Perceptions of energy leaders in private industrial sector energy project development models

by

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List of Acronyms

PPA – Power Purchase Agreement,

BOO – Build-Own-Operate,

SA – South Africa

SOE – State Owned Enterprise

REIPPP – Renewable Energy Independent Power Producer Programmeme

USD – United States Dollars

MW – Mega Watt

IRP – Integrated Resource Plan

ERA - Electricity Regulation Amendment

NERSA - National Energy Regulator of South Africa

IPP – Independent Power Producer

PPP – Public-Private-Partnership

CEO – Chief Executive Officer

FID – Final Investment Decision

ABSTRACT

This study explores the perceptions of energy leaders in South Africa's private industrial sector regarding two energy project development models, namely the Self-Build and Power Purchase Agreement (PPA) model. The study utilised qualitative research methods and thematic analysis to identify some of the key decision-making factors utilized by energy leaders when deciding on which development model is best suited for the application. These include cost vs. security of supply, financial considerations, grid impact, and environmental, social, and governance (ESG) factors. Findings indicate that the PPA model is generally preferred for industrial applications due to the larger capacity requirements and inherent complexities, however, the Self-Build model offers greater control and improved energy security. Furthermore, a growing trend toward modified PPA structures, such as energy trading models, was also observed. The study provides insights to guide future energy project development in the industrial sector.

CHAPTER 1: INTRODUCTION

1.1 Purpose of the study

This qualitative research seeks to explore how energy leaders, defined in this context as key decision makers and/or significant contributors to the development of energy projects within the industrial private sector of South Africa, perceive different project development models. The research focuses on two prominent models, namely the Power Purchase Agreement (PPA) and the Self-Build models, which have their benefits, constraints, and preferences that this study aims to investigate.

1.2 Context of the study

South Africa in 2008 experienced its first major stream of rolling blackouts, officially starting the energy crisis within the country. Ever since, the blackouts now referred to as loadshedding have gotten worse, with no clear solution from the government and state-owned enterprises (SOEs) in sight (Cohen, 2023).

Though the government's response to the crisis was by way of introducing the REIPPP programme (Eberhard & Naude, 2016) and their additional continued efforts are helping, the country as of 2024 is only generating approximately 50,000 MWs (Mega-Watts) and still experiencing loadshedding (ITA, 2024).

This has resulted in the private sector finding the generation of power for direct use by private customers, as a lucrative and necessary investment. Between 2018 and February 2024, the National Energy Regulator of South Africa (NERSA) registered a total of 905 (NERSA, 2024) power generation facilities by Independent Power Producers (IPPs).

When developing these projects, several development models are available, including the PPA, Self-Build, Build-Operate-Transfer, and leasing. The most prominent model noticed in South Africa is the Self-Build and PPA (NERSA, 2024), hence the focus area of this proposed research.

The criticality of the energy crisis in South Africa and the need for continued investments into alternative energy solutions to assist the South African government in resolving the problem are the driving factors for this research to be conducted.

1.3 Problem Statement

Due to the significant media attention surrounding the Renewable Energy Independent Power Producer Procurement Programmeme (REIPPPP), which operates under a Public-Private Partnership (PPP) model, most research on Independent Power Producers (IPPs) has focused on project development within this government-led initiative. For example, up to and including Bid Window 6, a total of 127 projects have been approved through the REIPPPP (Wikipedia, 2024), with extensive public information available across multiple sources. In contrast, the 157 private project licenses issued by NERSA have little to no publicly accessible data, resulting in a limited body of research on private-sector project development models (NERSA, 2024).

Not much is known about the key considerations that leaders consider in making decisions on project development models in the industrial private sector. This research seeks to identify the current key criteria that leaders utilize when determining which model to use at the initiation stage of their energy projects. Thus, providing future leaders with some insights to aid in the selection process on how to develop their projects going forward. There have been 157 licenses issued by NERSA between 2020 and 2024 for the development of energy projects in the private sector. It is not clear how the decision on the development models was taken and what the key considerations were by the leaders driving the development of these projects (NERSA, 2024).

The researcher aims to highlight some of the lessons learned, key benefits, disadvantages, and prerequisites from the perceptions of current leaders utilizing the two development models, thus paving the way forward for future leaders.

1.4 Research Objectives

1. Explore the perceptions of energy leaders on energy project development models for the private industrial sector.
2. Gather some of the key considerations/criteria used by the energy leaders when determining which model to use for energy project development.
3. Assess the key characteristics of these models in terms of benefits, constraints, and prerequisites.

1.5 Research Questions

1. How do leaders in the industry perceive the Self-Build and PPA development models
2. What are some of the key considerations/criteria being used by these leaders when determining which model to use?
3. What are the key characteristics of these models in terms of benefits and constraints?

1.6 Study Rationale

The industrial sector in South Africa accounts for approximately 48% of the country's total electricity consumption (SA Energy Information, 2023), and is also one of the largest contributors to national carbon emissions (Department of Forestry, Fisheries and Environment, 2023). In the final quarter of 2022, the mining sector reported a 3.7% decline in production, contributing to a broader contraction in national GDP (Gross Domestic Product), primarily driven by intensified load shedding (Lawlor, 2023). According to Electricity Minister Kgosientsho Ramokgopa, the elevated levels of load shedding in 2022 directly resulted in the loss of approximately 640,000 jobs, predominantly in the industrial sector, due to reduced production rates caused by unreliable electricity supply (BusinessTech, 2023).

While the Renewable Energy Independent Power Producer Procurement Programmeme (REIPPPP) has played a critical role in attracting private investment into the energy sector and expanding renewable capacity, its grid-tied, government-

led structure has limitations, particularly in addressing the immediate and specific energy needs of industrial users. As a result, there is a growing need for alternative project development models that offer more flexibility, greater energy security, and alignment with specific operational and financial objectives within the private sector.

This research, therefore, aims to investigate the suitability, characteristics, and decision-making considerations associated with various energy project development models in the industrial sector, to support more stable and future-ready energy strategies.

1.7 Delimitations of the study

1.7.1 In scope

a.) Energy projects that have utilized a self-build/ BOO (Build Own Operate) or PPA model in South Africa's industrial sector.

b.) Energy projects currently being developed on either a Self-Build or PPA model in South Africa's industrial sector.

c.) All generation technology types that support an alternative source (not from Eskom) of electricity, including but not limited to solar PV (Photovoltaic), biomass, and wind.

1.7.2 Out of scope

a.) All other economic sectors in South Africa, including commercial, residential, and government services.

b.) Energy projects that have been developed or are currently being developed using different models from the self-build/ BOO or PPA model.

c.) Projects outside of South Africa that have utilized the self-build/ BOO or PPA model.

d.) Projects that fall under the REIPP programme and the PPP (Public-Private Partnerships) model, I.e., Utility PPAs.

e.) Non energy related projects that have utilized the self-build/ BOO or PPA model.

f.) Virtual PPA projects

g.) Beneath each project development model, various contracting strategies may be adopted. For example, under a Self-Build model, the End User may establish a Special Purpose Vehicle (SPV) to secure funding through external sources. However, a similar strategy can also be applied by a developer in a PPA model, with each scenario having different implications for both the End User and the developer, depending on the chosen development model. Due to the broad and context-specific nature of contracting strategies, this aspect falls outside the scope of the current research.

1.8 Definitions of key terms

Refer to Appendix A.

1.9 Assumptions

This research proposal assumes that the human participants will provide dependable responses. It also assumes that the participants will comprehend the questions posed to them and provide a response with honesty and a transparent reflection of their understanding of project development models. Lastly, it is assumed that the participants will cooperate with the researcher through willing participation.

CHAPTER 2: LITERATURE REVIEW

2.1 PPA Development Model

Section 2.1 provides a definition, background discussion, and reviews the literature findings on the characteristics of the PPA contracting model for alternative power generation projects.

2.1.1 Definition

A PPA is an agreement between a power producer and one or multiple buyers. There are two main types of PPAs, namely Utility PPA and Corporate PPA. The utility PPA is signed between a power producer and a utility company. In South Africa, the utility would be ESKOM, and projects under the REIPPP programme are developed using this agreement. The Corporate PPA is signed between a power producer and a private company (End User); it has two primary structures as described below (Rold & Partner, 2024). This research focuses on the Corporate Physical PPA.

2.1.2 Corporate Virtual PPA

The Virtual Power Purchase Agreement (VPPA) is purely a financial agreement because there is no direct consumption of the energy generated from the producer by the corporate user. In this instance, the producer sells energy into the grid at market prices, and the End User buys energy from the grid (utility supplier) at market prices. Then there is a net settlement paid by one of the parties based on the delta between the agreed VPPA energy price and the market price (Larson, 2021).

2.1.3 Corporate Physical PPA

The fundamentals of this agreement dictate that the buyer agrees to purchase an agreed amount of energy from the seller at a predetermined pricing structure, for a predetermined period. The seller commits to generating the required capacity for off-take on demand (Ghiassi-Farrokhfal et al, 2021). This means the buyer and producer must be connected on the same grid. This is done through wheeling, which refers to the use of existing utility infrastructure to transmit power from a producer to the End User, usually in exchange for a regulated fee or with an onsite PPA, where the plant is directly connected to the user's facility on the same property (kyos, 2024).

2.1.4 Pricing a PPA

Determining the contract price (Selling price of energy) in a PPA is a complex exercise, however, it is typically done with the intent to ensure fairness to the buyer and seller. The contract price determination at a minimum would take into account the capital, maintenance, and operability costs of the power plant. These costs would then be summed over the life cycle of the asset and divided by the term of the PPA to obtain a levelized cost of energy. Additional costs considered when determining the selling price of energy include transmission, distribution, and contractual costs (Bruck & Sandborn, 2021).

2.1.5 Benefits

A key driving force promoting the growth and use of PPAs is the level of attractiveness funders have towards projects that have or will have a PPA in place, as this significantly derisks the investment and offers a predictable cash flow. With a PPA in place, the investment can be hedged against guaranteed revenues to be generated by the plant, barring events of force majeure (Trabesinger, et al., 2021). This derisking element of a PPA is being leveraged across multiple facets. The Danish Utility company, DONG, was able to alter the investment risk profile for the development of an offshore wind farm by deploying a PPA, ultimately gaining investment from Danish and Dutch pension funds (Kaminker & Stewart, 2012).

Additional key benefits include.

- Bonetti et al (2010) indicate that cash flow requirements and risks are transferred to the funders (typically in the form of an SPV) (Bonetti et al, 2010), resulting in limited cash requirements upfront for the End User.
- Bird & Bird (2022) proclaims that the removal of market price fluctuation risk to the buyer on energy prices is a key contributor to Europe's 2021 record volumes of PPA deals concluded (Bird & Bird, 2022).
- Allows companies to participate in green initiatives and achieve sustainability targets, without having to dilute focus on their core operation or purpose (Amanda, 2024)

2.1.6 Key Disadvantages and Constraints

PPAs are long-term contracts, typically 10 – 20 years (Bird & bird, 2023). For the End User, this requires that their balance sheet can support such a long-term commitment

(Thornton, 2017). The details of how a PPA is accounted for is dependent on the specifics within the contract as different accounting standards can be applied, however the only instance where a PPA can be considered an off-balance sheet transaction is when the End User does not intend to use all of the power generated by the asset and/or claim a substantial portion of the economic benefits from the generating asset (EY, 2020).

