Master's Thesis Internship –MSc Sustainable Business and Innovation

"Scenarios for the 2025 competitive environment for Distributed Energy Resources in New York State"

(GEO4 -2606)

Master Sustainable Business and Innovation

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Abstract

The electricity distribution system in New York State is at the dawn of an evolutionary change in which a new role for distributed energy resources (DER) is envisioned in enabling enhanced system resiliency, lower electricity costs and reduced carbon emissions. Deregulation, technological developments and market reform are amongst the driving factors which could allow for a growing and differentiated DER industry. This complex evolutionary change is accompanied by many uncertainties, and the future DER industry is likely to have a fundamentally different structure than today. DER providers thus encounter problems in anticipating the 2025 competitive environment, which limits focused innovation of their business models to adequately participate in the future DER industry.

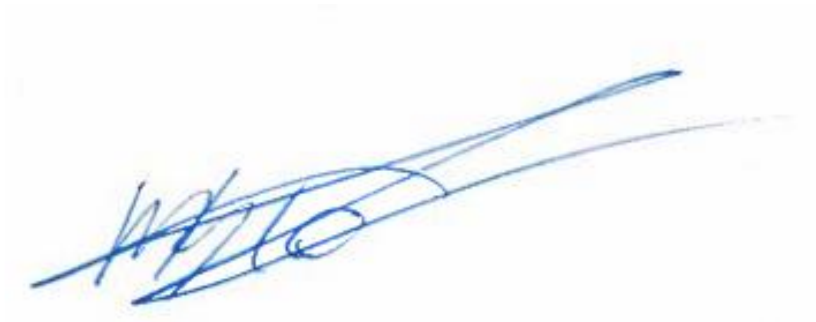
Four scenarios were built for the 2025 DER industry in New York State to provide a substantiated and strategically relevant industry structure forecast. Literature review provided an overview of the current DER industry, while interviews with ten DER industry experts revealed factors that are likely to drive change in this current industry structure up to 2025. Quantitative analysis of the experts' perceived potential impact of the factors on the DER industry structure and their uncertainty of occurrence allowed for identification of two scenario determining dimensions. These were: 1) the extent to which a thriving market is enabled with differentiated DER products and high levels of customer participation, and 2) the economic performance of DER products through cost, incentive and performance developments. Definition of the extreme positive and negative developments of both dimensions, allowed for the identification of four unique industry structure scenario combinations between which the future DER industry is very likely to develop.

The strategic relevance of the scenarios was demonstrated by analyzing the competition faced by an aquifer thermal energy storage business model in the scenarios. Porter's five forces analysis provided the basis for framing competition which originates from the DER industry structure of the four scenarios. The main competition faced by the ATES business model is an intensification of the threat of entry, while industry rivalry and the power of customers was lowered. Building defenses against entrants and positioning itself to benefit from the lower rivalry and customer power was recommended to strengthen its position. The obtained industry structure scenarios thus provide DER companies with strategically relevant knowledge that allows for more focused innovation of their business models to more adequately participate in the 2025 DER industry in NYS.

Statement of originality of the Master's thesis

I declare that:

1. this is an original report, which is entirely my own work,
2. where I have made use of the ideas of other writers, I have acknowledged the source in all instances,
3. where I have used and diagram or visuals I have acknowledged the source in all instances,
4. this report has not and will not be submitted elsewhere for academic assessment in any other academic course.



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List of abbreviations

AMI	Advanced Metering Infrastructure
ATES	Aquifer Thermal Energy Storage
CEF	Clean Energy Fund
CHP	Combined Heat and Power
DER	Distributed Energy Resources
DPS	Department of Public Service
DSP	Distributed System Platform
GHG	Greenhouse gas
IO	Industrial Organization
IPCC	Intergovernmental Panel on Climate Change
NYS	New York State
PV	Photovoltaic solar panel
REV	Reforming the Energy Vision
T&D	Transmission and distribution

1 Introduction

1.1 Background

According to the IPCC, It is extremely likely that human influence has been the dominant cause of the observed warming of the climate since the mid-20th century. This can mainly be assigned to the increased carbon dioxide concentration, caused primarily by fossil fuel emissions (IPCC, 2013). Global warming has several direct and indirect effects on the global climate system such as sea level rise and increased intensity of storms (IPCC, 2013). These effects will add to the coastal flood risk (Manual, 2013; Redlener, Reilly, 2012; Samenow, 2012), and disasters, such as caused by hurricane Sandy, which hit the shores of the Northeast coast of the United States in October 2012, may become more likely (Freedman, 2012; Magill, 2013a, 2013b).

Next to the flooding, a major impact Sandy caused was a power outage in New York State (NYS), which took several months to be fully restored (Magill, 2013b; Manual, 2013; Redlener, Reilly, 2012). Damage caused by the blackout included severely dangerous situations: trapped people in residential buildings due to elevators not working (Manual, 2013), carbon monoxide poisoning caused by flawed backup generators (Fitzgerald, 2012; Manual, 2013), shutdown of heating and life support systems in hospitals (Redlener & Reilly, 2012) and economic damage due to business interruption (EQECAT, 2012a, 2012b; Kearns, Pak, & Bloomberg, 2011). Sandy showed the increasing vulnerability of the current energy system to severe weather events, and gave urgency to what can be changed to the existing system to increase its resiliency (Bourgeois, Gerow, Litz, 2013; Magill, 2013b; Redlener, Reilly, 2012; von Uken, 2012).

1.1.1 Reforming the Energy Vision

On January 7th 2014 the New York State Energy Planning Board responded to this urgency by releasing its draft plan in which the vision of a dynamic, affordable and clean energy economy is expressed. The planning board consists of departments, divisions and authorities of the NYS government that will be responsible for the implementation of the identified initiatives (New York State Energy Planning Board, 2014). Amongst these, the Department of Public Service (DPS) plays a prominent role in the energy plan. The DPS regulates the electricity distribution utilities in NYS, and is responsible for setting rates and ensuring that adequate service is provided by these utilities (Brown, 2013). The DPS is requested by the New York State Energy Planning Board to:

"Enable and facilitate new energy business models for utilities, energy service companies, and customers to be compensated for activities that contribute to grid efficiency." (NYS Department of Public Service, 2014)

This is planned to be achieved through incremental changes regarding the current regulatory, tariff, market design and incentive structures in NYS (NYS Department of Public Service, 2014). These changes by the DPS are expressed in their "Reforming the Energy Vision" (REV) report released on April 24th 2014.

The REV report indicates a regulatory paradigm shift for electricity distribution utilities from their current physical energy distribution function towards a new role as a transactional platform for a distribution level market. A transition is also envisioned in the role of Distributed Energy Resources (DER) within the system. DER are resources that provide electricity generation, electricity storage or responsive load services within the utility distribution system or on the customer side of the system, unlike central generation plants that supply to the bulk transmission system (Akorede, Hizam, & Pouresmaeil, 2010; Alarcon-Rodriguez, Ault, & Galloway, 2010). Competitive third-party DER is envisioned to become a primary tool for meeting system demands, rather than traditional upgrades to the regulated utility infrastructure (NYS Department of Public Service, 2014; St. John, 2014).

1.1.2 Energy Transition New York

With this anticipated introduction of third-party competition of DER providers in the NYS energy market, wider integration of DER solutions might be enabled. Businesses providing these DER services thus require a strategy which takes the impact of REV into account. The internship organization, Energy Transition New York (ETNY), is a consulting firm specialized in helping renewable energy businesses in formulating its strategy, and in giving them the necessary tools to effectively implement it. Exchanging knowledge with their clients on the energy system of NYS is amongst the main activities in supporting this strategy formulation (Energy Transition New York, 2015). ETNY works with multiple clients that have the ambition of competing in the NYS DER industry, amongst these is a company with an Aquifer Thermal Energy Storage (ATES) business model. ATES is a DER solution that provides energy efficient heating and cooling in buildings and has the potential of significantly lowering or shifting the electricity demand to off-peak hours which contributes to the grid efficiency (MacCracken, 2014; Paksoy, Snijders, & Stiles, 2009). ATES can be applied in combination with certain other DER to create a complimentary solution for heating, cooling, storage and power. If a profitable business model for ATES or other DER clients would be enabled by ETNY's knowledge on the future impact of REV on the NYS DER industry, then a resulting implementation of ATES or other DER business models will realize the growth ambition of ETNY. In the meantime it will connect to the NYS government's vision by contributing to a cleaner and more resilient distributed energy system.

1.2 Problem

REV can be considered as a transformative reform of the energy industry regulation in NYS (New York State Department of Public Service, 2014). As a fundamental industry restructuring to allow for increased customer participation, a central role for DER solutions and a new role for the distribution utilities, REV is thus expected to significantly impact the factors that shape the DER industry structure (Viscusi, Harrington, & Vernon, 2005; Zinaman et al., 2015). The industry structure is composed of a set of economic and technical characteristics, which give rise to competition in this industry (Porter, 2008). Enabling increased competition on DER products and services is in fact one of the main pillars of REV (NYS Department of Public Service, 2014). Within strategic planning, the distinctive competence of a company should be matched with the competition it faces in the industry environment (Andrews, 1971; Ghemawat, 2002; Porter, 2008). The degree and characteristics of competition should thus be taken into account when formulating a business model for competing in this industry (Ghemawat, 2002; Porter, 1983). Knowledge on the future competition within the DER industry is thus crucial for formulating a business model to adequately compete in the NYS DER industry.

The underlying assumption of strategic planning is that this industry environment does not change or is predictable during the period the strategy is being developed and implemented (Mintzberg, 1994). The REV report is however still a draft, public proceeding, an implementation plan and policy decisions are yet to be made (New York State, 2014; NYS Department of Public Service, 2014). Although a clear direction for the regulatory reform is expressed, many issues need to be resolved before REV will come into effect. The shape of the future competition in the NYS DER industry is thus unknown due to the uncertainty in the impact that REV might have on the industry structure. Thus the scientific problem is that there is insufficient knowledge on the possible future shape of competition in the NYS DER industry. ETNY thus faces the problem that it is unable to provide this knowledge to its clients. These clients, and the ATES company specifically, are therefore unable to grasp the profit potential of their business model with which they intend to compete in the DER industry. Without an adequate strategy for the NYS DER industry, market participation is risky. A visual representation of the problem structure is presented in Figure 1.

Figure 1: Problem structure

1.3 Aim

In order to provide the knowledge on the possible future shape of competition in the NYS DER industry, this research aimed to provide a strategically relevant forecast of the DER industry structure in 2025. The impact of REV is the central element to this forecast. The timeframe of ten years in the future was thus chosen to provide a horizon in which an evolutionary change such as REV can take shape, while still providing a workable planning horizon for the clients of ETNY. The strategic relevance of the forecast is a crucial requirement, for this determines how effective the provided solution to ETNY's knowledge gap is in anticipating the competition which a client's business model might face. A secondary aim of this research is thus to assess the competition which the ATES business model would face in the NYS DER industry structure forecast. This aim on the one hand ensured the strategic relevance of the industry forecast, and on the other hand contributed to anticipating the competition which a business model of one of ETNY's clients might face in the 2025 NYS DER industry.

1.4 Research questions

In order to solve the research problem, this research was guided by a central research question. Additional to this question, a sub-question was defined to support the adequately fulfillment of the research aim. The central research question is:

What DER industry structure could result from the proposed REV proceeding in NYS in 2025?

This question aims to provide a strategically relevant forecast of the DER industry structure which is possible to result from the REV regulatory reform. It thus overcomes the problem of the lack of sufficient knowledge on the possible future shape of competition in the NYS DER industry. Considering the requirement of ensuring the strategic relevance of the answer of the central research question, a sub-question was formulated:

What competition will an ATES business model face in the 2025 NYS DER industry structure forecast?

This question employs the obtained industry structure forecast to request an overview of the competition that the ATES business model will face in the 2025 NYS DER industry. Hereby ensuring the strategic relevance of the forecast, and fulfilling the secondary research aim of providing an overview of the future competition faced by the ATES business model.

1.5 Content guide

The thesis proceeds by providing an overview of DER and the REV proceeding as the background to which this research is carried out in chapter 2. Chapter 3 then describes a relevant conceptualization of competition, industry structure, macro-environment and strategy, which provides a useful context for framing the research questions. The methods through which these research questions were answered are subsequently described in chapter 4. Chapter 5 presents the findings that were obtained by executing these methods. The implications of these findings are then discussed in chapter 6 in conjunction with the DER and REV overview of chapter 2 and theory of chapter 3. And chapter 7 concludes this thesis by providing the answers to the research questions.

2 Distributed Energy Resources and Reforming the Energy Vision

To provide a better understanding of DER and the REV proceeding in NYS, a brief outline on these topics is presented in this chapter as a background to which this research is carried out. The definition, products and services of DER are outlined in section 2.1, and the main goals and instruments of the REV proceeding are treated in section 2.2.

2.1 Distributed Energy Resources

The main features of DER is that it provides its services close to the customer's load and that it is of relative limited capacity as compared to central generation. DER can be deployed within the utility distribution system or on the customer side of the system, the latter is referred to as 'behind the meter' (Ackermann, Andersson, & Söder, 2001). The DER capacity delineation adopted by the Public Service Commission is smaller than 5 MW (DNV GL Energy, 2014). Although literature is not unanimous in its definition, DER can roughly be divided into two aspects: Distributed Generation (DG) and energy storage (Ackermann et al., 2001). Some authors argue that Demand Response (DR) can also be considered as DER (NYS Department of Public Service, 2014). Each of these resources is characterized by different products that support it. A brief description of DG is provided in section 2.1.1, and of energy storage in section 2.1.2, followed by an overview of the services provided by DER products in section 2.1.3.

2.1.1 Distributed Generation

The purpose of DG is to supply electric power of relatively limited capacity to end use customers connected to the distribution network (Ackermann et al., 2001). When placed behind the meter, DG can be operated to service all or a portion of the customer's electric load and any additional capacity can be deployed on the utility distribution system. Based upon the supporting product, different services can be provided by DG solutions. The DG solutions that have a significant presence in NYS are Photovoltaic panels (PV) and Combined Heat and Power (CHP); with 41% and 57% DER capacity respectively (Figure 2) (DNV GL Energy, 2014).

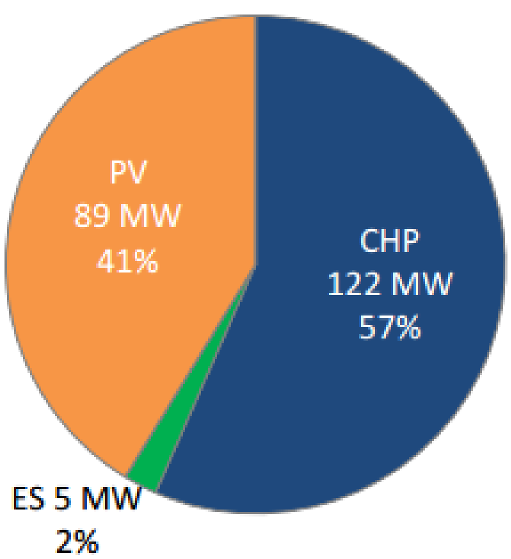

Figure 2: DER capacity in NYS (DNV GL Energy, 2014)

2.1.2 Energy storage

Electric energy storage provides the ability of storing energy and releasing it for usage during another time when the use or cost is more beneficial (Walawalkar, Apt, & Mancini, 2007). This ability can be used to store distribution system or DG electricity and to supply it back to either the distribution system or to the customer's load. Energy storage involves the conversion from electrical energy to another form of potential energy, which can subsequently be converted back to electrical energy (Akorede et al., 2010). Energy storage represents 2% of the total installed DER capacity in NYS as seen in Figure 2, this amount is entirely made up of battery storage (DNV GL Energy, 2014).

