climate change. Assets of the existing business was changed to embrace the new disruptive innovations, i.e. nuclear and coal plants were shut down earlier to make resources available for new assets that could generate clean energy. Whilst the Research and Innovation and Engineering functions worked in a collaborative manner to share knowledge and skills for the design of new nuclear reactors and conversion of coal fired stations to biomass, the

Corporate Strategy team and Group Chief Executive made the decision on what assets to modify and the timeline for implementation.

State-owned electric utilities are transforming existing organisational processes and procedures to respond to the turbulent business environment such as streamlining funding allocation processes for innovation activities that support partnerships with competitors, startups, manufacturers, customers and research institutes. The Research and Innovation processes have been modified to combine knowledge and skills from startups with in-house expertise to accelerate innovation and growth in the organisation. In addition, electric utilities developed new processes and procedures to execute the quick ramping up and down of nuclear plants, operate new biomass fired plants and integrate renewable energy plants onto the grid to adapt to the changing business environment. Specialised technical teams were set up to approve modifications or develop new organisational procedures and processes. The processes and procedures were the building blocks to implement changes in the organisation.

Furthermore, state-owned electric utilities have modified their organisational culture to become more entrepreneurial. Both Corporate Strategy and Human Resource teams collaborate to coordinate and drive changes in organisational culture. This can be done via roadshows to explain new strategic direction of the company, display leadership commitment, gather support for the changes, recognise and reward behaviours that reflect the desired culture and provide training to align to new values. For example, Électricité de France recognises achievements in innovation via its annual Pulse Awards. This programme encouraged collaboration and sharing of knowledge across functional teams to develop new concepts and compete for funds to advance the concepts into commercialised products or services.

Organisational structures were also changed to adapt the business and increase competitive advantage. This will be further elaborated on in Section 6.3.2 which discusses ambidexterity.

In general, this study finds that the ability to reconfigure skills and competencies, modify assets, processes and procedures, organisational culture and structures, and collaborate and coordinate across functions in the organisation are dynamic capabilities. These findings extend the Resource-based theory by providing explanations on how firms can transform resources to gain competitive advantages in VUCA environments (Adner & Helfat, 2003) and contribute to the development of a wider resource based theory perspective by suggesting that firms can achieve competitive advantage and respond to changes in the business environment not only by using existing assets but also by modifying, reconfiguring, realigning, building, coordinating, collaborating and transforming the tangible and intangible resources of the organisation. The results from the analysis concurs with the Teecian view that described transforming activities as dynamic capabilities required by the firm "to maintain competitiveness through enhancing, combining and, when necessary, reconfiguring the business enterprise's intangible and tangible assets" (Teece, 2007, p. 1320). The Teecian view explained that financial growth can be sustained via the ability to recombine and reconfigure assets and organisational structures as the firm experiences' changes. Reconfiguration is required to maintain evolutionary fitness and change strategic direction. But this accomplishment will result in the formation of routines, which is necessary for operational efficiency. When there is turbulence in the business environment these routines need to be modified in order for the firm to respond. Parting from routines tend to create anxiety within the organisation, hence the organisational culture should be shaped to accept high levels of change. The results from the analysis on transformation capabilities is also similar to Li and Liu's (2014, p. 2794) implementation capability, which is defined as "the ability to execute and coordinate strategic decision and corporate change, which involves a variety of managerial and organizational processes, depending on the nature of the objective".

Some authors (Sauser at al, 2018) emphasised that organisational culture can be reconfigured for responding to high levels of change by embedding quick decision-making into the fabric of the organisation and building tolerance towards failure from experimentation and learning from making errors. Others also advised that to shape culture, organisations should build capabilities in learning, development and inclusive decision-making (Santos et al., 2021). Hence managers from state-owned electric utilities can adopt these recommendations to build dynamic capabilities to reconfigure the culture in their organisation.

Contrary to the Teecian view (Teece, 2014a, 2018b, 2020), this research finds that transformation capabilities such as modifications to organisational processes and procedures do not only reside with top management i.e. meso levels but also reside at micro levels such as technical specialists who represent individuals in the organisation i.e. micro level. This can aggregate to firm level dynamic capabilities as strategic renewal of procedures and processes to respond to the changing external environment (Magistretti et al. , 2021), thus indicating a link between micro, meso and macro levels in the strategising of an organisation. Hence the dynamic capability theory can be expanded to account for capabilities that reside at micro, meso and macro levels.

6.3.2. Ambidexterity as a Response Tool

This section discusses ambidexterity theory as a tool for responding to disruptive innovations and expands Section 6.2.2.1 and Section 6.2.2.2 on strategic approaches.

Although various teams in the organisation provided insights for strategy development, the action of strategising is carried out by executives and board members and the emergent strategy is implemented in a top-down manner through workshops and roadshows.

The analysis indicated that state-owned electric utilities use an ambidextrous approach to respond to disruptive innovations however the speed to respond is slow and mainly reactive to most of the emerging disruptive innovations (discussed in Section 6.1.3). Électricité de France used a hybrid approach to simultaneously exploit the existing business i.e., (i) investing in the existing business with sustaining innovations like development of new nuclear reactors, converting coal fired stations into biomass fired stations, (ii) by adopting disruptive innovations like solar photovoltaics, wind and energy storage technologies as well as (iii) engaging in continuous innovation to compete against disruptive innovations and explore new opportunities such as development of light weight photovoltaic panels and floating offshore wind turbines. Light weight panels are cheaper than conventional panels as fewer supporting structures are required, are easier to installation, more versatile, have lower transportation costs and logistic processes are more efficient as delivering and handling is easier. Floating offshore wind turbines are cheaper than turbines that are anchored down to the seabed, can operate in deeper waters, have reduced environmental impacts, easier to install, can be strategically positioned to capture winds at optimal speed and direction and have lower maintenance costs as it can be towed back to shore for repairs.

Hence this research found state-owned electric utilities are responding to a wave of disruptive innovations in a VUCA environment by playing three games at once i.e., investing in the existing business, adopting disruptive innovations and competing against disruptive innovations. This finding extends earlier literature (Gans, 2016; Markides, 2013a) that found incumbents responded to disruptive innovations by playing two games simultaneously, i.e., simultaneously investing in the existing business whilst exploiting new business. For example, Markides and Oyon (2010) examined 42 incumbents that had created separate entities to play two games at once and found only 10 were successful. The successful incumbents had given the separate units more operational and financial autonomy than unsuccessful companies. The parent company closely monitored the separate units, whilst they were permitted to develop separate cultures, budgetary systems and appoint chief executive officers. Similarly, Osiyevskyy and Dewald (2015) researched the real estate brokerage industry and found that incumbents played two games and their explorative intentions were driven by opportunity perception, perceived performance-reducing threat, and risk experience. On the other hand, their exploitative intentions were negatively associated with perceived critical threat and industry tenure and positively associated with risk experience. In addition, Gao et al. (2020) examined incumbents in the metal and mining industry and concluded that incumbents played two games at once by beginning with exploitation activities and then gradually extending to exploration by adopting network capabilities both for execution of transformation activities, and for developing internal capabilities.

Hence the finding from this research that state-owned electric utilities can play three games simultaneously as a response to disruptive innovations extends the ambidexterity theory with a new concept and offers other incumbents a possible manner to respond to multiple disruptive innovations.