Additional Key disadvantages and constraints.

- There are ownership limitations for the End User, such as their inability to make decisions regarding modifications to the operation of the plant (Solar Voltaics, 2024). Additionally, this limitation extends to the owner's inability to claim tax benefits (depreciation) on the capital spent for developing the asset, even though it is an on-balance sheet transaction.
- The producer is obliged to meet the energy demands of the End User as agreed in the PPA. Failures in the system may hinder the producer's ability to achieve this obligation, and such loss of generation is typically linked to a penalty stipulated in the PPA (Qingan Qiu et al, 2018)
- Typically, the cost of energy for the purchaser will be cheaper when purchasing the generating asset outright (Tingle, 2023).
- Due to the long-term nature of the PPA, early termination of the agreement may be difficult and linked to penalties (Axia Solar, 2024)

2.2 Self-Build Development Model

Provides definition, background discussion, and reviews the literature findings on the characteristics of the Self-Build model for alternative power generation.

2.2.1 Definition:

The Self-Build model dictates that the End User takes ownership of the onsite generation plant, which provides the End User with total control over the asset from the development phase through to operations and maintenance. The End User assumes the funding responsibility for all aspects, inclusive of equipment,

construction, and maintenance costs. In return, the End User has total control of the asset, and the power generated from the asset (EnergyLink, 2023).

The self-build option typically results in the End User outsourcing the engineering, procurement, and construction services necessary to implement the project, requiring some level of internal competence by the End User to scope the works and select the correct service provider (Carroll, 2023).

The topic of self-build projects in the private industrial sector has limited research.

2.2.2 Key Benefits:

Arguably, the biggest driving factor for companies funding their own energy projects is due to the significant reduction in monthly energy costs. The cost of energy generated from an onsite self-build project is typically cheaper than the purchase rate of energy through a utility, and all of these savings are seen by the company with the Self-Build model (Whitworth, 2023). Thames Water, a private British utility company, reported a circa 12 million pound reduction on its energy bill in the first half of 2017, directly attributed to producing 23% of its electricity (Drax, 2018).

Additional key benefits.

- Cities in South Africa, such as Cape Town implementing the feed-in tariff scheme (Omarjee, 2023) and other cities, such as Johannesburg, announcing plans for the implementation of such (Hohm Energy, 2023), provides an opportunity for owners of self-build energy projects to sell surplus energy generated back into the grid, further improving the financial benefits of the project.
- The initial capital investment to build the asset is typically recovered over the life of the plant, i.e, the payback period (Whitworth, 2023).

2.2.3 Key Disadvantages and Constraints

Notably, the major constraint with the Self-Build model is that the End User is required to have a significant amount of cash up front to fund the capital cost of developing and constructing the asset. Similarly, the End User would be required to fund maintenance costs from its current cash as well (EnergyLink, 2023).

Additional key disadvantages and constraints.

- Ensuring that the performance and effectiveness of the asset are maintained becomes the responsibility of the End User. Typically requiring a dedicated team to be appointed for this purpose (Saxon Renewables, 2023).
- Restricted to an on-site solution, meaning that vacant real estate (land) needs to be available to construct the generation plant (Norton Rose Fulbright, 2024)

2.3 Discussion on recent market developments

The 905 energy projects registered by NERSA between 2018 and January 2024 indicate a mix primarily between self-build and IPP projects (NERSA, 2024). The data does not provide any clear indication of reasons why these registered facilities have adopted the development model of their choice; however, one key observation is that the projects with larger output capacities between the range of 150 to 283 MWs seem to adopt the PPA model.

According to Sibanye Stillwater's (Sibanye) integrated report for the year ending 2022, the mining house has pledged its commitment to reach carbon neutrality by 2040. To do so, they have indicated that reliance on ESKOM, which contributed to 89% of the group's scope 1 & 2 emissions, needs to be reduced. As such, they have opted to directly invest in alternative power generation and have funded 3 large-scale solar projects, totaling 175 MWs, on the Self-Build project development model (Sibanye Stillwater, 2022).

In May 2023, after Sibanye had initiated their Self-Build energy projects, the signing of their first PPA was announced, resulting in a contracted capacity of 103 MWs (BR Reporter, 2023). Later on in December 2023, they signed another two long-term PPAs, resulting in a total contracted capacity of 267 MWs through PPAs for the group.

Sibanye appears to be using both project models to meet their alternate energy demand requirements, however, the determining factors used for deciding which model to pursue for each project are unclear. The researcher notes the common key observation once again on the fact that more generating capacity was procured through Sibanye's PPA deals as opposed to the Self-Build projects.

Seriti Resources (Seriti) announced its intent to contract 155 MWs through a PPA arranged by Rand Merchant Bank and Standard Bank. This particular project sought to be funded through a first-to-market equity financing solution, with banks claiming a reduced cost of capital for shareholders (Arnoldi, 2024). There is no record by NERSA (NERSA, 2024) indicating that Seriti has registered any projects through the Self-Build model. This suggests their preference to only procure alternate energy through PPAs. The researcher notes that the PPA deal was announced by Seriti and partners before securing financing for the project, indicating the attractiveness of a PPA to potential investors.

2.4 Conceptual Framework

This conceptual framework, shown in Figure 2-1, illustrates how industrial private sector energy leaders assess and select the most suitable energy project development model. The framework focuses on two primary development models: Power Purchase Agreements (PPAs) and Self-Build approaches.

Each model is analyzed through four critical dimensions, namely, benefits, constraints, prerequisites, and challenges.

These dimensions feed into the key considerations energy leaders use when determining the most appropriate model for their specific needs. Ultimately, the framework leads to the selection of a fit-for-purpose project development model, tailored to the unique operational, financial, and strategic requirements of the organization.

This structure supports a comparative evaluation of project models and helps explain the decision-making processes guiding private sector energy investments.

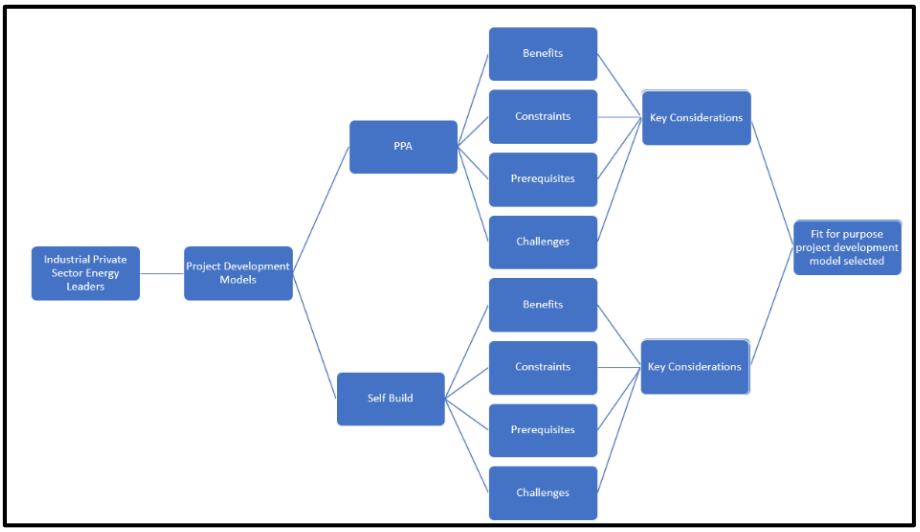

Figure 2-1: Conceptual Framework

2.5 Theoretical Framework

This study is grounded in the interpretivist paradigm, which emphasizes the understanding of social phenomena through the lived experiences and subjective meanings individuals assign to them (Abbadia, 2022). Thus, interpretivism provides a lens to explore how industrial private sector energy leaders perceive and evaluate different energy project development models.

Interpretivism is particularly well-suited to this study as it acknowledges the complexity and contextual nature of decision-making. Rather than seeking generalizable laws, policies, or concepts, the study aims to uncover the varying perspectives, judgments, and criteria that leaders apply when choosing between models.

By adopting this approach, the research prioritizes:

- In-depth insights into participant's interpretations of the benefits, constraints, prerequisites, and challenges of each model.
- An understanding of the key considerations influencing their decisions.
- The construction of meaning based on individual experiences and organizational contexts, leading to the identification of a fit-for-purpose development model.

Thus, interpretivism supports the study's goal of capturing the rich, contextual, and subjective dimensions of energy project development decision-making, as reflected in the conceptual framework.

2.6 Conclusion of Literature Review

The PPA model presents itself as a lucrative option for companies in pursuit of the energy needs without high capital reserves, however the overall assets, liabilities and owners' equity position (the balance sheet) need to be financially sound to provide confidence to all parties that the full term of the PPA can be honored, which is typically between 10 – 15 years.

Inclusive of the high upfront cash requirements when pursuing the Self-Build model, it appears to be a more economical model as the overall reduction in costs and payback period on the initial investment are superior to any energy cost savings that could be realized through the PPA model. However, the requirement to maintain and operate the plant may not be a viable option for companies that do not possess any of the relevant internal capabilities.

It is evident from the literature review that these models are being pursued and utilized within the private industrial sector, with some speculative indication on why one model may be chosen over the other.

Proposition 1

The PPA model is perceived to be a more viable option for projects with larger energy outputs, typically above 100 MWs.

Proposition 2

Cash balances and the strength of the organization's balance sheet are the key factors considered when determining which project development to utilize.

Proposition 3

The most prominent benefit of the PPA model is that it provides organizations with the ability to achieve their energy needs without any upfront capital investment, whereas the most prominent benefit of the Self-Build is the significant cost savings on energy bills.

Chapter 3: Research Methodology

3.1 Research Approach

The researcher utilized a qualitative research approach to explore emotions, thoughts, and experiences through non-numerical data collection (Ugwu Chinyere N et al, 2023).

The qualitative approach utilized interviews as the data collection method, supported by questions that do not limit the responses, as the participants needed to be allowed to describe their experiences (Agius, 2013).

3.2 Research Design

Akhtar (2016) indicates that research design is a planning process for data collection and analysis. Exploratory research suggests that a specific topic is in its first stages of research, meaning that there are limited studies in this area that can be referenced. In this typology, the researcher is in pursuit of new insights and experiences (Akhtar, 2016).

This study aligns with the exploratory research design concept.

3.3 Research Paradigm

The research paradigm, explained by Ulz (2023), is the framework used to direct the development of a research plan, which defines the study objective, research instruments, and analysis techniques (Ulz, 2023).