2.1.3 Services provided by DER

The different DER products can provide a variety of services, which determines how and why customers value the DER product. Services provided by DER products include: backup power, renewable integration and demand response (Ackermann et al., 2001; DNV GL Energy, 2014; Walawalkar et al., 2007). The features of these services will be briefly explained, after which a table is presented with the application feasibility of how these services are supported by which DER products (Table 1).

Backup power provides the service of power supply during events that disrupt the power supply from the distribution system. This comprises of either supplying the total load of the customer or a part of it. Backup power is valued by customers for resiliency reasons and can have financial benefits due to the possibility of business continuation for the commercial segment. The power supply of the DER should be initiated in a relatively short time and the power should be provided over a relatively long time to bridge the outage event´s duration. CHP and storage solutions with a high energy content are fit for this purpose (DNV GL Energy, 2014; U.S. Department of Energy, 2013).

Renewable integration is the ability to generate energy with reduced carbon dioxide emissions or to facilitate the connection of intermittent renewable generation. Next to the renewable DG such as PV, storage solution can thus also contribute to integrating renewable by buffering the variable output which PV and wind provides (Ackermann et al., 2001; DNV GL Energy, 2014).

Demand response (DR) comprises of changes in electric load by customers in response to time-variant changes in the price of electricity (Li, Jayaweera, Lavrova, & Jordan, 2011). DR can be achieved through various resources, including controllable DG, storage and other resources capable of supporting a net change in grid supplied power (Walawalkar et al., 2007; Zhou, 2009).

DER service	CHP	Battery storage	PV
Backup power	High	High	Low
Renewable	Low	Medium	High
Demand response	High	High	Low

Table 1: Application feasibility of DER services (DNV GL Energy, 2014)

2.2 Reforming the Energy Vision

REV is a regulatory proceeding by which the DPS aims to incrementally transform the distribution system towards increased reliability, resource diversity and efficiency. To reach these goals, DER is appointed as the primary tool in the planning and operation of this modernized system (NYS Department of Public Service, 2014). Central to achieving this new role of DER is the exploration and encouragement of new business models for utilities, DER providers, and customers in which they are compensated for activities that contribute to the goals of REV (State of New York Public Service Commission, 2015). The most important initiatives that correspond to this compensation of the utility, DER providers and customers are outlined by respectively describing the establishment of the Distributed System Platform in section 2.2.1, the rate restructuring in section 2.2.2, and customer engagement in section 2.2.3.

2.2.1 Distributed System Platform

The Distributed System Platform (DSP) is the distribution system retail market operator which manages a growing portfolio of DER (Zinaman et al., 2015). According to the REV proceeding, DER services will be provided by competitive markets in which the DSP is guided not to own DER. In NYS the existing distribution utilities are envisioned to take on this DSP role, in which their functions include: integrated system planning, system operations and market operations (State of New York Public Service Commission, 2015). These functions are briefly outlined in this section.

Integrated system planning involves the responsibility for distribution system planning and construction; the additional aspect within the DSP role is that this planning should facilitate increased DER integration. While traditional Transmission and Distribution (T&D) investments to meet system demands pose significant costs to utilities, strategically placed DER can defer these T&D investments and thus meet the system demands more efficiently. Because T&D investments are charge to utility customers through rate plans, customers can benefit from this deferral as well (Hyams, 2011). The incentive structure to foster this integrated system planning is provided by switching from annual capital plans towards multi-year plans. This should increase the investment horizon of the DSP by rewarding them based on performance rather than compensation of incurred costs (Zinaman et al., 2015). This considers the longer term benefits of integrating DER in system planning as compared to traditional system maintenance and upgrades.

Grid operations within the DSP function involves the monitoring and control of a distributed system with a higher penetration of DER. This poses the additional challenge of balancing supply, intermittent resources and potentially dynamically controllable loads. Real-time monitoring and automated control are amongst the capacities that the DSP will have to enhance in order to dispatch the DER. For this means, the distribution system will need to be upgraded with intelligent equipment (State of New York Public Service Commission, 2015). By this enhanced visibility and control, an optimized, secure, flexible and reliable distribution system is pursued.

Market operation involves the creation of a market platform in which transactions of the products and services provided by DER occur. In this market the definition and prices of services provided by DER products will be established by the DSP based on the value they provide to the system. To establish an open market for DER, the DSP will propose certain pricing schemes and procurement mechanisms to animate this market. DER providers are able to propose product or service offerings on the market based on their assessment of customer of DSP needs as well. This is envisioned to drive diversity in market offerings and business models. The DSP will also provide services to DER providers for which fees may be raised, these may include: transactions or usage fees, platform access, interconnection services, data sharing or analytical services. The magnitude of these transactions or fees can impact the attractiveness for DER providers to enter the market. Standardization amongst product offerings and participation conditions across the state is important in lowering these entry costs and encourage best practices (State of New York Public Service Commission, 2015).

In order to build the above outlined DSP capacities, the utilities are ordered by the DPS to engage in demonstration project together with DER providers. These projects help in exploring new business models for the utilities and DER providers, and will be in preparation of the upscaling and rollout of these demonstrated projects (NYS Department of Public Service, 2014). An additional consideration within the new DSP function is that by the increase in communication capacities and DER market data, the potential for harmful cyber threats will increase as well. Because this concerns critical infrastructure and potentially confidential data, the DSP should constantly develop new cyber security methods to guarantee system reliability and market confidence (State of New York Public Service Commission, 2015).

2.2.2 Rate structure

It is identified by the DPS that the current economic incentives for customers to participate in DER markets are insufficient, and that rate structures should reflect the value that DER provides to the system. Two relevant rate structure reforms under consideration within REV are time-variant pricing and carbon pricing (NYS Department of Public Service, 2014). These rate structure reforms will be elaborated upon in this section.

Time-variant pricing is a rate structure in which real-time cost fluctuations in the generation and T&D of electricity are reflected in the energy price of the customer. This is in contrast of the flat rate pricing in which customers pay a fixed price for energy regardless of the variations in electricity costs throughout the day (Spiller, 2015). Increased granularity in time-variant pricing schemes will enable an increasing amount of business models for DER that supports DR services (Thomas, Star, & Kim, 2009). The participation level in time-variant pricing schemes depends on whether customers are requested to opt-in, resulting in low participation, or opt-out, resulting in high participation (Faruqui, 2015).

The value that DG with low carbon dioxide emissions provides is currently not financially compensated for (Zibelman, Brown, Sayre, & Burman, 2014). Pricing carbon dioxide emissions of DER products is under considerations in REV, in which a choice will have to be made if the value of reduced carbon is included, and if so, what price will be adopted (New York State Department of Public Service, 2014). The implementation and profundity of this potential carbon pricing scheme influences the profitability of renewable DG relative to carbon emitting DG (Graham et al., 2013).

2.2.3 Customer engagement

The DPS identified that especially the commercial and residential market for DER is underdeveloped in terms of access to information, and that potential customers for DER providers are thus insufficiently facilitated in making an informed decision for a specific DER product and provider (State of New York Public Service Commission, 2015). Two main initiatives are planned to provide customer outreach and education in order to develop a thriving DER marketplace (NYS Department of Public Service, 2014). First, a uniform digital marketplace is envisioned by the DPS where potential customers are educated and facilitated in DER investments (State of New York Public Service Commission, 2015). And second, the Clean Energy Fund (CEF), a funding commitment which works in coordination with REV, which aims to raise customer awareness, reduce customer acquisition costs and improving customer confidence. These initiatives are expected to affect the diversity in customer segments being served by providers of existing and potentially new DER products and services (New York State Energy Research and Development Authority, 2015).

3 Theory

This chapter provides relevant concepts for competition, industry structure, macro-environment and strategy, describes their interrelations and substantiates how they created a useful frame for this research project. Section 3.1 defines how useful concepts are extracted from strategic management literature to describe the industry structure and how it gives rise to competition in an industry. Section 3.2 clarifies concepts for macro-environmental factors which might drive change in the industry structure. Section 3.3 reviews business strategy literature to obtain concepts for business models that articulate positioning towards a competitive industry environment. And section 3.4 substantiates how the interrelations between the obtained concepts create a coherent conceptual framework which is functional for framing the research project and obtaining the answers to the research question.

3.1 Strategic management and competition

According to strategic management literature, a company should formulate its strategy by matching its distinctive competences with the opportunities and threats if faces in the marketplace (Drucker, 1954; Ghemawat, 2002). The opportunities and threats it faces in the marketplace are determined by the conditions and trends in the broader environment the company is operating in (Andrews, 1971; Ghemawat, 2002). This provides a relevant perspective on the impact of the broader DER environment on a company's internal strategy formulation, but lacks a concrete conceptualization of this external environment.

The scientific field of Industrial Organization (IO) describes the relevant conditions in this broader environment as the industry structure, which is composed of a set of economic and technical characteristics (Bain, 1951; Ghemawat, 2002; Porter, 2008). This industry structure determines the strategies of the companies within this industry, which in turn dictates the collective performance of the industry (Bain, 1968; Porter, 1983). Although this relation could indicate the impact of the DER industry structure on the strategy formulation of DER companies in this industry, the notion of the strategic position of an individual company towards the industry structure is underexposed.

This means of framing strategic positioning is provided by Porter´s Five forces framework, which allows an individual company to assess its competitive position in its industry. This position is revealed by five distinct competitive forces that arise from the industry structure. Knowledge on these strengths and weaknesses against the competitive forces allows the company to formulate a strategy to improve its position relative to the industry structure (Ghemawat, 2002; ME Porter, 1979). This framework thus reveals the strengths and weaknesses of an individual company against the competition in the DER industry structure, in a manner which is relevant for strategy formulation. The Five forces framework is thus considered functional for this research in framing competition in relation to strategic positioning and the industry structure.

In the Porter's framework, competition takes the shape of five distinct forces which are grouped according to the five industry groups that exert them. Firstly, new entrants can pose a threat with their desire to gain market share, the seriousness of the threat of entry depends on the barriers present and on the reaction from existing competitors that entrants can expect. Secondly, suppliers can exert bargaining power on companies by raising prices or reducing the quality of supplied goods and services, the profitability of an industry can hereby be reduced due to these cost increases. Thirdly, customers can demand lower prices or higher quality; this way they can play competitors off against each other at the expense of industry profitability. Fourth, providers of substitute products or services can limit the profit potential of an industry by providing a more attractive price performance tradeoff. And finally, existing competitors pose the fifth force by jockeying for position with tactics such as price competition, product introduction, and advertising campaigns (ME Porter, 1979). Each of these five forces is shaped by a set of structural variables, which together form the industry structure that dictates the rules of competition (Porter, 2008). The Five forces framework is depicted in Figure 3, in which the forces exerted by the industry groups are depicted together with the variables from the industry structure that underlie them.

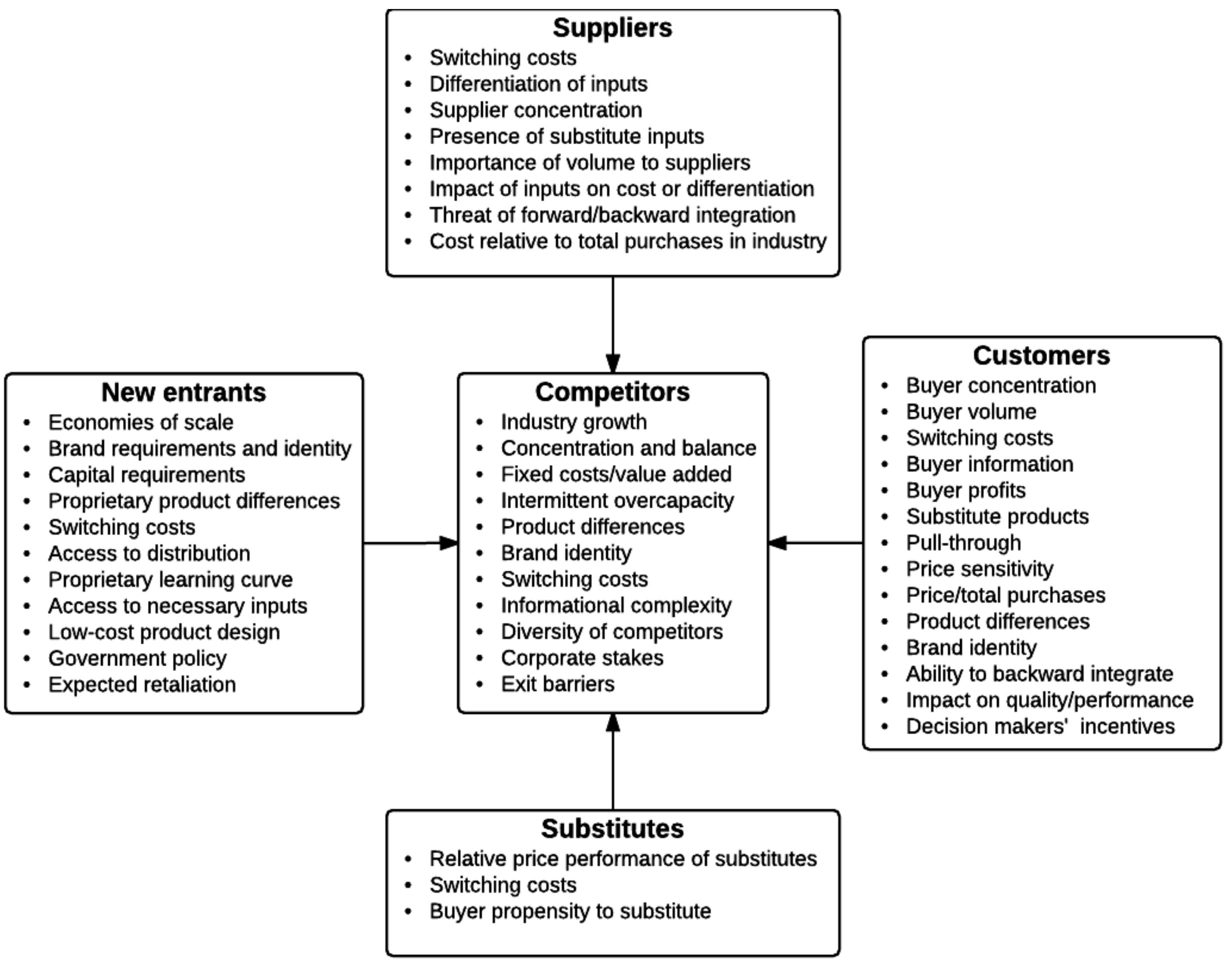

Figure 3: Five forces framework (Ghemawat, 2002)

3.2 Industry structure and macro-environment

Through the focus on a set of structural industry variables, the framework captures much of the complexity of actual competition (Ghemawat, 2002). Its value lies in the identification of a manageable set of relevant variables and the strategic implications that can be derived for a particular company in its industry (M. E. Porter, 1994). This structural approach is useful for framing the DER industry and obtaining the competitive implications for the ATES business model, but lacks a focus on relevant exogenous factors that influence the industry structure, such as the REV regulatory reform. These exogenous factors exist in the company's macro-environment, outside of the industry environment, and changes and trends in these factors can cause changes in the industry structure as well (Porter, 2008; Weber & Polo, 2010). A link is thus needed between the industry structure and the factors in the macro-environment.