This ambidextrous approach was achieved by:

(i) creating structural separation – parallel structures such as joint ventures, wholly owned subsidiaries, innovation hubs and specialised internal business units to focus on exploration activities,

(ii) forming intra and inter-organisational alliances – such as collaborations between cross functional teams to explore new energy solutions. For example, the team responsible for pumped hydro storage plants collaborated with the chemical engineering team to explore new energy storage solutions. Intra organisational alliances entailed collaborations and, partnerships with joint ventures, consortiums, startups, research institutions, competitors and specialised businesses for exploration and adaptation activities,

(iii) building dynamic capabilities to accelerate exploration activities. The firm is able to sense opportunities by identifying and finding threats and opportunities, thereafter, shapes and seizes the opportunity through making investments or exploiting patents and then transforming the business in order to seize the opportunity or mitigate the threat and,

(iv) establishing dual executive management roles whereby executives simultaneously manage functions of the existing business and exploration activities. For example, the executive manageing the Research and Development division is also the Chief Technology Officer of the Électricité de France Group. The Research and Development executive manages the exploration activities such as innovation of the organisation as well as exploits the existing business by managing everyday operations of the information technology business. In addition, Mr Bruno Bensasson is the group senior executive vice-president for renewable energy in the organisation and manages the Renewable Energy Division in the parent company as well as the chairman and chief executive officer of the subsidiary, EDF Renouvelables, which carries out exploration of renewable energy solutions in new geographic locations. The Renewable Energy Division is responsible for the operations related to existing hydro plants and renewable energy plants in France.

Hence this research showed that state-owned electric utilities used hybrid ambidextrous approaches i.e., combining different modes at both the meso and micro levels to respond to multiple disruptive innovations. Also, the analysis showed that dynamic capability is a type of ambidextrous approach as well as capabilities that can be built at both the meso and micro levels to respond to disruptive innovations (discussed in Section 6.3.1.1 and 6.3.1.3). Thus, the ambidexterity and dynamic capability theories are beginning to converge. This hybrid approach is contrary to existing conceptualisations of ambidexterity which are largely based on separation strategies and extends the ambidexterity theory by offering a new perspective on how incumbents can achieve ambidexterity when responding to multiple disruptive innovations.

Similarly, Foss and Kirkegaard (2020b) examined William Demant Holding and discussed that different modes of ambidexterity can coexist in firms and within business units but termed this blended ambidexterity. The authors explained that companies may deliberately seek to achieve ambidexterity through structural and contextual ways at the same time. Structural meaning a division of labour in separate units to conduct exploration and exploitative activities and contextual meaning employees outside of dedicated explorative units can also engage in exploration e.g., encourageing innovation at the individual level for all employees through various innovation reward initiatives. However, the research findings from the case study of state-owned electric utilities showed that there are additional modes of ambidexterity and extends the research of Foss and Kirkegaard (2020b) by adding additional modes such as building dynamic capabilities, forming intra and inter-organisational alliances, and establishing dual executive management roles.

The authors discussed that although at a glance this type of ambidexterity approach may appear to bring additional tensions due to the paradox of simultaneously exploiting and exploring such as organisational design choices and leadership decisions, a blended approach can reduce such complexities by moving some tasks from contextually ambidextrous individuals to dedicated units and this has the potential to realise beneficial combinations of intrinsic and prosocial motivation in employees which supports creativity and innovation. However, a downside to combining different modes of ambidexterity is that employees may desire to engage in more explorative activities but could become unsure concerning the extent that they would be supported as their management pushes to move explorative tasks into separate units that are tasked with research and development activities. Hence, employees cut back on exploration activities and there is a danger that structural ambidexterity may crowd out contextual ambidexterity through this mechanism. Furthermore, the authors highlighted that combining different modes of ambidexterity may create a divided organisation as informal social networks become eroded. This suggested that there may be limits to how much structural or contextual ambidexterity a firm should drive to maximise benefits.

But, Papachroni and Heracleous (2020) argued that individual ambidexterity is central to manageing organisational tensions between exploration and exploitation tasks and understanding how individuals deal with these conflicting demands is key to resolving tensions. The scholars reasoned that previous assumptions of manageing tensions (March, 1991) were based on binary either/or approaches to manageing tensions at the individual level through structural or temporal separation but individual practices transcend these assumed contractions. Their research suggested that individual ambidexterity can be accomplished via paradoxical practices and identified three such practices i.e. engaging in hybrid tasks, capitalising cumulatively on previous learning, and, adopting a mindset of seeking synergies between the competing demands of exploration and exploitation. This approach to manageing tensions is grounded in practices of individuals and conceptualised exploitation and exploration as a dynamic duality rather than static contradictions. Hence tensions arising from hybrid ambidexterity should be treated as dynamic duality and interventions to address the challenges should be targeted at the individual level.

Other thinkers (Jöhnk et al., 2022) also found incumbents used hybrid approaches, in a combination of structural and contextual ambidexterity to launch multiple concurrent strategies as a response to several digital innovations. This is similar to the work of Foss and Kirkegaard (2020b) however the latter scholars defined contextual approaches as cultural change programmes and permitting employees to choose how they split their time between exploration and existing business tasks. This suggests that in a hybrid approach there can be different combinations of modes of ambidexterity. Furthermore, these researchers highlighted that companies could face increasing organisational tensions due to multiple concurrent responses to disruptive innovations which may cause competing concerns and interdependencies such as competition for resources. Thus, the authors recommended that incumbents manage the dichotomy of exploration and exploitative activities through interplay management as this leads to a complementary duality instead of a competing dualism in organisational ambidexterity. The suggested interplay management includes the management of the interaction between elements of strategic alignment, governance, strategic methods, people and culture in the organisation.

Hence the suggested modes of hybrid ambidexterity from the research of state-owned electric utilities extends the disruptive innovation theory as it indicates that incumbents should do more than creating separate structures and engaging in continuous innovation to respond to multiple disruptive innovations simultaneously. The resource based theory can be expanded by combining it with ambidexterity to explain how firms can use a combination of modes to respond to multiple disruptive innovations and sustain competitive advantages in a VUCA environment.

The following section discusses the conclusion to requestion question 3.

6.3.3 Conclusion of responses to Research Question 3

Research question 3 related to dynamic capabilities and ambidexterity as response tools. Overall, the analysis showed that state-owned electric utilities are using dynamic capabilities of sensing, sensemaking, shaping, seizing and transforming and hybrid ambidexterity modes to respond to disruptive innovations.

Whilst the sensing functionally responsibility resides with the organisational Strategy and Research and Development teams, specialists in all departments and divisions are continuously scanning, searching, tracking and monitoring threats and opportunities in the market. This is done by building capabilities to (i) network i.e. connect to global innovation systems and gather information, (ii) collaborate with competitors, (iii) develop an intrapreneurial and entrepreneurial culture, (iv) develop a strong research, development, and innovation function and (v) detect and assess changes in the environment. The research found that state-owned electric utilities should widen their sensing capabilities to include both forward- and inward-looking activities to respond to the VUCA environment.

The dynamic capability theory proposed that sensing activities are carried out at an organisational level generally by top management, but this research finds that sensing activities can also be carried out at an individual level or at a micro level i.e. specialists representing individuals in the organisation (Teece, 2014a, 2018b, 2020). Individuals make choices and bring different human capital to an organisation. Variation in these dimensions may influence routines and capabilities that arise from organisational members and their interactions. These low-level mechanisms can aggregate to firm level dynamic capabilities indicating a link between micro and meso activities in the strategising of an organisation. But meso level activities also link to macro activities such as top management influencing policies to shape the macro level. Therefore, the dynamic capability theory can be broadened to account for capabilities that reside at micro, meso and macro levels.

Furthermore, managers and employees representing individuals in the organisation mainly from the Strategy, Research and Development and Business Development functions used sensemaking capabilities to identify and assess threats and opportunities such as new innovations, business ventures and markets. Decision logic is used in approaches such as market research, trend, competition, customer behaviour and SWOT analysis. After threats and opportunities are identified and assessed again sensemaking capabilities are used to make decisions to shape the opportunities or respond to threats and transform the organisation to adapt to the changing environment.