This proposed research has adopted the Methodology paradigm, which is centered on testing the assumptions (propositions) of the researcher through human experiences (Kawulich, 2012).

3.4 Selection of Participants

The selection of participants was conducted using purposeful sampling, which means that participants were selected based on their in-depth knowledge and experience relating to the research questions (Shaheen et al, 2019).

The researcher utilized the following minimum inclusion criteria when selecting the participants: 1) must have held a senior position for the development of at least one energy project developed using the PPA or Self-Build model, 2) at least 2 – 3 consecutive year's experience in energy project development, 3) willing to participate in the study.

The researcher's primary approach to identify qualifying participants was by contacting employees through a social media platform (LinkedIn) of companies that have registered energy projects with NERSA, noting that the names of these entities are public knowledge, available on the NERSA website (NERSA, 2024).

The researcher intended to recruit 12 participants to participate in this study based on the predicted data saturation point, which a study by Guest et al (2006) concluded that 12 is the estimated number at which this point is reached in qualitative studies using purposeful sampling (Guest et al, 2006). However, this study reached saturation earlier, and the researcher recruited a total of 11 participants based on the actual saturation point.

3.5 Data Collection Methods

According to Sahoo, conducting interviews is the preferred method for data collection to obtain the experiences, beliefs, and insights from target participants (Sahoo, 2022).

The researcher utilized a semi-structured interview process, which means that the questions were predetermined, but clarifying questions were asked (Griffee, 2005).

A total of 11 one-to-one interviews were conducted in English, yielding usable data from all interviews. All participants met the minimum inclusion criteria outlined in Chapter 3.4. All interviews were conducted online via Microsoft Teams and audio recorded with participant consent.

The first interview was conducted on 18 July 2024, and the last interview was conducted on 19 December 2024, spanning over a period of 6 months. All interview transcripts were reviewed and analyzed before the next interview, allowing for improved extraction of critical details by the researcher.

The profiles of the participants are displayed in Table 3-1 below, and they are all considered to be experts in the field of energy project development.

Participant	Energy Sector Roles	Number of Projects (Estimated)	Years of Experience
P1	Project Developer Consultant	10	Over 15
P2	Project Developer Consultant IPP	20	Over 15
P3	Project Developer Consultant End User	5	11 -15
P4	Project Developer	13	11 -15
P5	Consultant	5	Over 15
P6	End User IPP	4	6 - 10
P7	Project Developer	10	3 - 5
P8	Project Developer	9	6 - 10
P9	IPP Project Developer Consultant	50	6 - 10
P10	Consultant	2	3 - 5
P11	Consultant	2	11 -15

Table 3-1: Participant Profiles

3.5.1 Data Collection Tool (Research Instrument)

A semi-structured interview process is focused on having in-depth interviews, which do not follow a formal schedule. However, Mathers (2000) indicates that it is important to develop an interview schedule for the interview process (Nigel Mathers et al, 2000).

The researcher used the interview schedule as set out in Appendix C.

In addition to an interview schedule, Barret (2007) highlights the importance of the researcher in qualitative research, stating that the researcher is a critical instrument in the data collection process. The researcher is required to have the capacity to extract

critical details during the interview process (Barrett, 2007). This was achieved by asking probing and follow-up questions during each interview.

3.6 Data Analysis

Thematic analysis was utilized for the purpose of data analysis. Braun and Clarke (2012) identify thematic analysis as the appropriate method to enable the researcher to draw commonalities from the qualitative data set (Braun & Clark, 2006). Delahunt & Maguire (2017) provide a practical example of how Braun & Clark's (2006) six-phase framework can be utilized to conduct thematic analysis (Maguire & Delahunt, 2017). The research has adopted this framework as shown in figure 3.1 (Lloyd, 2020).

Figure 3-1: Six-phase Framework

The codes were extracted from the interview transcripts manually by the researcher with the use of Microsoft Excel and Word as supporting tools. The initial coding process yielded a total of 128 codes, and thereafter it was refined down to 118 codes. The saturation point was reached after interview no. 9, and Figure 3-2 demonstrates the number codes generated from each interview.

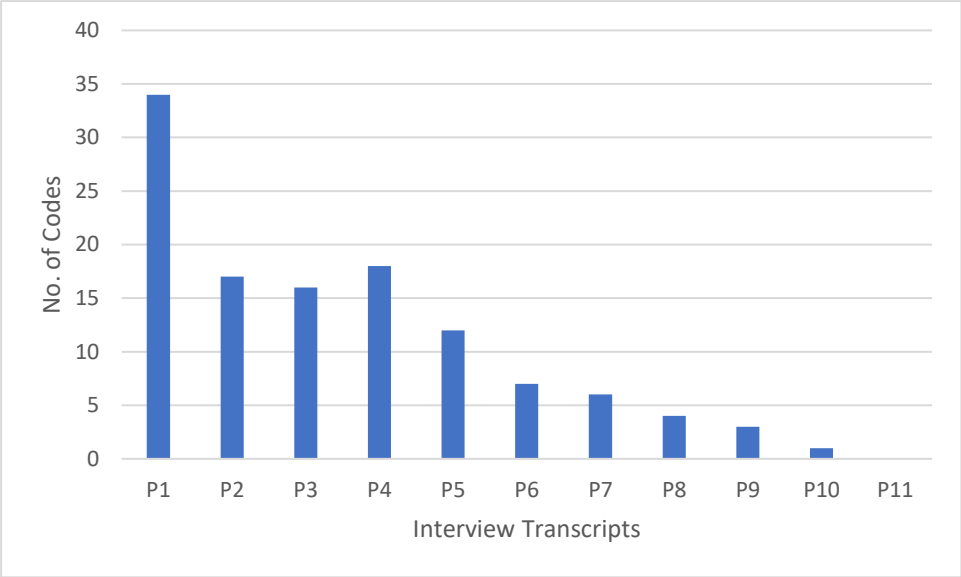

Figure 3-2: Data Saturation

Thereafter, the codes were sorted into 7 groups, namely 1) decision-making criteria, 2) PPA positives, 3) PPA negatives, 4) Self-Build positives, 5) Self-Build negatives and 6) Common characteristics, and 7) Current trends.

The grouping of the data allowed for rigorous testing against the research propositions to identify and refine themes, resulting in a structured analytic framework for analysis and development of a credible conclusion (Saunders et al, 2019, pp. 656-659).

Following the coding process, themes were generated as discussed in Chapter 4.2.

3.7 Study Limitations

- Data extracted from participant's experiences and insights has the potential for bias and memory retention to affect the accuracy of feedback.
- The participant's environment and state of mind during the interview process could compromise the effectiveness of the process.
- The researcher's subjectivity during the data analysis process may skew the themes identified.
- Qualitative research extracts insights and reasoning behind identified experiences, however, the process may leave some experiences unidentified.

3.8 Quality Assurance

3.8.1 External Validity (transferability)

The research was aimed at the industrial private sector. Though the data set reached saturation, it is not advised to apply the findings to other sectors, as themes relevant to other sectors may not be uncovered.

3.8.2 Internal Validity (credibility)

The following measures were adhered to, ensuring validity and trustworthiness of the research.

- Identified themes from the interview transcripts were reviewed with the supervisor, ensuring that researcher bias is eliminated.
- The research instrument was pilot tested
- Frequent debriefing sessions with the supervisor were conducted.
- The approved criterion for selecting participants was strictly adhered to.

3.8.3 Reliability (Dependability)

To ensure the same results of the study are achieved, should the research be repeated, the data collected was checked to ensure outliers and gaps are identified and addressed.

3.9 Ethical Considerations

Before engaging the human participants in this study, the proposal for the research was reviewed and approved by the Wits Business School Ethics Committee. All ethical principles prescribed by the committee and the school were strictly adhered to during the conduct of this research.

All participants were issued with a consent form and participant information sheet requesting their approval to participate in the study and confirming their data privacy requirements. The sheet and form outline the objective of the research and confirm that all data collected are strictly for use in this academic research.

Furthermore, the researcher ensured that data not relevant to the study was not collected, such as the names of the employers for which the participants had worked.

Chapter 4: Presentation of Results

4.1 Introduction

The results of the study are set out herein Chapter 4. The semi-structured interview process was utilized for all data collection and thereafter analyzed using thematic analysis, resulting in themes extracted from the data according to the research questions.

4.2 Themes

The data analysis process initially yielded a total of 12 themes, which were refined to 10 themes due to commonality. Each theme is linked to a respective research question as shown below in Table 4-1.

Research Question	Themes
Question 1 - How do leaders in the industry perceive the Self-Build and PPA development models?	1. Cost of supply versus security of supply
	2. Industry preferences
	3. Current trends
Question 2 - What are some of the key considerations/criteria being used by these leaders when determining which model to use?	1. Defining End User needs, objectives, and available resources
	2. Financial considerations
	3. Grid impact and availability
	4. Understanding the ESG factors
Question 3 - What are the key characteristics of these models in terms of benefits and constraints?	1. Development timelines
	2. Level of control and influence
	3. End User considerations

Table 4-1: Research Themes

4.3 Industry leader's perception in the self-build and PPA development models (question 1)

To this purpose, it set out to uncover how industry leaders view the PPA and Self-Build model based on their individual experiences. It sought to highlight their beliefs relating to the use of these models, suitable applications for each model, and their overall preference.

4.3.1 The cost of supply Vs security of supply

The data analysis revealed that the needs of the End User significantly influence the decision-making criteria; however, two points stand out and warrant separate discussions that being the need to reduce operational energy costs (cost of supply) or the need for a stable energy source (security of supply).

The data shows that an order of preference must be selected by the End User between these two needs because the PPA model is well suited to reduce energy costs, but cannot guarantee a stable supply, as shown by some of the participant quotes below;

> *"I am going to give the order priority in which this feasibility study was done, Security of supply, affordability of the generated power, and then reduced or lower carbon footprint," (P1)*

> *"Yes, I think so, because it depends on the needs of End Users and how to satisfy them. But in general, for energy stability, the self-build model works better, and if it is purely for the cost of supply, then the PPA would work better," (P6)*

> *"In the self-build model, the End User has a much bigger impact in terms of controlling the asset (technology, capacity, etc). This then allows them to design the system to ensure security of supply, where this is difficult to achieve in a PPA model," (P2).*

> *"So, the constraint on the PPA side, the End User is still exposed to transmission risk and security of supply is not guaranteed. So, it is not as secure as self-build, which is typically on site" (P5)*

> *"It is important to note that if energy stability is the need, then the PPA model does not solve that problem," (P8)*

Industry leaders found the PPA model to work better when the End User's primary objective is to reduce the cost of energy, whilst the Self-Build model works better when that objective is to obtain a stable energy supply.

4.3.2 Industry Preferences

The findings indicate that industry leaders have a preferred development model for industrial applications. This preference is influenced by factors such as the size of the plant, the South African government influence, and the bargaining power of larger consumers.