The PESTEL dimensions are one of the most widely used structures for framing macro-environmental factors in strategic management. According to the PESTEL factors, the macro-environment can be divided into political, economic, socio-cultural, technological, environmental, and legal dimensions (Gillespie, 2007; Yüksel, 2012). This conceptualization provided by the PESTEL dimensions is complementary to the five forces framework by providing the scoping from the macro-level to the industry level, and the combination of the two is common in literature (Gillespie, 2007; Grundy, 2006). Considering the research aim of analyzing the impact of REV on the DER industry structure, the PESTEL dimensions provide the frame in which the REV proceeding and other relevant macro-environmental factors can be placed. The PESTEL dimensions are thus not confined to the impact of industry regulation on the structural variables of the DER industry (Viscusi et al., 2005), but allow for a holistic identification of macro-environmental factors that are relevant or accompany REV in impacting the DER industry structure.

3.3 Business strategy

Although the five forces framework provides a basis for strategic recommendations, the industry level of analysis needs to be linked to the company level in order to provide a clear notion of the competition faced by individual strategies within the DER industry. The field of business strategy within strategic management argues that next to industry characteristics, unique competitive strategies of individual businesses are an important determinant of performance (Hansen & Wernerfelt, 1989; Kessides, 1987; Rumelt, 1991). The focal point is thus the strategy of a single business venture, which involves the creation of a position in which choices are made on where to compete and what activities to perform, based on knowledge of the industry and the company itself (Porter, 2008; Richardson, 2008). So the knowledge of the DER industry provided by the industry structure needs to be complemented by a concept which provides a frame for the positioning of an individual DER business.

The business model provides this conceptualization of positioning, by outlining how the activities of the business work together to execute its strategy (Richardson, 2008). It reflects the core choices the business makes in amongst others; delivered products or services, targeted customer segments, suppliers, and pricing of products (Zott, Amit, & Massa, 2011). A company thus competes in its industry by making a choice in its business model structure (Casadesus-Masanell & Ricart, 2010). A practical and transparent framework for outlining a business model is provided by the business model canvas. In this canvas the business model is described by nine building blocks that define its structure (Figure 4). These building blocks are: customer segments, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partners and cost structure (Osterwalder & Pigneur, 2010). For a more elaborate description of the building blocks, Osterwalder (2010) can be consulted. The visual structure of the business model canvas allows for transparent and concise presentation of the relevant core elements of the building blocks. The choices made by a DER company on these core elements thus practically reflect its strategy on competing in the DER industry, and can be confronted with Porter's five forces to analyze its competitive position.

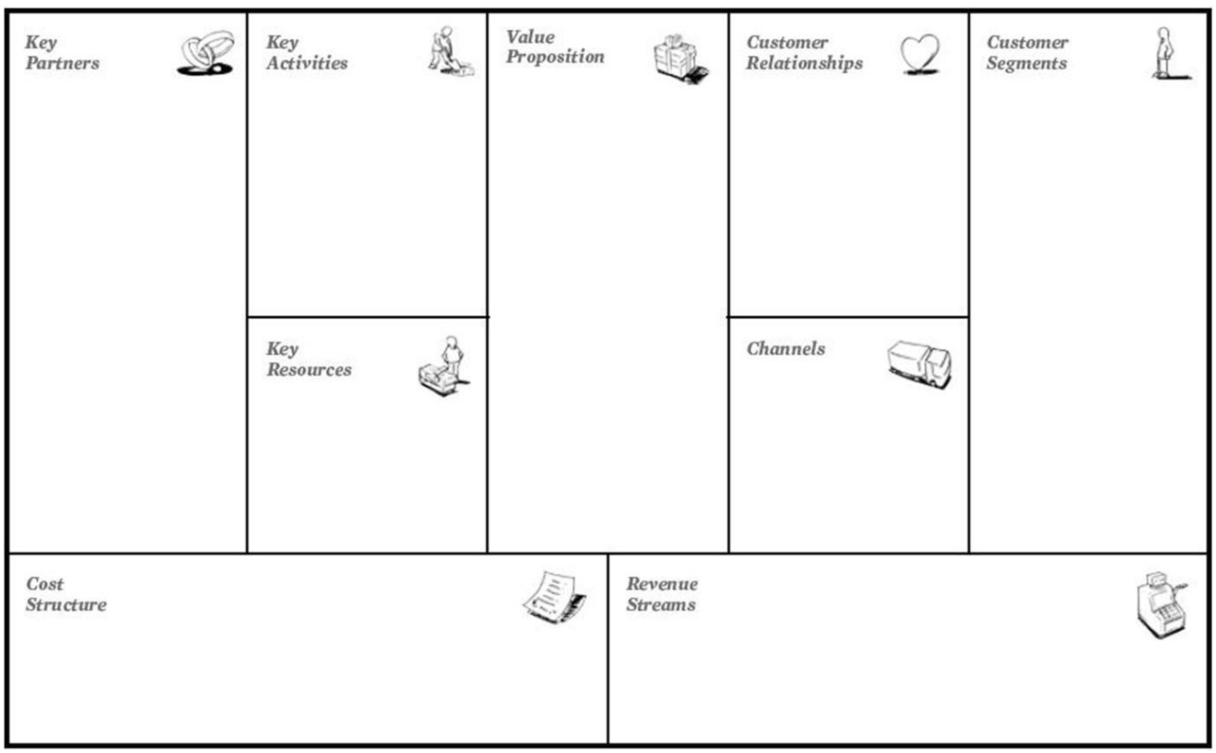

Figure 4: Business Model Canvas (Osterwalder & Pigneur, 2010)

3.4 Conceptual framework

The conceptual framework, as seen in Figure 5, combines the obtained concepts of PESTEL dimensions for the macro-environment, industry structure for the industry environment, Porter's competitive forces for competition in the industry environment and business model for the strategy of a business. These concepts interrelate in a coherent cascading flow which scopes from the macro-level, to the industry level, to the business level. Firstly, the macro-environmental PESTEL dimensions influences the shape of the structural variables of the industry. Then the industry structure gives rise to the five competitive forces in the industry. And finally, the five forces reveal the competitive position of a business strategy, as articulated through its business model.

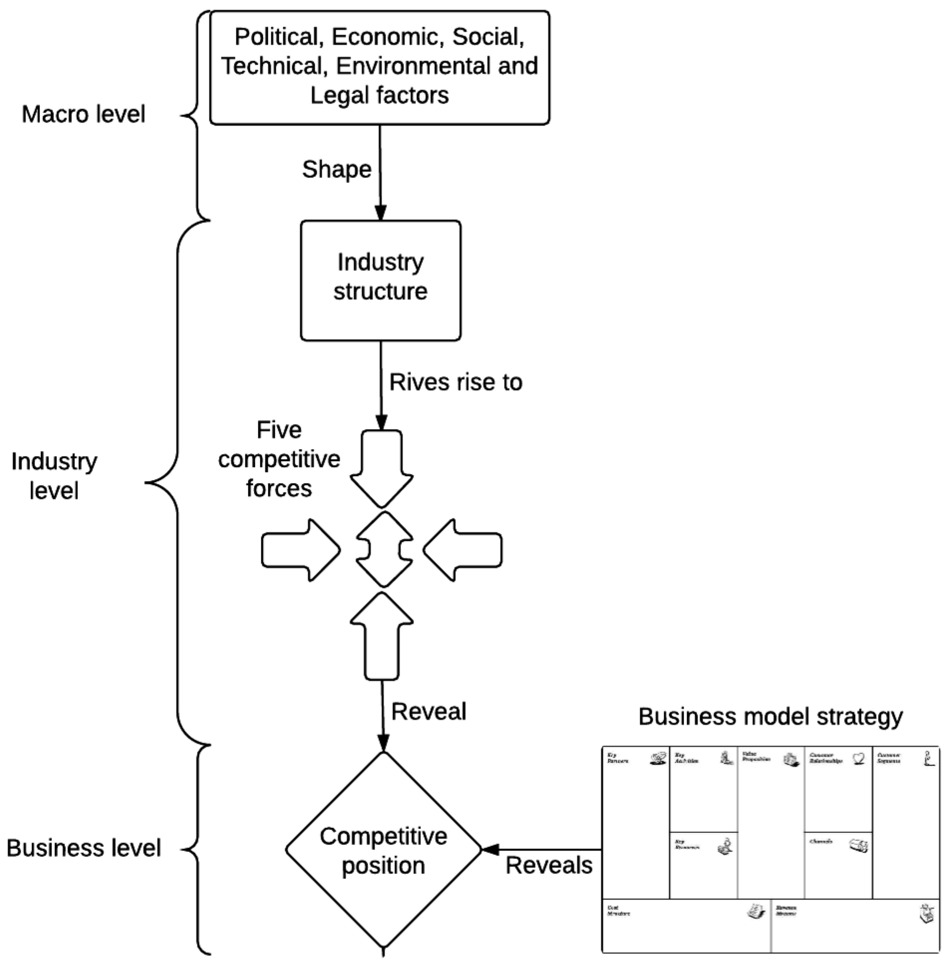

Figure 5: Conceptual framework

The framework hereby provides a practical foundation for analyzing and describing the DER industry structure which could result from the macro-environmental factors posed by REV, which contributes to answering the central research question. And it provides the foundation for analyzing and describing the competitive position of an ATES business model against the competitive forces that emerge from the DER industry structure, which contributes to answering the sub-question of this research.

4 Methodology

The central research question required a forecasting method for the 2025 DER industry structure, which incorporates the relations between the supporting concepts of macro-environment and industry structure as presented in the conceptual framework. The second sub-question additionally required a competitive analysis method of an ATES strategy against the obtained industry structure forecast, supported by Porter's five forces framework and the business model canvas. These distinct methods for forecasting and competition analysis are briefly elaborated upon, and subsequently integrated in the steps of the chosen research method.

A single accurate forecast of the DER industry structure is made difficult given the uncertainty in the macro-environment which governs it. An inaccurate forecast is problematic for the application of Porter's framework (Coyne & Subramaniam, 1996), and thus for the strategic relevance of the research. Scenario planning .The forecasting method of scenario planning resolves this inaccurate single forecast in complex and highly uncertain business environments by developing different possible future scenarios, whose consequences for strategies can be assessed (Swart, Raskin, & Robinson, 2004; Wulf, Meißner, & Stubner, 2010). A scenario planning approach which allows for the creation of strategically relevant industry scenarios in uncertain environments is proposed by Wulf et al. in 2010 (Wulf et al., 2010). This approach makes the complexity, dynamics and volatility of industry conditions more manageable by including expert participation to overcome bias of a single researcher and integrate coherence and consistence (Bradfield, Wright, Burt, Cairns, & Van Der Heijden, 2005; Schwenker & Wulf, 2013a).

The four steps from this approach which are relevant for the creation of industry structure scenarios were adopted in this research, which are: industry definition, factor identification, ranking of factors into trends and uncertainties, and scenario building (Wulf et al., 2010). These steps were followed by a fifth step for the competition analysis of the ATES business model using Porter's five forces framework (ME Porter, 1979). This chapter describes the research activities as presented in the research method chart in Figure 6. First, Section 4.1 describes how the DER industry was defined by framing the DER and REV knowledge provided by chapter 2 into the industry concepts as described in chapter 3. Then section 4.2 elaborates on how qualitative data on the macro-environmental PESTEL factors was obtained through expert sampling, interviews and analysis. In section 4.3 the quantitative data gathering through questionnaires and subsequent analysis are described to allow for ranking of the macro-environmental factors into trends and uncertainties. After this, section 4.4 describes how these the trends and uncertainties allowed for scenario identification and synthesis into scenarios for the 2025 DER industry structure. And section 4.5 finally elaborates on the competition analysis of an ATES business model against the industry structure of these scenarios, by defining the business model and performing the five forces analysis.

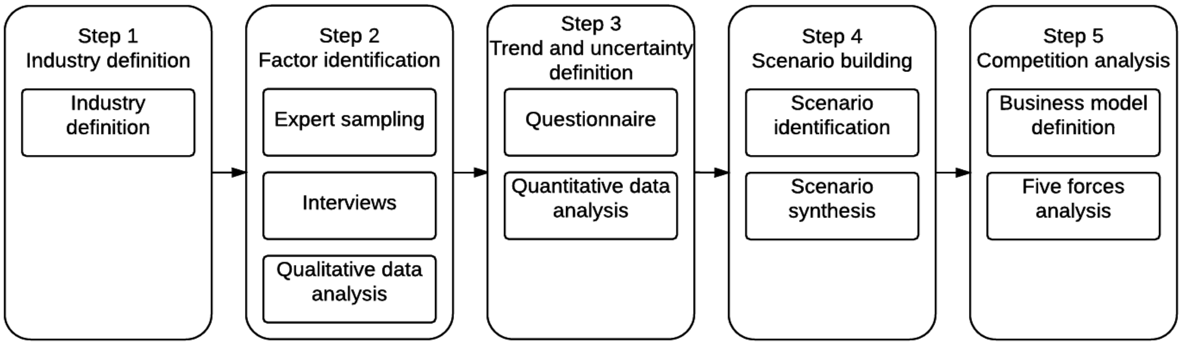

Figure 6: Research method chart

4.1 Industry definition

The required data in this step, the delineation of the NYS DER industry, was acquired by reviewing the DER and REV overview of chapter 2, and the industry conceptualization as outlined in chapter 3. The industry was then conceptualized according to the five groups which exert competition in the DER industry. This supported a clear and helpful definition of the DER industry.

4.2 Factor identification

The required data in this step consists of the factors in the macro-environment that are likely to shape the DER industry structure over the next ten years, and the impact that these factors might have on the DER industry structure. This qualitative data was obtained from industry experts by interviews and subsequent analysis. Section 4.2.1 describes how the expert sample is obtained. The interview is described in section 4.2.2. And section 4.2.3 explains how the interview data is analyzed to allow for its conceptualization.

4.2.1 Expert sample

A sampling frame was set up within the population of DER industry experts, which included politicians, market experts, research institutes and competitive industry groups with a strategic overview of REV and the DER industry (Schwenker & Wulf, 2013a). Non-probability sampling was performed by using online directories, the researcher’s professional network and snowball techniques until a sample of ten experts was reached (Walliman, 2010).