Whilst the dynamic capability theory (Teece, 2018b, 2020) appeared silent on sensemaking as a micro foundation, other studies affirmed these findings (Harvey, 2023; Mero & Haapio, 2022; Sakellariou & Vecchiato, 2022). Some writers proposed that the two logics i.e., causation and effectuation can coexist simultaneously as they overlap and intertwine in different contexts of decisions and actions (Agogué et al., 2015; Zhang et al., 2023). The application of both decision-making logics can result in better firm performance rather than applying a single logic. So, the dynamic capability theory can be expanded to include sensemaking as a dynamic capability and state-owned electric utilities should use both causation and effectuation decision logic for sensemaking. The analysis of Eskom and Électricité de France revealed that both types of logic coexist as state-owned electric utilities use an integrated approach to respond to disruptive innovations, for example, causal logic guides investment decisions f,or the existence business and effectuation logic guides decisions for exploration, such as adopting disruptive innovations and investing in research and innovation. Thus, sensemaking is a micro foundation element that advances the understanding that firms require capabilities to respond to threats and opportunities in VUCA environments. This finding also contributes to the resource theory by providing a source to heterogeneity (Barney, 1991; Barney, 1995). This research suggests that the simultaneous use of casual and effectuation decision-making logic can be a source of heterogeneity for firms as individuals make decisions and bring different human capital such as skills, experience and competencies which varies. Variation in these intangible resources influences the capabilities of a firm.

The analysis showed that employees and managers in the Regulation, Strategy, Business Development and Research and Development units carried out activities of shaping threats and opportunities to disruptive innovations. State-owned electric utilities can shape threats such as influencing policy and regulation decisions because the company's shareholder is the state. Hence, state-owned electric utilities can be protected via policy to prevent market share and revenues loss. In addition, opportunities are shaped according to the ability of the utility to raise debt to fund investments, skills, competencies, knowledge and shareholders and funders agreement and expectations. Shaping capabilities were also used in seizing and transforming activities. Shaping for transformation or reconfiguration is influenced by all mangers in divisions and departments.

Initially Teece (2007) suggested that a firm senses and shapes opportunities and threats before undertaking activities to seize opportunities but over the years (Teece, 2014b, 2018a, 2018b, 2020) did not explicitly recognise shaping as a micro element of dynamic capabilities. This is contrary to the research analysis, which indicated that shaping is a building block element that orchestrates strategic direction which drives a firm's competitive advantage. Also, this research finds that shaping capabilities are not limited to only sensing activities as suggested by the theory (Teece, 2007) but is also used in the activities of seizing and transforming the business. So, the dynamic capability theory can be broadened to include shaping as a core element of dynamic capability.

The analysis indicated that state-owned electric utilities modified the organisation in order to seize opportunities for example a new Growth Office was created. Seizing opportunities consisted of making investments in innovation and commercial activities for new products and services e.g. developing and exploiting patents, joint ventures, and new partnerships. Generally, when threats are sensed, shaping and seizing capabilities are used to respond. This study found that the ability to negotiate is a core dynamic capability required to seize opportunities or defend against threats. Negotiations link the micro to meso and macro levels as threats and opportunities are sensed at a micro level by specialist/ individual in the organisation who raises these concerns to executives at meso level whom in turn negotiate at macro level i.e., national energy regulators and other governmental stakeholders. Therefore the dynamic capability theory can be extended to include the ability to negotiate as a core element required to seize opportunities and shape threats.

This research supported findings in literature (Kump et al., 2019; Mero & Haapio, 2022; Teece, 2007, 2014b, 2020) that described seizing capabilities to be a dynamic capability which determines how quickly the organisation can respond to opportunities and threats once these have been sensed. Although literature categorised dynamic capabilities into main groupings like sensing, seizing and transforming and suggested lower levels of ranking i.e. sub capabilities (Leemann & Kanbach, 2022), this research found no evidence of levels of superiority between dynamic capabilities.

The analysis indicated that risk-taking and agility are dynamic capabilities that are required to seize opportunities and this finding is supported by other workers (Barlette & Baillette, 2022). Also, electric utilities with higher percentages of state-ownership were more risk averse and had less entrepreneurial and innovation capabilities in the organisation. In VUCA environments, dynamic capabilities such as innovation are supported by managers' risk-taking abilities, thereby assisting a firm in responding to change more effectively (Varma et al., 2020).

Whilst all managers within the companies are responsible for the renewal of skills and competencies of their staff, the Corporate Human Resources Department is accountable for the headcount and renewal of skills. State-owned electric utilities are modifying the skills set in their business in four ways: by enhancing the skills of staff to build and integrate disruptive innovations; building new skills and competencies via training and development programmes; hiring of people with new skills sets; and acquisition and partnering with startups. The electric utilities are reconfigured through the redeployment of staff to new growth areas, e.g., from coal-fired stations to wind and solar plants. Staff were offered early retirement packages to manage headcount and renew the business with new skills. Assets were modified to support the transition to cleaner energy fuel sources, for example, nuclear reactors were designed to increase the ramping capabilities of reactors to accommodate periods of high renewable energy availability on the grid and coal stations were converted to biomass stations. The Research and Development and Engineering functions collaborated to share knowledge and skills to construct and operate new clean energy assets for the company, whilst the Corporate Strategy team and the Group Chief Executive made final decisions on what assets to modify and the timeline for implementation.

The Research and Innovation processes were modified to combine knowledge and skills from startups with inhouse expertise to accelerate growth and innovation. State-owned electric utilities developed new processes to integrate renewable energy plants onto the grid, new procedures to adapt the operation of existing plants to accommodate independent power producers and the changing environment. Processes and procedures were the building blocks to implement changes in the organisation.

Organisational culture was modified to become more entrepreneurial, driven by the collaboration of the Corporate Strategy and Human Resources teams. Change management was executed via roadshows, display of leader commitment, training, recognition and reward for changed behaviour.

The analysis showed that state-owned electric utilities are continuously transforming the organisation through five main areas to address changes in the business environment i.e., human resources, organisational structures, assets, processes and culture. Overall, the ability to collaborate across functions of the organisation is a dynamic capability required to implement changes, resulting in the renewal of the organisation.

These findings extend the Resource based theory by providing explanations on how firms can transform resources to gain competitive advantages in VUCA environments (Adner & Helfat, 2003) and contribute to the development of a wider resource based theory perspective by suggesting that firms can achieve competitive advantage and respond to changes in the business environment not only by using existing assets but also by modifying, reconfiguring, realigning, building, coordinating, collaborating and transforming the tangible and intangible resources of the organisation.

Contrary to the Teecian view (Teece, 2014a, 2018b, 2020), this research found that transformation capabilities such as modifications to organisational processes and procedures do not only reside with top management i.e., meso levels but also reside at micro levels such as technical specialists who represent individuals in the organisation. This can aggregate to firm level dynamic capabilities as strategic renewal of procedures and processes to respond to the changing external environment (Magistretti et al., 2021), thus indicating a link between micro, meso and macro levels in the strategising of an organisation. Hence the dynamic capability theory can be expanded to account for capabilities that reside at micro, meso and macro levels.

The action of strategising is carried out by executives and board members and the emergent strategy is implemented in a top-down manner through workshops and roadshows. The analysis indicated that state-owned electric utilities used an ambidextrous approach to respond to disruptive innovations; however, the speed to respond is slow and mainly reactive to most of the emerging disruptive innovations. State-owned electric utilities used a hybrid approach to simultaneously exploit the existing business by, investing in the existing business with sustaining innovations like development of new nuclear reactors, and converting coal fired stations into biomass fired stations; by adopting disruptive innovations like solar photovoltaics, wind and energy storage technologies; as well as engaging in continuous innovation to compete against disruptive innovations and explore new opportunities.

Hence this research found state-owned electric utilities are responding to a wave of disruptive innovations in a VUCA environment by playing three games at once. This finding extends earlier literature (Gans, 2016; Markides, 2013b; Osiyevskyy & Dewald, 2015) that found incumbents responded to disruptive innovations by playing two games at once i.e., simultaneously investing in the existing business whilst exploiting new business. This finding also extends the ambidexterity theory with a new concept and offers other incumbents' choices to respond under multiple disruptive innovations.