The PPA model is preferred for industrial applications, as indicated by the participants, because the larger energy requirements will increase the size of the plant. This gives the End User the ability to strongly negotiate preferred energy rates on a PPA model. In addition, the REIPP government programme has created a high level of familiarity and expertise in the country with regard to the PPA development process, thus influencing the preference towards the PPA model. Some (non-exhaustive) of the participant's quotes in this regard are shown below.

> *"So I was on a very large project, where it made more sense for the End User to go the PPA route, so that all the maintenance, operations, personnel required, and risk for operating the plant efficiently can be transferred to the PPA. Whereas on a smaller plant, the client can typically manage this in-house or utilize service-level agreements to run the plant. Typically, I would classify the smaller projects to be below 20 MWs, anything over that is a bigger plant," (P10)*

> *"Yes, both models should still exist. A lot of End Users still want to own their assets, and if they have free cash flow, then why not but for bigger systems, I still recommend the IPP route. For me, anything above 350 MWp should be developed on a PPA model," (P9)*

> *"And then the other thing again, for example, major mining houses, when they negotiate with power producers, they understand their importance based on being a large consumer. They offer stability to the power producer, and it must*

be noted that this negotiating power cannot be enjoyed if you have a self-build," (P1)

In contrast, some of the participants indicated that the Self-Build model is preferable due to the flexibility it provides the End User and that security of supply is always a bigger concern, as indicated by the quotes below;

"Three years ago, I would have told you PPA was my preference, and that is because the major focus was reducing the cost of supply; however, currently in South Africa, the need is now security of supply, and for this, self-build is the better option," (P2)

"However, personally, if I have the funding available, though, I would go the self-build option because of the flexibility I have with the asset," (P3)

4.3.3 Current Trends

The data indicates a gradual shift away from the Self-Build and conventional PPA models towards modified versions of the PPA model, with the primary objective to reduce the balance sheet impact.

"The other one is when the PPA is from a trading entity, and then the balance sheet of the End User is not that important, and this is the one that is preferred by the End Users. This avoids the End User incurring a contingent liability, allowing them to freely allocate their funds for other purposes within the business, such as an expansion project," (P1)

"However, what we are doing now with Anglo Envusa (Public Knowledge) is structured such that ENVUSA, as the IPP, will supply power to the mine. What Anglo has done with Envusa is that they partnered with a known IPP that has the expertise and established this new organization to act as an IPP. So, the intent, even though Envusa is owned by Anglo, is that they will be a third party to the core business. Envusa is meant to be an energy trader, and the traditional PPA structure will be followed," (P6)

“Sometimes you can even have a hybrid model, where the End User follows a PPA route but takes equity in the Asset as well,” (P4)

“There has been a trend where End Users go the PPA route but then take equity in the asset itself, ultimately for bigger assets to be built and still have some skin in the game. We see Anglo doing this now with Envusa,” (P7)

End Users are taking advantage of the funding flexibility in a PPA model. Rather than investing large amounts of their capital into a Self-Build model, they are leaning towards investing capital into the project through the IPP. Additionally, the data indicates that IPPs are moving towards becoming energy traders and selling power as a commodity based on supply and demand, as opposed to locking in PPA contracts with selected End Users.

4.4 Key considerations/criteria used by industry leaders when determining which model to use (Question 2)

To this purpose, it sets out to uncover how leaders in the industry go through the process of determining and selecting which model is best suited for the required application. Seeking to unpack some of the key steps taken, lessons learned, and key determining factors.

4.4.1 Defining End User needs, objectives, and available resources

The development model chosen should be able to satisfy all or most of the End User’s needs that initiated their quest to source an alternative energy supply. To enable that, all participants in the study indicated that they would start by gaining a full understanding of the needs, objectives, and available resources of the End User before selecting a development model or advising the End User. There were no contrasting views to this belief, with some participants repeating this point during the interview.

“I think a study must be conducted to determine which model is to be used, though, because it depends on the needs of the End User and what the long-term goals are vs the long-term consequences,” (P3)

“It goes back to my comment of the End User defining their objectives, which will drive the best solution or model to be used,” (P4)

“It is very contextual and it is part of my job to outline some of the benefits to the End Users. It really depends on the End User situation, though,” (P5)

“The need must be the first thing defined. Then a feasibility/trade-off study should be conducted to determine which models work best to meet the needs with the available resources,” (P1)

“because it depends on the needs of End Users and how to satisfy them,” (P6)

“So, first of all, we have to engage the End User to identify their needs, available resources (Capital, human resources), and risk appetite, and then from there, you consider the location, applicable technologies, and take it from there,” (P10)

The research indicates that the decision on the development should not be concluded without fully understanding the End User’s overall position. The needs, objectives, and available resources are unpacked during an upfront study, typically in the form of a feasibility or trade-off study, thus suggesting that the point of departure in the decision-making process is to conduct a study.

4.4.2 Financial considerations

The data indicates that ultimately the financial position of the End User is a key factor in determining which model to adopt and proving project viability. This is due to how significantly the financial structure between the models varies, as described in the literature review.

"Absolutely yes, first of all, a PPA won't be signed with an End User if their balance sheet can't support the term of the contract. For a self-build option, it may be less important, but the capex is still required, and that must come from somewhere, typically a bank, which again will interrogate the financial position of the End User. So yes, the financial position of the End User is a key consideration for both models, and definitely it is the most important," (P3)

"Yes, it is, definitely the financial position, it is all about the money. With either model, it is relevant," (P10)

"Yes, it is, if you are going the PPA route, the End User is the anchor, and the End User needs to be bankable. The funders will need to determine if they can honor the long-term PPA agreement. If you are looking at self-build, the End User needs a large amount of free cash available. So, the financial position of the End User is important for both models," (P8)

"Credit checks are done by developers on the End User. If it is self-build, the funds are needed. The financial position would determine if an End User takes the self-build or ppa route," (P9)

The research indicates that the PPA model requires a level of confidence to be established by the funders, to show that the probability of the End User honoring the agreement for the full term is high. Even though the End User is not responsible for sourcing the funds, ultimately, someone must fund the development, and typically, the funders would interrogate the strength of the End User's balance sheet to gain this confidence, which directly influences their expected returns. With the Self-Build option, the End User is directly responsible for sourcing the project funds, and this may be done by using their capital, seeking external funders, or debt funding, all of which still require the End User to be in a good financial position.

In contrast, one participant indicated that the financial position of the End User is the second biggest factor in the decision-making process, whilst the End User's needs are the most important, as shown below;

“No, defining the needs of the End User is the most important, and then following closely is the financial position,” (P2)

4.4.3 Grid impact and availability

The data indicates, with common responses from the participants, that the South African national grid cannot be ignored when embarking on the journey to source alternative energy. Understanding the impact of the project on the grid and the availability of the grid is critical during the decision-making process, because grid instabilities cannot be accommodated by the regulator. The remaining participants did not provide comments on this topic, and there were no contrary views identified.

“Another big constraint on both models is ESKOM (South African National power utility provider), and this comes in from a grid impact perspective. The grid availability is an issue as the grid is constrained. There needs to be an expansion of grid infrastructure. They (ESKOM) recently introduced the curtailment rule, which is not fully expanded yet, but in general, the rule states that the grid will accept the project, and it can be brought online, but they will curtail the generator based on grid availability. It is also not clear who pays for deemed energy losses when this happens. Important to note that even on a self-build onsite project, the curtailment rule will still apply,” (P6)

“It is more of a technical constraint, and it is the same for both models; this constraint is related to tying into the grid. Note that the constraint still exists even if you build behind the meter” (P9)

“Another very big lesson is the grid connection. Can the project connect to the grid? Getting your grid impact and connection study defined upfront is really important. If a plant cannot connect to the grid due to capacity issues, it will kill a project as expansions on the grid are linked to the utility provider (Eskom),” (P8)

“But from a country point of view, it must be applied with due consideration of maintaining the utility model so that it does not break. If that happens, we have a decentralized issue and stability of the grid can be lost due to the utility losing share of the grid,” (P1)

Some constraints exist in the grid; hence, ensuring that the stability of the grid is preserved is a critical success factor. Not properly understanding the impact of the project on the national grid could lead to regulators ultimately declining to approve the project, and, in some instances, based on the outcomes of a grid impact assessment, the chosen development model may need to be revised.

4.4.4 Understanding the ESG factors

Leaders have experienced issues centered around environmental, social, and governance (ESG) factors, that have stopped projects or caused a significant hinderance as indicated by the participants. These include factors such as wildlife preservation, permitting and the impact on local communities. Some participants did not provide comment on this topic and there were no contrary views identified.

“So, in summary, proper analysis of the local community and wildlife preservation requirements are crucial to determine upfront and not leave for later on.” (P8)

“Public relations in the ESG (Environment, Social, Governance) must be considered and it is important to present a clean perception by considering all three elements of ESG,” (P4)

“A big debate at the moment is the concrete towers versus steel towers for turbines, depends on what’s chosen, the timeline is affected and ultimately cost, in my opinion steel towers just makes more sense but concrete towers create more jobs,’ (P6)

“It is a balancing act, and government must ensure they do their part. South Africa has to have a unique set of guidelines on how they run their

utility network because they are in a position where neighboring countries can't help, in fact the neighboring countries rely on South Africa," (P1)

It is important to note that most of the participants spoke about the ESG impact when reflecting on some of their lessons learned, ultimately confirming that it is a vital element to be considered upfront at the initiation phase of development.

4.5 Key characteristics of the models in terms of benefits and constraints (Question 3)

To this purpose, it sets out to highlight what leaders in the industry deem to be the defining and differentiating characteristics of the two development models.

4.5.1 Development Timelines

The participants indicated the timelines for development and construction vary significantly between the two models. Revealing that the PPA model is faster to construct, whereas the Self-Build model is faster to reach the final investment decision. This is due to the construction phase in the PPA model being executed by experts with extensive experience, whereas during the development phase of a Self-Build, there are fewer stakeholders and decisions are made quicker. Some of the participants did not deem the timelines to be a major consideration, however, none of them indicated any contrary beliefs.

"However, a PPA typically takes longer to reach financial close, and contracts only get signed after months/years of negotiations, this is dead time that the End User could be building." (P2)

"No, not at all. Generally, IPPs can construct a project faster than an End User, because they understand the unknowns and the risk" (P3)

"With the self-build, there is flexibility for the End User as they are not developing to a specific framework and not really answering to anyone else besides themselves. They still have to stick to the rules of

development and permitting, but it's not additional measures imposed by the funders and a condition precedent; for example, putting out a website can be a prerequisite to financial close in the PPA model. Decisions are made quicker on the self-build model," (P7)

"I think the PPA model works best. However, the grid availability and off-take agreements remain as prerequisites. This model generally takes longer to develop just due to all the agreements that need to be put in place," (P9)

"Specific to the PPA space, when it comes to developing the project, there are a lot more stakeholders involved, and in this regard, at any given point, if one of the stakeholders loses interest, it could hinder the development process. Having contingent plans is critical," (P4)

4.5.2 Level of control and influence

The level of control and influence that comes with the Self-Build model is a key benefit for End Users, as by the participants. Allowing for control over the time of delivery and flexibility to implement changes to suit evolving business objectives and needs.