4.2.2 Interview

The data was gathered by semi-structured face-to-face interviews with the sample of industry experts, in which the six PESTEL dimensions were the standardized structure (Schwenker & Wulf, 2013a). The interview questions can be seen in Appendix I. Audio recordings were made to collect the data, and probing was applied to encourage the respondent to be complete in his or her answers (Walliman, 2010).

4.2.3 Qualitative data analysis

The recorded audio of the interviews was transcribed on a summary level consistent with the research scope (McLellan, MacQueen, & Neidig, 2003). The data in the transcripts was reduced by coding, clustering and summarizing in the qualitative data analysis software NVIVO version 10. A grounded theory coding system was set up, in which the data empirically emerged from the transcripts. The subsequent clustering of coded factors between the transcripts was supported by the cluster analysis function within NVivo, and the researcher's interpretation of common themes and patterns (McLellan et al., 2003; QSR international, 2015). The resulting more compact set of factors was then summarized and conceptualized into the macro-environmental factors that impact a specific or multiple industry structural variables.

4.3 Trend and uncertainty definition

The goal of this step is to obtain quantitative data about the perceived impact and uncertainty of each of the obtained factors, and to come to a subsequent division into trends and critical uncertainties which will shape the future DER industry. Section 4.3.1 explains how quantitative data was obtained by questionnaires with industry experts. Then section 4.3.2 describes what analysis was used to identify trends and critical uncertainties from the obtained data.

4.3.1 Questionnaire

The uncertainty and impact of the factors as perceived by the sample of industry experts was obtained by means of an online closed format questionnaire, in which the uncertainty and impact of each factor could be indicated on a one to five likert scale (Schwenker & Wulf, 2013a).

4.3.2 Quantitative data analysis

The average impact and uncertainty values across the sample of ten experts was analyzed for each individual factor in excel, and the Cronbach's alpha coefficient was calculated to measure the internal consistency (Gadermann, Guhn, & Zumbo, 2012). The averages were plotted in the impact and uncertainty grid, which was segmented into secondary elements, trends and critical uncertainties according to the impact and uncertainty value (Figure 7). The resulting visual scattering of the different factors allowed for across the graph allowed for division amongst the segments. Secondary elements have a relatively weak impact, trends have a strong impact but are relatively predictable in nature, and critical uncertainties have a strong impact and high uncertainty. The trends and critical uncertainties were used in the next scenario building step (Wulf et al., 2010).

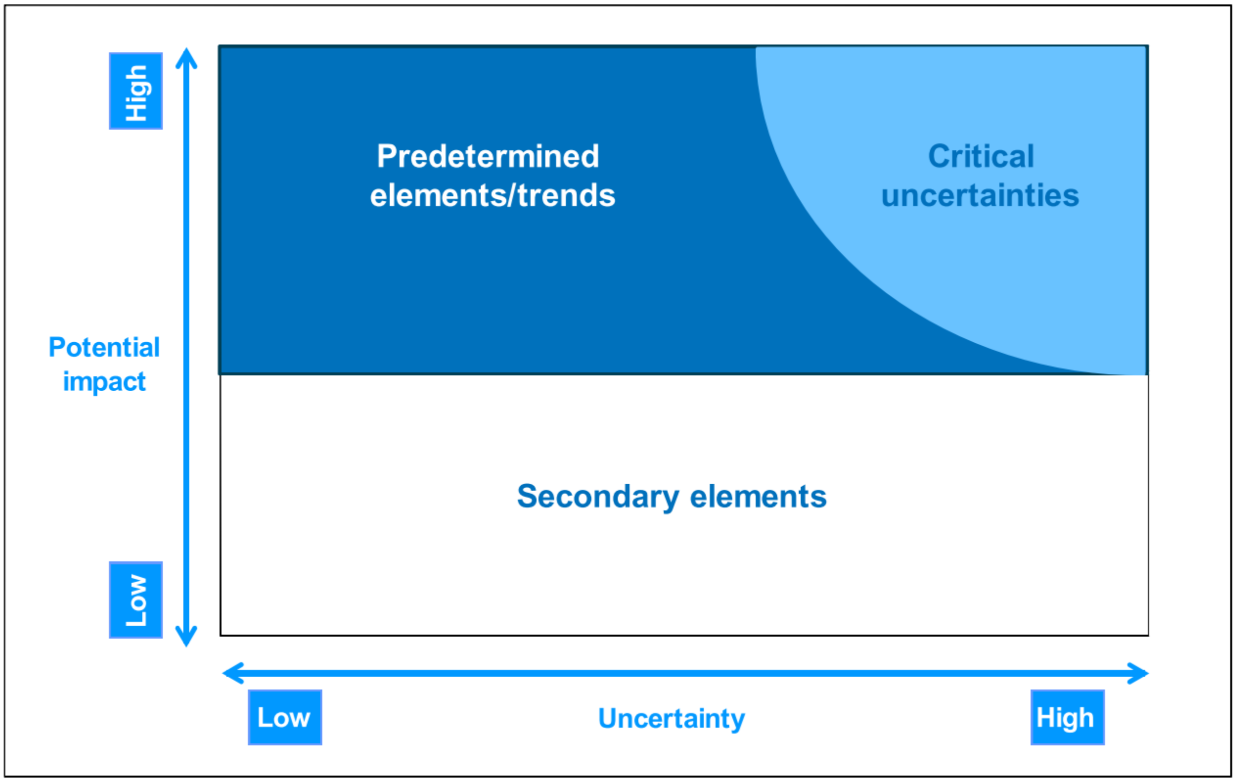

Figure 7: Impact and uncertainty grid (Brands & Meissner, 2011)

4.4 Scenario building

The goal of this step, to obtain the four DER industry structure scenarios, was approached by identifying the development of the trends and critical uncertainties first, followed by a synthesis of how these factors will shape the industry structure in each scenario. Section 4.4.1 describes the scenario identification process, and section 4.4.2 describes how the industry structure of the scenarios was synthesized.

4.4.1 Scenario identification

To facilitate the scenario identification process the scenario matrix was used, in which two scenario dimensions serve as the axis that span the matrix (Figure 8). These scenario dimensions were obtained by clustering the critical uncertainties based on common elements and impacts (Fildes, 1998; Wilk, 1991; Wulf et al., 2010). For each scenario dimension two extreme developments, positive and negative, were defined by synthesis of the conceptualized factors (Fildes, 1998; Wulf et al., 2010). These developments of both scenario dimensions were then combined to yield four distinct development scenarios for the critical uncertainties. The trends were then added to each scenario to complete the scenarios for the macro-environment level.

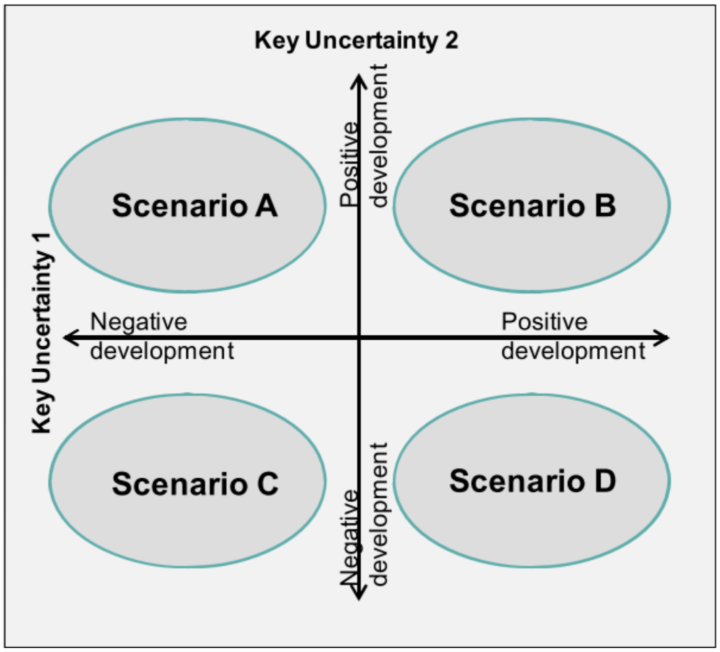

Figure 8: Scenario matrix (Wulf et al., 2010)

4.4.2 Scenario synthesis

Synthesis of the impact of the trends and scenario dimensions was aided the influence diagram, in which the influence on the structural variables of the DER industry structure was visualized (Schwenker & Wulf, 2013a). This allowed for substantiated determination of the scenario specific industry structures by assessing the combined influences of the trends and scenario dimensions. The industry structure of the scenarios was then described according to its suppliers, customers, substitutes, new entrants and competitors.

4.5 Competition analysis

This step aimed at analyzing the competition which an ATES business model faces against the five competitive forces that emerge from the industry structure of the four obtained scenarios (Wulf et al., 2010).

4.5.1 Business model

The business model was obtained as document from the ATES company, which was conceptualized into the business model canvas. This was done by assessing the key elements within the obtained business model which outline its competitive positioning, and by subsequent framing within the building blocks of the business model canvas (Osterwalder & Pigneur, 2010).

4.5.2 Five forces analysis

This was followed by the analysis of the business model's position against the underlying causes of the competitive forces, by systematically confronting elements framed in the building blocks of the business model canvas with each of the structural variables of the industry structure (ME Porter, 1979). This yielded an overview of the intensity of the competition that the business model faced against the five forces in the four industry structure scenarios.

5 Findings

This chapter presents the analyzed results that were obtained through the conducted activities as described in the previous methods chapter. The same structure is followed in this chapter; findings will thus be presented and analyzed in their respective order of: industry definition in section 5.1, factor identification in section 5.2, trend and uncertainty definition in section 5.3, scenario building in section 5.4, and competition analysis in section 5.5.

5.1 Industry definition

The conceptualization of the DER industry yielded data on the current DER industry structure, which served as the scope of the DER industry. This scope is presented by respectively defining: existing competitors, customers, substitutes, new entrants and suppliers.

- Existing competitors were defined as providers of DG and energy storage products, DR was considered as a service supported by certain types of DER products. The capacity delineation of smaller than 5 MW was adapted, in which CHP, PV and battery storage are the dominant products as provided by the current existing competitors.
- Customers were defined as the residential and commercial segment, which could value base load power, backup power, renewable energy, demand response and T&D deferral services provided by behind the meter DER products. Industrial customers and utility sited DER were not included as customers.
- The substitutes were defined as the current distribution utilities, who provide electricity generated by non DER assets to its customers. Their offering was framed as the electricity provision through the T&D system. The seven distribution utilities in NYS were treated uniformly.
- New entrants were defined as DER providers that will potentially enter the DER industry in the next ten years. The likelihood of entry and the products and solutions they might offer were considered.
- Suppliers were broadly defined as the companies from which DER providers procure the vital products and services in order to provide their own product to their customers.

5.2 Factor identification

This section describes the obtained data on macro-environmental factors impacting the industry structure. Section 5.2.1 shows the obtained expert sample, the outcomes of the interview process are described in section 5.2.2, and section 5.2.3 elaborates on the clustered and conceptualized factors.

5.2.1 Expert sample

The obtained sample of experts represented: existing competitors, customers, suppliers, government regulators, media and research institutes. Four notable results were observed. First, the sample represents all industry groups of the sampling frame apart from new entrants. Second, a private distribution utility is missing. Third, seven experts were in a senior, manager or director function. And four, only one expert was not a resident of New York City. A more elaborate overview of the sample including demographics is presented in Appendix II.

5.2.2 Interview

The interviews took between thirty-five minutes and an hour and fifteen minutes. Probing was often applied for reminding to explain the impact on the industry structure of an identified factor. In two instances the respondents did not approve with an audio recording, which limited the obtained data to notes.

5.2.3 Qualitative data analysis

After transcribing, eight transcripts and two field note documents were obtained. The subsequent coding yielded a total of hundred-fifty-two nodes representing factors impacting the industry structure. The word similarity between these nodes in the cluster analysis yielded Pearson correlation coefficients ranging between 0.59 and -0.02, in which 1 indicates most similar and -1 least similar (QSR international, 2015). Twenty-seven nodes were obtained by interpretation and clustering of correlating nodes. These were subsequently summarized into factors. The subsequent conceptualization of the impact of the factors on the industry structure is illustrated by an example of two quotes from the "Utility infrastructure" factor:

> *"The shape of the physical grid infrastructure, plus how you coordinate that, will determine how much DER assets can be applied to the grid. This dictates to growth of DER"* (Smarter Grid Solutions, 2015b)

And:

> *"Distribution side technologies ... being able to really understand where demand is happening and where best to essentially place distributed energy resources."* (Greentech Media, 2015b)

An impact on two industry structural variables was interpreted from this example. First, the DER industry growth will be impacted. And second, the price performance of the substitute T&D system is affected through the effectiveness in placing DER to prevent more expensive T&D reinforcements. The total set of factors with their industry structure impacts can be seen in Appendix III. Notable results included that thirteen of the twenty-eight structural variables were impacted, within which the variables underlying the power of suppliers were not represented and industry growth was by far the dominant impacted variable. Four interrelations between nodes were additionally identified from the data.

5.3 Trend and uncertainty definition

The ranking of factors into trends and critical uncertainties is described in this section. Section 5.3.1 briefly describes the results of the questionnaire, and section 5.3.2 shows the quantitative data, its internal consistency and the subsequent ranking into trends and critical uncertainties.

5.3.1 Questionnaire

Quantitative data on the impact and uncertainty of the twenty-seven factors was obtained from all industry experts. Many experts took significantly longer to complete the questionnaire than the estimated completion time. The expert sample furthermore indicated that especially the uncertainty was hard to quantify.

5.3.2 Quantitative data analysis

The two excel datasets yielded average values for the impact and uncertainty for each of the twenty-seven factors. These varied from 2.7 to 4.3 for the uncertainty, and from 2.7 to 4.5 for the impact. The dispersion of some factors was particularly high, the Cronbach's alpha coefficient of 0.73 for the impact and 0.79 for the uncertainty however indicated acceptable overall internal consistency. The plotted average impact and uncertainty values of the factors in the impact uncertainty grid can be seen in Figure 9. The dissection of the graph at the chosen suitable axis scales yielded eleven critical uncertainties, seven trends and nine secondary elements. Five factors ended up on or very close to the dissection borders.