The hybrid ambidextrous approach can be achieved by creating structural separation, forming intra and inter-organisational alliances, and building dynamic capabilities to accelerate exploration activities and establishing dual executive management roles. Hence this research showed that state-owned electric utilities used hybrid ambidextrous approaches i.e., combining different modes at both the meso and micro levels to respond to multiple disruptive innovations. Also, the analysis showed that dynamic capability is a type of ambidextrous approach as well as capabilities that can be built at both the meso and micro levels to respond to disruptive innovations. Thus, the ambidexterity and dynamic capability theories are beginning to converge. This hybrid approach is contrary to existing conceptualisations of ambidexterity which are largely based on separation strategies and extends the ambidexterity theory by offering a new perspective on how incumbents can achieve ambidexterity when responding to multiple disruptive innovations. However, there may also be disadvantages associated with hybrid ambidexterity approaches such as limitations for all employees to participate in explorative activities as management seeks to create separate structures for exploration. So, employees in other parts of the existing business cut back on exploration activities and there is a danger of structural ambidexterity crowding out contextual ambidexterity. Furthermore Foss and Kirkegaard (2020a) highlight that combining different modes of ambidexterity may create a divided organisation as informal social networks become eroded and other writers (e.g.Jöhnk et al., 2022) also discussed that multiple modes of ambidexterity could cause tensions due to competition for resources. Papachroni and Heracleous (2020) advise that hybrid ambidexterity should be treated as dynamic duality and interventions to address the challenges should be aimed at the individual level, while others suggested that the dichotomy of exploration and exploitation should be resolved through interplay management which entails manageing the elements of strategic alignment, governance, strategic methods, people and culture in the organisation (Jöhnk et al., 2022).

Consequently, the suggested modes of hybrid ambidexterity from the research of state-owned electric utilities extends the disruptive innovation theory as it indicates that incumbents should do more than creating separate structures and engaging in continuous innovation to respond to multiple disruptive innovations. The resource-based theory can be expanded by combining it with ambidexterity to explain how firms can use a combination of modes to respond to multiple disruptive innovations and sustain competitive advantages in a VUCA environment.

The conceptual framework (Figure 16) illustrates the conclusions for Research Question 3.

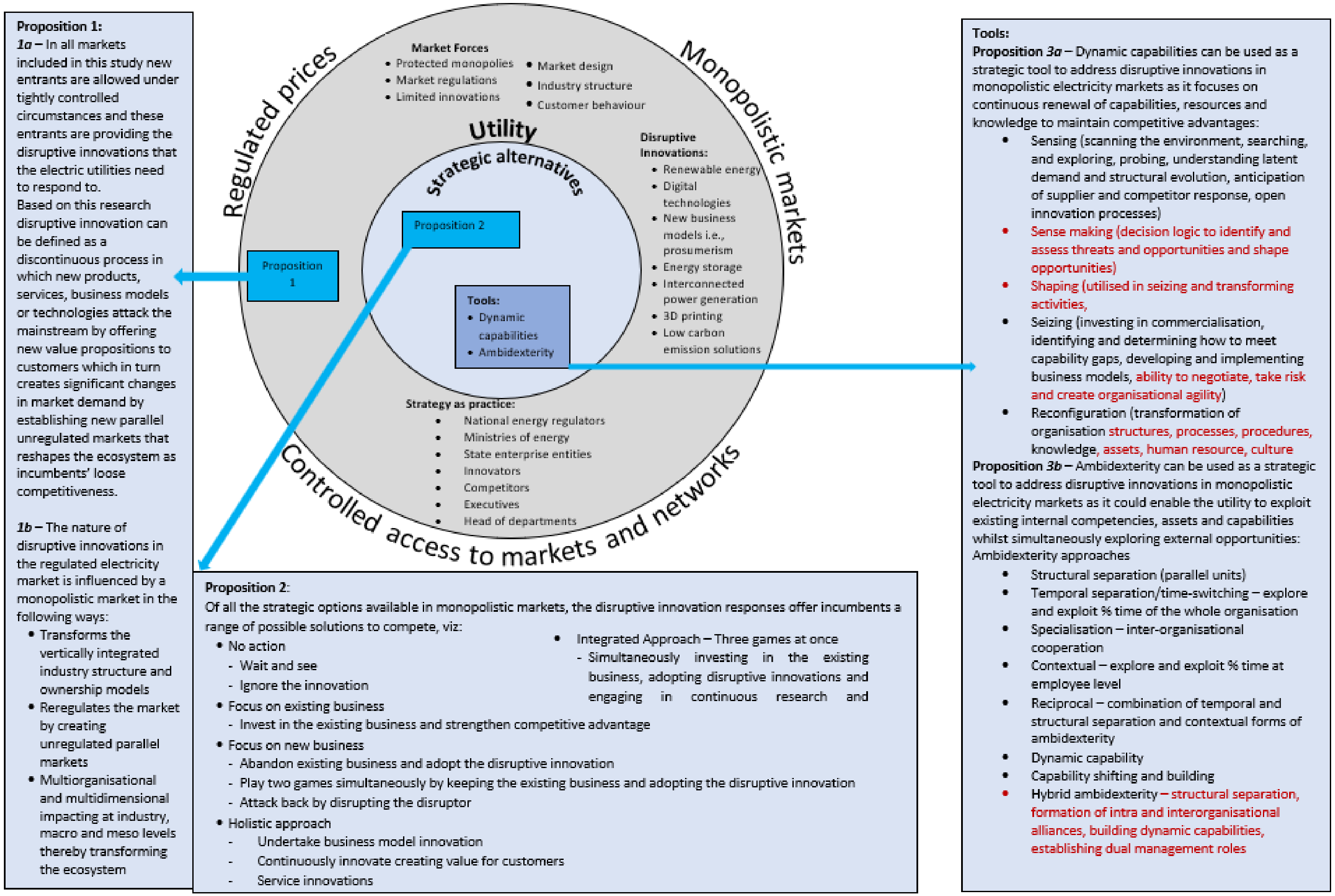

Figure 16: Conceptual Framework for Research Question 3

CHAPTER 7 CONCLUSION & RECOMMENDATIONS

Electric utilities are facing a threat to their current business due to a wave of disruptive innovations co-occurring in several sectors at the same time. Although the phenomenon of disruptive innovations was coined more than two decades ago by the late Professor Clayton Christensen, the core underpinnings had remained the same and there has been little agreement amongst scholars on how incumbents should respond to a wave of disruptive innovations. The failure of electric utilities to respond to a wave of disruptive innovations would lead to loss of revenues and profitability which would be of national interest since electricity usage is coupled with economic growth and unserved energy would have negative impacts on the lives and livelihoods of the citizens of the country. This study used a qualitative multi case study approach to explore market dynamics and investigate possible strategic responses to threats and opportunities from disruptive innovations in regulated markets.

This chapter concludes the research by outlining the theoretical, methodical and empirical contribution and its practical relevance, listing the limitations of the study and recommending areas for further research.

7.1. Theoretical contributions

This study has contributed to furthering understandings of disruptive innovation, resource-based and dynamic capability theories, ambidexterity, and strategy as practice perspectives.

After exploring the market dynamics, this research proposed a new definition of *disruptive innovations* for the electricity industry i.e. "**a discontinuous process in which new products, services, business models or technologies attack the mainstream by offering new value propositions to customers which in turn creates significant changes in market demand by establishing parallel markets that reshape the ecosystem as incumbents lose competitiveness".**

The disruptive innovation theory is silent on how companies with dual mandates can survive and thrive when faced with multiple disruptive innovations. This study extended the disruptive innovation theory by adding the concept of coopetition to increase overall value creation in companies with dual mandates so that they can support and compete with disruptive innovations.