"On the self-build, I think the benefit here is that the End User has full control of the project, they can manage the specifications, the quality, the delivery time, they are basically in charge of it, but it comes at a cost" (P7)

"On the PPA, there is a higher long-term cost due to the agreement, which ensures the IPP makes a profit. There is limited control by the End User in terms of grid code compliance, technology selection, and design. Furthermore, the asset could be used to supply power to other End Users as well," (P10)

The PPA model does not provide this benefit, and this can result in both financial and operational issues for the End User. For example, this lack of control, coupled with the

take-or-pay arrangement in a PPA model, can leave End Users paying for energy they are not utilizing.

In contrast, one participant indicated that they believe this level of control and influence is typically governed by a false sense of confidence and can be a negative factor for End Users, as they may not be able to effectively control the asset. This is further explored in chapter 4.6.3.

> *"It is on the assumption that they will be able to manage it. So, for example, the End User could be a mine, who has nothing to do with power generation, but they decide they are engineers, and they should be able to build and maintain this, which is typically false confidence as a power plant is different from a mine," (P5)*

4.5.3 End User Considerations

The data reveals a range of implications for the End User applicable to both development models, categorized into three main areas: risk, partners, and core focus. The findings suggest the Self-Build model entails a higher level of risk. Additionally, it underscores the necessity of partnering with experts due to the scarcity of in-house expertise, which concurrently shifts the core focus of the business. These factors are identified as constraints associated with the Self-Build model.

4.5.3.1 Risk

The type of risk assumed by the End User with the Self-Build model varies from the development phase through to the operational and maintenance phase of the project.

The data indicates that with all participants sharing the same view that the associated risks from the development stage, such as selecting the correct technology, through the risks at the operational stage, such as ensuring the plant is operated efficiently, all reside with the End User with the Self-Build model. Though all participants provided different examples of the type of risks assumed by the End User, as shown below in some of the quotes, it is evident that the PPA model is a lower risk option, with no contrasting opinions provided.

"Yes, it is a huge factor, but I also think whether or not the End User wants to take on that risk of developing and building a power project. There is a lot of risk, like a project can be modelled and will work perfectly from a technoeconomic perspective to meet their own needs but then they find that they have operational issues later on, so willingness of the End User to take on the risk is a big factor as well," (P6)

"Then, when we talk PPA, one is admitting that they are not a power producer, and they have no business in power generation, so why not give it to the experts. This can also be behind the meter or not, which means it is on-site or off site. But ultimately, all the risks have to do with financing, permitting, etc, with someone else, and all the End User wants is to buy electrons. But yeah, the main thing is transferring the risk to someone else for generating power. Sometimes there is also transmission risk that comes into play because there are different risks that are added," (P5)

"The biggest thing, though, is that with the PPA, the End User transfers the risk to another person, but with a self-build, the risk sits with the End User even though they have more control" (P4)

"Most End Users prefer PPA because they don't take the risk" (P1)

"So I was on a very large project, where it made more sense for the End User to go the PPA route, so that all the maintenance, operations, personnel required and risk for operating the plant efficiently can be transferred to the PPA," (P10)

4.5.3.2 Choosing the right Partners

The experience of the participants indicated that End Users typically do not have all the relevant expertise in-house to independently execute a Self-Build energy project. Thus, creating a dependency on external partners whilst still retaining ultimate accountability. In contrast, one participant indicated that this provides an opportunity for in-house experience to be developed and should be seen as a positive, whilst the remaining two participants did not provide comment on the topic.

“The End User would always need to partner with a third-party expert to build the asset in the self-build model,” (P9)

“That’s a tough one, for me I think the key thing is does the End User have the expertise to develop in house or do they have the ability to contract the resources,” (P8)

“Taking into account that in the self-build option most of the time in house capabilities do not exist, so they would then need to appoint an EPC to develop the project on their behalf,” (P4)

“It depends, for example if you look at my current employment at this large mining house, they don’t have a very mature in-house project team. They will rely on an EPC partner to get something like this done. In this case, I would not go for the self-build,” (P3)

“Another common mistake that End Users make is trying to cut cost on development costs, especially at feasibility stage, for example they have a common approach of only paying the feasibility team if the project is found feasible, however that creates an incentive to the team to force viability instead of presenting all the facts and highlighting all the risks,” (P1)

4.5.3.3 Core Focus

The data reveals that participants believe there is an inherent shift in the core focus of the business associated with the Self-Build model. Although the impact of this shift can be challenging to quantify, participants indicate that diverting human and financial resources towards an energy project can be detrimental to any business. The remaining three participants did not provide comments on this topic and there were no contrary views identified.

“I would go the PPA route because it frees up the End Users time, allowing them to focus on the core business growth and sustainability,” (P9)

“I mean we have seen this before right, where you see a business that makes bottles, then they start making the bottle caps, then they want to make a cooler for the bottles and these side businesses take up a lot of energy and money and detracts from what their actually really good at,” (P8)

“So theoretically, an IPP allows the End User to use the capital in their core business, for example if you are miner, you don’t want use your capital investing in a power plant, you want to direct it to you core operation,” (P2)

“With the PPA, it is about sourcing alternate power without shifting my core focus, however affordability to buy the electricity is critical,” (P1)

4.6 Summary of the results

4.6.1 Research Objective 1

The findings reveal a clear divergence in industry leaders’ preferences based on the underlying strategic goal of the energy project. When the primary objective is cost reduction, most participants favor PPA models due to their minimal upfront capital requirements and off-balance-sheet treatment. Conversely, when energy security and long-term control are prioritized, the Self-Build model is seen as superior, offering greater autonomy and reliability over supply.

Quantitative insights from the qualitative interviews reinforce this. As a significant majority of participants indicated a preference for the PPA model in large-scale industrial contexts, citing its flexibility and financial simplicity. Whilst only a few expressed support for the Self-Build model, typically in cases where long-term strategic control outweighed initial cost considerations, which typically resonated with the ability to scale energy production across multiple operations owned by the End User.

An emerging trend noted across several interviews was the increasing interest in hybrid or modified PPA structures, including mechanisms such as energy trading agreements. These approaches allow firms to maintain flexibility while minimizing

balance sheet exposure, reflecting a broader shift in the sector toward innovative contractual models that balance risk, control, and financial impact.

4.6.2 Research Objective 2

The study reveals that energy leaders place strong emphasis on clearly articulating project objectives, available resources, and potential risks at the outset of the development process. There was unanimous agreement among participants that this foundational step is critical to aligning stakeholder expectations and choosing an appropriate development model. Without a clear understanding of these core factors, the decision-making process becomes fragmented and vulnerable to misalignment between technical feasibility and business outcomes.

Financial considerations emerged as a particularly dominant theme, with most participants asserting that the End User's financial position is often the decisive factor in selecting a development model. Respondents explained that companies with limited capital are more likely to pursue PPA models, while those with stronger balance sheets may be positioned to undertake self-funded, self-build projects.

Additionally, grid availability and impact were cited by participants as essential criteria. Grid capacity constraints or costly upgrades can significantly delay or derail projects, making early engagement with utilities and technical consultants vital to the model selection process.

Finally, environmental, social, and governance (ESG) factors were recognized by respondents as increasingly central to project planning. Beyond regulatory compliance, ESG considerations are shaping stakeholder expectations, influencing investor appetite, and impacting public acceptance. Several participants noted that a failure to address ESG risks, such as community engagement, land use, or carbon intensity, can threaten project viability, even in technically sound proposals.

These findings highlight a multidimensional decision-making process in which technical, financial, and social variables must be balanced to arrive at an appropriate development strategy.

4.6.3 Research Objective 3

The analysis revealed distinct trade-offs between the Self-Build and PPA models, each offering unique benefits and constraints depending on organisational priorities. A key differentiator lies in the project timeline. Participants noted that while PPA models typically take longer to reach financial close, due to complex contractual and legal arrangements, the Self-Build model generally experiences longer construction timelines, due to procurement and project management demands placed directly on the End User.

Control and influence over the project emerged as a major consideration. A significant majority of participants agreed that the Self-Build model affords the End User greater autonomy over technical specifications, vendor selection, and operational decisions. However, this autonomy comes at a cost. All respondents confirmed that the Self-Build route exposes the End User to increased project risk and financial responsibility, particularly in areas such as cost overruns, construction delays, and regulatory compliance. In contrast, the PPA model shifts much of this risk to the developer and associated funders, offering a more hands off approach for End Users with lower risk tolerance or limited technical capacity.

The necessity of strategic partnerships was also a recurrent theme. Participants highlighted that Self-Build projects often require significant external technical and financial expertise. As such, forming the right partnerships, whether with engineering firms, lenders, or consultants is critical to project success. This need for collaboration, however, can introduce additional complexity and coordination challenges.

Finally, the issue of operational focus was noted by respondents. They indicated that Self-Build models tend to divert internal resources and management attention away from the core business, potentially impacting productivity and strategic focus. In contrast, PPA models are generally viewed as more aligned with a “business as usual” approach, allowing the End User to benefit from clean energy while maintaining focus on its primary operations.

These findings underscore that development model selection involves balancing trade-offs between control, risk, time, and organisational capacity. The characteristics

of each model must be carefully matched to the End User's strategic priorities and internal capabilities.

Chapter 5: Discussion of Results

5.1 Introduction

Chapter 5.0 provides an interpretation of the results presented in Chapter 4. The insights drawn from the data and literature reviewed are used to guide the interpretation of the results.

The study focused on comparing the Self-Build and PPA project development models in the private energy sector, focusing on industrial consumers. The research was conducted to gain insights on how energy leaders perceive these development models, ultimately shedding light on when best to utilize each model and the determination process.

The literature review comparing the two models was conducted and is presented in Chapter 2. Consequently, this chapter compares, connects, and contrasts the research findings and the literature review.

5.2 How do leaders in the industry perceive the Self-Build and PPA development models?

There is consensus in the industry that both development models should still exist and are effective based on the context they are being applied, with the key determining criterion for selection being the size of the asset and what takes precedence for the End User between the need for security of supply or cost of supply.

It was found that for industrial applications, the size of the plant is generally larger, and End Users typically lack the in-house expertise to design, build, and operate such large-scale power plants, thus resulting in the PPA being the preferred model.

These findings align with the literature review, as the projects registered by NERSA indicate that both of these models are being used, and in general, the larger projects are being registered by IPPs, indicating the use of the PPA model (NERSA, 2024).