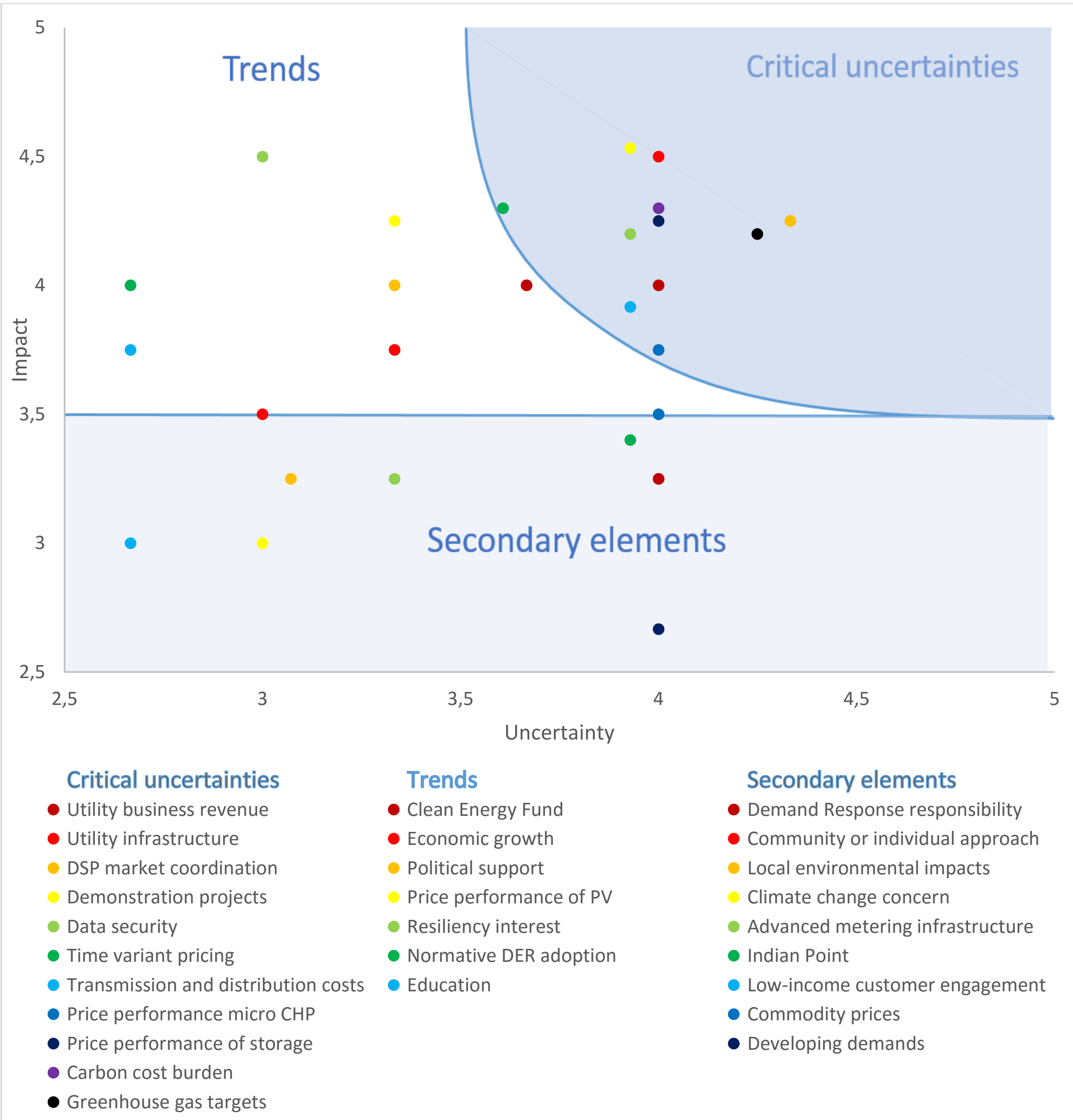

Figure 9: Impact uncertainty grid

5.4 Scenario building

This section identifies and describes the industry structure scenarios. Section 5.4.1 identifies the four scenarios based on the critical uncertainties from the previous trend and uncertainty definition step. And section 5.4.2 synthesizes the impacts of the trends and critical uncertainties in each of the scenarios into a description of the DER industry structure changes.

5.4.1 Scenario identification

The first scenario dimensions was named "DSP capacity building", for its common theme of the distribution utility transforming into the DSP role, and the development of its accompanying capacities in facilitating DER. The five underlying critical uncertainties were:

- Utility business revenue
- Utility infrastructure
- DSP market coordination
- Demonstration projects
- Data security

This second scenario dimension was named "Economic performance DER", for its common theme of governing the relative economic attractiveness of the various DER products and services. Its underlying critical uncertainties were:

- Transmission and distribution costs
- Time variant pricing
- Price performance of micro CHP
- Price performance of storage
- Carbon cost burden
- Greenhouse gas targets

The extreme positive and extreme negative developments of the "Economic performance DER" and "DSP capacity building" scenario dimensions were defined through their underlying critical uncertainties, of which the positive development of the earlier conceptualized utility infrastructure was defined as:

The roll out of distribution side technologies for supporting real-time monitoring and control capacities facilitate increasing penetration of DER. The utility infrastructure is thus not the limiting factor in DER growth. This roll out of distribution side technologies will initially increase T&D costs, but enables future T&D cost referral.

While the negative development was defined as:

The effectiveness of the roll out of distribution side technologies is low and real-time monitoring and control capacities develop slowly. The utility infrastructure is the limiting factor in increasing the penetration of DER in a reliable manner. This roll out of distribution side technologies will initially increase T&D costs, and limit the future T&D cost deferral ability of DER.

The subsequent plotting of the scenario dimension developments in the scenario matrix yielded the four scenarios as seen in Figure 10. For an overview of the positive and negative developments of the scenario dimensions and trends Appendix IV can be consulted.

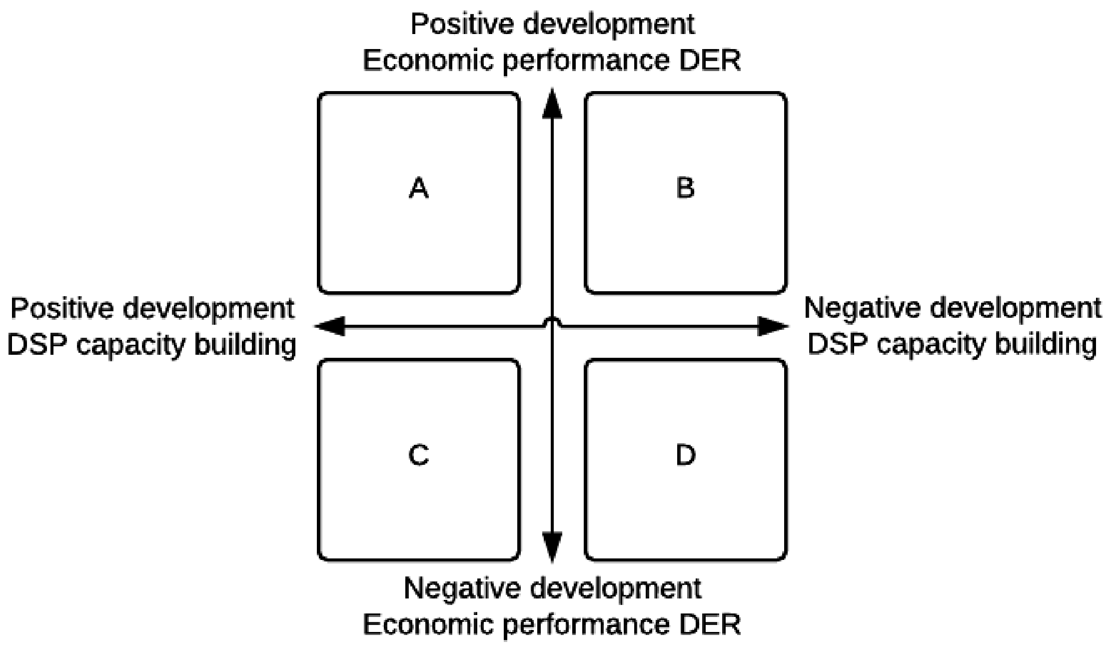

Figure 10: Scenario matrix

5.4.2 Scenario synthesis

The influence of the scenario dimensions and trends on the four impacted stakeholder groups in each scenario was visualized in the influence diagram in Figure 11. The arrows represent interrelations between trends and scenario dimensions, or an impact on a structural variable that underlies the competition exerted by one of the industry groups. A notable result was that the T&D costs was dependent on Economic growth, Utility infrastructure and Utility business revenue, which limited its ability to vary independently in each scenario.

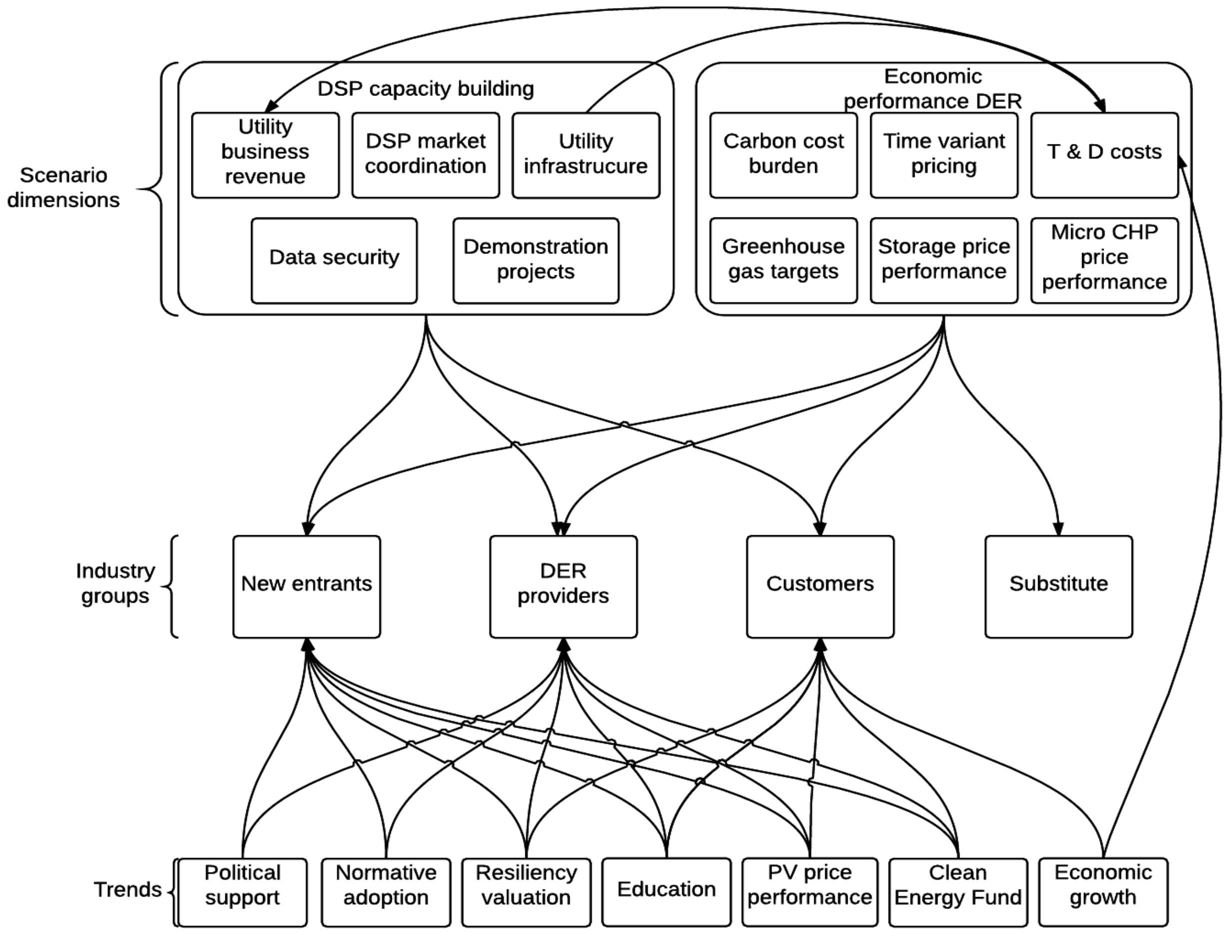

Figure 11: Influence diagram

The subsequent synthesis of scenario specific impacts of the trends and scenario dimensions yielded the list of changes in the structural variables of the DER industry structure as seen in Appendix V. An overall industry structure description is presented in Figure 12, in which developments in the structural variables underlying the power of substitutes, existing competitors, customers and new entrants are respectively presented in each scenario.

Figure 12: Scenario description

5.5 Competition analysis

The competitive position of the ATES business model in the four scenarios is presented by first describing the obtained ATES business model in section 5.5.1, and subsequently presenting the strengths and weaknesses of this business model against the competition in the scenarios in section 5.5.2.

5.5.1 Business model

The key elements of the ATES business model can be seen in Figure 13, and are briefly described.

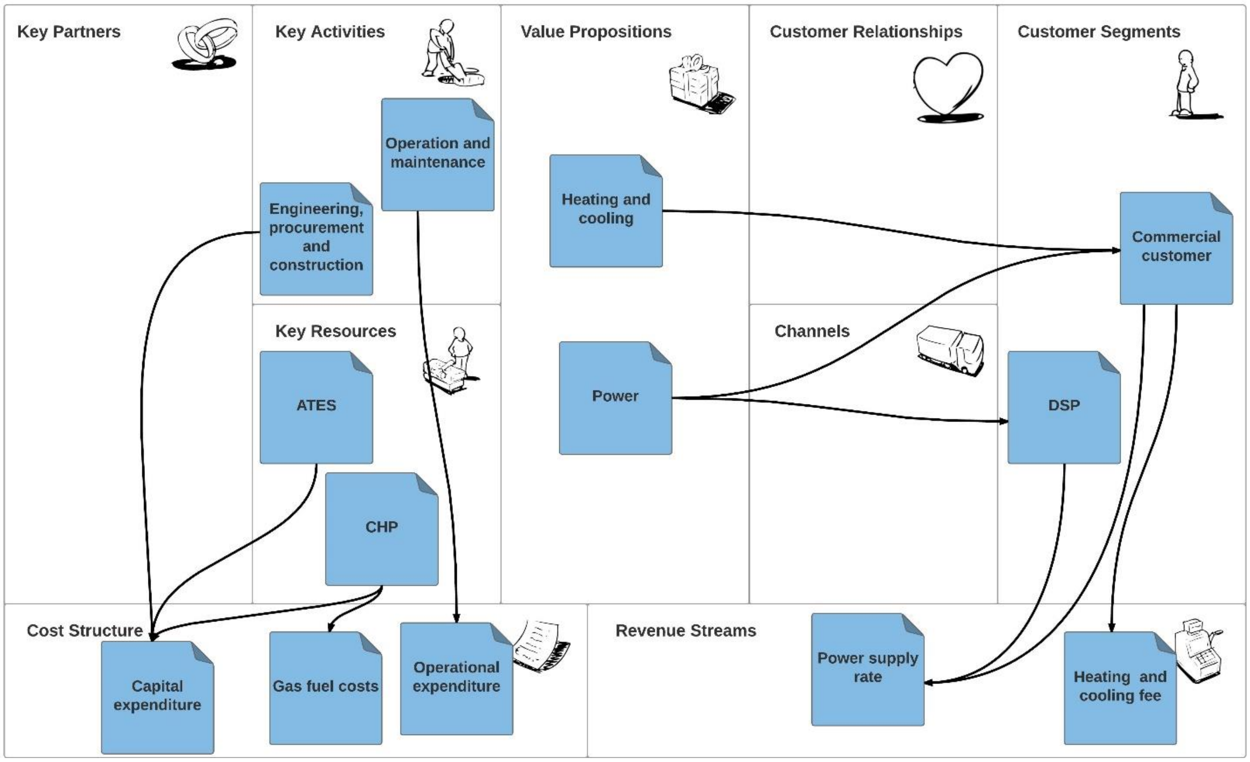

Figure 13: ATES business model

The customer segment is commercial, for which the value proposition is the supply of heating and cooling, and a power supply to provide part of the building's load. Additional services are the possibility of providing backup power, DR, and providing excess power to the DSP. The customer has a long-term contract, in which the performance is guaranteed. The revenue streams are a fixed fee per amount of heat and cold provided, and a fee for the supplied power based on the then prevailing electricity rate. The value proposition is supported by an ATES and CHP system as resources, for which engineering, procurement and construction are the main activities. These resources and activities result in the capital expenditures. The cost structure furthermore includes operational expenditure resulting from operation and maintenance of the system, and fuel costs due to the gas consumption of the CHP.