The study expanded the literature by outlining the types of disruptive innovations in the electricity market which the electric utilities need to respond to i.e. renewable energy, energy storage, digital technologies, 3D printing, low carbon emitting technologies, interconnected power generation systems and new business models such as prosumerism. The literature was further extended by explicating the nature of disruptive innovations in regulated markets. Disruptive innovations were found to be multi-organisational and multi-dimensional in nature impacting at the industry, macro and meso levels thereby transforming the entire ecosystem through first, the modification of the vertically integrated structure of the industry, secondly, mergers and acquisitions and creation of new types of markets, competitors and customers at a macro level, and thirdly, creating new subsidiaries with new ownership structures at a meso level. Thus, the literature was expanded from the view that disruption only occurs at a firm and market level. The multiple innovations in the regulated market are simultaneously disrupting the ecosystem at various levels via concurrent interconnected actions throughout the ecosystem. This shifts the literature from the view that disruption takes place in a linear manner only impacting the incumbent.

This study found that disruptive innovations have the ability to reregulate the electricity market by creating parallel markets such as unregulated prices for electricity and new unregulated concepts such as wheeling of electricity. Hence disruptive innovations ignored existing regulations and grew to create unregulated markets, eventually reducing incumbents' market share. This broadens the disruptive innovation theory to account for the nature of disruptive innovations in regulated markets. But, not all disruptive innovations were found to be necessarily cheaper and more accessible than main stream products as suggested by the disruptive innovation theory (Si & Chen, 2020) because energy produced from nuclear and coal sources were found to be cheaper than large scale renewable energy when total system costs to deliver the electricity to the end user were considered. Hence, this research proposes that there are many pathways to disruption. The surge of disruptive innovations has created a business environment with VUCA conditions, and electric utilities need to reposition themselves and respond to the threats and opportunities from disruptive innovations.

This research widened the domains for strategy as practice research by extending the levels of praxis from micro, meso, and macro to include an industry level (Jarzabkowski & Spee, 2009). This extension increased the original topology of nine possible domains for strategy as practice research to eleven. Two new domains can be created to focus on research where individual organisational practitioners act intersubjectively with the industry environment and aggregate organisational practitioners act intersubjectively with the industry environment. This is important as industry level praxis can contribute to the multiple levels of action and interaction that needs to be considered by practitioners during strategising and moves strategising actions beyond the firm to incorporate wider practices in society.

The study improved our understanding of response types by clarifying that a response type is not either/or as suggested in literature (Jin & Shin, 2020; Kumaraswamy et al., 2018) but can be both reactive to some disruptive innovations and proactive to others. Therefore, this research contributes to the understandings of the disruptive innovation theory by clarifying the types of responses that will guide incumbents on their choices when responding to multiple disruptive innovations.

Furthermore, the study extended the literature on disruptive innovation theory to account for multiple disruptive innovations by suggesting that incumbents respond in an integrated manner that involves playing three games at once i.e., investing in the existing business with sustaining innovations, adopting disruptive innovations, and competing against disruptive innovations. This expands the existing literature as it suggested a combination of actions rather than a choice of only one action at a time (Gans, 2016; Markides, 2013a). Thus, the disruptive innovation theory can be broadened to account for multiple disruptive innovations by using an integrated response.

The dynamic capability theory (Teece, 2014a, 2018b, 2020) proposed that sensing activities are carried out at an organisational level generally by top management, but this research found that sensing activities can also be carried out at an individual level or at a micro level. These low-level mechanisms can aggregate to firm level dynamic capabilities indicating a link between micro and meso activities in the strategising of an organisation. But meso level activities also link to macro activities such as top management influencing policies to shape the macro level. Therefore, this research broadened the dynamic capability theory.

The dynamic capability theory was extended to include sensemaking and shaping as micro foundations which furthers our understanding on which capabilities firms need to build in order to respond to disruptive innovations and maintain competitive advantages under VUCA conditions. This finding also contributed to understanding the resource-based theory by providing a source to heterogeneity (Barney, 1991; Barney, 1995). This research suggested that the simultaneous use of causal and effectuation decision-making logic can be a source of heterogeneity for firms as individuals make decisions and bring different human capital such as skills, experience and competencies which varies.

Originally Teece (2007) reported that shaping is a dynamic capability used during sensing to shape opportunities and threats before seizing opportunities. This study extended the dynamic capability theory by clarifying that shaping capabilities are used not only during sensing and seizing opportunities but also to influence or shape transformation or reconfiguration of the firm.

In addition, this study found that the ability to negotiate is a core dynamic capability required to seize opportunities or defend against threats. This finding extends our understanding on the theory by adding a new construct and clarifying which capabilities are required to respond to disruptive innovations. Negotiations link the micro to meso and macro levels therefore the dynamic capability theory can be extended to capabilities beyond the meso level and this improves our understanding on the action of strategising. Moreover, the study reaffirms that risk-taking and agility are dynamic capabilities required to seize opportunities.

The research also improves our understanding of the dynamic theory by identifying the main capabilities that a firm needs to transform the organisation, i.e., human resources, structures, assets, processes and culture. The study identified the ability to collaborate across functions of the organisation as a new dynamic capability which expands the dynamic capability theory. These findings extended the Resource based theory by providing explanations on how firms can transform resources to gain competitive advantages in VUCA environments (Adner & Helfat, 2003) and contributed to the development of a wider resource based theory perspective by suggesting that firms can achieve competitive advantage and respond to changes in the business environment not only by using existing assets but also by modifying, reconfiguring, realigning, building, coordinating, collaborating and transforming the tangible and intangible resources of the organisation.

This study clarified that transformation capabilities such as modifications to organisational processes and procedures reside not only with top management i.e. meso levels but also at micro levels. This can aggregate to firm level dynamic capabilities as strategic renewal of procedures and processes to respond to the changing external environment (Magistretti et al., 2021), thus indicating a link between micro, meso and macro levels in the strategising of an organisation. For this reason, the dynamic capability theory can be expanded to account for capabilities that reside at micro, meso and macro levels.

This research also extended the ambidexterity view by building on the concept of hybrid ambidexterity which offers incumbents further options to respond to multiple disruptive innovations. The ambidexterity view is extended by adding the concept that different modes of ambidexterity can be combined at both the meso and micro levels to respond to changes in the business environment. The study presented an alternative combination of modes within the hybrid ambidexterity approach.

7.2. Practical contributions and relevance

Due to the role that state-owned electric utilities play in economies i.e. dual mandate of commercial and developmental objectives, electric utilities should be positioned to both support and compete against disruptive innovations by incorporating coopetition strategies such as partnering to launch new businesses and engaging in research and innovation. The cooperation aspects pool collective interests to create greater value and coexists with the competitive part to accentuate private gains from the value created (Seepana et al., 2020).

This research suggested that an integrated approach of playing three games at once is a more appropriate response to a wave of disruptive innovations. Electric utilities can achieve this by first, investing in the existing business with sustaining innovations to improve efficiencies and retain existing customers, whilst at the same time, adopting disruptive innovations which have emerged in the market to offer new products and services and finally, investing in continuous research and innovation to compete with disruptors. An integrated approach would allow electric utilities to both defend against threats and take advantage of opportunities.

Furthermore, ambidexterity and dynamic capability can be used as tools by electric utilities to effectively strategise under VUCA conditions. Dynamic capabilities should be built to support sensing, sensemaking, shaping, seizing and transforming the organisation to retain competitive advantages and market leadership. Electric utilities should widen their sensing capabilities to include both forward- and inward-looking activities to respond to disruptive innovations and build strong negotiation abilities to seize opportunities and defend against threats.

In addition, risk-taking, and organisational agility are dynamic capabilities that are required to seize opportunities. State-owned electric utilities are encouraged to move away from 100% state-ownership and introduce minority shareholding for private entities as this will support a risk-taking and entrepreneurial culture. Electric utilities can continuously transform their organisation to respond to changes in the environment through modification and reconfiguration of human resources, organisational structure, assets, processes and culture.