The results and the literature review further align with regard to the shift in market preferences towards financially modified versions of the PPA. This is evident in Anglo's venture with Envusa (Money & Investing, 2024).

The findings are discussed in further detail based on the themes presented in Chapter 4.

5.2.1 The cost of supply Vs security of supply

The research found that among the many factors to be considered when determining which model to implement, emphasis should be on determining whether the End User's strategic objectives are more focused on reducing the kWh cost of energy or ensuring a stable and consistent supply of energy. The results indicated that End Users pursue both, but an order of precedence must be set.

The literature review indicates potential penalties faced by an IPP failing to generate power as stipulated in the agreement (Qingan Qiu et al., 2018). However, the findings clarify that the PPA is structured around an agreed quantity of energy, measured in kWh (Kilo-Watt Hour) or MWh (Mega-Watt Hour), to be produced over a specified period. There are no guarantees or penalties tied to the precise timing of energy delivery, meaning the End User remains vulnerable to operational disruptions.

Participants indicated a common misperception that most End Users are unaware that the PPA model does not offer any stability in power supply capable of overcoming the stability issues in the national grid. In essence, when the grid is down due to load shedding, breakdowns, or any other factor (BusinessTech, 2023), the IPP will not be able to deliver power.

In conjunction, the research indicates the Self-Build option allows for connections behind the meter, which means directly supplying the user without passing through the public grid; hence, the delivery of power to the End User is not influenced by downtime issues the national grid may be experiencing. The research further highlights that though the PPA model can be established with a behind the meter connection, all

participants that were asked about this, indicated that they have never witnessed such a project in operation and these would typically default to the use of other development models such as the Build, Own, Operate and Transfer (BOOT) model which falls outside the scope of this study.

Regarding the cost of supply, the research indicates this to be a scenario where the End User's main objective is to achieve a lower cost of energy per kWh in comparison to the utility rate. The PPA model is better suited when this is the primary objective. However, the research is inconclusive in determining which model will provide a cheaper cost per unit of energy, and this is due to various factors such as the cost of capital, choice of development partners, and the buying power of the End User, among others.

In summary, the research indicates that when the primary objective of the End User is to achieve a cheaper cost of energy per unit, then the PPA model is better suited, and when the primary objective is to achieve a stable supply, the Self-Build model is best suited.

5.2.2 Industry Preferences

The research indicates that leaders in the industry prefer the PPA model for industrial applications because the size of the plant required for industrial applications is typically larger.

A larger plant size with the Self-Build model implies larger upfront capital requirements, increased construction complexities, and more difficulties ensuring the plant operates under optimal conditions. For these reasons, leaders suggest larger projects are better suited for development by energy generation experts, hence, the PPA model works better.

The research aligns with the literature review, in the case of Sibanye, smaller-scale projects were developed using a Self-Build model, while their larger projects were executed through a PPA model (BR Reporter, 2023).

The research reveals varying perspectives on the classification of large-scale projects, with participant responses ranging from 20 MW to 350 MW. However, most

participants identified 100 MW and above as the threshold for large-scale projects. This finding aligns with Proposition 1 of the study and with the literature review. The NERSA report (NERSA, 2024), shows a higher prevalence of registrations utilizing the PPA model for projects exceeding 100 MW.

The generation license threshold in South Africa further supports the classification of 100 MWs being the tipping point between large and small-scale projects. Schedule 2 of the Electricity Regulation Act 4 of 2006 (“ERA”), indicates that embedded power generation facilities up to 100 MWs are not required to hold a generation license (Richards, 2021).

The literature review highlights the presence of South Africa’s REIPPP programme, a successful government initiative driving South Africa’s commitments towards clean energy and decarbonization (Department of Energy, 2015). The research indicates that the presence and widely used nature of the PPA model in the government sector has enhanced the preference for the PPA in the private sector.

5.2.3 Current Trends

Though there is prominent use of the Self-Build and PPA development models, the research highlights a shift in the market starting to gain traction.

This trend highlights a shift toward modified versions of the PPA model. Specifically, End Users are opting for the PPA route while acquiring equity stakes in the project or procuring energy through energy trading mechanisms to reduce balance sheet implications.

The data aligns with the literature review, where Seriti Green, a subsidiary of the mining company Seriti, was formed to develop energy projects and supply electricity to Seriti’s mining operations. This internal supplier model mirrors how Independent Power Producers (IPPs) operate in the open. Seriti Green will develop these projects by sourcing external funding, however, the holding company Seriti will retain a stake in these projects (RMB, 2024) and hence some level of control.

Energy trading is becoming increasingly popular as we see with the Day Ahead Market, which is a bidding platform allowing for the auction and sale of electricity (semopx, 2025). Similarly, a frequent example used by the participants highlights the

joint venture between Anglo American and EDF Renewables known as Envusa Energy, an energy trading company. The benefit of energy trading is that it allows for multiple generation plants to be developed under a cluster and serve multiple operations, promoting maximized utilization of location-based resources and the aggregation of power (Pierre Herben, 2024). With the energy trading route, there is less of a constraint on the End User's balance sheet, and it can assist in improving the security of supply issue that persists with PPAs (danskecommodities, 2024).

5.2.4 Summary of discussion for research question 1

The findings reveal consensus among industry leaders that both models are effective, with their preference on when to utilise them largely driven by project size and End User priorities. The PPA model is preferred for larger industrial projects due to the complexity, while the Self-Build model is often used for smaller projects, offering more control over energy delivery.

A critical distinction is made between cost and security of supply. PPAs are better suited when the intent is to purely reduce energy costs, but they lack guarantees for consistent delivery. In contrast, Self-Build models, particularly with behind-the-meter connections, provide greater stability and autonomy.

In summary, there is a preference for the PPA model to be utilised for industrial applications, however, the study highlights a market shift toward modified PPA models that reduce financial constraints, including equity investments and the use of energy trading mechanisms.

5.3 What are some of the key considerations/criteria being used by these leaders when determining which model to use?

The research highlights common elements such as defining the End User's needs, financial considerations, and grid impact, which must be considered when making this decision.

The research is congruent with the literature review, indicating a strong focus on the End User's requirements and financial position.

5.3.1 Defining End User needs, objectives, and available resources (Understanding the End User)

The research indicates it is essential to conduct an upfront study, such as a feasibility study, trade-off analysis, or options assessment, to define the End User's needs comprehensively. This study should evaluate operational timelines, available land, risk appetite, carbon reduction goals, asset size, and alignment with broader business strategies, among others.

For example, in the mining sector, the remaining life of the mine (LOM) is a complex consideration. A short LOM may render the PPA model unviable, as securing funding for short-term PPAs can be challenging, and the Self-Build option would require selecting technologies that allow assets to be repurposed beyond the LOM.

For End Users considering the Self-Build model, the availability of in-house expertise to operate and maintain the asset plays a key role. The need to develop internal capabilities should align with the strategic objective of supporting multiple Self-Build projects, however, it does incur additional costs and must be carefully weighed.

In summary, the study indicates that leaders in the industry should define and understand the End User's position upfront. A clear outline of their needs, objectives, and resources will guide the decision-making process and assist in managing expectations.

5.3.2 Financial considerations

The data indicates that financials are ultimately the determining factor when selecting the development model, specifically, the financial position of the End User.

This concurs with the literature review, Thornton highlights the importance of the End User's ability to financially honour a long-term PPA agreement (Thornton, 2017) whereas the Self-Build model requires upfront cash investments by the End User (EnergyLink, 2023).

The findings indicate that the financial position of the End User should be evaluated from multiple perspectives. Firstly, for the PPA model, the research highlights the link

between the End User's balance sheet and the bankability of the project. The funders in a PPA project will analyse the strength of the End User's balance, ultimately trying to establish their ability to honour the full term. Depending on the outcome of this analysis, the cost of capital and energy per kWh is affected. For End User's that can clearly demonstrate the ability to honour the term, typically obtain a cheaper cost per kWh of energy and vice versa.

Similarly, the data highlighted the inherent negotiating power for End Users in strong financial positions, with some participants referring to them as "high-quality End Users". In essence, leaders in the industry should take into consideration this negotiating power that they can leverage with IPPs to establish a very favourable PPA agreement, and note that this benefit would not be available with the Self-Build model. In contrast, for End Users that are financially exposed to market fluctuations in commodity prices (for example, gold, copper, and crude oil), the funders in a PPA project will perform some form of market risk analysis and factor this into the contract price, potentially increasing the cost of capital.

The study identifies a primary constraint of the Self-Build model to be the upfront capital requirements, which the End User must provide. While these funds can be sourced from cash reserves, debt financing, external funders, or other means, the critical distinction is that the End User assumes full responsibility for securing the financing, unlike in the PPA model. The challenge is not only in sourcing funds but also in the competing priorities for capital allocation within the business. Executives must decide whether to allocate funds toward core operations, such as business expansions and digital transformation, or to invest in a non-core function like developing a power generation facility. Leaders indicate that when bringing these opportunity costs into the financial model, the cost of capital can vary significantly and influence the decision on which model to utilize.

In contrast, the literature review indicates that the Self-Build model provides End Users with the flexibility to financially report against the asset in a manner that best suits their needs (Solar Voltaics, 2024). Depreciating the asset sooner or later, registering the asset as a new entity/branch, and so forth, are some of the opportunities that End Users can utilize to amend or improve the representation of their financial position.

The PPA model is limited in this regard, and the balance sheet will reflect the long-term commitment.

In summary, the funding structure of the project is a key differentiating factor between the two models, however, it is not as simple as defining who provides the capital, it is rather a complex comparison, and all financial factors must be considered.

5.3.3 Grid impact and availability

The literature review highlights the energy crisis in South Africa (Cohen, 2023) largely due to the lack of investment in maintaining and expanding the transmission network (grid) (Nguyen, 2023). The research indicates that the private sector is influenced and hindered by this factor when attempting to develop its energy projects.

Furthermore, Eskom has announced its intent to utilize a curtailment framework to address the security and capacity needs of the grid. Curtailment means generation facilities connected to the grid will be required to adjust their output in accordance with grid requirements (Creamer T. , 2023).

The research indicates that industry leaders should assess the grid impact early in the development process, as this could affect viability and alter the decision on which development model to utilize. Although the state of the national grid would impact both development models, the impact will vary depending on factors such as location, neighbouring generation facilities, wheeling requirements, and neighbouring consumers, among other factors.

For example, in the Western Cape, the grid is constrained, and additional connections for wind farms are not being approved. In this instance, for a PPA project within this area, the timelines would be hindered as approval of the new curtailment rule is required before releasing additional capacity in the grid (Creamer, 2024). Additionally, leaders would need to consider the impact of curtailment on the End User and structure this in the PPA contract. Furthermore, there would potentially be deemed energy losses applicable, which must also be considered. Taking this into account within the financial model could alter the project development model of choice.