5.5.2 Five forces analysis

The key findings on the changes in the intensity of the competitive forces faced by the ATES business model are presented in Figure 14 for each scenario. These forces emerged from the industry structure changes in the scenarios, which are presented in Appendix V, that were relevant to the ATES business model. Additional to the shaping effect of the industry structure on the competitive forces, two interactions between the competitive forces were found to play an important role in shaping their intensity as well. First, the impact of an intensification of the threat of entry on the industry growth was included in scenario A and C by partly offsetting the rivalry lowering effect of this industry growth against the intensity of the threat of entry. Second, the impact of a favorable price performance of the utility substitute, combined with limited differentiation, on the industry growth was considered in scenario D by lowering the industry growth according to the intensity of the utility's price performance and differentiation.

Figure 14: Competitive forces faced by ATES business model

6 Discussion

This thesis aimed to provide a strategically relevant forecast of the 2025 DER industry in NYS. To achieve this aim, industry structure scenarios were constructed and a competitive analysis was performed for an ATES business model against the obtained industry structure scenarios. The obtained findings were presented in chapter 5, and are discussed in this chapter in conjunction with the DER and REV overview of chapter 2 and theory of chapter 3. This yielded implications, limitations and suggestions for future research. This chapter follows the same structure as the findings in chapter 5, and discusses the industry definition in section 6.1 the factor identification in section 6.2, the trend and uncertainty definition in section 6.3, the scenario building in section 6.4, and the competition analysis in section 6.5. Additionally, areas for future research are proposed in section 6.6.

6.1 Industry definition

The aim of this step was to obtain a workable definition of the five groups that exert industry competition. A discussion of the contributions and limitations of the findings towards fulfilling this aim is provided by respectively discussing existing competitors, customers, substitutes, new entrants, and suppliers.

Existing competitors were defined as DG and energy storage providers, which is a multi-product industry through which multiple services can be provided to the customer. This can be considered as a broad industry definition, which potentially limits the description of product specific industry conditions. This limitation was overcome by accounting for PV, CHP and battery storage as current products, and base load power, backup power, renewable energy, demand response and T&D deferral as services provided by existing competitors or new entrants that potentially become part of the existing competitors in 2025.

Customers were defined as behind the meter residential and commercial DER customers, which excludes industrial customers and distribution utilities as a potential customers. The mostly larger baseload than 5 MW of industrial customers (DNV GL Energy, 2014), and inhibition of utility ownership of DER indicates a limited size of this potentially excluded market (State of New York Public Service Commission, 2015).

Utility supplied electricity was defined as the substitute for DER services, which disregards substitutes within the DER industry. Battery storage can for example be a substitute for CHP when DR is the valued service. Relative price performance developments within the DER industry are however taken into account via the customers' cost reduction potential of the different DER solutions and services. Energy efficiency and load shifting appliances can be considered to be substitutes as well, because they can provide DR or T&D deferral services (NYS Department of Public Service, 2014). These are excluded in the industry definition, which limits the predictive power of the impact of energy efficiency and load shifting appliances on the industry structure scenarios. Additionally, NYS was considered as a uniform region, and different regional characteristics of the seven different distribution utilities serving it were not accounted for. The development of each utility of these utilities into DSPs will probably be accompanied by unique challenges and impacts on the regional customers and DER providers. Modeling the utilities in NYS as one uniform entity will thus probably not include the full complexity of the impact of REV on the DER industry in NYS. The future developments of each of the seven distribution utilities in NYS are however very likely to happen between the four extreme scenarios defined in this research.

The new entrants were defined as DER providers that will potentially enter the DER industry in the next ten years. This contributed to explaining the existing competitors in 2025, because the likelihood of entry is partly determined by the industry growth, which in turn determines the new capacity likely to be added by these entrants to benefit from this growing industry (ME Porter, 1979).

Suppliers were broadly defined as the companies from which DER providers procure the vital products and services in order to provide their own product to their customers. Because suppliers are but are highly company specific, the ability to make generalizations over a group of suppliers could have been limited. The broad definition on the other hand potentially impeded the identification of suppliers specific to certain DER providers as well.

Despite of the potential limitations caused by the broad supplier definition and the uniformity of the utility definition, the obtained definition of the five industry groups contributed to the research by providing a workable scope of the DER industry. This contributed to a clear and concise scenario definition as discussed in section 6.4.

6.2 Factor identification

The goal of this step was to obtain the factors in the macro-environment that are likely to shape the DER industry structure over the next ten years, and the impact that these factors might have on the DER industry structure. A discussion of the contributions and limitations of the findings towards fulfilling this aim is provided by discussing the expert sample in section 6.2.1, the interview in section 6.2.2, and the qualitative data analysis in section 6.2.3.

6.2.1 Expert sample

The sample represented senior experts from all defined industry groups, apart from the distribution utility. Although a utility was contacted multiple times, an interview appointment could not be planned. This could have limited the inclusiveness of the interview data, considering the large role of the utilities in enabling DER integration in their new DSP function as elaborated in chapter 2. Furthermore, nine out of ten respondents resided in New York City and one in Albany. This can mainly be contributed to the sampling methods that used the researcher's professional network and snowball techniques, because the researcher was based in New York City. This could limit the external validity of the factors towards other regions of NYS.

6.2.2 Interview

Two respondents didn't agree with the audio recording, so field notes were used for the data collection. This lowered the level of detail of the interview data, and could have limited the reliability as compared to transcripts. Probing was applied in multiple instances during the interviews to request a specification of the impact of the identified factors on the industry structure. This could give an indication that the experts were overall more focused on the factors rather than the conceptualization of their industry structure impact, which could have limited the validity in actually measuring the industry structure impact. The application of probing contributed to overcoming this potential limitation.

6.2.3 Qualitative data analysis

The large total of hundred-fifty-two initial factors was likely caused by the grounded theory coding system, which stayed open for potential new factors in the transcripts. The subsequent cluster analysis yielded large differences in the Pearson correlation coefficients ranging between 0.59 and -0.02, which was found to be useful in objectively indicating similarities as a complement to the researcher's interpretation. The eventual amount of twenty-seven factors was however well within the workable amount of forty factors as mentioned by literature (Boyce & Associate, 2006; Schwenker & Wulf, 2013b). Most of these factors were mentioned by multiple or all experts, this emergence of the same factors from the interview data arguably indicated that a sufficient sample size was reached (Boyce & Associate, 2006). Two factors were only mentioned by one expert, of which one, data security, was eventually ranked as a critical uncertainty. This emphasized the value of including factors mentioned by a single expert. The twenty-seven factors thus represent the crucial driving factors for change in the DER industry as perceived by experts, which are valuable for sketching an image of potential future developments in the DER industry.

Within the industry structure impact of the factors, thirteen of the twenty-eight structural variables were found to be impacted by the macro-environmental factors. Most notably, the structural variables underlying the power of suppliers were not found to be impacted at all. The fact that suppliers were not mentioned could indicate that the experts didn't perceive suppliers to have a relevant role in shaping the DER industry. It could indeed be argued that suppliers would to a lesser extent be prone to changes as proposed in REV, due to the predominant focus on reforming the roles of customers, utilities and DER providers (NYS Department of Public Service, 2014). The broad definition of suppliers might have limited the identification of these structural variables as well, as argued in section 6.1. Their absence in any case limits the inclusiveness of the scenarios. Another notable finding was that industry growth was by far the dominant impacted variable; fourteen of the twenty-seven factors impacted the industry growth. This demonstrates that industry growth is perceived as the dominant industry structure impact of the factors.

The obtained set of factors was established in comprehensive consultation with a broad sample of relevant experts. The conceptualized industry structure impacts of these factors thus represent a substantiated overview of variables that are likely to underlie structural change in the DER industry up to 2025. This contributed to the synthesis of valid scenarios as discussed later on in section 6.4.

6.3 Trend and uncertainty definition

The aim of this step was to come to a division of the obtained factors into trends and critical uncertainties which will shape the future DER industry. A discussion of the contributions and limitations of the findings towards fulfilling this goal is provided by discussing the questionnaire in section 6.3.1, and the quantitative data analysis in section 6.3.2.

6.3.1 Questionnaire

Consulting the same experts as during the factor identification step led to a sample of ten respondents, which is relatively small for a quantitative analysis. Although no detailed statistical test were employed, this number could have limited the representation of the total population. Most respondents took longer to complete the questionnaire, and some indicated that they struggled with rating the uncertainty value of certain factors.

6.3.2 Quantitative data analysis

The obtained Cronbach's alpha coefficient of 0.73 and 0.79 for the impact and uncertainty respectively indicated an acceptable internal consistency, as defined by a Cronbach's alpha of 0.70 or higher (Gadermann et al., 2012). The sample size and difficulties in completing the questionnaire did thus not decrease the overall reliability, of the experts consistently providing the same results, towards unacceptable levels. Due to the dissection of the impact uncertainty grid, five factors ended up on or very close to the dissection borders. The role of the adopted axis scales can be considered relatively large in determining the relevance of these factors in the further scenario process. Small differences in the questionnaire could thus be amplified in their influence on the eventual scenarios.

Overall, the division of the factors into trends, critical uncertainties and secondary elements was supported by reliable quantitative data, which contributed to the adequate identification of the scenarios as discussed in the next section 6.4.

6.4 Scenario building

The scenario building aimed to obtain four 2025 DER industry structure scenarios that are likely to result from REV in NYS. A discussion on the identification of these scenarios through the development of the trends and critical uncertainties is provided in first in section 6.4.1, followed by the discussion on the synthesis of industry structure in each scenario in section 6.4.2.

6.4.1 Scenario identification

DSP capacity building and Economic performance DER emerged as scenario dimensions after clustering of the critical uncertainties. The proper clustering of these scenario dimensions was crucial for guaranteeing the quality of the scenarios. Although this was done based on identified common elements and impacts as perceived by the researcher, the literature review of chapter 2 supports the connections between the critical uncertainties within the obtained clusters. These will be briefly elaborated upon.

The "DSP capacity building" aligns with the transition of the existing distribution utilities into the DSP role. Within this role their new functions include: integrated system planning to create a mutual incentive for the DSP and DER providers towards DER integration (Zinaman et al., 2015), system operation in which improved monitoring and control technologies and capacities allow for increased DER integration, and the establishment of a marketplace to enable transactions of DER services (State of New York Public Service Commission, 2015). This supports the connection between the critical uncertainties of utility business revenue, utility infrastructure and DSP market coordination respectively. The increase in these monitoring, control and market coordination activities also increases the potential for harmful cyber threats, for which the DSP should constantly develop new security methods (State of New York Public Service Commission, 2015). This supports the connection between the new DSP functions and the critical uncertainty of data security. The development of these capacities will be facilitated by and becomes apparent through the demonstration projects, as planned by the PSC (NYS Department of Public Service, 2014). This supports the connection with the critical uncertainty of demonstration projects.

The “Economic performance DER” aligns with financial incentives or technological developments that govern the economic performance of DER. As elaborated in chapter 2, there are two relevant financial incentive structures under consideration within REV: time variant pricing, in which DR services can create value from time-based fluctuations in the customers’ energy price (Spiller, 2015; Walawalkar et al., 2007), and carbon pricing to reflect the value of reduced carbon emissions (New York State Department of Public Service, 2014). These rate structures align with the critical uncertainties of time variant pricing, carbon cost burden and the connected greenhouse gas targets critical uncertainty. Next to the financial incentives for DER, developments in the price of electricity delivered via T&D is subject to change as well. Utility investments in T&D are charged to its customers, while DER can be used to prevent the need for these investments (Hyams, 2011; NYS Department of Public Service, 2014). This aligns with the critical uncertainty of transmission and distribution costs. Finally there are the technological developments in CHP, which occurred over the last years in the soft cost and smaller load size applications (DNV GL Energy, 2014; Lawton, 2014), and battery storage, which has seen improvements in physical performance (U.S. Department of Energy, 2013). These technological developments emphasize the potential for improvements in the cost and performance of these DER products, which aligns with the critical uncertainties of price performance of micro CHP and price performance of storage. The potential contribution of this scenario dimension is however limited by the qualitative description of the data, while the impact of economic performance would be approximated more meaningful with quantitative data.

The unity of the critical uncertainties within the obtained scenario dimensions is thus supported by the DER and REV literature of chapter 2, which contributed to the consistency and quality of the scenarios.

6.4.2 Scenario synthesis

The influence diagram visualized four interrelations between trends and critical uncertainties: T&D costs was impacted by economic growth, utility infrastructure and utility business revenue, and utility business revenue was in turn impacted by the T&D costs. While this limited the ability of these factors to vary independently according to the extreme scenario developments, the elimination of incompatible development combinations increased the consistency of the scenarios.

The obtained scenario descriptions, as presented in section 5.4.2, provide an overview of the industry structures of the four scenarios. Common elements of all scenarios include: industry growth, a decrease in customer concentration, an increase in the customer cost saving ability of DER, and a favorable position for backup power services and PV products. Additional DER industry structure characteristics depend on the development of two highly uncertain and impactful scenario dimensions. The 2025 DER industry structure could thus move to any of the extreme scenarios. A less extreme development of either one or both of the scenario dimensions would however induce a 2025 DER industry structure state which is positioned between the four extreme scenarios.

The scenario building thus contributed to obtaining four 2025 DER industry structure scenarios that take the highly uncertain impact of REV and its accompanying developments into consideration. These scenarios are supported by a clear and concise industry definition, comprehensive expert perceptions, reliable ranking of salient developments, and DER and REV literature. The 2025 DER industry is thus very likely to develop towards or between the four industry structure scenarios.

6.5 Competition analysis

This step aimed to obtain an overview of the competition that the ATES business model faces in the four industry structure scenarios. The research's contributions and limitations towards this aim are presented by first discussing the business model in section 6.5.1, followed by the five forces analysis in section 6.5.2.

6.5.1 Business model

The product CHP, the commercial customer segment, and the services of baseload power, DR and backup power could be framed in the business model. The other main value proposition, heating and cooling, was framed in the business model as well, but had no direct relevance to the five forces analysis because the industry focus was on electricity services. The business model thus competed in another industry as well.