Moreover, electric utilities can also use a hybrid ambidextrous approach to respond to a wave of disruptive innovations. This may be achieved by simultaneously combining different modes at both the meso and micro levels such as creating structural separation, forming intra and inter-organisational alliances, building dynamic capabilities to accelerate exploration activities and finally, establishing dual executive management roles.

This research has contributed to the understandings of the nature of disruptive innovations in regulated markets and makes national energy regulators aware that new codes and regulations need to be developed to consider both the regulated and unregulated markets inorder to be fair to all participants in the market. Energy consumers can circumvent monopolies to adopt disruptive innovations that do not require infrastructure such as off grid systems. Hence, national energy regulators need to consider an inclusive balanced approach of the entire ecosystem when designing new market models, shaping the development and adoption of disruptive innovations and not just the macro environment. Furthermore, regulators have a huge role to play in shaping how disruptive innovations impact regulated monopolies and regulated monopolies can only succeed if they are pre-emptively responding to what regulators are going to prioritise.

The research also highlights to the national energy regulator and various government departments that when disruptive innovations emerge, the structure of the industry and ownership of entities is likely to change. Therefore, new regulatory frameworks need to take a balanced approach to permit electric utilities to support and compete with innovations in the market.

7.3 Empirical contributions

Empirically this study has contributed to evidence to support and extend the underpinnings of the disruptive innovation, resource based and dynamic capabilities theories as well as strategy as practice and ambidexterity perspectives. Evidence was collected from two state-owned electric utilities representing developed and developing countries which enriched the data as it permitted the phenomenon of disruptive innovations to be studied in different contexts and increased the credibility of this study. These cases were information rich and produced similar and contrary predicable findings and reasons.

7.4. Methodological contributions

Methodologically this research has contributed to an alternative way in analysing data for case studies. The integrated analysis used in this study extended the manner from the common methods of using within case and cross case analysis to a method which includes the examination of emerging themes, constructs and issues in an unrestricted manner i.e. not confined to each research question or theory during the analysis. In conventional methods the emerging themes from the individual case evidence is used to inform the themes in the cross-case analysis per research question or theory (Takahashi & Araujo, 2020). The unrestricted manner allowed for themes and constructs to be holistically analysed and integrated to answer the study's research questions. This type of case study analysis assisted to develop a more robust and well-rounded interpretation of the case under investigation which lent itself to theory building.

7.5 Limitations of the study

The context, research design and methods employed to enable the study’s contribution to theory, scholarship and practice can be seen as its limitations:

(i) The study did not include interviews with Board members and shareholders who may have different perspectives to executives in utilities and regulators. These insights may yield different recommendations for response strategies.

(ii) Language was a barrier to the population size and sample size. Only two countries were used in this study and the implication is that the results cannot be generalised to a wider population, even though they are likely to have wider applicability and relevance in other developed and developing countries.

(iii) Disruption is not static and a large scale longitudinal study of responses to disruptive innovations would be essential to validate the research results to a wider populace.

(iv) Generally, interviewing participants at work could lead to bias responses as participants may be reluctant to share honest or critical feedback. However, in this research participants were open minded and critical as required. Furthermore, the participants chose where they wanted to be interviewed and were also assured of confidentiality by the researcher.

7.6 Suggestions for future research

The delimitations, limitations, assumptions, and contributions of the study have alluded to potential areas for further research that may be of both scholarly and practical value. Some of these are listed below:

(i) Implementation factors such as risks can be investigated as this can improve the success of achieving strategies and create new knowledge on how to effectively respond to multiple disruptive innovations. For example, employee resistance, cultural misalignment, insufficient resources, communication failures, leadership management and stakeholder management can have an impact on achieving strategies. Investigating implementation factors could further enhance our understanding of the disruptive innovation theory.

(ii) The agency and stakeholder theories can also be examined to give further insights on how electric utilities can respond to disruptive innovations. For example, researching principal-agent relationships such as how incentives of managers should be aligned with long-term goals of shareholders to encourage investment in disruptive innovations. Agency theory can assist to design mechanisms to manage risk aversion as utilities are risk averse and prefer investment into sustaining innovations rather than disruptive innovations. Stakeholder theories such as the concept of engaging with a diverse range of stakeholders can provide valuable insights into unserved needs and emerging market trends which could influence how an electric utility responds to disruptive innovations. The implementation of disruptive innovations in an organisation requires support from various stakeholders and understanding stakeholders concerns or reasons for resistance could enhance the acceptance of strategies for disruptive innovations.

(iii) Electric utilities are facing several challenges besides disruptive innovations, such as increasing debt levels, theft of assets and equipment, cyber security threats, and compliance with environmental regulations. Further research can be undertaken to develop new understandings of how the utility's challenges can be simultaneously addressed whilst responding to disruptive innovations to set the utility on a sustainable path.

(iv) This study recommends that electric utilities employ coopetition strategies to both support and compete against disruptive innovations. Therefore, an examination of optimal coopetition strategies including the relationship between electric utilities and stakeholders in addressing complex challenges and risks will be of value to managers and policy-makers.

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Annexure A: The Interview Guide For The Electric Utility

Introduction: The paragraph below will be read out verbatim prior to the start of the interview.

This study investigates strategic responses to disruptive innovations in regulated markets utilising case studies of electric utilities. Your knowledge and experiences as a senior executive will add immense value and insight into this study. Your participation is strictly confidential and voluntary. I will be recording our discussion with my phone as well as taking notes. Please let me know if you I have your consent for this.

This is usually done to preserve your words and thoughts and for accurately, recalling and keeping track of the information collected. Subsequently the recording will be transcribed, coded and analysed by me. Thereafter all recordings will be destroyed to conceal your identity and maintain confidentiality. All summaries and preliminary results will be shared with you. Your participation is important to me but should you be uncomfortable with any questions please let me know and we can stop. You will not be prejudiced in any way and you should feel free to ask me questions about the study at any time. If you are ready, then we can begin.

Interview Questions	Literature Guide
Section 1: Understanding the context in which the utility operates, what is the strategic intent of electric utilities and how these objectives are measured.	
1.1. How does your utility operate in this country i.e. your policy and regulation?	Understanding the context in which the utility operates
1.2. How is the electricity industry structured in this country?	Understanding the context in which the utility operates
1.3. Who are your main competitors?	The main role of state owned electric utilities is to provide universal access to energy (Lazaroiu et al., 2017). Social welfare and economic growth are primarily the key drivers for state owned electric utilities (Mazer, 2007; Power et al., 2016).

Interview Questions	Literature Guide
1.4. Describe the strategic intent of this utility?	"Strategic intent" is defined as the obsession with winning and beating a competitor (Hamel & Prahalad, 1990). Authors Hamel and Prahalad (1993) and Sitkin, See, Miller, Lawless, and Carton (2011) describe strategic intent as a "stretch" as it is considered to be a misalignment between current resources and capabilities to reach seemingly unattainable goals.
1.5. How are existing resources and capabilities being aligned to achieve the vision of this utility?	Strategic intent allows a firm to think beyond its current restrictions to achieve its goals (Elaydi & Harrison, 2010).
1.6. What system and processes are used to measure strategic intent in this utility and what do you measure?	Strategic intent perspective relates to whether a firm has an ambitious goal, makes that strategic goal its foremost priority, makes rational choices and has a decision making role for its senior manager (Rui & Yip, 2008). Performance measurement and management includes the recording of present levels of performance and comparing it with a desired state and it also communicates the strategic intent of a firm together with information on what the firm has prioritised (Melnyk, Bititci, Platts, Tobias, & Andersen, 2014)
Section 2: Understanding why electric utilities need a response to disruptive innovations	
2.1. Why do you think electric utilities need to respond to disruptive innovations?	Extant literature (Barney, 2014; Birkinshaw et al., 2016; Christensen et al., 2015b; Porter & Heppelmann, 2015; Teece & Leih, 2016) appears primarily focused on non-regulatory business which is mainly driven by profit maximisation and assumes that all incumbents are in pursuit of long term survival and maintaining competitive advantages. Due to the rapidly decreasing costs of distributed renewable electricity generation systems and energy storage systems, centralised power systems are no longer a necessary condition of universal access to modern energy services (Levin & Thomas, 2016; Wainstein & Bumpus, 2016).