There are alternate distribution options such as embedded generation and connecting behind the meter, however, the research highlights that though these may have less of an impact on the grid, they are not completely independent, and the necessary grid impact studies and permits must still be obtained. The study specifically highlights that Self-Build projects behind the meter would still be impacted by the curtailment ruling and will still have an impact on the grid since there would still be load fluctuations imposed on the grid.

5.3.4 Understanding the ESG factors

The research indicates that when ESG factors are not thoroughly assessed, it can result in the project team making progress in developing the project, only to have the project deemed unviable later. The research is not exhaustive in identifying all the ESG factors that should be considered; however, the examples below are intended to create awareness on some of the potential concern areas.

Conducting an Environmental Impact Assessment (EIA) is a standard requirement in the project development process. This is the process where all potential effects on the environment due to the project are analysed and mitigations are identified to the satisfaction of the relevant authorities, allowing the project to be constructed (epa, 2024). However, the research places emphasis on ensuring this approval is achieved early on. For example, during the data collection, it was found that one of the projects had continued with other aspects of project development, such as the grid impact assessment, sourcing funds, and detailed design in parallel to the EIA process. After approximately two years of development work, the environmental clearance was denied due to the impact of the wind farm on the local bats. This stopped the project from progressing, rendering the development work done as wasted efforts.

Similarly, social factors play a pivotal role in project feasibility. The research cites an example of a Self-Build project by a major mining company, where the inability to relocate a community residing on the designated land led to project cancellation. Despite the End User owning the land, the assumption that construction could proceed without fully addressing community concerns proved costly.

Based on South Africa's history of apartheid, there are regulations, guidelines, and commitments that are applicable when developing a project. Primarily with the intent to build skills, create employment, and establish suitable livelihoods for neighbouring communities (Ebekozien et al, 2024). The research highlights the importance of leaders understanding these requirements upfront and factoring them into the initial study. For this, communication with local bargaining councils and neighbouring communities, as well as listing the End User's commitments, is all useful in ensuring governance. The Moonlight Range Wind Farm in Queensland, Australia, serves as a strong example of how ESG factors can influence the viability of renewable energy projects. The project was cancelled due to significant public opposition. Concerns raised by the community included pressure on local accommodation, insufficient consultation, potential environmental impacts, and increased bushfire risk. This case highlights the importance of integrating robust environmental, social, and governance considerations (Vorrath, 2025).

In conclusion, the research highlights the need for detailed analysis and consideration of the applicable ESG factors as these could impact the viability of a project or sway the development model of choice.

5.3.5 Summary of discussion for research question 2

The findings indicate that financial factors are the critical determinant in the decision-making process. The PPA model offers benefits to End Users with strong financial stability, while Self-Build projects demand upfront capital, with core business functions competing for this capital.

Additionally, understanding End User requirements is fundamental, with feasibility studies and upfront assessments recommended to evaluate timelines, resources, risk appetite, and alignment with strategic goals.

Grid constraints further complicate decision-making, prompting the need for early grid impact assessments to secure approvals and address challenges such as Eskom's curtailment framework. Furthermore, ESG factors also play a pivotal role, as inadequate assessment can lead to project cancellations.

In conclusion, the research highlights that while both models can be effective, the choice depends on a complex interplay of financial, operational, and regulatory considerations, with each model presenting distinct advantages and challenges.

5.4 What are the key characteristics of these models in terms of benefits and constraints?

Research question 3 identified defining characteristics of these models as perceived by leaders in the industry, other than the financial traits. The research draws focus to the fact that, should financial factors not be a hindrance and both models seem financially viable, there are other characteristics that could influence the development model chosen and/or improve project execution.

5.4.1 Development Timelines

The research indicates development timeline for the Self-Build model is shorter when compared to the PPA model. The primary reason is that there are fewer stakeholders to satisfy, thus resulting in fewer and quicker approvals. In contrast, the PPA model requires the funders to be satisfied before the project can reach financial closure. This process can be lengthy, as funders (private and banks) have a set of prerequisites that need to be met prior to sign off. Though these requirements can vary depending on the project and the different funding organizations, they range from conditions such as having a website established for the project to more complex requirements such as having a signed PPA contract, which itself can be a long process as energy costs, penalties, usage requirements and so forth all have to be determined first.

The findings indicate that once a project has reached financial closure, the construction phase for PPA projects has a shorter timeline when compared to the Self-Build model. This is attributable to the extensive experience that an IPP would have in constructing energy projects when compared to an End User that is constructing their own project.

The literature review highlights Sibanye's dual approach to sourcing alternative energy by utilizing both the Self-Build and PPA development models. The Self-Build projects started by Sibanye in September 2021, with a total build capacity of 174 MW, are scheduled for completion in the first quarter of 2025. This timeline includes the duration

required for financial close (development phase) and construction (Creamer M. , 2021). In contrast, the PPA projects announced in May 2023 already achieved financial close and have a similar target for commercial operation in the first quarter of 2025 for the first of three projects (iol, 2023). However, public records reveal that development on the PPA project initially began in 2011 (Juwi, 2025). This example serves as a practical illustration of the findings from the research.

The study highlights that End Users, should consider the urgency of their needs. End Users with urgent timelines should opt for the Self-Build option or seek projects in the market that are significantly advanced from a development perspective.

5.4.2 Level of control and influence

The literature review and findings are congruent in highlighting one of the major disadvantages of the PPA model, being that the End User has limited to no influence over the development and construction of the project (Solar Voltaics, 2024).

The PPA model requires a strong influence by the End User for initiation and financial closure, however, they have no control over how the project is developed, constructed, operated, and maintained. Although this may align with the End User's preference to avoid involvement in non-core activities, signing a long-term PPA with an operational dependency on the supplied energy effectively means the End User has a vested interest in an asset without any control.

This lack of control over the PPA duration with shifting operational needs or strategic objectives could present issues. The End User would not have the flexibility to sell the asset or redirect power to another consumer if the energy is no longer needed. Additionally, adjustments to the asset, such as increasing its generating capacity or integrating storage facilities, would not be possible. This lack of control ties directly to the security of supply risk discussed previously. If the plant fails to produce energy, the End User cannot intervene operationally to address the issue. The literature review supports this, noting that while penalties may be enforced on the producer, no further corrective action is typically imposed (Qingan Qiu et al, 2018).

From a skills development perspective, the PPA model does not offer the opportunity for the End User to deploy internal resources on the project. Thus, limiting their ability to develop in-house capabilities.

From a public relations perspective, the findings indicate that the Self-Build model provides End Users with the opportunity to market the project in a manner that best suits their needs. This makes it easier for the End User to demonstrate their green initiatives and carbon reductions. Though this is still achievable with the PPA model, by nature of having more stakeholders to satisfy, all public demonstrations require additional approvals, stringent protocols, and shared attributes.

In summary, the research highlights that one of the key benefits of the Self-Build model is the End User's ability to maintain control over the project throughout its lifecycle, allowing it to adapt to evolving business needs and objectives.

5.4.3 End User Considerations

Section 5.4.3 highlights three prominent benefits and constraints for the End User to bear in mind when deciding on which model to utilize. These are centred around the level of risk assumed, the resources required, and a shift in core focus.

5.4.3.1 Risk

The findings indicate that with the Self-Build model, the End User assumes all the project risk through its entire life cycle. As discussed previously, funding the project is the responsibility of the End User with this model, and so is the associated funding risk. Ensuring the project is accurately costed upfront is the End User's responsibility, and should funds run out as the project is advancing, it is their responsibility to ensure these funds are made available to complete the project. Additionally, should the costs be inaccurately calculated upfront, the viability of the project can be affected. The literature review shows that in the PPA model, these financial risks are managed by other stakeholders (Bonetti et al, 2010) and not the End User.

Similarly, with the End User taking responsibility for all aspects of the project with the Self-Build model, there are other associated risks assumed. These include (but are not limited to) the geotechnical investigation of the project site, which is often deemed high risk as it is common for the expected ground conditions to vary, selecting the correct technology, and sizing the plant correctly.

There are various permits that need to be obtained throughout the phases of the project, which include water use licenses, environmental clearance, and land use

rights, among others. Should a required permit not be obtained timeously, it could result in the project being stopped or additional cost and time implications.

Post construction of the asset, the End User is required to ensure the plant is maintained correctly and operates efficiently. Not having extensive experience in this field can result in downtime or an undesirable output.

The risks listed above are non-exhaustive, however, the findings indicate that all the project risks reside with the End User in a Self-Build model, whereas with the PPA model, the risks are managed by others.

The literature review indicates that the PPA model offers a derisking element to the funders because tariffs are locked in, and cash flows are predictable (Trabesinger, et al., 2021). Thus, coupling the literature review and findings, the research concludes that the PPA model is a lower risk model to all stakeholders.

5.4.3.2 Choosing the right partners

With the Self-Build model, End Users will be required to appoint/manage development and execution partners as the research indicates that it is rare for End Users to have a fully experienced in-house team.

This reliance on external partners, whilst still being held accountable for the overall investment, is seen as a negative factor regarding the Self-Build model, primarily due to the associated costs and risks in doing so.

Furthermore, the findings indicate some caution to bear when structuring these partnerships. When appointing a development partner, the research indicates it is quite common for End Users to enter into agreements with service providers on the basis of paying for their services only if the project is found to be viable. This is a counterintuitive approach and creates an incentive for the development team to force viability. Ultimately, the data suggests that End Users should not seek to cut on development costs, to ensure that the project is developed correctly and minimize overrun of costs in the latter stages.

The Self-Build model requires the End User to design, procure, and construct the plant. To perform these services, the data indicates that End Users should utilize an EPCm (Engineer, Procurement and Construction management) partner as opposed

to utilizing an EPC (Engineer, Procure and Construct) partner. The primary reason is that the EPCm approach offers more transparency between the parties, allowing for risks to be presented as they arise and mitigated in a collaborative manner, whereas the EPC approach results in the EPC contractor pricing in all the risks or claiming additional funds from the End User at a later stage.

The Kogan Creek Solar Boost project in Queensland, Australia, provides an example of where poor partnerships could lead to significant financial loss and project failure. Allegedly, the inexperience of the principal contractor appointed to execute the project led to multiple issues with downstream suppliers and poor project management principles (Nova, 2017).

It is imperative that the End User considers the level of skills available internally and the selection criteria for project partners when opting for the Self-Build model.

5.4.3.3 Shift in core focus

The literature review and the findings are congruent in indicating one of the key benefits of the PPA model, which allows End Users to meet their strategic objectives and alternate energy requirements without shifting their focus from core operations (Amanda, 2024).

The research indicates that shifting focus from core business operations to developing, building, and operating a power generation plant with the Self-Build model can have a negative impact on the End User's primary activities. While this impact cannot be fully quantified upfront, the data suggests that End Users often overlook this factor. As a result, it can lead to neglect in certain areas of the core business or inefficient operation of the power generation plant, both of which can be detrimental to the End User's overall business.