6.5.2 Five forces analysis

The overview of the competition faced by the ATES business model in the four scenarios, as presented in section 5.5.2, provided insights in the intensity of the different competitive forces. The range of scenario specific changes in the intensity of the of the competitive forces can be expected to be: a small to extreme decrease of rivalry, a small to extreme increase in the threat of entry, a moderate to extreme decrease in the bargaining power of customers, and equal to a small decrease in the threat of substitute providers. As elaborated in section 6.2.3, changes in the supplier power could not be accounted for. For the ATES business model, shifts in the power of providers of the ATES and CHP assets and gas suppliers were thus missing in its competitive environment. The inclusion of the relation between the threat of entry and industry rivalry and between the utility's price performance and industry growth, as supported by Porter (1979), contributed to the validity of the combined competitive forces by increasing its consistency.

The competition intensity of the combined forces was reduced the most in scenario A, followed by scenario C and B, and scenario D with a moderate reduction. This indicated an overall increase in the profit potential of the ATES solution within the 2025 DER industry. In order to reap the benefits of this increased profit potential, defenses should be built against the intensifying forces and favorable positions should be found in respect to weakening forces. From a strategic standpoint, most attention should go out to the changes that induce the highest intensity effects on these forces (ME Porter, 1979). This research thus suggests that building defenses against an increasing threat of entry, and positioning to benefit from a less intense rivalry and customer power could prove favorable for the profit potential of the ATES business model. Determining the adequate direction for business model innovation to benefit from this should however be accompanied by knowledge on the company's capabilities as well (ME Porter, 1979).

The competition analysis overall contributed to ETNY's aim of providing strategic advice to its ATES company client as elaborated in chapter 1. This will help the ATES company in anticipating shifts in the competition they will face in the DER industry, which contributes to adequately innovating their business model to obtain a favorable position within this future competitive environment. Moreover, the competition analysis of the ATES business model demonstrated the strategic value of the obtained DER industry structure scenarios in providing relevant knowledge on the future shape of competition in the NYS DER industry. The obtained industry structure scenarios, which were discussed in section 6.4, thus contribute to more adequate strategy formulation by DER providers that desire to obtain a position in this industry.

6.6 Future research

The limitations of this research and notable findings discussed in this chapter provided several relevant areas for future research. These are briefly presented in this section by first discussing improvements that might overcome the encountered research limitations, and then discussing topics which were less closely related to the research aim, but on which further knowledge expansion might nonetheless yield interesting results.

Several areas for improvement of the research were found, five of these which aimed to overcome the most important research limitation will be briefly mentioned. First, suppliers could be defined more concrete and subsequent probing could be applied during the interviews to inquire whether the factors impact each specific industry group. This might overcome the absence of several industry structure impacts, or at least exclude their potential presence. Second, adding a distribution utility to the sample to include the internal perception of the utilities will be potentially valuable. Third, the sampling technique could be applied in other regions in NYS to overcome the bias towards Ney York City, which benefits the external reliability. Fourth, the sample size for the quantitative questionnaire could be increased in order to lower data dispersion and increase the reliability. If appropriate research resources are available, an alternative is applying a Delphi method to increase consensus amongst the experts. This could be done by collectively exploring the reasons behind the observed dispersion and holding a second questionnaire round to account for potentially changed expert perceptions (Tapio, 2003). Finally, a quantification of the scenario dimension "Economic performance DER" would allow for a more meaningful assessment of the profit potential of the scenarios through its impact on the business model viability as defined by the cost structure and revenue streams (Osterwalder & Pigneur, 2010).

Notable findings of this research gave rise to the identification of two potentially interesting areas for future research. First, complementary product providers were accounted for through their effect on the relevant industry structural variables, as recommended by Porter, 2001 (Michael Porter, 2001). It was found that the extent to which the distribution utility could build the capacities to play a complementary role to the DER industry was a highly uncertain and impactful determinant for the future success of the DER industry. The extent to which the distribution utility provided a favorable price performance trade-off towards potential DER customers in the role of substitute, on the other hand, influenced the success of the DER industry as well. Because distribution utilities across the globe encounter the need to react to DER (Richter, 2012), the impact of this apparently dueling role of the distribution utility on the DER industry could be an interesting topic for future research. Secondly, this research demonstrated that industry growth was the dominant industry structure impact of the macro-environmental factors. This is emphasized as well in Grundy's research into the growth drivers concept, which assesses the impact of the PEST dimensions on Porter's five forces via industry growth drivers (Grundy, 2006). Further research into the interface between the macro-environment, the industry structure, and the role of industry growth specifically could provide a better integration between the PESTEL dimensions and Porter's competitive industry forces.

7 Conclusion

This thesis aimed at providing a strategically relevant forecast of the 2025 DER industry structure in NYS which could result from the REV proceeding as elaborated in chapter 1. By qualitative interviews, quantitative questionnaires and analysis of the obtained data, findings were obtained on four industry structure scenarios and the competitive position of an ATES business model in these industry scenarios as seen in chapter 5. In chapter 6 these findings were discussed against the conceptual model of chapter 3 and the DER and REV outline as presented in chapter 2, which allowed for obtaining the answers of the research questions which were presented in chapter 1. This chapter provides the answers to these research questions by answering the central research question in section 7.1, and provides the sub-question in section 7.2. Recommendation to the company are additionally provided in section D, after which the chapter is concluded by the overall contribution of this thesis.

7.1 Industry structure forecast

The central research question was formulated to overcome the lack of knowledge on the impact of REV on the future shape of the DER industry in NYS, by requesting a strategically relevant forecast of the industry structure. The central research question, which is answered in this section, is:

What DER industry structure could result from the proposed REV proceeding in NYS in 2025?

This research suggests that the REV proceeding induces developments that result in a 2025 DER industry structure state that will overall experience industry growth, a decrease in customer concentration, an increase in the customer cost saving ability of DER, and a favorable position for backup power services and PV products. Additional DER industry structure characteristics are dependent on the development of two highly uncertain and impactful scenario dimensions. The first is the extent to which the distribution utilities builds up capacities in integrated system planning, system operation, marketplace coordination, secure data handling and demonstrating new business models. The second is the development of economic incentives through time variant pricing, carbon cost burden, T&D costs and the price performance of CHP and battery storage. The potential further development of these dimensions induces a divergence of the future pathways, which results in a DER industry structure that will be positioned between the following four scenarios:

A. Extreme industry growth and moderate differentiation. A small decrease of capital requirements and a small increase in distribution channel access. A small increase in customers' quality and cost pressure, and a moderate increase in the cost saving ability of DER and a decrease in customer concentration. A small decrease of the price performance of utility power. And a favorable position for renewable and DR services.

B. Strong industry growth, a small increase of fixed costs, and a small increase in differentiation. A small decrease in distribution channel access. A strong increase in cost saving ability of DER, a moderate decrease of the customer concentration, and a small increase of the cost pressure on customers. A small decrease of the price performance of utility power. And a favorable position for renewable and DR services.

C. Strong industry growth and a small increase in differentiation. A small decrease of capital requirements, entry favoring government policy and a small increase in distribution channel access. And a small increase in customers' quality and cost saving ability of DER, a moderate decrease of the customer concentration and a small decrease of the cost pressure on customers.

D. Moderate industry growth and a small increase in fixed costs. Entry favoring government policy and a small decrease in distribution channel access. A small decrease customer concentration and a small increase in customer cost saving ability of DER and cost pressure. And a small decrease of the price performance of utility power.

7.2 ATES business model competition

The sub-question was defined to ensure the strategic relevance of the DER industry structure forecast as requested by the central research question, and to request an overview of the future competition faced by an ATES business model in the obtained industry structure forecast. The sub-question, which is answered in this section, is:

What competition will an ATES business model face in the 2025 NYS DER industry structure forecast?

Overall the ATES business model will face a small decrease in rivalry amongst competitors, a moderate decrease in the bargaining power of customers, and a small increase in the threat of entry in its industry. Additional to these common competitive forces, the following scenario specific shifts in competitive forces are perceivable:

A. Low price performance of the utility lowers the substitute's threat. The extreme industry growth initially lowers rivalry, but the large threat of entry eventually limits the rivalry lowering effect of the industry growth. The overall strong decrease in rivalry, in combination with an extreme decrease in customer power, causes mild competition that focuses more on differentiation and quality than cost.

B. Low price performance of the utility lowers the substitute's threat. The small increase in entry barriers and moderate industry growth limits the threat of entry, which enables a continued rivalry lowering effect of this industry growth. Limited differentiation poses the threat of increased cost focus, but the strong decrease in the bargaining power of customers prevents intense cost competition.

C. The strong decrease in rivalry in combination with an extreme decrease in customer power causes initial mild competition that focuses more on differentiation and quality than cost. Lower entry barriers, in combination with moderate industry growth, however causes an extreme threat of entry that is likely to intensify rivalry in the long run.

D. Unchanged price performance of the utility, combined with a lack of differentiation, lowers industry growth. This causes only a small decrease in rivalry, which is focused on cost competition. The bargaining power of customers is moreover moderately reduced. The threat of entry is limited due to a small increase in industry growth and unchanged entry barriers.

7.3 Recommendations to company

The obtained industry structure scenarios could aid ETNY in providing enhanced consulting services to their DER clients. This will help their clients in formulating their strategy for obtaining a sustainable competitive advantage in the NYS DER industry. ETNY is thus advised to apply these industry structure scenarios, in conjunction with their client's business model, to assess the competitive forces to which this business model might be prone to in the future. This will give the client the necessary industry knowledge to effectively innovate their business model to enable a long-term competitive position. This could both benefit the clients' strategies, and the success and growth of ETNY as a consulting firm.

The competition analysis furthermore contributed to ETNY's aim of providing strategic advice to its ATES company client as elaborated in chapter 1. Based on this thesis, the ATES company is advised to assess their capabilities in order to find a direction for business model innovation that builds defenses against an increasing threat of entry, and positions itself to benefit from a less intense rivalry and customer power. It is furthermore advisable to monitor and compare real world developments with the potential developments as outlined in this thesis. This helps in anticipating which scenario specific competitive forces may become important in the future. These recommendation help the ATES company in obtaining a favorable position within the 2025 DER industry environment of NYS.

In conclusion, the industry scenarios provided in this thesis delivered strategically relevant knowledge on the future of the NYS DER industry, despite of its high uncertainty induced by REV. This allows ETNY to grasp the competitive position of its clients' DER business models, as demonstrated by the overview of the competition faced by the ATES business model. The provided understanding of the faced competition in the 2025 DER industry enables DER providers, and the ATES company in particular, to more successfully implement their solution in NYS. The successful roll out of these DER solutions could provide increased resiliency of the NYS energy system and reduced CO_2 emissions. This response to the urgency of climate change mitigation can decrease coastal flood risks globally, while the adaptation towards a resilient energy system in NYS decreases the disastrous effects of future storms, like experienced by the severe impact of Sandy in 2012. The researcher hopes that this thesis contributes to this earnest cause.

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Appendix I

1. What important POLITICAL factors (f.e. presidential elections, local corruption, and geopolitical stability) can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

2. What important ECONOMICAL factors (f.e. global economic stability, unemployment rates, and access to credit) can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

3. What important SOCIO-CULTURAL factors (f.e. global population growth, state demographics, and societal attitudes towards distributed energy) can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

4. What important TECHNOLOGICAL factors (f.e. access to technologies, infrastructural changes, research and development) can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

5. What important ENVIRONMENTAL factors (f.e. local weather, climate change, pollution, attitudes towards renewable energy)can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

6. What important LEGAL (f.e. anti-trust law, intellectual property law, consumer protection) factors can you identify that will have a crucial influence on shaping the DER industry environment in New York State over the next five years? Please provide a brief explanation of the factor and its influence on the industry environment.

7. What individual or joint strategies that stakeholder from within the industry pay pursue can you identify that will have a crucial influence on shaping the industry environment over the next five years?

Appendix II

Ten respondents were reached in the sampling process. A small company profile, its place in the sampling frame, and the function of the respondent can be found in the overview below. First, a table with demographics of the sample is presented below (Table 2).

Variable	Residence		Age			Sex		Nationality		Highest education		
Options	NYC	Other	25-44	45-65	65+	Male	Female	USA	Other	BSc	MSc	PhD
Amount	9	1	6	2	2	7	3	10	0	3	5	2

Table 2: Demographics of sample

SolarCity

America's largest solar power provider; vertically integrated in manufacturing, sales, financing, design, installation, monitoring (SolarCity, 2015). This is considered an existing competitor, from which a deputy director was interviewed.

New York Energy Consumers Council

Largest energy customer advocacy organization in New York State; representing energy customers, including hospitals, universities, financial institutions, residential and commercial property managers, public benefit corporations, energy service companies, and energy consumers or groups of consumers in Con Edison's service territory (NYECC, 2015). This is considered a customer, from which an executive director was interviewed.

Smarter Grid Solutions

Supplier of Active Network Management products for real-time, autonomous, deterministic control of Distributed Energy Resources (Smarter Grid Solutions, 2015a). This is considered a supplier, from which a senior analyst was interviewed.

Department of Public Service

State regulator of the distribution utilities and distribution grid; initiator of REV. The DPS represented the political community, from which an advisor of the executive office was interviewed.

New York Power Authority

Authority responsible for the power supply to various government entities, municipalities, non-profit institutions and industries in NYS respectively (NYPA, 2012; NYS Department of Public Service, 2014). This is considered a substitute, from which a program manager was interviewed.

EnerKnol

Energy policy data and analytics company; providing real-time access to regulatory information for customers in the energy industry, in segments including fossil fuels, power and utilities, environmental commodities and renewable (EnerKnol, 2015). This is considered a market expert, from which a research manager was interviewed.

Environmental Defense Fund

Nonprofit environmental advocacy group; active in energy and environmental issues where it strives for policy and market-based solutions (Environmental Defense Fund, 2014). This is considered a market expert, from which an attorney was interviewed.

Greentech Media

Media company that delivers business-to-business news, market analysis and conferences that inform and connect players in the global clean energy market (Greentech Media, 2015a). This is considered a customer, from which an executive director was interviewed. Greentech media represented the media, from which a director was interviewed.

NYU Guarini Centre

Think-tank focused on environmental and energy challenges that range from global climate change to regional energy policy (Center, 2015). This is considered a research institute, from which a senior fellow was interviewed.

Columbia University, Center on Global Energy Policy

Center on energy policy providing analysis and recommendations that address pressing energy challenges (SIPA, 2015). This is considered a research institute, from which a senior fellow was interviewed.