Interview Questions	Literature Guide
2.2. What innovations are causing disruptions in the electricity market	A surge in rooftop solar installations leads a wave of disruptive innovations in energy markets that manifests as disruptive competition and challenges for utilities (Agnew & Dargusch, 2015; Felder & Athawale, 2014).
2.3. Do you look for innovations to make your business obsolete?	Innovation is a process through which industries revolutionise the economic structure from within, destroying the old one and creating a new one (Schumpeter, 1942).
Section 3 : Understanding how utilities are responding to disruptive innovations	
3.1. How have you adapted or changed your business to respond to disruptive innovations?	When faced with disruptive innovations incumbents always flee from entrant attacks rather than fight them (Christensen & Raynor, 2003, p. 31). The only way to respond to disruptive innovations the disruption is to accept it and exploit it by creating autonomous units and launching several new growth businesses early when the firm is still healthy (Christensen, 1997, 2013).
3.2 How do you plan to become a disruptor?	The strategy to disrupt the disruptor is a proactive response (Alpkan & Gemici, 2016; Gans, 2016).
3.3. What motivated this response to change or adapt?	How a company responds to disruptive innovation depends on its motivation and ability to do so (Charitou & Markides, 2003).
3.4. How were roles and responsibilities changed to explore new opportunities?	The only way to respond to disruptive innovations the disruption is to accept it and exploit it by creating autonomous units and launching several new growth businesses early when the firm is still healthy (Christensen, 1997, 2013).
3.5 What type of innovations have you produced?	"The very best sustaining companies systematically ignore disruptive threats and opportunities until the game is over " (Christensen & Raynor, 2003, p. 40). Engage in continuous innovation that creates value for the customer (Denning, 2016). The disruption theory predicts that incumbents will defend sustaining innovations by trying to eliminate a competitor by ignoring or fleeing upmarket when threatened by disruptive innovations (Denning, 2016).
3.6. What is the utility's operating model and what	Disruption is a theory of competitive response which can be used to inform strategy (Denning, 2016).

Interview Questions	Literature Guide
are your lessons learnt from this choice?	
3.7. What unexpected consequences did you get from implementing or launching these innovations?	
3.8. To what extent did your response strategy involve partnering or buying out the competitor?	Incumbents should not attack but buy or partner with the disruptor (Gans, 2016; Markides, 2006).
3.9. To what extent was existing capabilities, skills and competencies considered in the response strategy?	Incumbents seem to be restrained by their previous successes associated with the old technological paradigm as their existing skills, processes and operating procedures restrict their ability to respond effectively (Tushman & Anderson, 1986).
3.10. What lessons did you learn from your choice of response to disruptive innovations?	
Section 4: Understanding what strategies electric utilities have used to become ambidextrous	
4.1 What strategies have you used to take advantage of new opportunities whilst focusing on existing business?	Adaptation is a response strategy in rapidly changing business environments (March, 1991). Mechanistic and organic structure are difficult to reconcile within a single firm (Ford & Ford, 1994; Lewis, 2000).
4.2 How were roles and responsibilities changed to explore new opportunities whilst exploiting existing business?	The ambidextrous perspective requires firms to exploit existing (internal) competencies and assets as well as explore new external opportunities to maintain a competitive advantage (Sollosy, 2013).
4.3 How were assets changed to explore new opportunities whilst exploiting existing business?	The ambidextrous perspective requires firms to exploit existing (internal) competencies and assets as well as explore new external opportunities to maintain a competitive advantage (Sollosy, 2013).
4.4 How were synergies created between the different business units to	The paradox of having separate organic structures to craft innovations and mechanistic structures to action and deploy them can be resolved by merging both structures

Interview Questions	Literature Guide
craft innovation and deploy innovative products or services?	(Adler et al., 1999; Jansen, Van den Bosch, & Volberda, 2005; Sheremata, 2000).
4.5 What were the unexpected challenges experienced or lessons learned from choosing this strategy, operating model, or structure?	
Section 5: Understanding which dynamic capabilities are required for responding to disruptive innovations	
5.1. Describe what new capabilities were developed to adapt or innovate. These capabilities are beyond the business as usual existing capabilities.	(Teece, 2014b) describes ordinary capabilities as the ability to attain technical efficiency and doing things right in the core business of operations, administration and governance whereas dynamic capabilities are about adapting, orchestrating and innovating.
5.2. Describe the capabilities used to sense and shape opportunities and threats.	(Teece, 2007) categorises the capacity to sense and shape opportunities and threats as a dynamic capability.
5.3. Describe which capabilities are used to seize and prioritize opportunities.	(Teece, 2007) categorises the capability to seize opportunities as a dynamic capability.
5.4. Describe which capabilities are used to maintain competitiveness. This could be through enhancing, combining, protecting, reconfiguring or transforming internal and external competencies.	(Teece, 2007) categorises the capability to maintain competitiveness through enhancing, combining, protecting, reconfiguring or transforming internal and external competencies as a dynamic capability.
5.5. What did you stop doing or which capabilities were realigned or replaced?	Dynamic capabilities are higher level activities which allow an organisation to direct its ordinary activities towards high-payoff actions that exploit internal and external competencies (Teece, 2014b)
5.6. Describe how your strategy and resources are difficult to imitate by competitors.	Success is only attained by developing dynamic capabilities together with a good strategy that is grounded by difficult to imitate resources (Teece, 2007).

Interview Questions	Literature Guide
Section 6: Close and wrap up Thank the participant and create room for follow up.	

Annexure B: The Interview Guide for The National Energy Regulator

Introduction: The paragraph below will be read out verbatim prior to the start of the interview.

This study investigates strategic responses to disruptive innovations in regulated markets utilising case studies of electric utilities. Your knowledge and experiences as a senior executive will add immense value and insight into this study. Your participation is strictly confidential and voluntary. I will be recording our discussion with my phone as well as taking notes. Please let me know if you I have your consent for this.

This is usually done to preserve your words and thoughts and for accurately recalling and keeping track of the information collected. Subsequently the recording will be transcribed, coded, and analysed by me. Thereafter all recordings will be destroyed to conceal your identity and maintain confidentiality. All summaries and preliminary results will be shared with you. Your participation is important to me but should you be uncomfortable with any questions please let me know and we can stop. You will not be prejudiced in any way and you should feel free to ask me questions about the study at any time. If you are ready, then we can begin.

Interview Questions	Literature Guide
Section 1: Understanding the context in which the utility operates, what is the strategic intent of electric utilities and how these objectives are measured.	
1.7. How does your utility operate in this country i.e. your policy and regulation?	Understanding the context in which the utility operates
1.8. How is the electricity industry structured in this country?	Understanding the context in which the utility operates
1.9. Who are the main competitors for electricity supply and distribution?	The main role of state owned electric utilities is to provide universal access to energy (Lazaroiu et al., 2017). Social welfare and economic growth are primarily the key drivers for state owned electric utilities (Mazer, 2007; Power et al., 2016).