The data indicates that sharing the same human resources is not ideal and should be avoided. Thus, implying that End Users should ultimately establish a dedicated team focused on power generation or opt for the PPA model.

5.4.4 Summary of discussion for research question 3

The Findings emphasize that timelines, control, risk management, and alignment with strategic objectives are identified as key considerations outside of the financial

elements. The Self-Build model offers greater control and flexibility, but it demands significant resources and exposes End Users to all associated risks. In contrast, the PPA model minimizes risks and operational burden, making it more suitable for End Users to prioritize core business activities.

Chapter 6: Conclusion and Recommendations

6.1 Introduction

The study explored how energy leaders in South Africa's industrial private sector perceive the Self-Build and PPA project development models, focusing on their benefits, constraints, and decision-making criteria. The research highlighted that while both models are widely utilized, their applicability and success depend significantly on the End User's needs, financial position, and key objectives.

6.2 Principal Findings

The research indicates that financial factors are dominant in the decision-making process. The PPA model is favourable for End Users with limited upfront cash reserves but who possess strong enough balance sheets to demonstrate a firm commitment to honour the full term of a PPA contract. It is imperative to note that signing a PPA has an impact on the End User's balance sheet and implications for the financial reporting of the business. The Self-Build model has a significant upfront capital requirement to be provided by the End User, however, the savings over the full life cycle of the project are greater, and it offers financial accounting flexibility from a reporting perspective.

The research indicated that defining the needs and objectives of the End User closely follows the level of dominance of the financial factors in the decision-making process, with one participant indicating that it is more important. The PPA model has been identified as the best-suited model when the primary objective is to reduce short-term energy costs, whilst the Self-Build model offers an improvement on energy stability. Albeit government regulations are applicable to both models and must be thoroughly assessed during the feasibility stage.

The research indicates that there are other significant differentiating characteristics apart from the financial structure, such as timelines, level of control, and risks that

further distinguish the models for consideration. Self-Build projects typically progress faster during the development phase due to reduced stakeholder involvement, but require expertise and operational focus. In contrast, PPA projects are constructed faster due to experienced IPPs, but have prolonged development stages.

Forming part of the rationale to conduct this study, the South African national grid is strained and suffering from capacity issues. As such, the study found that the impact on the grid of any energy project should be assessed and minimised to ensure permitting and grid connection challenges do not hinder the advancement of the project. Similarly, South Africa's history relating to previously disadvantaged communities is an influential factor for consideration. Leaders in the industry are encouraged to understand these requirements and factor them into the feasibility stage of the project.

The research highlights that while the Self-Build model offers control, flexibility, and long-term cost advantages, it demands significant resource allocation and risk assumption for the End User. The PPA model, on the other hand, enables organizations to achieve energy goals without diluting their operational focus, albeit with less control and higher energy costs than the Self-Build over the longer term.

6.3 Recommendations

The research extracts the following points as the key actions for future leaders in the industry to consider when embarking on deciding on which development model to utilise.

6.3.1 Conduct comprehensive feasibility studies early.

Leaders should undertake detailed feasibility assessments to align energy project goals with organizational objectives and needs. This includes evaluating financial resources, risk appetite, grid impact, and ESG compliance.

6.3.2 Assess financial aspects from a broad but detailed perspective.

Leaders should place emphasis on understanding an organization's holistic financial position. For entities with constrained liquidity, the PPA model should be considered.

Self-Build projects should only be pursued if the projected returns outweigh the opportunity costs from alternative capital investments.

6.3.3 Choosing the right partners.

Given the technical and operational complexities of energy projects, selecting reliable partners, such as EPCm contractors for Self-Build projects or experienced IPPs for PPA projects is essential. Transparent partnerships mitigate risks and enhance project success.

6.3.4 Develop expertise in-house.

For organizations pursuing the Self-Build model with a strategic view of developing multiple projects. The research indicates that establishing dedicated teams for project development and operation is vital to minimize the risk of inefficiencies and operational disruptions.

6.3.5 Thoroughly assess and mitigate grid and ESG factors.

Proactive engagement with regulatory authorities and community stakeholders is essential to navigate grid constraints and secure environmental approvals. Emphasis should be placed on incoming regulations as well, such as curtailment policies, and contracts should be structured to minimize associated risks.

6.3.6 Consider required timelines.

Leaders should understand the urgency of the project's commercial operation date and opt for the Self-Build model or seek IPPs with well-advanced, shelfed projects to satisfy very urgent needs.

6.4 Future Research Directions

Given the evolving landscape of energy projects in South Africa, further research is suggested to explore:

- The long-term financial performance of hybrid energy development models and energy trading.
- The impact of emerging regulatory policies, such as grid expansion plans and carbon tax frameworks, on model selection.

- A comparative analysis of Self-Build and PPA models across different sectors beyond industrial applications
- A comparative analysis of other energy project development models.
- The impact of the evolving landscape in South Africa with regard to competing needs of energy security, reduced costs, and carbon reduction goals.
- While this study focuses on the selection of appropriate energy project development models, future research should explore the range of contracting strategies that can be employed once a model has been selected. The choice of contracting strategy, such as the establishment of a joint venture by either the End User or developer, can have significant implications for the project's risk profile, financing, and operational outcomes. Investigating how specific contracting strategies align with the different development models could provide valuable insights into how to de-risk implementation and enhance project success.

6.5 Study Limitations

Participant bias: qualitative research is based on a small sample size, and the biases of the participants can alter the accuracy of the findings. This study bases its findings on the one-to-one interviews conducted with 11 participants. Though 11 participants cannot be deemed to provide a full representation on the comparative analysis of the Self-Build and PPA models, Figure 4-1 shows that saturation was reached, and further interviews were conducted beyond saturation, ultimately testing the saturation point and proving that data collection was reasonably stopped.

Sample selection: the participants in the study all demonstrated adequate experience in the energy sector and use of the development models being investigated. The research highlights the dominant role of the End User when utilising these development models, and only two of the participants have been directly employed by an End User in an energy project development role. Though reasonable efforts were applied to interview more End User employees, this was not fruitful and remains a limitation, however, the other participants all indicated that they have represented End

Users and acted for or on behalf of them in an advisory or service provider capacity in their careers.

Researcher bias: though attempts were utilised to minimise the influence of the researcher's bias on the findings by asking probing questions in interviews and follow-up discussions with participants during the transcribing process. It is not possible to completely eliminate the researcher’s bias.

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Appendix A: Definition of Key Terms

Self-Build refers to a project development model in which the End User develops and implements their own power generation asset for their dedicated electricity consumption needs.

Power Purchase Agreement (PPA) refers to an energy supply and purchase development contract between two (or more) parties over a long-term period for electricity (Next Kraftwerke, 2024).

Independent Power Producer (IPP) refers to a non-government party that generates electricity for sale (Havenhill Synergy, 2018).

NERSA refers to the national energy regulator of South Africa, which is a regulatory body established to regulate the energy industry of the country. One of their key functions is setting the electricity price that Eskom is obliged to sell at (NERSA, 2024).

Asset/Plant refers to the constructed and operational energy generation facility.

Energy Leaders refers to professionals with proven experience in the field of energy project development and in the use of the Self-Build and/or PPA development models.

End User refers to the industrial or commercial entity that consumes the electricity generated by a renewable energy project. The End User may either purchase energy through a Power Purchase Agreement (PPA) or self-generate power through a Self-Build model. These entities are typically large-scale energy consumers, such as factories and mines, seeking to secure a reliable, cost-effective, and sustainable energy supply. In both cases, the End User is the final recipient of the energy but may differ in their level of involvement in the generation or procurement process.

kWh/MWH refers to unit of measurement in which electricity is produced and sold.

Appendix B: Consistency Table

RQ #	State Research Question or Objective	Prop #	State Proposition	Research findings	Data collection detail	Data analysis method
1	How do leaders in the industry perceive the self-build/BOO and PPA development models?	Prop #1	The PPA model is perceived to be a more viable option for projects with larger energy outputs, typically above 100 MW's.	The research directly aligns with the proposition.	Interview guide questions 7-11	Thematic analysis
2	What are some of the key considerations/criteria being used by these leaders when determining which model to use?	Prop #2	Cash balances and the strength of the organization's balance sheet are the key factors considered when determining which project development to utilize.	The research directly aligns with the proposition.	Interview guide Questions12-17	Thematic analysis
3	What are the key characteristics of these models in terms of benefits and constraints?	Prop #3	The most prominent benefit of the PPA model, is that it provides organizations with the ability to achieve their energy needs without any upfront capital investment, whereas the most prominent benefit of the Self-Build is the significant cost savings on energy bills.	The research partially aligns with the proposition. The most prominent benefit of the Self-Build identified is the improvements in energy stability for the End User.	Interview guide Questions 18-20	Thematic analysis

Appendix C: Interview Schedule

INTERVIEW GUIDE: Perceptions of energy leaders on private industrial sector energy project development models

Section 1: Information of participant

Introductory question
Please tell me about yourself, specifically your work and experience with developing energy projects.

1. Age of participant

18-25 years	26-30 years	31-35 years	36-50 years	50-65 Years	Older than 65 years

2. Work related

End User	IPP	Project Developer	Consultant	Regulator

3. Position Held

Please state title.

4. Number of years in position held

0-5 years and below	6-10 years	11-15 years	Over 15 years

5. Number of years being associated with energy project development within the industrial private sector?

0-5 years and below	6-10 years	11-15 years	Over 15 years

6. Number of PPA and/or Self-Build projects developed with your involvement in the industrial private sector?

Please state number of projects.

Section 2: Interview guide- research objectives and questions

Research objective 1: To explore the perceptions of energy leaders on energy project development models for private industrial sector.

7. What comparison have you done between the PPA and Self-Build project development models
8. Can you state in your opinion which model you prefer utilizing and why?
9. Do you believe one model is superior to the other, please explain?
10. Which model do you think works best for industrial energy consumers in the private sector?
11. Do you believe there is a need for both models to exist or can one of them satisfy the needs of End Users?

Research objective 2: To gather some of the key considerations / criterion used by the energy leaders when determining which model to use for energy project development.

12. How do you determine which model to use prior to initiating the development of an energy project.
13. Can you describe some of the guidelines utilized when making this decision?
14. Can you outline some of the key personnel and their functions that you consult when making this decision?

15. Can you highlight the top elements you consider when making this decision?

16. Do you make reference to some of the learnings from previous projects when making this decision, can you please elaborate on a few?

17. Do you consider the financial position of the End User to be the biggest factor to be considered when making this decision? If yes please elaborate, if no, please outline what you believe is the most relevant consideration.

Research objective 3: To assess the key characteristics of these models in terms of benefits, constraints and pre-requisites.

18. Can you briefly describe your understanding of the fundamental characteristics that describe each of these models.

19. In your opinion what do you consider to be the key benefits of each model.

20. In your opinion what do you consider to be the key constraints of each model.