Appendix III

Factor	Impacted industry structure variable			
	New entrants	Competitors	Substitutes	Customers
Utility business revenue	Capital requirements Industry growth	Industry growth		
DSP market coordination	Distribution channels			Customer concentration
Clean Energy Fund	Capital requirements	Product differentiation		Product differentiation
Commodity prices	Industry growth	Industry growth	Price performance	
Transmission and distribution costs	Industry growth	Industry growth	Price performance	
Carbon cost burden	Industry growth	Industry growth	Price performance	
Price performance micro CHP	Industry growth	Industry growth		Customer concentration Customers' costs
Price performance of PV	Industry growth	Industry growth		Customers' costs
Price performance of storage	Industry growth	Industry growth		Customers' costs
Time variant pricing	Industry growth	Industry growth Product differentiation		Customer concentration Product differentiation Customers' costs
Greenhouse gas targets	Industry growth Government policy	Industry growth		
Political support	Industry growth Government policy	Industry growth		
Demand Response responsibility	Industry growth	Industry growth		Customers' costs
Indian Point	Industry growth	Industry growth		
Resiliency interest	Industry growth	Industry growth		Customers' quality
Climate change concern	Industry growth	Industry growth		
Local environmental impacts	Industry growth Government policy	Industry growth Product differentiation		
Advanced metering infrastructure	Industry growth	Industry growth		Product differentiation

		Product differentiation		Customer concentration
Utility infrastructure	Industry growth	Industry growth	Price performance	
Data security	Industry growth	Industry growth		Customers' quality
Low-income customer engagement	Industry growth	Industry growth		Customer concentration Cost pressure
Normative DER adoption	Benefits of scale Industry growth	Industry growth		
Developing demands	Industry growth	Industry growth		
Economic growth	Industry growth	Industry growth	Price performance	Cost pressure
Education	Industry growth	Industry growth		Customer concentration
Community individual				Customer concentration
Demonstration projects	Distribution channels Industry growth	Industry growth Product differentiation		Product differentiation Customer concentration

Table 3: Factors' industry structure impact

Appendix IV

Positive development DSP capacity building

- DSP multi-year plans provide transparent distribution system information to customers and DER providers, which help in identifying a wide range of attractive investment opportunities.
- Performance benefits of DER integration in distribution system planning are experienced by DSP; DER integration is preferred over traditional distribution system planning.
- The roll out of intelligent monitoring and control equipment on the distribution system facilitates increasing penetration of DER; distribution system operation is thus not the limiting factor in DER growth.
- Enhanced real-time monitoring and control capacity is developed by the DSP; reliability, flexibility and security of the distribution system are ensured.
- Procurement and pricing mechanisms by the DSP are aligned with many current DER services, fair competition is facilitated.
- Many DER products proposed by DER providers are acknowledged by the DSP and adopted in the marketplace; results in increasingly differentiated DER offering.
- Transactions for market offerings by DSP are efficient and not an entry barrier for many DER providers.
- Broad range of customer segments can be served in marketplace, including aggregated customer solution that reaches deeper into less accessible markets.
- Neglect able amount of severe cyber security incidents on the distribution favors market confidence and DSP perceives minimum security barriers in sharing distribution system information.
- New increased communication infrastructure is perceived to be reliable and privacy is guaranteed; further roll out of the monitoring and control equipment and enhanced system operations is not limited by data security issues .
- Many revenue streams in business model of the DSP are positive, metrics of cost avoidance and customer engagement overall met in most demonstration projects; regulatory constructs needs minor adjustments which do not significantly slow down the process of scaling and roll out of successful markets.

Negative development DSP capacity building

- DSP multi-year plans provide limited distribution system information to customers and DER providers, few attractive investment opportunities can be identified.
- Performance benefits of DER integration in distribution system planning are not significantly experienced by the DSP; T&D system planning mostly continues business as usual.
- The effectiveness of the roll out of intelligent monitoring and control equipment on the distribution system is limited; enhanced real-time monitoring and control capacity of the DSP develop slowly.
- Increasing penetration of DER is raising reliability concerns of the distribution system, in which the operation of this system by the DSP is the limiting factor.

- Procurement and pricing mechanisms by the DSP are not aligned with many DER services, fair competition is not facilitated.
- Many DER products proposed by DER providers not acknowledged by the DSP in the DER marketplace; this hampers differentiation in business models.
- Transactions for market offerings by DSP are high for many DER providers, especially for new entrants.
- Participation of new customers in the marketplace stays limited; many customer segments not represented.
- Several incidents of cyber security breaches on the distribution system cause failures; DSP is hesitant in sharing distribution system planning data
- New increased communication infrastructure perceived to endanger reliability of the system and privacy of users on the system; further roll out of the monitoring and control equipment is limited.
- Customers perceive low quality from DER products due to privacy concerns.
- Revenue streams of DSP business models are not positive initially, metrics of cost avoidance and customer engagement not met; regulatory constructs needs deep reconsidering which slows down process of scaling and roll out of successful markets.

Positive development Economic performance DER

- Economic growth, system planning and roll out of intelligent equipment on the distribution system increase the cost burden that T&D poses on the electricity price.
- Higher electricity rates via increased T&D costs make adoption of DG to lower load for customers more cost attractive.
- Decrease in soft cost due to CEF investments and industry advancements of CHP will increase the cost competitiveness of all CHP solutions.
- Micro-CHP price performance improvements will make CHP fit for smaller load sizes; more customers can benefit from CHP adoption, including larger residential customers.
- Continuing price performance improvements and decreasing soft cost due to CEF investments, will make established battery storage solution more cost attractive.
- Differentiated energy storage solution will see improvements and increasingly reach new customer segments, including higher residential segments later on.
- Real-time pricing schemes are introduced across the state on an opt-in basis to ensure high participation levels state wide for commercial and residential customers.
- Commercial customers receive more granular pricing schemes additional to the demand charge and critical peak rebate; residential customers are now enabled to participate individually in the DR supporting DER market.
- The profit potential of an increasing number of DR supporting DER business models is increased.
- Increasing GHG emission targets cause the establishment of a high price for carbon within the DER market place.
- DG providers and customers can generate significant revenue through adopting renewable DG; carbon emitting DG will have a cost burden decreasing its competitiveness.

Negative development Economic performance DER

- Economic growth, system planning and roll out of intelligent equipment on the distribution system decrease the cost burden that T&D poses on the electricity price.
- Lower electricity rates via lower T&D costs make adoption of DG to lower load for customers less cost attractive.
- Stabilization of soft cost, despite of CEF investments, will not change the cost competitiveness of CHP.
- Micro-CHP price performance improvements stay limited and CHP will not be able to penetrate into smaller load size markets.
- Price performance improvements will reach the limit of what is physically achievable and soft cost will not decrease despite of CEF investments; current solutions for battery storage will minimally improve
- Improvements in differentiated battery storage solution are too limited to achieve commercial success; the reaching of new customer segments will be very limited.
- An opt-in choice structure results in neglect able participation levels for time-variant pricing schemes.
- The revenue of DR supporting DER business models increases mildly for participating customers.
- Critical peak rebate stays the dominant time-variant pricing scheme for commercial customers; more granular approaches not widely adopted and have limited participation.
- Residential customers have minimal incentives to individually participants in the DR supporting DER market.
- No concrete GHG emission targets prevent the establishment of a price for carbon within the DER market place.
- Renewable DG will have no significant cost advantage over carbon emitting DG.

Trends development

- CEF support reduces soft costs of all DER solutions.
- More customer segments will become accessible through customer aggregation, especially residential customers.
- Entry barriers for new DER solutions lower through increased access to distribution channels.
- Cost pressure on customers slightly lowers through stable economic growth.
- Continued support for DER of the NYS government will enable the further implementation of the REV proceeding.
- PV soft costs will continue to drop due to industry efforts and CEF support; causing a growth increase in residential and commercial segments.
- Based upon the intelligent monitoring and control devices on the distribution system, the growth of PV can be limited in particular compared to other DER solutions.
- In combination with battery storage system improvements, PV will grow dramatically.
- Resiliency will remain an important value in DSP system planning; procurement and pricing mechanisms will favor DER that can provide this value

- Customers consider business continuation or backup for critical appliances as a valuable quality of a DER solution. Customers perceive strong added value for DER which provides backup power.
- Customers will consider investing in DER solutions that are dominant and visible in its specific customer segment as compared to less dominant and visible DER solutions as a behavioral norm.
- DER with a high market share in a certain customer segment will thus see increased growth.
- aCEF investments will raise awareness amongst an increasing number of customer segments; medium income residential segments will be reached additional to commercial and high income residential segments. This will create demand
- The digital marketplace will subsequently facilitate the marketing and transaction process, which will lower costs for DER providers

Appendix V

Scenario A

Industry growth

- All DER
  - Stimulated by efficient market, DSP business revenue, political support, norms and education
  - Enabled by utility infrastructure, demonstrations and data security
- CHP
  - Stimulated by price performance, time variant pricing and resiliency
  - Deceased by carbon cost
- PV; Stimulated by price performance and carbon price
- Battery storage; Stimulated by time variant pricing, price performance and resiliency
- Renewable; Stimulated by carbon price
- Fossil; Decreased by carbon price
- DR; Stimulated by time variant pricing
- Backup power; Stimulated by resiliency

Fixed costs

- Reasonable fixed DSP fee

Differentiation

- Stimulated by DSP market coordination, clean energy fund and demonstration projects
- DR especially stimulated by time variant pricing

Capital requirements

- Reasonable raise by DSP fee
- Lowered by clean energy fund

Government policy

- DER entry favored by favorable politics
- Fossil DG entry restricted, GHG heavy DG foreclosed

Distribution channels

- Fair access by DSP market coordination

Customer quality

- Ensured by data security
- Backup power quality increased by resiliency interest

Customers' cost impact

- Overall; increased by clean energy fund
- DR; increased by time variant pricing
- DG; increased by rising T&D costs
- Fossil DG; decreased by carbon cost burden
- CHP; increased by time variant pricing, rising T&D costs, price performance and clean energy fund
- Decreased by carbon cost
- Battery storage; increased by time variant pricing, price performance and clean energy fund
- PV; increased by rising T&D costs, price performance and clean energy fund

Customer concentration

- Overall decreased by DSP market coordination, demonstration projects and aggregation through clean energy fund
    - DR customers; lowered by time variant pricing
    - Smaller load size CHP customers; lowered by increased price performance

Cost pressure

- Lowered by economic growth
- Increased by rising T&D costs

Price performance substitute

- Lowered by rising T&D
- Fossil utility power; lowered by carbon cost burden

Scenario B

Industry growth

- All DER
    - Stimulated by political support, norms and education
    - Limited stimulation by inefficient market coordination and DSP business revenue
    - Inhibited by inadequate utility infrastructure, poor data security and limited success of demonstration projects
- CHP
    - Stimulated by price performance, time variant pricing and resiliency
    - Deceased by carbon cost
- PV; Stimulated by price performance and carbon price
- Battery storage; Stimulated by time variant pricing, price performance and resiliency
- Renewable; Stimulated by carbon price
- Fossil; Decreased by carbon price
- DR; Stimulated by time variant pricing
- Backup power; stimulated by resiliency

Fixed costs

- High fixed DSP fee

Differentiation

- Stimulated by clean energy fund
- Very limited stimulation or impeded by DSP market coordination and demonstration projects
- DR product differentiation stimulated by time variant pricing

Capital requirements

- High raise by DSP fee
- Lowered by clean energy fund

Government policy

- DER entry favored by favorable politics
- Fossil DG entry restricted, GHG heavy DG foreclosed

Distribution channels

- Impeded by unfair DSP market coordination

Customer quality

- Significantly lowered by unreliable data security
- Backup power quality increased by resiliency interest

Customers' cost impact

- Overall; increased by clean energy fund
- DR; increased by time variant pricing
- DG; increased by rising T&D costs
- Fossil DG; decreased by carbon cost burden
- CHP; increased by time variant pricing, rising T&D costs, price performance and clean energy fund
    - Decreased by carbon cost
- Battery storage; increased by time variant pricing, price performance and clean energy fund
- PV; increased by rising T&D costs, price performance and clean energy fund

Customer concentration

- Not significantly decreased by inefficient DSP market coordination and limited success of demonstration projects
- Decreased by aggregation through clean energy fund
- DR customers; lowered by time variant pricing
- Smaller load size CHP customers; lowered by increased price performance

Cost pressure

- Lowered by economic growth
- Increased by rising T&D costs

Price performance substitute

- Lowered by rising T&D
- Fossil utility power; lowered by carbon cost burden

Scenario C

Industry growth

- All DER
    - Stimulated by efficient market, DSP business revenue, political support, norms and education
    - Enabled by utility infrastructure, demonstrations and data security
- CHP
    - Limited stimulation by time variant pricing
    - Stimulated by resiliency
- PV; stimulated by price performance
- Battery storage
    - Limited stimulation by time variant pricing
    - Stimulated by resiliency
- DR; limited stimulation by time variant pricing
- Backup power; Stimulated by resiliency

Fixed costs

- Reasonable fixed DSP fee

Differentiation

- Stimulated by DSP market coordination, clean energy fund and demonstration projects
- DR; limited stimulation by time variant pricing

Capital requirements

- Reasonable raise by DSP fee
- Lowered by clean energy fund

Government policy

- DER entry favored by favorable politics

Distribution channels

- Fair access by DSP market coordination

Customer quality

- Ensured by data security
- Backup power quality increased by resiliency interest

Customers' cost impact

- Overall; increased by clean energy fund
- DR; limited increase by time variant pricing
- DG; decreased by lower T&D costs
- CHP
    - Limited increase by time variant pricing
    - Increased by clean energy fund
    - Decreased by lower T&D costs carbon cost
- Battery storage
    - Limited increase by time variant pricing
    - Increase by clean energy fund
- PV
    - Decreased by lower T&D costs,
    - Increased by price performance and clean energy fund

Customer concentration

- Overall decreased by DSP market coordination, demonstration projects and aggregation through clean energy fund
- DR customers; slightly lowered by time variant pricing

Cost pressure

- Lowered by economic growth and lower T&D costs

Price performance substitute

- Increased by lower T&D

Scenario D

Industry growth

- All DER
    - Stimulated by political support, norms and education
    - Limited stimulation by inefficient market coordination and DSP business revenue
    - Inhibited by inadequate utility infrastructure, poor data security and limited success of demonstration projects
- CHP
    - Limited stimulation by time variant pricing
    - Stimulated by resiliency
- PV; stimulated by price performance
- Battery storage
    - Limited stimulation by time variant pricing
    - Stimulated by resiliency
- DR; limited stimulation by time variant pricing
- Backup power; Stimulated by resiliency

Fixed costs

- High fixed DSP fee

Differentiation

- Stimulated by clean energy fund
- Very limited stimulation or impeded by DSP market coordination and demonstration projects
- DR; limited stimulation by time variant pricing

Capital requirements

- High raise by DSP fee
- Lowered by clean energy fund

Government policy

- DER entry favored by favorable politics

Distribution channels

- Impeded by unfair DSP market coordination

Customer quality

- Significantly lowered by unreliable data security
- Backup power quality increased by resiliency interest

Customers' cost impact

- Overall; increased by clean energy fund
- DR; limited increase by time variant pricing
- DG; decreased by lower T&D costs
- CHP
  - Limited increase by time variant pricing
  - Increased by clean energy fund
  - Decreased by lower T&D costs carbon cost
- Battery storage
  - Limited increase by time variant pricing
  - Increase by clean energy fund
- PV
  - Decreased by lower T&D costs,
  - Increased by price performance and clean energy fund

Customer concentration

- Not significantly decreased by inefficient DSP market coordination and limited success of demonstration projects
- Decreased by aggregation through clean energy fund
- DR customers; slightly lowered by time variant pricing

Cost pressure

- Lowered by economic growth and lower T&D costs
- Price performance substitute; increased by lower T&D