Interview Questions	Literature Guide
1.10. Describe the strategic intent of the state utility?	"Strategic intent" is defined as the obsession with winning and beating a competitor (Hamel & Prahalad, 1990). Authors Hamel and Prahalad (1993) and Sitkin et al. (2011) describe strategic intent as a "stretch" as it is considered to be a misalignment between current resources and capabilities to reach seemingly unattainable goals.
1.11. How are existing resources and capabilities being aligned to achieve the vision of this utility?	Strategic intent allows a firm to think beyond its current restrictions to achieve its goals (Elaydi & Harrison, 2010).
1.12. What system and processes are used to measure strategic intent in the utility and what do you measure?	Strategic intent perspective relates to whether a firm has an ambitious goal, makes that strategic goal its foremost priority, makes rational choices and has a decision making role for its senior manager (Rui & Yip, 2008). Performance measurement and management includes the recording of present levels of performance and comparing it with a desired state and it also communicates the strategic intent of a firm together with information on what the firm has prioritised (Melnyk et al., 2014)
Section 2: Understanding why electric utilities need a response to disruptive innovations	
2.1. Why do you think electric utilities need to respond to disruptive innovations?	Extant literature (Barney, 2014; Birkinshaw et al., 2016; Christensen et al., 2015b; Porter & Heppelmann, 2015; Teece & Leih, 2016) appears primarily focused on non-regulatory business which is mainly driven by profit maximisation and assumes that all incumbents are in pursuit of long term survival and maintaining competitive advantages. Due to the rapidly decreasing costs of distributed renewable electricity generation systems and energy storage systems, centralised power systems are no longer a necessary condition of universal access to modern energy services (Levin & Thomas, 2016; Wainstein & Bumpus, 2016).

Interview Questions	Literature Guide
2.2. What innovations are causing disruptions in the electricity market	A surge in rooftop solar installations leads a wave of disruptive innovations in energy markets that manifests as disruptive competition and challenges for utilities (Agnew & Dargusch, 2015; Felder & Athawale, 2014).
2.3. Do you believe that the utility seeks and implements innovations that could make their existing business obsolete?	Innovation is a process through which industries revolutionise the economic structure from within, destroying the old one and creating a new one (Schumpeter, 1942).
Section 3 : Understanding how utilities are responding to disruptive innovations	
3.1. How has the electric utility changed their business to respond to disruptive innovations?	When faced with disruptive innovations incumbents always flee from entrant attacks rather than fight them (Christensen & Raynor, 2003, p. 31). The only way to respond to disruptive innovations the disruption is to accept it and exploit it by creating autonomous units and launching several new growth businesses early when the firm is still healthy (Christensen, 1997, 2013).
3.2 Do you think that the electric utility would become a disruptor?	The strategy to disrupt the disruptor is a proactive response (Alpkan & Gemici, 2016; Gans, 2016).
3.3. What do you think motivated or motivates an electric utility to respond to change or adapt to the environment?	How a company responds to disruptive innovation depends on its motivation and ability to do so (Charitou & Markides, 2003).
3.4. How were roles and responsibilities changed by the electric utility to explore new opportunities?	The only way to respond to disruptive innovations the disruption is to accept it and exploit it by creating autonomous units and launching several new growth businesses early when the firm is still healthy (Christensen, 1997, 2013).
3.5 What type of innovations has the utility produced?	“The very best sustaining companies systematically ignore disruptive threats and opportunities until the game is over ” (Christensen & Raynor, 2003, p. 40). Engage in continuous innovation that creates value for the customer (Denning, 2016).

Interview Questions	Literature Guide
	The disruption theory predicts that incumbents will defend sustaining innovations by trying to eliminate a competitor by ignoring or fleeing upmarket when threatened by disruptive innovations (Denning, 2016).
3.6. What is the utility’s operating model?	Disruption is a theory of competitive response which can be used to inform strategy (Denning, 2016).
3.7. What unexpected consequences did the utility get from implementing or launching innovations?	
3.8. To what extent did the utility’s response strategy involve partnering or buying out the competitor?	Incumbents should not attack but buy or partner with the disruptor (Gans, 2016; Markides, 2006).
3.9. To what extent was existing capabilities, skills and competencies considered in the response strategy?	Incumbents seem to be restrained by their previous successes associated with the old technological paradigm as their existing skills, processes and operating procedures restrict their ability to respond effectively (Tushman & Anderson, 1986).
Section 4: Close and wrap up Thank the participant and create room for follow up.	

Annexure C: Participant Information Sheet

Wits Business School
2 St Davids Place
Parktown
Johannesburg
2193

Dear……………………………………………………………………………………….

You are cordially invited to participate in a PhD study entitled “Strategic Responses to Disruptive Innovations in Regulated Markets: Three Cases of State Owned Electric Utilities”. The purpose of this study is to understand strategic responses to disruptive innovation opportunities and threats in regulated markets. The intention of this study is to contribute to the debate on disruptive innovations and to provide possible solutions to how state-owned electric utilities could respond to disruptive threats and opportunities.

This study involves a series of face-to-face conversations with participants from state owned electric utilities and national energy regulators who have knowledge and experience with strategic responses to disruptive innovations.

Through the conversations and analyses thereof, it is intended to elicit themes for conceptions of strategic responses that may be reported as findings from this study in publications and conference presentations. It is hoped that through your participation, the study will derive a comprehensive body of knowledge on which to improve the theorical undertandings of disruptive innovations. The results of this research may also be published at a future date.

Please note that participation in this study will not amount to financial benefits. Your participation is voluntary and declining to participate in this study will not result in any prenalities or predujices. You are also free to withdraw as a participant at any time without fear or prejudice.

The transcipts and analysis thereof will be dealt with in strictest of confidence. Your identity will be kept confidential via use of psedunoyms.

The duration of this discussion will be scheduled for 60 minutes. These conversations will be recorded with your prior consent, for data capturing purposes to be analysed at a later stage. If you do not consent to the recording, notes will be taken instead. The conversations will be transcribed verbatim.

If you have any questions afterwards about this research, feel free to contact me at the details listed below. This study will be written up as a thesis which will be available online through the university library website. If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email Shaun.Schoeman@wits.ac.za

Kubeshine Bhugwandin

KubeshnieB@gmail.com

Supervisors contact details

Prof Terri Carmichael

terri.carmichael@wits.ac.za

Prof Chris van der Hoven

Cvdh500@gmail.com

Annexure D: Formal Consent Form

Wits Business School
2 St Davids Place
Parktown
Johannesburg
2193

I ………………………………………………………………………………willingly consent to participate in the study entitled "Strategic Responses to Disruptive Innovations in Regulated Markets: Three Cases of State-Owned Electric Utilities". This study focuses on how state-owned electric utilities are responding to threats and opportunities from disruptive innovations.

I have read and understood the participant information sheet availed to me which explains the study and what it entails. I also understand that there is no monetary compensation for participating in this study.

I understand that the research is being undertaken for the purposes of a PhD study at the University of the Witwatersrand and that I voluntarily agree to participate in the study. I also understand that I am free to withdraw from being a participant in the study at any time.

I do give permission to record the interviews for data capturing purposes. These recordings will be used for the purposes of analysis during the data analysis stage of the research process. All recordings and transcripts will be stored and locked away in a locked cabinet at all times and will be destroyed after the results are released.

I am aware that the information disclosed during the interviews will be treated confidentially. I appreciate that my identity will be kept confidential and will not appear in the transcripts, recordings, or the thesis. I understand that through my participation in this study a comprehensive body of knowledge will be generated to improve the theorical undertandings of disruptive innovations. The results of this research may also be published in reports, theses and conference presentations in a generalised manner.

I agree that my participation will remain anonymous YES / NO (Circle Choice)

I agree that this interview may be audio recorded YES/NO (Circle Choice)

Signature…………………………………………………………….

Date……………………………………………………………..

Annexure E: Ethics Clearance Certificate

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Bhugwandin

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H18/11/02**
PROJECT TITLE	Strategic responses to disruptive innovation in regulated markets: Three cases of state owned electric utilities
INVESTIGATOR(S)	Mrs K Bhugwandin
SCHOOL/DEPARTMENT	Business School/
DATE CONSIDERED	16 November 2018
DECISION OF THE COMMITTEE	Approved
EXPIRY DATE	09 May 2022

DATE 10 May 2019 **CHAIRPERSON** J-Knight
(Professor J Knight)

cc: Supervisor : Prof T Carmichael and Dr C Van Der Hoven